Capacitance and Capacitor

1. Choose the correct statement(s) about the point charge

   (a) point charge is a concept

   (b) point charges do not exist in reality

   (c) the field produced by a point charge in inversely proportional to the square of the distance

   (d) the concentration of a charge at a point is called a point charge

2. A dielectric slab of thickness d is inserted in a parallel plate capacitor whose negative plate is at x = 0 and positive plate is at x = 3d. The slab is equidistant from the plates. The capacitor is given some charge. As x goes from 0 to 3d

   (a) the magnitude of the electric field remains the same

   (b) the direction of the electric field remains the same

   (c) the electric potential increases continuously

   (d) the electric potential increases at first, then decreases and again increases

3. A small sphere of mass m and having charge q is suspended by a light thread

   (a) tension in the thread may reduce to zero if another charged sphere is placed vertically below it

   (b) tension in the thread may increases to twice of its original value if another charged sphere is placed vertically below it

   (c) tension in the thread is greater than mg if another charged sphere is held in the same horizontal line in which first sphere stays in equilibrium

   (d) tension in the thread is always equal to zero

4. A point charge q is placed at origin. Let $\vec{E}_A$, $\vec{E}_B$ and $\vec{E}_C$ be the electric field at three points A(1, 2, 3) B(1, 1, –1) and C(2, 2, 2) due to charge q then

   (a) $\vec{E}_A \perp \vec{E}_B$

   (b) $\vec{E}_A \parallel \vec{E}_C$

   (c) $|\vec{E}_B| = 4|\vec{E}_C|$

   (d) $|\vec{E}_B| = 8|\vec{E}_C|$

5. Which of the following is/are incorrect statement?

   (a) electric field is always conservative

   (b) electric field due to a varying magnetic field is non-conservative

   (c) electric field due to a stationary charge is conservative

   (d) electric field lines are always closed loops

6. A parallel plate air capacitor is connected to a battery. The quantities charge, voltage, electric field and energy associated with the capacitor are given by Q_0, V_0, E_0 and U_0 respectively. A dielectric slab is now introduced to fill the space between the plates with the battery still in connection. The corresponding quantities now given by Q, V, E and U are related to previous ones by

(a) $Q > Q_0$ (b) $V > V_0$

(c) $E > E_0$ (d) $U > U_0$

7. The positive charge +Q is located at centre 'O' of a thin metallic spherical shell. Select the correct statement(s) from the following

(a) the electric field at any point outside the shell is zero

(b) the electric potential at any point outside the shell is $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$, where r is the distance of point from O

(c) the outer surface of the spherical shell is an equipotential surface

(d) the electric field at any point inside the shell other than O is zero

8. Two large, parallel conducting plates are placed close to each other. The inner surfaces of the two plates have surface charge densities $+\sigma$ and $-\sigma$. The outer surfaces are with out charge. The electric field has a magnitude of

(a) $\frac{2\sigma}{\varepsilon_0}$ in the region between the plates

(b) $\frac{\sigma}{\varepsilon_0}$ in the region between the plates

(c) $\frac{\sigma}{\varepsilon_0}$ in the region outside the plates

(d) zero in the region out side the plates

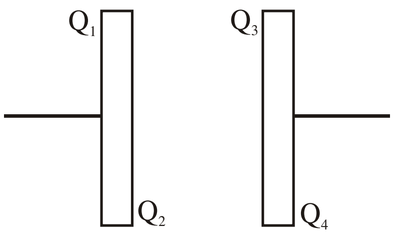
9. In an isolated parallel plate capacitor of capacitance c, the four surfaces have charges Q_1, Q_2, Q_3 and Q_4 as shown, the potential difference between the plates is

(a) $\frac{Q_1 + Q_2}{C}$

(b) $\left|\frac{Q_2}{C}\right|$

(c) $\left|\frac{Q_3}{C}\right|$

(d) $\frac{1}{C}[(Q_1 + Q_2) - (Q_3 - Q_4)]$



10. A non-conducting solid sphere of radius R is uniformally charged. The magnitude of electric field due to the sphere at a distance r from its centre

(a) increases as r increases for $r < R$

(b) decreases as r increases for $0 < r < \infty$

(c) decreases as r increases for $R < r < \infty$

(d) is discontinuous at $r = R$

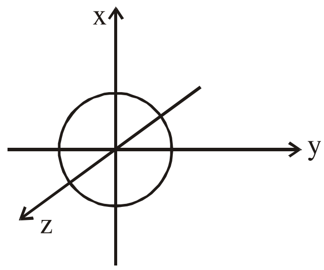
11. A circular ring of radius R with uniformly distributed charge q is placed in the yz-plane with its centre at the origin as shown in figure, then

(a) the electric intensity is maximum at $x = \pm R\sqrt{2}$

(b) the electric intensity is maximum at $x = \pm \frac{R}{\sqrt{2}}$

(c) the maximum intensity is $\frac{q}{6\sqrt{3}\,\pi\varepsilon_0 R^2}$

(d) the maximum intensity is $\frac{q}{6\sqrt{6}\,\pi\varepsilon_0 R^2}$



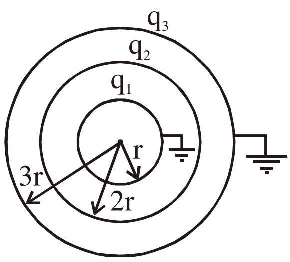
12. Three concentric conducting spherical shells have radii r, 2r and 3r and charges q_1, q_2 and q_3 respectively innermost and outer most shells are earthed as shown in figure. Select the correct alternative(s)

(a) $q_1 + q_2 = -q_2$

(b) $q_1 = -\frac{q_2}{4}$

(c) $\frac{q_3}{q_1} = 3$

(d) $\frac{q_3}{q_2} = -\frac{1}{3}$



13. The electric field intensity at a point between the plates of a charged isolated capacitor is

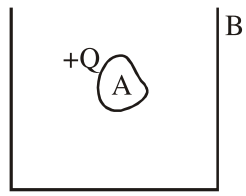
(a) proportional to the square of the charge on the plates

(b) proportional to the charge on the plates

(c) inversely proportional to the distance between the plates

(d) independent of the distance between the plates

14. A conductor A is given a charge of amount +Q and then placed inside, a deep metal ca B, with out touching it



(a) the potential of a does not charges when it is placed inside B

(b) if B is earthed, +Q amount of charge flows from it into the earth

(c) if B is earthed, the potential of A is reduced

(d) none of these

15. The electric potential in a region along the x-axis varies with x according to the relation $V_{(x)} = 4 + 5x^2$, then

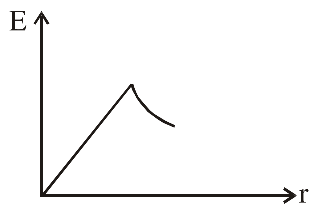
(a) potential difference between the points x = 1 and x = –2 is 15 volt

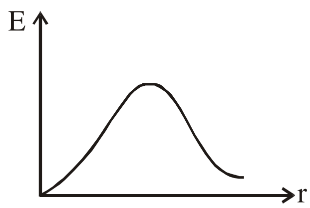
(b) force experienced by one coulomb charge at x = –1 will be 10N

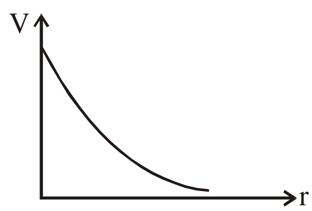
(c) force experienced by the above charge will be towards +X-axis

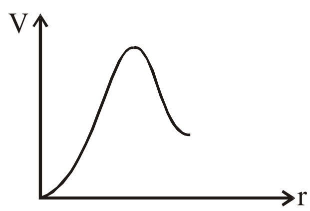
(d) a uniform electric field exists in this region along the X-axis

16. A circular ring carries a uniformly distributed positive charge. The electric field (E) and potential (V) varies with distance (r) from the centre of the ring along its axis as

(a)


(b)


(c)


(d)


17. A capacitor C is charged to a potential V by a battery. The e.m.f. of the battery is V. It is then disconnected from the battery and again connected with its polarity reversed to the battery

(a) the work done by the battery is CV^2

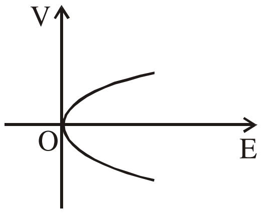
(b) the total charge that passes through battery is 2CV

(c) the initial and final energy of the capacitor is same

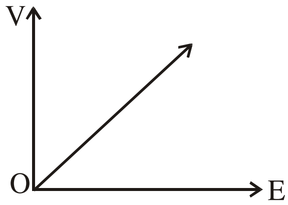
(d) the work done by the battery is $2CV^2$

18. If at a distance r from a positively charged particle, electric field strength and potential are E and V respectively, which of the following graph(s) is/are

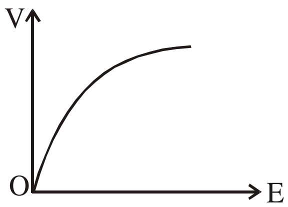
(a)



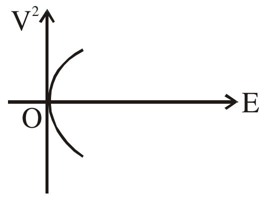
(b)



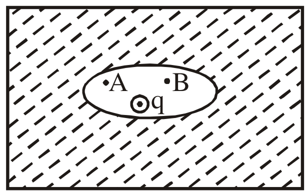
(c)



(d)



19. An elliptical cavity is carved within a perfect conductor. A positive charged q is placed at the centre of cavity. The point A and B are on the cavity surface as shown in figure. Then



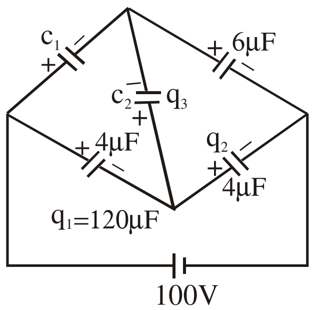
(a) electric field near A in the cavity is equal to electric field war B in cavity

(b) charge density at A is equal to charge density at B

(c) potential at A is equal to potential at B

(d) total electric flux through the surface of cavity is equal to $\frac{q}{\varepsilon_0}$

20. In the circuit shown



(a) $|q_2| = 280\ \mu C$

(b) $|q_3| = 160\ \mu C$

(c) $|q_2| = 120\ \mu C,\ q_3 = 0$

(d) it is impossible to find q_2 and q_3 unless c_1 and c_2 are known

21. Two identical parallel plate capacitors of same dimensions joined in series are connected to a D.C. source. When one of the plates of one capacitor is brought closer to the other plate

(a) the voltage on the capacitor whose plates come closer is greater than the voltage on the capacitor whose plates are not moved

(b) the voltage on the capacitor whose plate comes closer is smaller than the voltage on the capacitor whose plates are not moved

(c) the voltage on the two capacitor remain equal

(d) the applied voltage is divided among the two inversely as the capacitance

22. A parallel plate capacitor is first connected to D.C. source. It is then disconnected and then immersed in a liquid dielectric, then

(a) the capacity increases

(b) the liquid level between the plates increases

(c) the liquid level will remain same as that outside the plates

(d) the potential on the plates will decreases

23. Identity the correct statement(s) about electric intensity (E) and electric potential (V).

(a) E and V may be zero simultaneously

(b) $E = 0$ but $V \neq 0$

(c) $E \neq = 0$ but $V = 0$

(d) $E \neq 0$ and $V \neq 0$

24. The electric potential at a certain distance from a point charge is 600 Volts and the electric field is 200 N/C. Which of the following statement(s) will be true

(a) the magnitude of charge is 0.2×10^{-3} C

(b) the distance of the given point from the charge is 3m

(c) the potential at a distance of 9m will be 200 Volt

(d) the work done in moving a point charge of 1 μC from the given point to a point at a distance of 9 m will be 4×10^{-4} J.

25. A positively charged thin metal ring of radius R is fixed in the xy-plane with its centre at the origin O. A negatively charged particle P is released from rest at the point $(0,0, Z_0)$ where $Z_0 > O$. Then motion of P is

(a) periodic for all values of z_0 satisfying $0 < z_0 < \infty$

(b) simple harmonic, for all values of z0 satisfying $0 < z_0 \leq R$

(c) approximately simple harmonic, provided $z_0 << R$

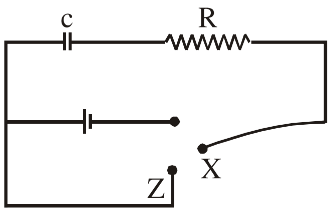
(d) such that P crosses O and continues to move along the negative z-axis towards $z = -\infty$

26. In a parallel plate capacitor of plate area A, plate separation d and charge Q, the force of attraction between the plate is F, then

(a) $F \propto Q2$ (b) $F \propto \frac{1}{A}$

(c) $F \propto d$ (d) $F \propto \frac{1}{d}$

27. The capacitor C is initially without charge. X is now joining to Y for a long time, during which H_1 heat is produced in the resistance R. X is now joined to Z for a long time, during which H_2 heat is produced in R, then



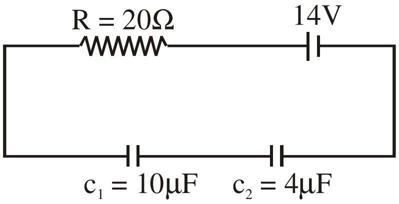
(a) $H_1 = H_2$

(b) $H_1 = \frac{1}{2} H_2$

(c) $H_1 = 2H_2$

(d) the maximum energy stored in C at any time is H_1

28. In the given circuit, in steady state



(a) the potential difference across c_1 is 4 volt

(b) the potential difference across c_2 is 4 volt

(c) the charge on each of c_1 and c_2 is 40 μC

(d) the charges on c_1 and c_2 are in the ratio 2 : 7

29. Two identical charge +Q are kept fixed some distance apart. A small particle P with charge q is placed midway between them. If P is given a small displacement Δ, it will undergo simple harmonic motion, if

(a) q is positive and Δ is along line joining the charges

(b) q is positive and Δ is perpendicular to the line joining the charges

(c) q is negative and Δ is perpendicular to line joining the charges

(d) q is negative and Δ is along the line joining the charges

30. A parallel plate capacitor is charged with a battery and the battery remains connected. Then,

(a) all the charge drawn from the battery is stored in the capacitor

(b) all the energy drawn from the battery is stored in the capacitor

(c) one half the energy drawn from the battery is stored in the capacitor

(d) the potential difference across capacitor increases exponentially and then attains a constant value

31. Capacitor c_1 of capacitance 1 μF and capacitor c_2 of capacitance 2 μF are separately charged fully by a common battery. The two capacitors are then separately allowed to discharge through equal resistors at time t = 0,

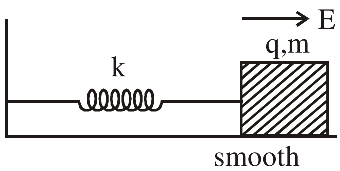
(a) the current in each of the two discharging circuits is zero at t = 0

(b) the current in the two discharging circuits at t = 0 are equal but not zero

(c) the current in the two discharging circuits at t = 0 are unequal

(d) c_1 loses 50% of its initial charge sooner than c_2 loses 50% of its initial charge

32. A block of mass m is attached to a spring of force constant k charge on the block is q. A horizontal electric field E is acting in the direction as show block is released with the spring in unstretched position



(a) block will execute SHM

(b) Terne period of oscillation is $2\pi\sqrt{\frac{m}{k}}$

(c) Ampti tude of oscillation is $\frac{qE}{k}$

(d) block will oscillate but not simple harmonically

33. A deuteron and an α-particle are placed in an electric field. The forces acting on them are F_1 and F_2 and their acceleration are a_1 and a_2 respectively. Then

(a) $F_1 = F_2$

(b) $F_1 \neq F_2$

(c) $a_1 = a_2$

(d) $a_1 \neq a_2$

34. A parallel plate capacitor of plate area A and plate separation d is charged to potential V and then battery is disconnected. A slab of dielectric constant k is then inserted between the plates of the capacitor so as the fill the space between the plates. If Q, E and W denote respectively, the magnitude of charge on each plate the electric field between the plates (after the slab is inserted) and work done on the system in question in the process of inserting the slab, then

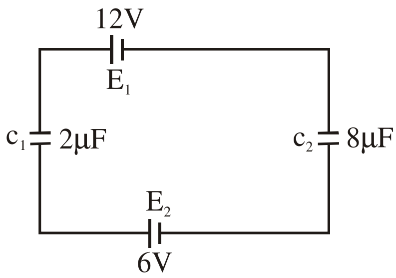
(a) $Q = \frac{\varepsilon_0 AV}{d}$

(b) $Q = \frac{\varepsilon_0 kAV}{d}$

(c) $E = \frac{V}{kd}$

(d) $W = \frac{\varepsilon_0 AV^2}{2d}\left(1 - \frac{1}{k}\right)$

35. In this circuit shown in figure,



(a) the charge on c_2 is greater than on c_1

(b) the charge on c_1 and c_2 are the same

(c) the p.d. across c_1 and c_2 are same

(d) the p.d. across c_1 is greater than that across c_2

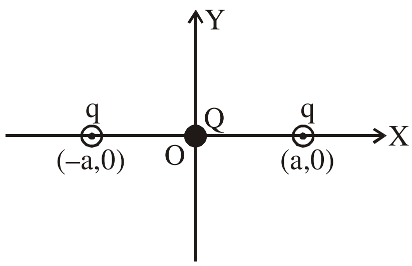
36. Two point charges q each are fixed at (a, 0) and (–a, 0). A third charge Q is placed at origin. Electrostatic potential energy of the system will

(a) increases if Q is slightly displaced along x-axis

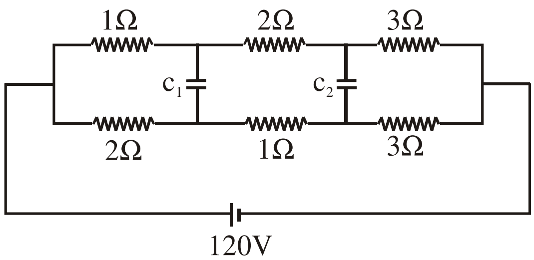
(b) decreases if Q is slightly displaced along x-axis

(c) increases if Q is slightly displaced along y-axis

(d) decreases if Q is slightly displaced along y-axis



37. In the circuit shown in figure $c_1 = c_2 = 2\mu F$, then charge stored in



(a) capacitor c_1 is zero

(b) capacitor c_2 is zero

(c) both capacitors is zero

(d) capacitor c_1 is 40μC

38. An electric dipole of dipole moment 10^{-6}cm is released from rest in uniform electric field 10^2 V/m at an angle $\theta = 60^o$. Maximum rotational kinetic energy of the dipole is say k and maximum torque during the motion is I, then

(a) $k = 5.0 \times 10^{-5}$ J

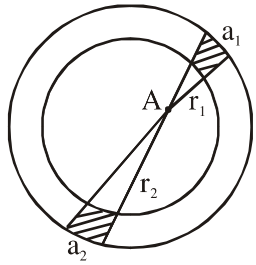
(b) $k = 2.0 \times 10^{-4}$ J

(c) $I = 5.0 \times 10^{-4}$ Nm

(d) $I = 8.7 \times 10^{-5}$ Nm

39. A wire having a uniform linear charge density λ, is bent in the form of a ring of radius R. Point A as shown in the figure, is in the plane of the ring but not at the centre. Two elements

of the ring of lengths a_1 and a_2 substend very small same angle at the point A. They are at distances r_1 and r_2 from the point A respectively



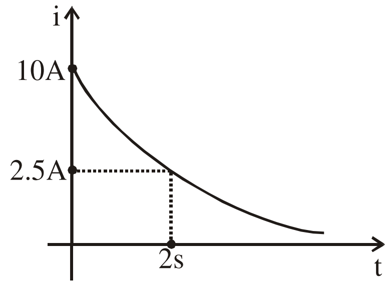
(a) the ratio of charge of element a_1 and a_2 is $\frac{r_1}{r_2}$

(b) the elements a, produced greater magnitude of electric field at A than element a_2

(c) the element a_1 and a_2 produce same potential at A

(d) the direction of net electric field at A is towards element a_2

40. The figure shows, a graph of the current in a discharging circuit of a capacitor through a resistor of resistance 10Ω



(a) the initial potential difference across the capacitor is 100V

(b) the capacitance of the capacitor is $\frac{1}{10\ell n2}$F

(c) the total heat produced in the circuit will be $\frac{500}{\ell n2}$J

(d) the thermal power in the resistor will decrease with a time constant $\frac{1}{2\ell n2}$s

Magnetic Field

1. If a long copper rod carries a direct current, the magnetic field associated with the current will be

(a) only inside the rod (b) only outside the rod

(c) both inside and outside the rod (d) neither inside nor outside the rod

2. A charge particle moves with velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$. The magnetic force experienced by the particle is

(a) always zero (b) never zero

(c) zero if $\vec{B}$ and $\vec{v}$ are perpendicular (d) zero if $\vec{B}$ and $\vec{v}$ are parallel

3. An electric charge in uniform motion produces

(a) an electric field only | (b) a magnetic field only

(c) both electric and magnetic fields | (d) no such field at all

4. Two parallel wires carrying currents in the same direction attract each other because of

(a) potential difference between them | (b) mutual induction between them

(c) electric force between them | (d) magnetic force between them

5. A conducting circular loop of radius r carries a constant current i. It is placed in uniform magnetic field B such that B is perpendicular to the plane of loop. The magnetic force acting on the loop is

(a) i r B | (b) 2π i r B

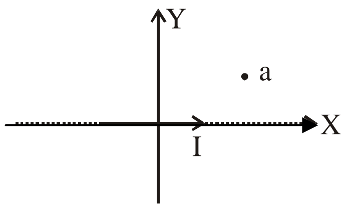
(c) zero | (d) π i r B

6. A straight steel wire of length *l* has a magnetic moment M. When it is bent in the form of a semi circle, its magnetic moment will be

(a) M | (b) $\frac{M}{\pi}$

(c) $\frac{2M}{\pi}$ | (d) $M\pi$

7. A current I flows in an infinitely long straight conductor along the positive X-axis, as shown in the figure. At the point a the direction of magnetic field is



(a) along the positive Y-axis
(b) along the negative Y-axis
(c) along the positive Z-axis
(d) along the negative X-axis

8. The magnitude of magnetic induction produced by an infinite sheet of current with linear current density j at a distance r is given by

(a) $\frac{\mu_0 j}{2}$ | (b) $\mu_0 j$

(c) $\frac{\mu_0 j}{2r}$ | (d) $\frac{\mu_0 j}{r}$

9. Ampere's law states $\oint \vec{B}\cdot d\vec{l} = \mu_0 I$ Choose the correct statement

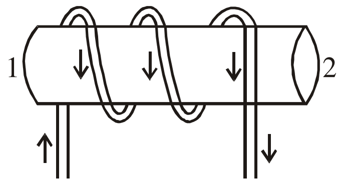
(a) I is the current enclosed at the centre of the loop

(b) $\vec{B}$ is the magnetic field produced by the enclosed current only.

(c) It is not valid for a straight wire of finite length

(d) All the above

10. A stream of electron is flowing in a solenoid conductor as indicated below



(a) The entire solenoide behaves like the south pole of magnet

(b) The entire solenoide behaves like north pole of magnet

(c) Face -1 behaves like north pole and Face-2 like south pole

(d) Face -1 behaves like south pole and Face-2 like north pole

11. X, Y and Z are three mutually perpendicular axes. A proton moving with a constant velocity along the X-axis, the magnetic field along the X-axis. Indicate whether the force on the proton acts along.

(a) Z-axis | (b) Y-axis

(c) X-axis | (d) bisector of Z and Y-axes

12. The north pole of a magnet is brought near a stationary positively charged conductor. the north pole will exert a force which will

(a) attract the conductor | (b) try to repel the conductor

(c) not affect the conductor at all | (d) repel the north pole itself

13. Two protons move parallel to each other with equal speed 9×10^5 m/s. The ratio of magnetic force and electric force between them is

(a) 9×10^{-9} | (b) 9×10^{-6}

(c) 9×10^{-3} | (d) $\frac{1}{9}\times10^{6}$

14. Two long parallel wires separated by a distance r have equal current I flowing, each. wire experiences a magnetic force F N/m. If the distance r is increased to 3r and current in each wire is reduced to $\frac{I}{3}$. The force between them will be

(a) $3F\,N/m$ | (b) 9 F N/m

(c) $\frac{F}{9}\ N/m$ | (d) $\frac{F}{27}\ N/m$

15. A circular loop 'A' has radius R and current I flows through it, another circular loop 'B' is of radius 2R and a current of 2I flows through it. Ratio of magnetic fields at their centres is

(a) $\frac{1}{4}$ (b) 1

(c) 2 (d) 4

16. A circular current carrying coil has a radius R. The distance from the centre of the coil on the axis where the magnetic induction will be $\frac{1}{8}$th to its value at the centre of the coil is

(a) $\frac{R}{\sqrt{3}}$ (b) $R\sqrt{3}$

(c) $\frac{2R}{\sqrt{3}}$ (d) $2\sqrt{3}R$

17. A person is facing magnetic north pole, an electron infront of him flies horizontally towards north and then deflects towards east. He is in/at

(a) northern hemisphere (b) southern hemisphere

(c) equator (d) can not be predicated by this data

18. A magnetic needle is kept in a non uniform magnetic field, it experiences

(a) a force and a torque (b) a force but not a torque

(c) a torque but not a force (d) neither a force nor a torque

19. A charge particle entering magnetic field from outside in a direction perpendicular to the field.

(a) can never complete one rotation inside the field
(b) may or may not complete one rotation in the field depending on its angle of entry into the field
(c) will always complete exactly half the rotation before leaving the field
(d) may follow a helical path depending on its angle of entry into the field

20. A moving charge will gain energy due to the application of

(a) electric field (b) magnetic field (c) both of these (d) none of these

21. Power associated with the force exerted by a magnetic field on a moving charged particle

(a) is always equal to zero

(b) is equal to zero only when direction of motion is perpendicular to the magnetic field.

(c) is equal to zero only when direction of motion is parallel to the magnetic field.

(d) is never equal to zero

22. Choose the incorrect statement about the magnetic force

(a) It is does not act on stationary charge

(b) It is always perpendicular to the velocity vector

(c) It can not accelerate a moving charge

(d) none of these

23. The expression $\vec{F} = \int I\, d\vec{\ell} \times \vec{B}$

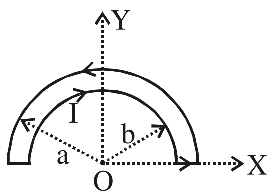
(a) denotes the force experienced by a small current element $Id\vec{\ell}$ in a magnetic field $\vec{B}$

(b) it is aplicable only when field is uniform

(c) is equal to $I(\vec{\ell} \times \vec{B})$ if the magnitude and direction of $\vec{B}$ over the conductor $\vec{\ell}$ is constant

(d) all the above

24. The magnetic moment of the loop as shown in the figure is given by



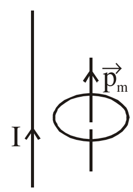
(a) $\frac{\pi}{2}(a^2 + b^2)I\hat{k}$

(b) $-\frac{\pi}{2}(a^2 + b^2)I\hat{k}$

(c) $\frac{\pi}{2}(a^2 - b^2)I\hat{k}$

(d) $-\frac{\pi}{2}(a^2 - b^2)I\hat{k}$

25. If magnetic dipole $\vec{p}_m$ is placed parallel to an infinitely long straight wire as shown in the figure



(a) the potential energy of the dipole is minimum

(b) the torque acting on the dipole is zero

(c) the force acting on the dipole is zero

(d) none of these

26. Two concentric coplanar circular loops of radii r_1 and r_2 carry currents of i_1 and i_2 in opposite directions (one clock and other anticlock wise) The magnetic induction at the centre of the loops is half of that due to i_1 along the centre. If $r_2 = 2r_1$, the value of i_2/i_1 is

(a) 1 (b) 2

(c) 3 (d) 4

27. Two infinitely long parallel wires having linear charge densities λ_1 and λ_2 respectively are placed at a distance of R metre. The force per unit length on either wire will be $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

(a) $k\frac{2\lambda_1\lambda_2}{R^2}$ (b) $k\frac{2\lambda_1\lambda_2}{R}$

(c) $k\frac{\lambda_1\lambda_2}{R^2}$ (d) $k\frac{\lambda_1\lambda_2}{R}$

28. In a certain region of space, electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other and an electron enters in region perpendicular to the direction of $\vec{B}$ and $\vec{E}$ both and moves undeflected, then velocity of electron is

(a) $\frac{|\vec{E}|}{|\vec{B}|}$ (b) $\vec{E}\times\vec{B}$

(c) $\frac{|\vec{B}|}{|\vec{E}|}$ (d) $\vec{E}\cdot\vec{B}$

29. An ionised gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along +X-axis and magnetic field along +Z axis. then

(a) positive ions are deflected towards +Y-axis and negative ions towards −Y−axis

(b) all ions are deflected towards +Y−axis

(c) all ions are deflected towards – Y−axis

(d) positive ions are deflected towards –Y−axis and negative ions towards +Y−axis

30. A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on

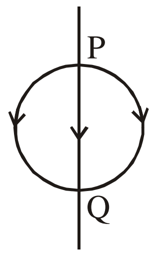
(a) ω and q (b) ω, q and m

(c) q and m (d) ω and m

SECTION – B

PHYSICS

1. A circular coil of wire carries a current. PQ is the part of long wire carrying a current and passing close to the circular coil. If the direction of current in both wires is as shown in the figure, hat is the direction of force acting on PQ?



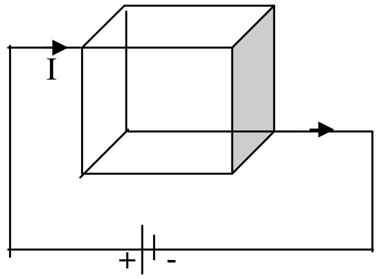
(a) parallel to PQ, towards P

(b) parallel to PQ, towards Q

(c) at right angles to PQ, to the right

(d) at right angles to PQ, to the left

2. A cube made of wires of equal length is connected to a battery as shown in the figure. The side of cube is L. The magnetic field at the centre of the cube is



(a) $\frac{12}{\sqrt{2}}\frac{\mu_0 I}{\pi L}$ (b) $\frac{6}{\sqrt{2}}\frac{\mu_0 I}{\pi L}$

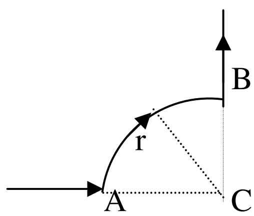
(c) $6\frac{\mu_0 I}{\pi L}$ (d) zero

3. A coaxial cable consists of a thin inner conductor fixed along the axis of a hollow outer conductor. The two conductors carry equal currents in opposite direction. Let B_1 and B_2 be the magnetic fields in the region between the conductors and outside the conductor respectively then

(a) $B_1 \neq 0, B_2 \neq 0$ (b) $B_1 = B_2 = 0$

(c) $B_1 \neq 0, B_2 = 0$ (d) $B_1 = 0, B_2 \neq 0$

4. A wire is carrying current I as shown in the figure. Section AB is a quarter circle of radius r. The magnetic field at C is directed



(a) along the bisector of the angle ACB, away from AB

(b) along the bisector of the angle ACB, towards AB

(c) perpendicular to the plane of the paper directed into the paper

(d) at an angle $\frac{\pi}{4}$ to the plane of the paper

5. Two particles X and Y having equal charges, after being accelerated through the same potential difference enter a region of uniform magnetic field and described circular paths of radii R_1 and R_2 respectively. The ratio of masses of X to that of Y

(a) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (b) $\frac{R_1}{R_2}$

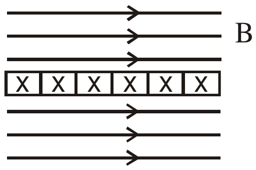
(c) $\left(\frac{R_1}{R_2}\right)^2$ (d) $\frac{R_2}{R_1}$

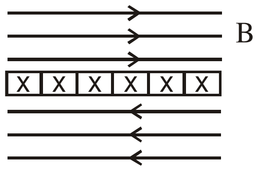
6. The field normal to the plane of a wire of n turns and radius r which carries a current i is measured on the axis of the coil at a small distance h from the centre of the coil. This is smaller than the field at the centre by the fraction

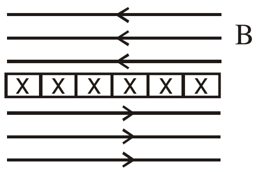
(a) $\frac{3}{2}\frac{h^2}{r^2}$ (b) $\frac{2}{3}\frac{h^2}{r^2}$

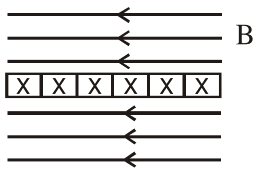
(c) $\frac{3}{2}\frac{r^2}{h^2}$ (d) $\frac{2}{3}\frac{r^2}{h^2}$

7. The field pattern produced by an infinite sheet of current with linear current density j⊗ is given by

(a) 

(b) 

(c) 

(d) 

8. Consider a thick infinitely long wire of radius R carrying a current I. Assuming that the current is uniformly distributed over the cross-section of wire

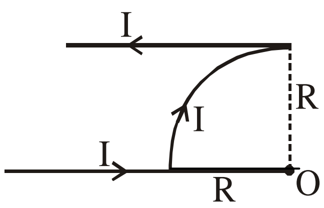
(a) the magnetic field at the centre of the wire is maximum

(b) the magnetic field at any point in the cross-section is zero

(c) the magnetic field at the surface of the wire is maximum

(d) the magnetic field inside the cross-section is constant everywhere.

9. In the figure shown, the value of B at the centre O is



(a) $\left(\frac{\mu_0 I}{4\pi R}-\frac{\mu_0 I}{8R}\right)$ outwards (b) $\left(\frac{\mu_0 I}{4\pi R}-\frac{\mu_0 I}{4R}\right)$ outwards

(c) $\left(\frac{\mu_0 I}{4\pi R} + \frac{\mu_0 I}{8R}\right)$ inwards

(d) $\left(\frac{\mu_0 I}{8R} - \frac{\mu_0 I}{4\pi R}\right)$ inwards

10. A positively charged particle moving with velocity v enters a region of space having a constant magnetic induction B. The particle will experience the largest force when the angle between vector $\vec{v}$ and $\vec{B}$ is

(a) 0^o

(b) 45^o

(c) 90^o

(d) 180^o

11. Due to magnetic field of earth, charged particles coming from outer space

(a) require greater kinetic energy to reach the equator than the poles.
(b) require lesser kinetic energy to reach the equator than the poles.
(c) can never reach the equator.
(d) can never reach the poles.

12. If electron velocity is $(2\hat{i} + 3\hat{j})$ and it is subjected to a magnetic field $4\hat{k}$, then

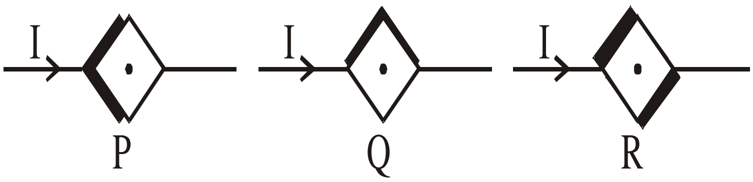
(a) speed will change

(b) path will change

(c) both (a) and (b)

(d) none of these

13. Two thick wires and two thin wires, all of the same material and same length form a square in three different ways P, Q and R as shown in the figure. With the current connection shown, the magnetic field at the centre of the square is zero in case of



(a) P only

(b) P and Q only

(c) R and Q only

(d) P and R only

14. A steady current I flows in a small square loop of wire of side L in a horizontal plane. The loop is now folded in the middle such that half of it lies in a vertical plane. Let $\vec{\mu}_1$ and $\vec{\mu}_2$ respectively denote the magnetic moment due to the current before and after folding, then

(a) $\vec{\mu}_2 = 0$

(b) $\vec{\mu}_1$ and $\vec{\mu}_2$ are in same direction

(c) $\frac{|\vec{\mu}_1|}{|\vec{\mu}_2|} = \sqrt{2}$

(d) $\frac{|\vec{\mu}_1|}{|\vec{\mu}_2|} = \frac{1}{\sqrt{2}}$

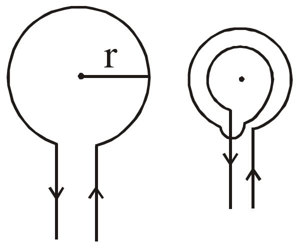
15. When a proton is released from rest in a room, it starts with an initial acceleration 'a' towards west. When it is projected towards north with speed v it moves with an initial acceleration 3a towards west. The magnetic field in the room is

(a) $\frac{ma}{ev}$ upward (b) $\frac{ma}{ev}$ downward

(c) $\frac{2ma}{ev}$ upward (d) $\frac{2ma}{ev}$ downward

16. A length of wire carries a steady current. It is bent first to form a circular plane coil of one turn. The same length is now bent more sharply to give a double loop of smaller radius as shown in the figure. The magnetic field at the centre caused by the same current is

(a) a quarter of its initial value
(b) unaltered
(c) four times its initial value
(d) half of its initial value

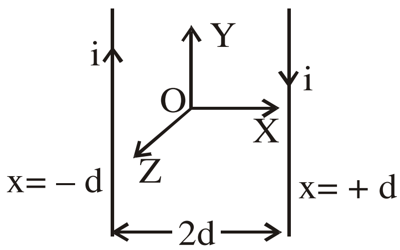


17. An electron is revolving around a proton in a circular orbit of diameter 1 Å. It produces a magnetic field of 14 Wb/m^2 at the proton, its angular velocity will be

(a) 4×10^{16} rad/s (b) 10^{16} rad/s (c) 4×10^{15} rad/s (d) 10^{15} rad/s

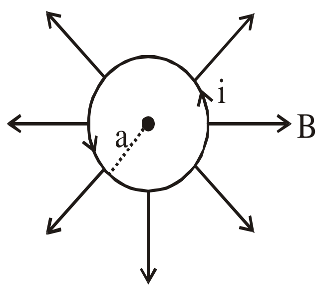
18. In the given diagram, two long parallel wires carry equal currents in opposite directions. Point O is situated midway between the wires and X–Y plane contains the two wires and the positive Z-axis comes normally out of the plane of paper. The magnetic field B at O is non-zero along

(a) X, Y and Z-axis
(b) X-axis
(c) Y-axis
(d) Z-axis

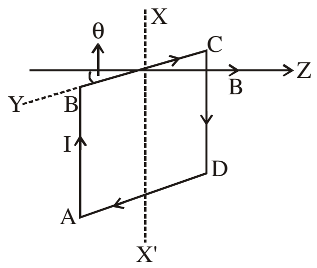


19. A circular loop of radius a, carrying a current I, is placed in a two dimensional magnetic field. The centre of the loop coincides with the centre of the field. The strength of the magnetic field at the periphery of the loop is B. Find magnetic force on the wire

(a) π i a B (b) 4π i a B
(c) zero (d) 2π i a B



20. The square ABCD, carrying a current I is placed in a uniform magnetic field B as shown in the figure. The loop can rotate about the axis XX′. The plane of the loop makes an angle $\theta(\theta < 90^o)$ with the direction of B. Through what angle will the loop rotate by itself before the torque on it becomes zero?



(a) θ (b) $90^o - \theta$

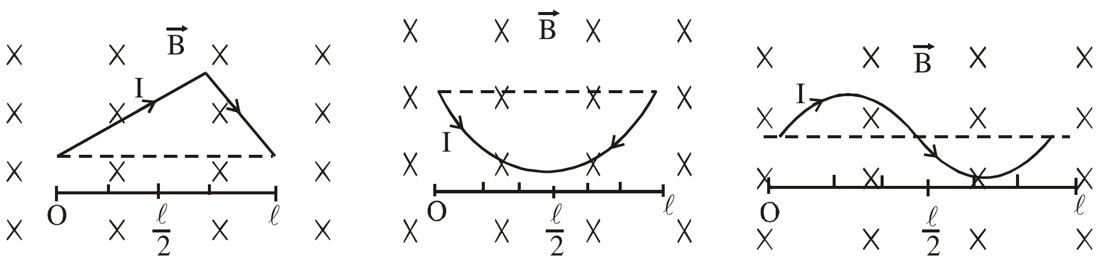
(c) $90^o + \theta$ (d) $180^o - \theta$

21. A charged particle moves undeflected in a region of crossed electric and magnetic fields. If the electric field is switched off, the particle has an initial acceleration a. If the magnetic field is switched off, the particle will have an initial acceleration

(a) equal to 0 (b) > a

(c) equal to a (d) < a

22. Three conductors 1, 2 and 3 each carrying the same current I are placed in a uniform magnetic field B, as shown in the figure.



(1) (2) (3)

The force experienced by conductor 1, 2 and 3 are F_1, F_2 and F_3 respectively

(a) $F_3 > F_2 > F_1$

(b) $F_1 \neq 0, F_2 \neq 0, F_3 = 0$

(c) F_1 acts upwards, F_2 acts downwards, $F_3 = 0$

(d) all experience the same force in the same direction.

23. A closed loop is placed in a uniform magnetic field. If the force experienced by the loop is F, then

(a) F is always equal to zero.

(b) F is equal to zero only if B is perpendicular to loop.

(c) F is equal to zero only if B is parallel to loop.

(d) F may be equal to zero.

24. Choose the incorrect statement about the magnetic moment $\vec{P}_m$ of a loop of area $\vec{A}$ carrying a current I

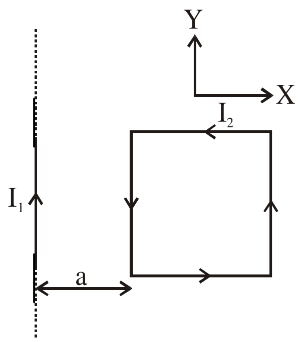
(a) It is defined as $\vec{P}_m = I\vec{A}$

(b) It is a vector quantity

(c) It is defined only for a planer loop

(d) none of these

25. A square loop of side ℓ is placed in the neighbourhood of an infinitely long straight wire carrying a current I_1. The loop carries a current I_2 as shown in the figure



(a) The magnetic moment of the loop is $\vec{P}_m = \ell^2 I_2 \hat{k}$

(b) The magnetic moment of the loop is $\vec{P}_m = -\ell^2 I_2 \hat{k}$

(c) The P.E. of the loop is minimum

(d) The torque experienced by the loop is maximum

26. A cyclotron is operating with a flux density of 3 Wb/m^2. The ion which enters the field is a proton having mass 1.67×10^{-27} kg. If the maximum radius of the orbit of the particle is 0.5 m. Find the period for half cycle

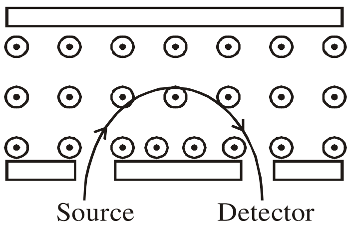
(a) 1.09×10^{-5} s

(b) 1.09×10^{-8} s

(c) 2.18×10^{-8} s

(d) 2.18×10^{-5} s

27. A uniform magnetic field with a slit system as shown in the figure is to be used as a momentum filter for high energy charged particles. With a field of B tesla it is found that the filter transmits α particle each of energy 5.3 MeV. The magnetic field is increased to 2.3 B tesla and deuterons are passed into the filter. What is the energy of each deuterons transmitted by the filter?



(a) 5.3 MeV

(b) 10.06 MeV

(c) 14.02 MeV

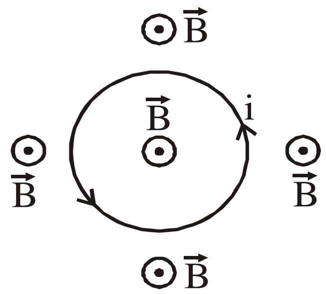
(d) 15.03 MeV

28. A particle having charge 100 times that of an electron is revolving in a circular path of radius 0.8 m with one rotation per second. The magnetic field produced at the centre is

(a) $10^{-7}\,\mu_0$ (b) $10^{-17}\,\mu_0$

(c) $10^{-6}\,\mu_0$ (d) $10^{-15}\,\mu_0$

29. An elastic circular wire of length ℓ carries a current i. It is placed in a uniform magnetic field $\vec{B}$ (out of paper) such that its plane is perpendicular to the direction of $\vec{B}$. The wire will experience



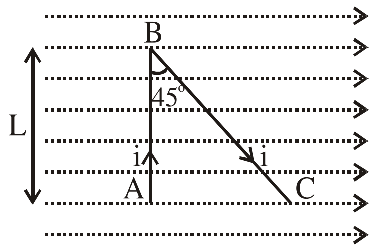
(a) a torque

(b) no force

(c) a compressive force

(d) a stretching force

30. A wire ABC, carrying current. is bent as shown in the figure. It is placed in a uniform magnetic field of magnetic induction B. (Length AB = L and ∠ABC = 45°.) The ratio of force on AB and on BC is



(a) $\frac{1}{\sqrt{2}}$

(b) $\sqrt{2}$

(c) 1

(d) 2/3

SECTION C

1. A long straight wire of radius R carries a current distributed uniformally over its cross section. The magnitude of magnetic field is

   (a) maximum at the axis of wire.

   (b) minimum at the axis of wire.

   (c) maximum at the surface of the wire.

   (d) minimum at the surface of the wire.

2. If a charged particle kept at rest experiences an electromagnetic force

   (a) the electric field must not be zero.

   (b) the magnetic field must not be zero.

   (c) the electric field may or may not be zero.

   (d) the magnetic field may or may not be zero.

3. The unit of magnetic flux can be written as

   (a) Vs (b) HA

   (c) Tm^2 (d) N m s-C^{-1}

4. A circular loop of radius R carrying current I is placed in the XY-plane. Choose the correct statement(s) about magnetic field produced by this loop

   (a) the magnetic field on Z-axis is only along the Z-axis.
   (b) the magnetic field at the points lying in the XY-plane is zero.
   (c) the magnetic field at all the points lying in the XY-plane is only along the Z-axis.
   (d) the magnetic field at the origin is zero.

5. A charge q is moving along a straight line with a velocity $\vec{v}$.

   (a) It produces both electric field $\vec{E}$ and magnetic field $\vec{B}$
   (b) The magnetic field is perpendicular to the plane of $\vec{v}$ and $\vec{E}$
   (c) The magnitude of $\vec{B}$ is less than that of $\vec{E}$
   (d) The magnetic field is only perpendicular to $\vec{v}$

6. A constant current is flowing through a long straight wire of circular cross-section. On the axis of the wire

   (a) strength of electric and magnetic field, both may be equal to zero

(b) strength of electric field alone may be equal to zero

(c) strength of magnetic field is equal to zero

(d) strength of electric field cannot be equal to zero

7. A charged particle having charge q and mass m enters into a uniform magnetic field of induction B at an angle θ with direction of the field. The frequency of revolution of the particle

(a) is independent of the angle θ.

(b) is proportional to the specific charge $\frac{q}{m}$ of the particle.

(c) is inversely proportional to the value of B.

(d) is independent of speed of the particle, at the instant entering into the field.

8. The Gauss Law for magnetic field is given by $\oint \vec{B}\cdot d\vec{S} = 0$. It means that

(a) magnetic field lines are always closed.

(b) monopoles do not exist .

(c) magnetic field is conservative.

(d) a bar magnet is enclosed by the surface.

9. If the Lorentz force on a charge particle is zero in a region where $\vec{E}$ and $\vec{B}$ are not zero, then (if v is the velocity of particle)

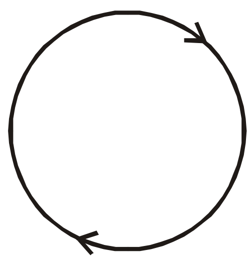
(a) E must be parallel to B

(b) E must be perpendicular to B

(c) $B \geq \frac{E}{v}$

(d) $B \leq \frac{E}{v}$

10. In the given diagram, a line of force of a particular force field is shown. Out of the following options, it can never represent



(a) an electrostatic field

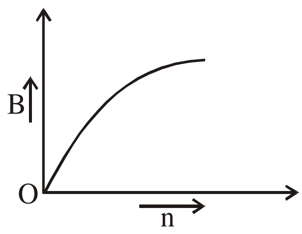
(b) a magnetostatic field

(c) a gravitational field of a mass at rest

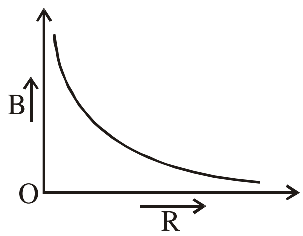
(d) an induced electric field

11. A thin wire of length ℓ is carrying a constant current. The wire is bent to form a circular coil. If radius of the coil thus formed is equal to R and number of turn in it is equal to n, then which of the following graphs represent(s) variation of magnetic field induction (B) at the centre of coil?

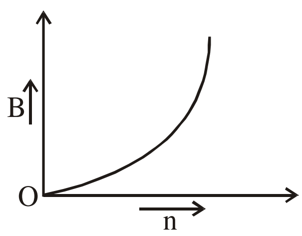
(a)



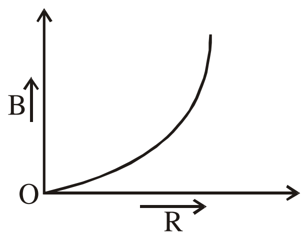
(b)



(c)



(d)



12. The direction of magnetic moment is given by

(a) the direction of area vector

(b) the direction of external magnetic field vector in which the loop is placed

(c) the direction of the magnetic field produced by the loop itself

(d) the direction of current

13. Choose the correct statements about the relation between magnetic momentum $\vec{P}_m$ and angular momentum $\vec{L}$ of a body of mass m and carrying charge q

(a) It is given by $\vec{P}_m = \frac{q}{2m}\vec{L}$

(b) It is valid only for regular shaped bodies.

(c) It is valid for any finite size body.

(d) It is not true for elementary particles.

14. A charged particle is fired at an angle of θ in an uniform magnetic field directed along the X-axis. During its motion along a helical path, the particle will,

(a) never move parallel to X-axis

(b) move parallel to X-axis once during every rotation for all values of θ

(c) move parallel to the X-axis at least once during every rotation if $\theta = 45^o$

(d) never move perpendicular to the X-direction

15. An electron moving in a circular orbit around the nucleus of an atom

(a) exerts an electric force on the nucleus equal to that on it by the nucleus

(b) produces a magnetic induction at the nucleus

(c) has a magnetic dipole moment

(d) has a net energy inversely proportional to its distance from the nucleus.

16. Choose the correct statement(s) about the magnetic force

(a) It can accelerate a moving charge

(b) It can change the velocity of the charge

(c) It is a central force

(d) It can do work on a moving charge

17. Choose the correct statement(s) about the magnetic dipole of dipole moment $\vec{P}_m$ placed in a uniform magnetic field $\vec{B}$

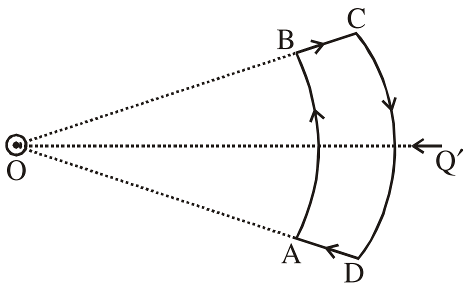
(a) It experiences torque $\vec{\tau}$, if $\vec{P}_m$ and $\vec{B}$ are neither parallel nor antiparallel to each other

(b) It posses potential energy, if $\vec{P}_m$ is not perpendicular to $\vec{B}$

(c) It does not experience force $\vec{F}$

(d) If $\vec{\tau} \neq 0$, then $\vec{F} \neq 0$

18. An infinite current carrying wire passes through point O and perpendicular to plane containing a current carrying loop ABCD as shown in the figure choose the correct option(s)



(a) net force on the loop is zero

(b) net torque on the loop is zero

(c) as seen from O, the loop rotates clockwise

(d) as seen from O, the loop rotates anticlockwise

19. A hollow tube is carrying an electric current along its length distributed uniformly over its surface. Then the magnetic field

(a) is zero inside the tube

(b) is zero outside the tube

(c) increases linearly from the axis upto the surface

(d) is proportional to $\frac{1}{r}$ where r is distance of external point from the axis

20. A particle of mass 0.6 gm and charge 2.5×10^{-8} C is given an initial horizontal velocity of 6×10^{5} m/s. To keep the particle moving in horizontal direction

(a) the magnetic field should be parallel to direction of velocity

(b) the magnetic field should be perpendicular to the direction of velocity

(c) the minimum value of magnetic field must be 0.4T

(d) no magnetic field is required

21. H^+, He^+ and O^{++} all having the same kinetic energy pass through a region in which there is a uniform magnetic field perpendicular to their velocity. The masses of H^+, He^+ and O^{++} are 1 amu, 4 amu and 16 amu respectively, then

(a) H^+ will be deflected most

(b) O^{++} will be deflected most

(c) He^+ and O^{++} will be deflected equally

(d) All will be deflected equally

22. A small circular flexible loop of wire of radius r carries a current I. It is placed in a uniform magnetic field B perpendicular to the plane of the loop. The tension in the loop will be double if

(a) I is doubled

(b) B is doubled

(c) r is doubled

(d) both B and I are doubled

23. An α-particle moving with velocity v enters a region of simultaneous electric and magnetic field, but remains undeflected. Then,

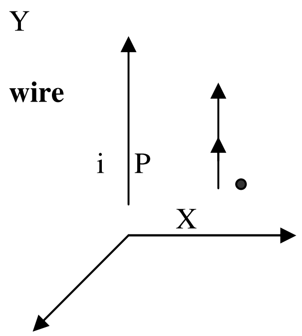
(a) $\vec{E}$ is parallel to $\vec{v}$ and $\vec{B}$

(b) $\vec{E}$, $\vec{v}$ and $\vec{B}$ are mutually perpendicular

(c) The speed of particle is $v = \frac{E}{B}$

(d) The speed of particle is v = EB

24. A straight wire carrying current i is parallel to Y-axis, then



(a) the magnetic field at point P is parallel to X-axis.

(b) the magnetic field at point P is parallel to Z-axis.

(c) the magnetic lines are concentric circles having common centre at the wire.

(d) magnetic field at P depends on length of the wire.

Z

25. A proton and an electron both moving with the same velocity enter a region of uniform magnetic field directed perpendicular to the velocity of the particles. They will now move in circular orbits such that

(a) their time period will be same

(b) the time period of proton will be more

(c) the radius of proton's orbit will be more

(d) the radius of electron's orbit will be more

Current Electricity

SECTION – A

1. A steady current I pass through a linear conductor of uniform cross-section. Any given segment of the conductor has
   (a) a net positive charge
   (b) a net negative charge
   (c) a net charge proportional to volume of the segment
   (d) a zero net charge of any kind

2. A metallic block has no potential difference applied across it, then the mean velocity of the free electron is
   (a) proportional to T
   (b) proportional to $\sqrt{T}$
   (c) zero
   (d) finite but independent of temperature

3. A current I flows through a uniform wire of diameter 'd' when the mean drift velocity is v_d. The same current will flow through a wire of diameter $\frac{d}{2}$ made of the same material, if the mean drift velocity of the electron is
   (a) $\frac{v_d}{4}$
   (b) $\frac{v_d}{2}$
   (c) $4\ v_d$
   (d) $2v_d$

4. The momentum acquired by the electron in 10 cm of wire when a current of 1A starts flowing is
   (a) 2.8×10^{-12} kg m/s
   (b) 5.6×10^{-17} kg m/s
   (c) 5.6×10^{-13} kg m/s
   (d) 2.8×10^{-7} kg m/s

5. The resistance across two opposite faces of a cube of side 2 cm is $2 \times 10^{-6}\Omega$. The specific resistance of its material in Ω cm is
   (a) 10^{-6}
   (b) 2×10^{-6}
   (c) 4×10^{-6}
   (d) 0.5×10^{-6}

6. A wire of length ℓ is drawn such that its diameter is reduced to half of its original diameter. If the initial resistance of the wire was 10Ω, its new resistance would be
   (a) 40Ω
   (b) 80 Ω
   (c) 120 Ω
   (d) 160 Ω

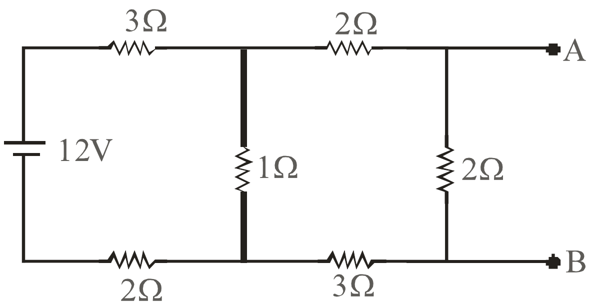
7. Masses of three wires of same metal are in the ratio 1 : 2 : 3 and their lengths in the ratio 3 : 2 : 1. Electric resistance of these wires will be in the ratio
   (a) 1 : 1 : 1
   (b) 1 : 2 : 3
   (c) 9 : 4 : 1
   (d) 27 : 6 : 1

8. If the resistance of wire at 50°C is 5RΩ and at 100°C is 6RΩ, find resistance at 0°C.

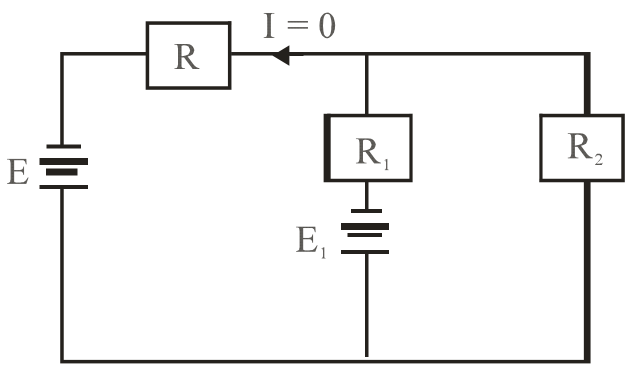
(a) 0RΩ (b) 2RΩ
(c) 3RΩ (d) 4RΩ

9. The temperature coefficient of resistance of a wire is 0.00125 per °C. Its resistance is 1Ω at 300 K, its resistance will be 2Ω at
(a) 1154 K (b) 1100 K
(c) 1127 K (d) 1400 K

10. Potential difference between the points A and B is
(a) 1.00 V
(b) 0.50 V
(c) 1.50 V
(d) 2.50 V



11. Figure shows a circuit with known resistance R_1, and R_2. Neglecting the resistance of conducting wires and internal resistance of current sources find the magnitude of electromotive force E_1 such that current I through the resistance R is zero.



(a) $E\left(\frac{R_1}{R_2}\right)$ (b) $E\left(\frac{R_1+R_2}{R_2}\right)$

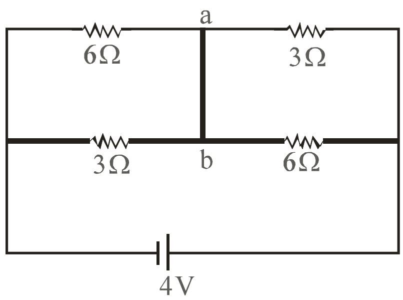
(c) $E\left(\frac{R_2}{R_1}\right)$ (d) $E\left(\frac{R_1}{R_1+R_2}\right)$

12. In the given circuit below the current through the conductor ab is

(a) $\frac{1}{3}$A from a to b

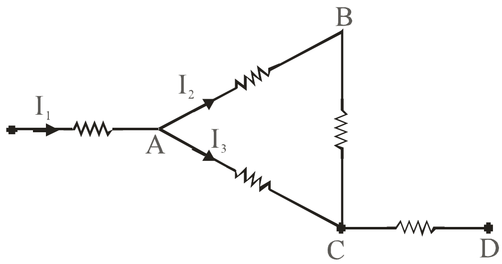
(b) $\frac{1}{3}$A from b to a

(c) $\frac{2}{3}$A from a to b



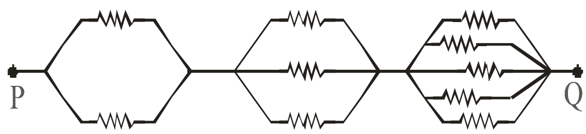
(d) zero

13. The current in the arm CD of the circuit is
(a) $I_1 + I_2$
(b) $I_2 + I_3$
(c) $I_1 + I_3$
(d) $I_1 - I_2 + I_3$



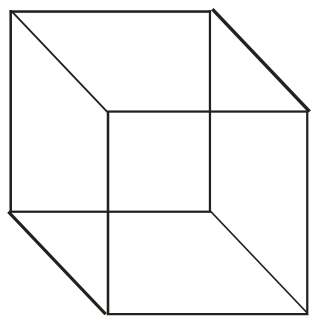
14. Kirchhoff's law is an application of conservation of
(a) charge and energy
(b) charge and linear momentum
(c) energy and linear momentum
(d) none of these

15. In the circuit shown in the figure, every resistance has 24Ω value. The resistance between terminal P and Q is

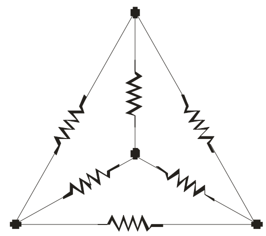


(a) 42 Ω
(b) 36 Ω
(c) 32 Ω
(d) 24.8 Ω

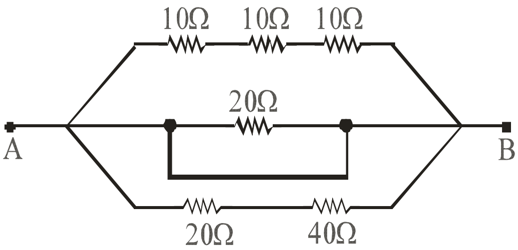
16. Twelve wires of equal length and same cross-section are connected in the form of a cube. If the resistance of each of the wire is R, then effective resistance between each diagonal ends would be
(a) 2 R
(b) 12 R
(c) $\frac{5}{6}$R
(d) 8 R



17. Six equal resistances of 4Ω each are connected as shown in the figure. The resistance between any two corners, is
(a) 4 Ω
(b) 2 Ω
(c) 1 Ω
(d) $\frac{4}{6}$ Ω

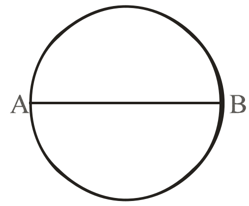


18. The total electrical resistance between the points A and B for the circuit as shown in the figure is



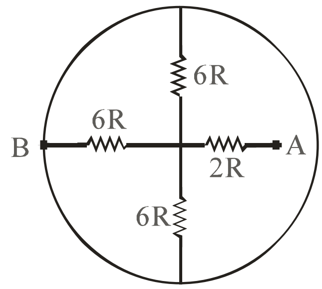
(a) 0 Ω
(b) 15 Ω
(c) 30 Ω
(d) 100 Ω

19. In the given figure find the resistance between points A and B. Both the circle and diameter are made of uniform wire of resistance 1×10^{-4} Ω/m. The length AB is 2 m.



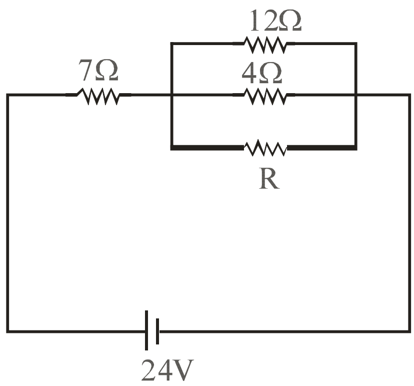
(a) $\frac{2}{3}\times 10^{-4}\ \Omega$
(b) $\frac{2\pi}{3}\times 10^{-4}\ \Omega$
(c) $14.56 \times 10^{-4}\Omega$
(d) $0.88 \times 10^{-4}\ \Omega$

20. The ring shown in the figure has zero resistance. The equivalent resistance between points A and B will be



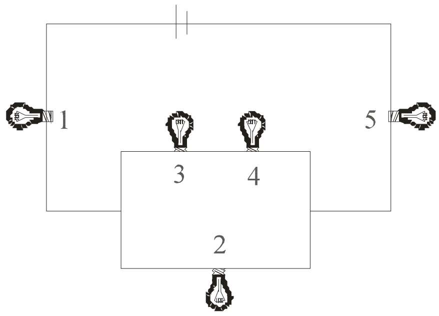
(a) R
(b) 2R
(c) 3R
(d) 4R

21. In the given circuit, for what value of R, will the ideal battery transfer energy at the rate of 60 W.



(a) 0.40 Ω
(b) 19.5 Ω
(c) 9.6 Ω
(d) 6.9 Ω

22. All bulbs shown in the figure are identical, which of the bulb/bulb's light/lights most brightly?
(a) 1 only
(b) 2 only
(c) 3 and 4
(d) 1 and 5

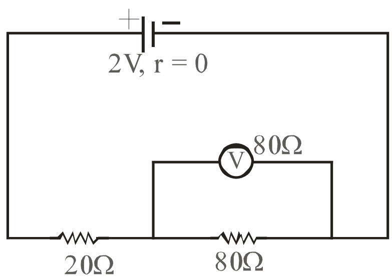


23. A battery of emf 10 V and internal resistance 0.5Ω is connected across a variable resistance R. The value of R for which the power delivered in it is maximum, is given by
(a) 2.0Ω
(b) 0.25 Ω
(c) 1.0 Ω
(d) 0.5 Ω

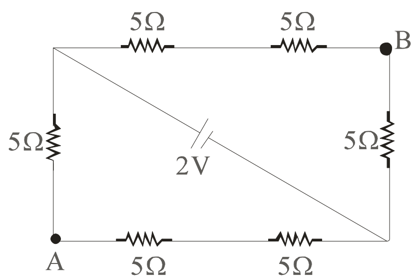
24. Two electric bulbs whose resistance is in the ratio of 1: 2 are connected in parallel to a constant voltage source. The power dissipated in them has the ratio
(a) 1 : 2
(b) 1 : 1
(c) 2 : 1
(d) 1 : 4

25. An electric kettle has two coils when one of these is switched on the water in the kettle boils in 6 minutes. When the other coil is switched on, the water boils in 3 minutes. If the two coils are connected in series, the time taken in minutes to boil the water in the kettle, is
(a) 3
(b) 6
(c) 2
(d) 9

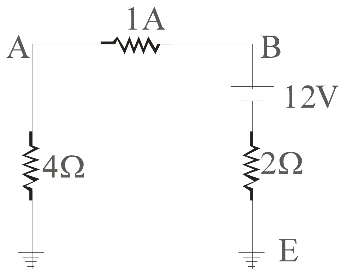
26. In the circuit shown in figure, the reading of voltmeter is
(a) 1.33 V
(b) 0.80 V
(c) 2.00 V
(d) 1.60 V



27. The potential difference between the points A and B in the figure will be
(a) $\frac{2}{3}$V
(b) $\frac{8}{9}$V
(c) $\frac{4}{3}$V
(d) 2V

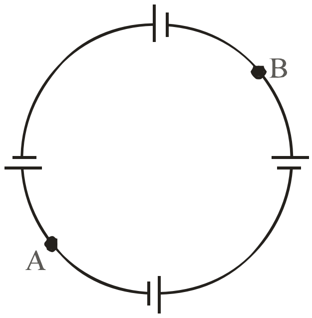


28. In the given circuit



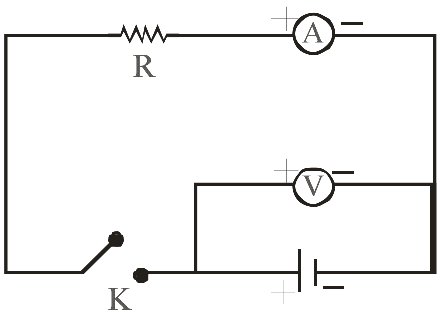
(a) R = 8 Ω
(b) R = 6 Ω
(c) R = 10 Ω
(d) Potential difference between point A and E is 2 V.

29. Four identical cells each having e.m.f. E and internal resistance zero are shown in the figure. The potential difference between points A and B is



(a) 4 E (b) 2 E
(c) zero (d) E

30. In the given circuit an ammeter of negligible resistance and a voltmeter of very high resistance are used. When key K is open, the voltmeter reads 1.53 V. When the key is closed, the ammeter reads 1.0 A and the voltmeter reads 1.03 V. The resistance R is



(a) 0.5 Ω
(b) 1.03 Ω
(c) 1.53 Ω
(d) 0.53 Ω

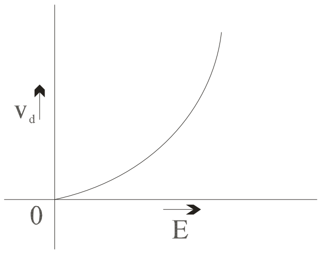
SECTION – B

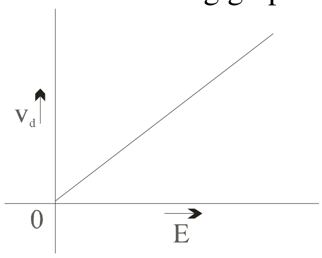
1. A potential difference is applied across the ends of a metallic wire. If the potential difference is doubled, the drift velocity
   (a) will be doubled. (b) will be halved.
   (c) will be quadrupled. (d) will remain unchanged.

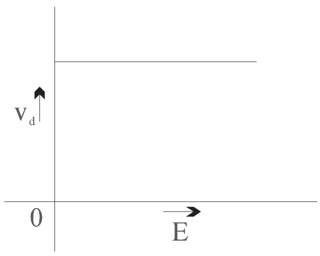
2. An ionization chamber with parallel conducting plates as anode and cathode, has 5×10^7 electrons and the same number of singly charged positive ions per cm^3. The electrons are moving towards the anode with velocity 0.4 m/s. The current density from anode to cathode is 4 $\mu A/m^2$. The velocity of positive ions moving towards cathode is
   (a) 0.4 m/s (b) zero
   (c) 1.6 m/s (d) 0.1 m/s

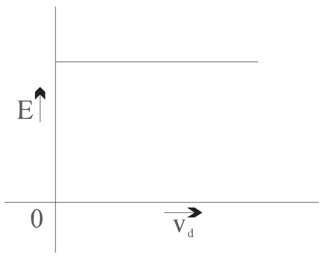
3. The electron beam in a television picture tube travels a total distance of 0.50 m in the evacuated space of the tube. If the speed of the electrons is 8.0×10^7 m/s and the beam current is 2.0 mA. Then number of electrons in the beam at any one instant is
   (a) 1.56×10^8 (b) 7.8×10^7
   (c) 3.9×10^5 (d) 7.8×10^9

4. If E denotes electric field in a uniform conductor and v_d corresponding drift velocity of the free electrons in the conductor then which of the following graph is correct?

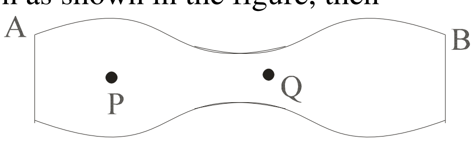
(a)


(b)


(c)


(d)


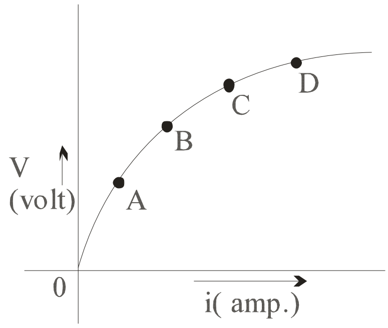
5. If a source of constant potential difference is connected across a conductor having irregular cross-section as shown in the figure, then



   (a) electric field intensity at P is greater than that at Q.

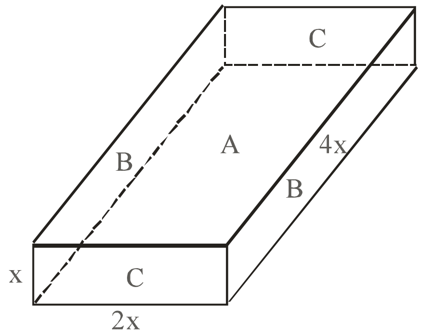
(b) rate of electron crossing per unit area of cross-section at P is less than that at Q
(c) rate of generation of heat per unit length at P is greater than that at Q
(d) mean kinetic energy of free electron at P is greater than that at Q

6. Variation of current passing through a conductor as the voltage is applied to its ends varies as shown in the figure. If the resistance is determined at points A, B, C and D we find that resistance at



(a) C and D are equal
(b) B is higher than that at A
(c) C is higher than that at B
(d) A is lower than that at B

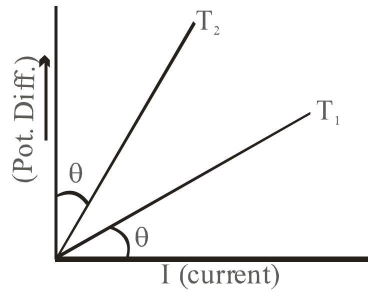
7. Figure shows a rectangular block with dimensions x, 2x and 4x. Electrical contacts can be made to the block between opposite pairs of faces (for example between the faces labeled A – A, B – B and C – C). The maximum electrical resistance that can be obtained at which of the two faces-



(a) A – A
(b) B – B
(c) C – C
(d) same for all the three pairs

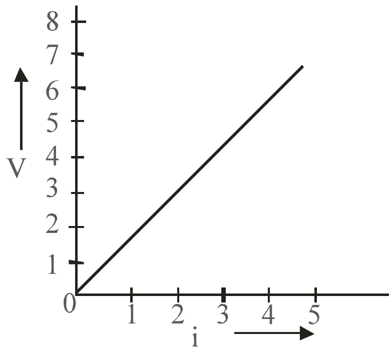
8. A certain piece of copper is to be shaped into a conductor of a minimum resistance the length and diameter should be
(a) ℓ, d
(b) 2ℓ, d
(c) $\frac{\ell}{2}$, 2d
(d) $2\ell, \frac{d}{2}$

9. V – I graph for a conductor (Platinum wire) at temperature T_1 and T_2 as shown, $(T_2 - T_1)$ is proportional to



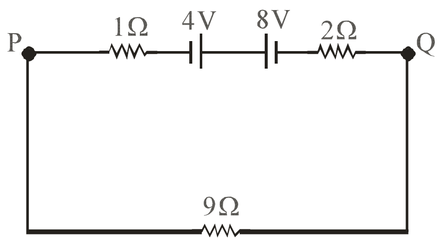
(a) cos 2θ
(b) sin 2θ
(c) cot 2θ
(d) tan 2θ

10. Variation of current and voltage in a conductor has been shown in the figure. The resistance of the conductor is



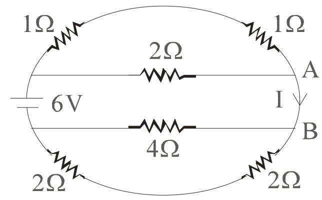
(a) 4 μ
(b) 2 Ω
(c) 3 Ω
(d) 1 Ω

11. Two batteries of e.m.f 4V and 8V with internal resistance 1Ω and 2 Ω are connected in a circuit with a resistance of 9Ω as shown in the figure. The current and potential difference between the points P and Q are



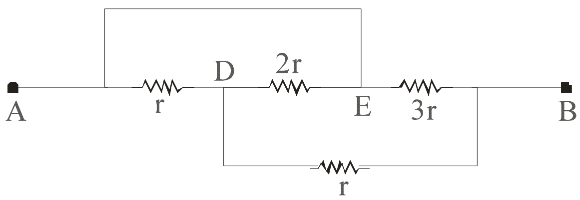
(a) $\frac{1}{3}$A and 3V
(b) $\frac{1}{6}$A and 4V
(c) $\frac{1}{9}$A and 9V
(d) $\frac{1}{12}$A and 12V

12. The current in the branch AB is (as shown in the figure)



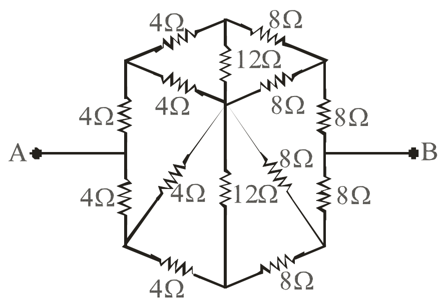
(a) 1A
(b) 2A
(c) 1.5 A
(d) 3 A

13. What is the equivalent resistance across the terminals A and B?



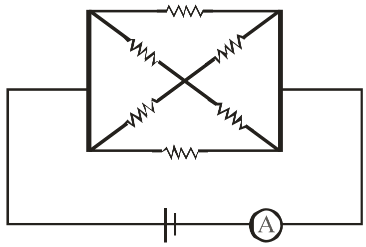
(a) $\frac{15}{7}$r
(b) $\frac{7}{15}$r
(c) $\frac{15}{14}$r
(d) $\frac{8}{15}$r

14. In the given circuit the electrical resistance between points A and B is



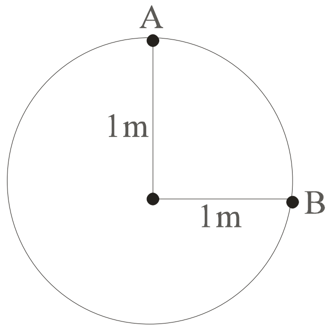
(a) 24Ω
(b) 12 Ω
(c) 18 Ω
(d) 9 Ω

15. The current shown by ammeter A in the circuit is



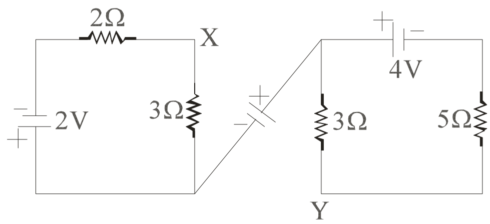
(a) 2.5 A (b) 2.6 A
(c) 3.5 A (d) 3.6 A

16. The wire used in the arrangement shown in the figure, has a resistance of 1 Ω/m. What is the equivalent resistance between point A and B



(a) $\frac{3\pi}{6\pi+16}\Omega$ (b) $\frac{5\pi}{8\pi+15}\Omega$
(c) $\frac{6\pi}{3\pi+16}\Omega$ (d) none.

17. The potential drop between X and Y in the given circuit is

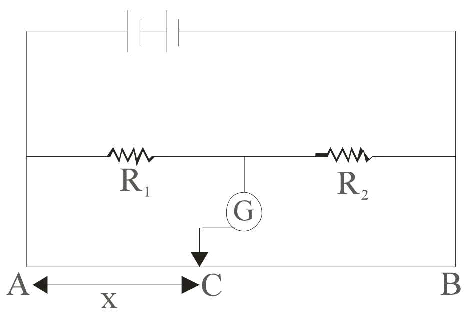


(a) 1.2 V (b) 4.0 V
(c) 3.7 V (d) 1.5 V

18. The length of a wire of a potentiometer is 10 cm, and the e.m.f. of its standard cell is E volt. It is employed to measure the e.m.f. of a battery whose internal resistance is 0.5 Ω. If the balance point is obtained at ℓ = 30 cm from the positive end, the e.m.f. of the battery is (If i is current in potentiometer wire)

(a) $\frac{30E}{100}$ (b) $\frac{30E}{100.5}$
(c) $\frac{30E}{(100-0.5)}$ (d) $\frac{30(E-0.5i)}{100}$

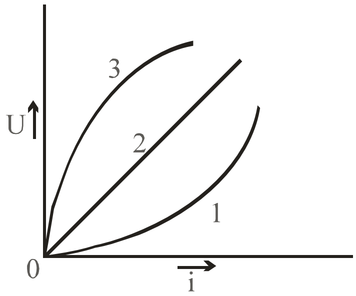
19. In the given circuit, no current is passing through the galvanometer, connected to a meter bridge. AC corresponding to null deflection of galvanometer is x. What would be its value if radius of wire AB is doubled?



(a) $\frac{x}{2}$
(b) 2x

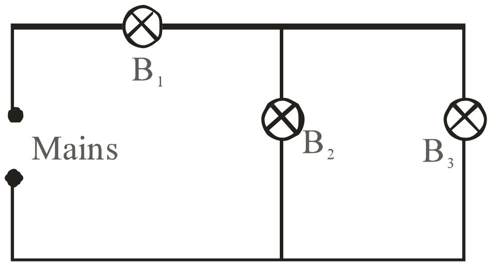
(c) x
(d) none of these

20. Which of the following plots may represent the thermal energy (U) produced in a resistor in a given time as a function of electric current?



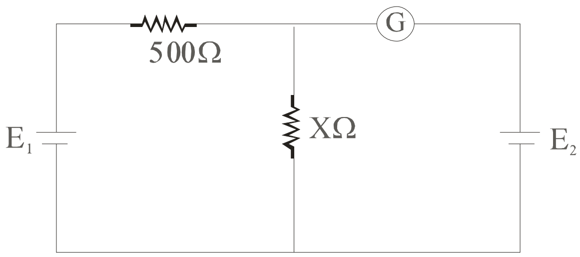
(a) 1
(b) 2
(c) 3
(d) any one of them

21. Three bulbs B_1, B_2 and B_3 are connected to the mains as shown in the figure. How will the incandescence of bulb. B_1 be affected if one of bulbs B_2 or B_3 is disconnected from the circuit?



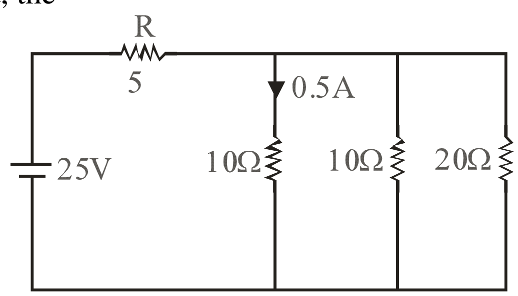
(a) No change in incandescence
(b) Bulb B_1 will become brighter
(c) Bulb B_1 will become less bright
(d) The bulb B_1 may become brighter or dimmer depending upon the candle power of the bulb which is disconnected

22. In the adjoining circuit the battery E_1 has an e.m.f. of 12V and zero internal resistance while the battery E_2 has an e.m.f. of 2 V. If the galvanometer G reads zero, then the value of the resistance X in ohms is



(a) 10
(b) 100
(c) 14
(d) 200

23. In the given circuit, the



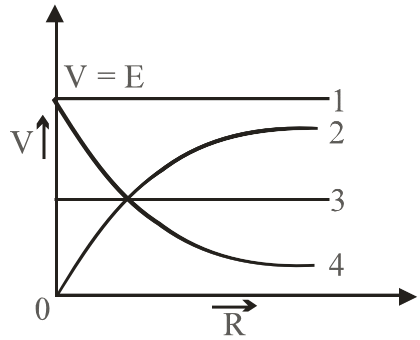
(a) resistance R = 16Ω
(b) current through 20Ω resistance is 1A
(c) Potential difference across the middle resistance is 15V

(d) Potential difference across R is 10V

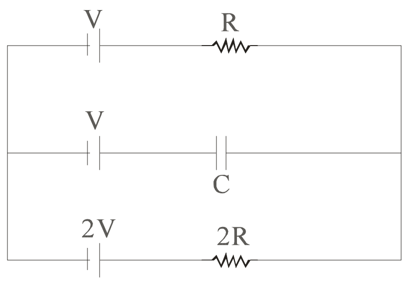
24. A cell of e.m.f. E having an internal resistance r is connected to an external resistance R. The potential drop V across the resistance R as shown in the figure by the curve marked is

(a) 4 (b) 1

(c) 2 (d) 3



25. In the given circuit, with steady current, the potential difference across the capacitor will be



(a) V (b) $\frac{V}{2}$

(c) $\frac{V}{3}$ (d) $\frac{2V}{3}$

SECTION – C

1. Choose the correct statement(s) from the following

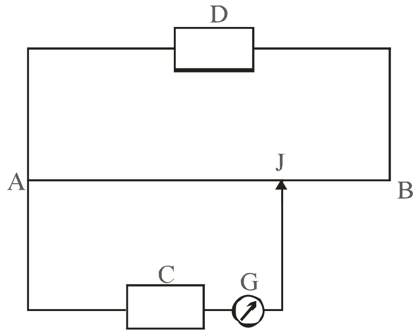
(a) A low voltage supply of 6V must have a very low internal resistance

(b) A high voltage supply of 6000 V must have a very high resistance

(c) A wire carrying current stays electrically neutral
(d) A high resistance voltmeter is used to measure the e.m.f. of a cell

2. When a resistance of 9.5 Ω is connected across a battery, the voltage across the resistance is 11.4V. If the resistance connected across the same battery is 11.5 Ω, the voltage across the resistance is 11.5V.
(a) The emf of the battery is 12.0 V.
(b) The internal resistance of the battery is 0.5 Ω.
(c) The e.m.f. of the battery is 11.45 V.
(d) The e.m.f. of the battery is 11.50 V.

3. The figure shows a potentiometer arrangement. D is the driving cell, C is the cell whose emf is to be determined, AB is the potentiometer wire, G is a galvanometer and J is a sliding contact which can touch any point on AB. Which of the following are essential conditions for obtaining balance?

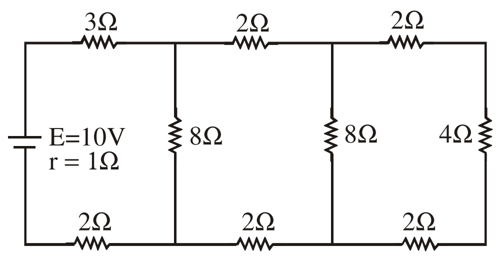


(a) The emf of D must be greater than the emf of C
(b) Either the positive terminals of both D and C or the negative terminals of both D and C must be joined to A
(c) The positive terminals of D and C must be joined to A
(d) The resistance of G must be less than the resistance of AB

4. Unit of e.m.f. is
(a) joule/ampere (b) volt/ampere
(c) $\frac{\text{henry} - \text{amper}}{\text{second}}$ (d) joule/coulomb

5. Constantan wire is used for making standard resistance because it has
(a) low specific resistance. (b) high specific resistance.
(c) neglible temperature coefficient of resistance.
(d) high melting point.

6. In the circuit, the cell has e.m.f. = 10 V, and internal resistance = 1 Ω. Then,



(a) the current through the 3 Ω resistance is 1 A
(b) the current through 3 Ω resistance is 0.5A
(c) the current through 4 Ω resistance is 0.5 A

(d) the current through the 4 Ω resistance is 0.25 A

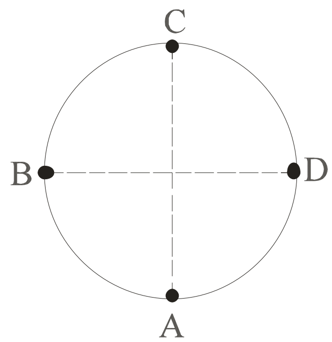
7. In a circuit containing two unequal resistors connected in parallel,
(a) the current is the same in both the resistors.
(b) a large current flows through the large resistance.
(c) the voltage drop across both the resistors is the same.
(d) the smaller resistance has smaller conductance.

8. If three bulbs of 40W, 60W and 100 W are connected in series with a 200V power supply, then
(a) the potential difference will be maximum across 40W bulb.
(b) the current will be maximum through 100W bulb.
(c) the 40 W bulb has the maximum resistance.
(d) the current in the circuit is 0.097 A.

9. Choose the correct statement(s)
(a) The product of a volt and a coulomb is a joule
(b) The product of a volt and an ampere is joule/sec.
(c) The product of a volt and a watt is horse power
(c) Watt-hour can be measured in terms of electron-volts

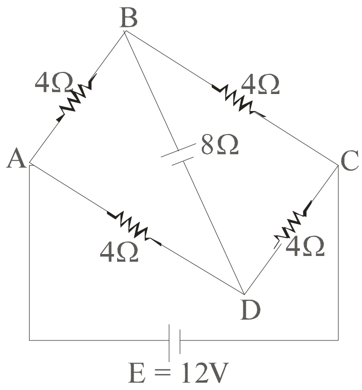
10. Two identical fuses are rated at 10A. If they are joined
(a) in parallel, the combination acts as a fuse of rating 20A.
(b) in parallel, the combination acts as a fuse of rating 5A.
(c) in series, the combination acts as a fuse of rating 10A.
(d) in series, the combination acts as a fuse of rating 20A.

11. A uniform wire of resistance R is bent in the form of a ring. Four points A, B, C and D are marked on the ring as shown in the figure. A battery of emf E may be connected across the ring in two ways:
Case I: Battery is connected between B and D
Case II: Battery is connected between A and B
Choose the correct statement(s)

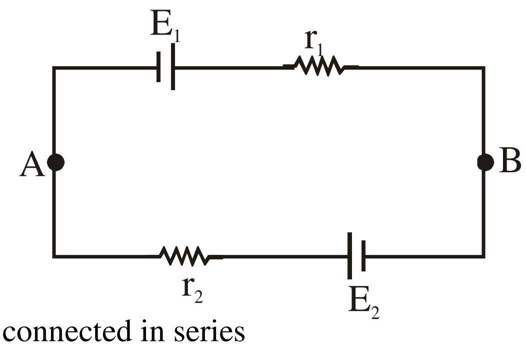


(a) In each case same current flows out of the battery
(b) In case I, more current comes out of the battery
(c) In case II, more current comes out of the battery
(d) In case I, minimum current comes out of the battery

12. The given figure shows the network of resistances and a battery. Identify the correct statement(s)
(a) The circuit satisfies the condition of balance wheat stone bridge
(b) $V_B - V_D = 0$
(c) $V_B - V_D = 8V$
(d) No current flows in the branch BD

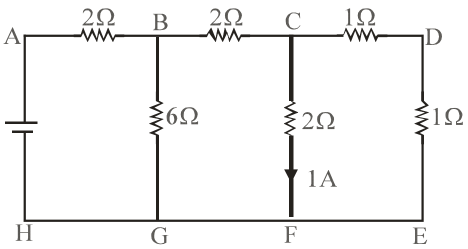


13. In the given circuit



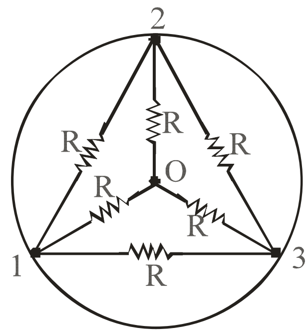
(a) The two cells are connected in series
(b) The potential difference between points A and B cannot be zero
(c) The potential difference between A and B becomes zero when $E_1 r_2 = E_2 r_1$
(d) When $V_A = V_B$, no current flows in the circuit

14. The figure shows the network of resistors and a battery. If 1A current flows through the branch CF, then the current through branch



(a) DE is 1 A
(b) BC is 2 A
(c) BG is 4 A
(d) HG is 6 A

15. Inside a super conducting ring six identical resistors each of resistance R are connected as shown in the figure, the equivalent resistance(s)



(a) between 1 and 2, 2 and 3 and 3 and 1 all are equal.

(b) between 1 and 3 is zero.

(c) between 1 and 3 is $\frac{R}{2}$.

(d) between 1 and 3 is two times that between 1 and 2.

16. Identify the correct statement(s) related to a galvanometer

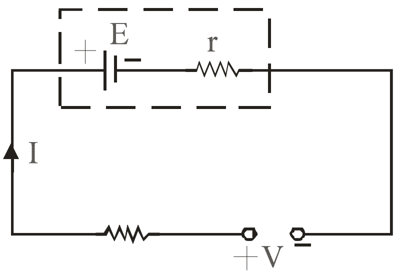
(a) It measures current.

(b) It is marked with positive and negative polarity.

(c) The deflection in galvanometer is proportional to current.

(d) Zero is marked at the middle of the scale.

17. A battery of e.m.f. E with internal resistance r is connected with a generator through a resistance R, as shown in the figure. In time t, the energy



(a) stored in battery is **(E – Ir)It**

(b) dissipated as heat is $\mathbf{I^2 (R + r)t}$

(c) supplied by the generator is **VIt**

(d) supplied by the generator is **(V – E)It**

18. Choose the statement(s), which are correct for the magnitude of shunt resistance

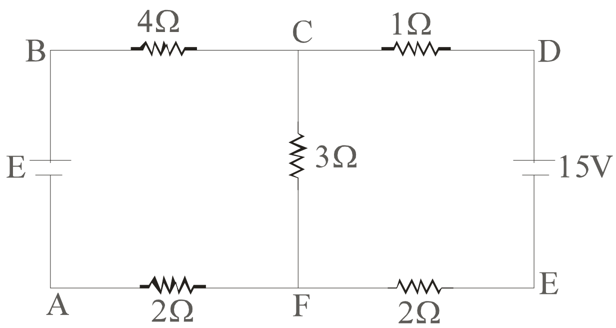
(a) Higher the resistance of galvanometer, larger the value of shunt resistance.

(b) Lower the resistance of galvanometer, larger the value of shunt resistance.

(c) Larger the range of ammeter, lower the value of shunt resistance.

(d) Larger the full scale current, larger the value of shunt resistance.

19. In the circuit as shown in figure. If no current flows through the branch CD, then choose the correct statement(s)



(a) Potential difference $V_F - V_E = 0$

(b) Potential difference $V_C - V_F = 0$

(c) 15V battery does not deliver current

(d) No current flows in the branch DE

20. A potentiometer can be used to measure

(a) e.m.f. of an unknown cell

(b) internal resistance of a cell

(c) unknown resistance

(d) voltage drop across a resistor

SECTION A

1. (d)	**2. (c)**	**3. (c)**	**4. (c)**	**5. (c)**	**6. (d)**
7. (d)	**8.(d)**	**9. (c)**	**10. (b)**	**11. (b)**	**12.(a)**
13. (b)	**14. (a)**	**15. (d)**	**16. (c)**	**17. (b)**	**18. (a)**
19. (d)	**20. (d)**	**21. (b)**	**22. (d)**	**23. (d)**	**24. (c)**
25. (d)	**26. (a)**	**27. (a)**	**28. (b)**	**29. (c)**	**30. (b)**

SECTION B

1. (a)	**2. (d)**	**3. (b)**	**4. (b)**	**5. (b)**	**6. (a)**
7. (c)	**8.(c)**	**9. (c)**	**10. (b)**	**11. (a)**	**12.(b)**
13. (c)	**14. (d)**	**15. (d)**	**16. (c)**	**17. (c)**	**18. (a)**
19. (c)	**20. (a)**	**21. (c)**	**22. (b)**	**23. (a)**	**24. (c)**
25. (c)					

SECTION C

1.	a,b,c	2.	a,b	3.	a,b	4.	c,d
5.	b,c	6.	a,d	7.	c,d	8.	a,c,d
9.	a,b,d	10.	a,c	11.	c,d	12.	a,c
13.	a,c	14.	a,b	15.	a,b	16.	c,d
17.	b,c	18.	a,c,d	19.	b,d	20.	a,b,c,d

Electromagnetic Induction

SECTION A

1. Two identical coils of insulated wire are hung freely, facing each other. If they are fed exactly in the same way with an alternating current, they will

(a) repeal each other. (b) attract each other.

(c) rotate in anticlockwise direction. (d) rotate in clockwise direction.

2. A magnet is allowed to fall through a metal ring held horizontally. During this fall its acceleration is

(a) equal to g (b) less than g

(c) more than g

(d) less than g when magnet is above the ring and more than g when the magnet is below the ring

3. Self-induction is the property of the coil by which

(a) it opposes the decreasing current only

(b) it opposes the increasing current only

(c) it opposes the time varying current

(d) it keeps the current constant

4. Two coils 1 and 2 have their self induction coefficient L_1 and L_2 respectively. Their coefficient of mutual induction M is given by

(a) $M = L_1 + L_2$ (b) $M = |L_1 - L_2|$

(c) $M = \sqrt{L_1 L_2}$ (d) $M \leq \sqrt{L_1 L_2}$

5. When the current in a coil changes from 8A to 2A in 3×10^{-2}s the e.m.f. induced in the coil is 2V. What is the self inductance of the coil

(a) 10H (b) 10 mH (c) 1 mH (d) zero

6. If L and R denote inductance and resistance respectively, then the dimension of $\frac{L}{R}$ is

(a) $M^o L^o T^o$ (b) $M^o L^o T$

(c) $M^2 L^o T^2$ (d) $M L T^2$

7. A coil having an area A_0 is placed in magnetic field which changes from B_0 to $4B_0$ in time interval t. The e.m.f. induced in the coil will be

(a) $\frac{3A_0B_0}{t}$ (b) $\frac{4A_0B_0}{t}$

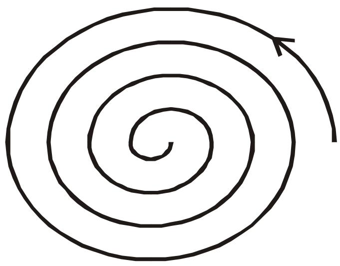
(c) $\frac{3B_0}{A_0 t}$ (d) $\frac{4B_0}{A_0 t}$

8. The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. The direction of induced current in the conducting plane will be

(a) horizontal (b) vertical

(c) clock wire (d) anti clockwise

9. An electron moves in a uniform magnetic field and follows a spiral path as shown in figure. Which of the following statement is wrong



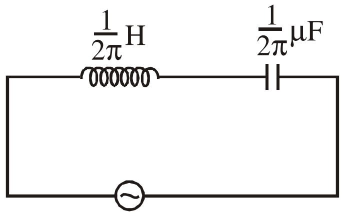
(a) Angular velocity of electron remains constant.

(b) Magnitude of velocity of electron decreases continuously.

(c) Net force on the electron is always perpendicular to its direction of motion.

(d) Magnitude of net force on electron decreases continuously.

10. In the a.c. circuit shown in figure. The supply voltage has a constant r.m.s value V, but variable frequency f. The resonance frequency is



(a) 10 Hz

(b) 100 Hz

(c) 1000 Hz

(d) 200 Hz

11. The dipole moment of small, single turn current loop is 2.0×10^{-4} A m^2. What is the magnetic field induction due to the dipole on its axis 8.0 cm away?

(a) 7.8×10^{-2} Wb/m^2 (b) 7.8×10^{-4} Wb/m^2

(c) 7.8×10^{-8} Wb/m^2 (d) 7.8×10^{-12} Wb/m^2

12. A circular coil of N turns has an effective radius **a** and carries a current i. How much work is done in rotating it in an external magnetic field $\vec{B}$ from a position $\theta = 0$ to

$\theta = 180^o$ where θ is the angle between the normal to the plane of the coil and the direction of $\vec{B}$. Assume N = 100, a = 5.0 cm, i = 0.1 A and B =1.5 Wb/m^2

(a) 2.35 J (b) 0.235 J

(c) 3.25 J (d) 0.325 J

13. If 2.2 kW power is transmitted through a 10Ω line at 22000V, the power loss in the form of heat will be

(a) 0.1 W (b) 1 W

(c) 10 W (d) 100 W

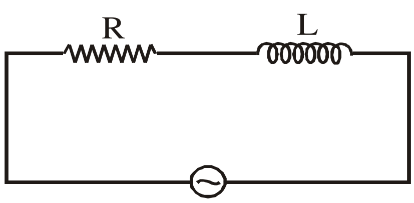
14. A circuit contains resistance R, and inductance L in series. An alternating voltage $V = V_0 \sin \omega t$ is applied across it. The current in R and L respectively will be

(a) $I = I_0 \cos\omega t$, $I = I_0$ cost ωt

(b) $I = -I_0 \sin \omega t$, $I = I_0 \cos \omega t$

(c) $I = I_0 \sin\omega t$, $I = -I_0 \cos \omega t$

(d) $I = I_0 \cos \omega t$, $I = -I_0 \sin \omega t$



15. If ϕ is phase difference between current and voltage, the watt less component of current is

(a) $I_v \cos\phi$ (b) $I_v \sin\phi$

(c) $I_v \tan\phi$ (d) $I_v \cos^2\phi$

16. A rectangular loop of sides 8 cm and 2 cm having resistance of 1.6 Ω is placed in a magnetic field of 0.3T directed normal to the loop. The magnetic field is gradually reduced at the rate of 0.02T/s. How much power is dissipated by the loop as heat?

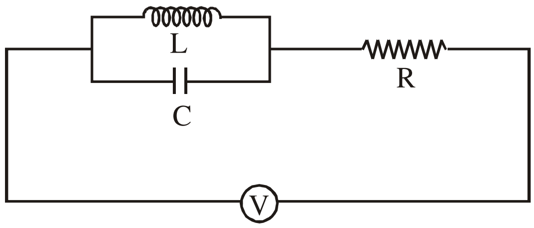
(a) 1.6×10^{-4} W (b) 3.2×10^{-8} W

(c) 6.4×10^{-10} W (d) 12.8×10^{-8} W

17. If a current $i = i_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ flows in an A.C. circuit across a potential $E = E_0 \sin \omega t$ Then power consumption P in the circuit will be

(a) $P = \frac{E_0 I_0}{\sqrt{2}}$ (b) $P = \frac{EI}{\sqrt{2}}$ (c) $P = \frac{E_0 I_0}{2}$ (d) zero

18. In the circuit show below , the current flowing through resistance R at resonance is



(a) zero
(b) $\frac{V}{R}$

(c) $\frac{V}{\sqrt{(R^2+\omega^2L^2)}}$
(d) $\frac{V}{\sqrt{\left\{R^2+\left(\frac{1}{\omega C}\right)^2\right\}}}$

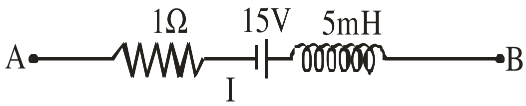
19. A short circuited coil is placed in a time varying magnetic field. Electric power is dissipated due to the current induced in the coil. If the number of turns was to be quadrupled and wire radius halved, the electrical power dissipated would be

(a) halved
(b) the same
(c) doubled
(d) quadrupled

20. A 50 Hz alternating current of crest value 1A flows through the primary of a transformer. What is the crest voltage induced in the secondary if the mutual inductance between primary and secondary is 1.5 H

(a) 271 V
(b) 703 V
(c) 473 V
(d) 471 V

21. The network shown in the figure is part of complete circuit. What is the potential difference $V_B - V_A$, when the current I is 5A and is decreasing at a rate of 10^3 A/s?



(a) 10 V
(b) 15 V
(c) 20 V
(d) 25 V

22. A 100 V a.c. source of frequency 500 Hz is connected to an LCR circuit with L = 8.1 mH, C = 12.5 F and R = 10Ω all connected in series. The potential difference across the resistance

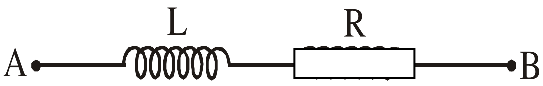
(a) 100 V
(b) 200 V
(c) 250 V
(d) 125 V

23. An a.c. source is 120V – 60 Hz, the value of voltage after $\frac{1}{720}$ s from start will be

(a) 20.2 V
(b) 42.4 V

(c) 84.8 V (d) 106.8 V

24. In an a.c. sub circuit, the resistance $R = 0.2\Omega$. At a certain instant $V_A - V_B = 0.5V$, $I = 0.5A$, $\frac{\Delta I}{\Delta t} = 8A/s$. Find the inductance of the coil



(a) 0.01 H (b) 0.02 H

(c) 0.05 H (d) 0.5 H

25. An e.m.f. of 15 V is applied in a circuit containing 5H inductance and 10Ω resistance. The ratio of current at time $t = \infty$ and at $t = 1$ s is

(a) $\frac{e^{1/2}}{e^{1/2}-1}$ (b) $\frac{e^2}{e^2-1}$

(c) $1-e^1$ (d) e^{-1}

26. The ratio of the secondary to the primary turns in a transformer is 3 : 2 and the out put power is P. Neglecting all power losses, the input power must be

(a) $\frac{2P}{3}$ (b) $\frac{3P}{2}$

(c) $\frac{P}{2}$ (d) P

27. For a coil having L = 2mH, current flow through it is $i = t^2e^{-1}$, then time at which e.m.f. becomes zero is

(a) 2s (b) 1s

(c) 4s (d) 3s

28. A solenoid of resistance 50Ω and inductance 80H is connected to a 200V battery. In how much time current developed will be half of steady state current?

(a) $(8\log_e 2)/5$ (b) $(4\log_e 2)/5$

(c) $(8\log_e 4)/5$ (d) $(4\log_e 4)/5$

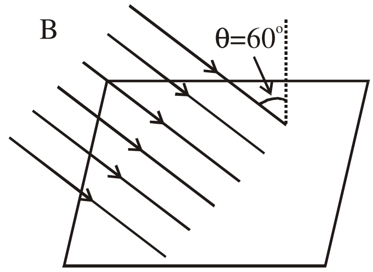
29. A square loop of side 4 cm is lying on a horizontal table. A uniform magnetic field of 0.5T is directed towards at an angle of 60^o to the vertical as shown in figure. If the field increases from zero to its final value in 0.2s then e.m.f. induced in the loop is

(a) 2 mV

(b) 4 mV

(c) 6 mV

(d) 8 mV



SECTION B

1. The speed of rotation of a fan is reduced by putting a rheostat in series with the fan. Let us say the supply is D.C. for convenience. We consume

   (a) the same power than at full speed.

   (b) more power than at full speed.

   (c) less power than at full speed but less efficiently.

   (d) less power than at full speed but more efficiently.

2. A coil of area 80 cm^2 and 50 terns is rotating with 2000 rpm about an axis perpendicular to a magnetic field of 0.05 T. The maximum value of e.m.f. developed in it is

   (a) 200π V (b) $\frac{10\pi}{3}$V

   (c) $\frac{4\pi}{3}$V (d) $\frac{2}{3}$V

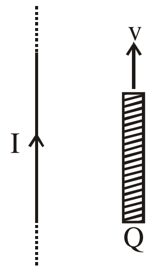
3. An steady current I flows in an infinitely long straight wire. A conducting rod is aligned parallel to the infinitely long wire and moved parallel to it then

   (a) $V_P - V_Q > 0$

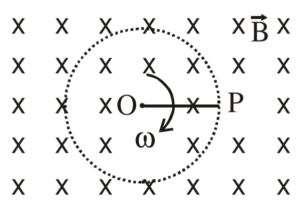
   (b) $V_P - V_Q < 0$

   (c) $V_P - V_Q = 0$

   (d) nothing can be said, as there is no change in flux



4. Figure shows a rod of length ℓ which is rotated in a plane perpendicular to uniform magnetic field B with a constant angular velocity ω



   (a) the end P is positive with respect to O during upper half motion and then becomes negative in the lower half motion

   (b) the end P is negative with respect to O during upper half motion and then becomes positive during in lower half motion

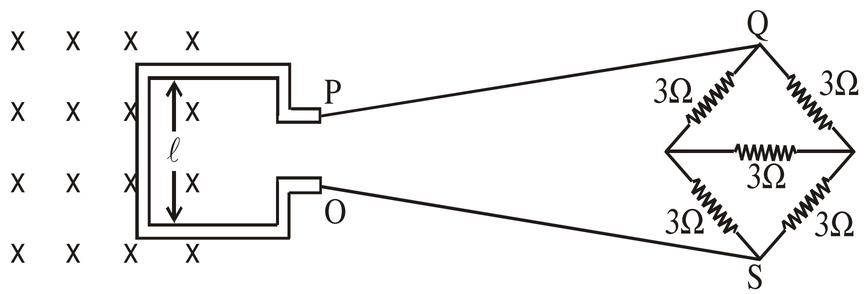
   (c) the end P is always positive with respect to O

(d) the end P is always negative with respect to O

5. An air-plane with 20m wing spread is flying at 250 m/s straight south parallel to earth's surface. The earth's magnetic field has a horizontal component of 2×10^{-5} Wb/m^2 and the dip angle is 60^o. Calculate the induced e.m.f. between the plans tips

(a) zero
(b) 0.173 V
(c) 0.141 V
(d) 0.346 V

6. A square metal wire loop of side 10 cm and resistance 1 Ω is moved with a constant velocity v_0 in a uniform magnetic field of induction B = 2 Wb/m^2 as shown in the figure. The magnetic field lines are perpendicular to the plane of the loop. The loop is connected to a network of resistance 3 Ω of each. The resistance of lead wires OS and PQ are negligible. What should be the speed of loop so as to have a steady current of 1 mA in the loop



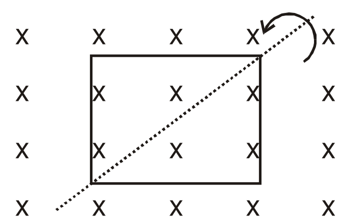
(a) 1 cm/s
(b) 2 cm/s
(c) 4 cm/s
(d) 8 cm/s

7. A square loop of side 1m is placed in a perpendicular magnetic field. Half of the area of the loop lies inside the magnetic field. A battery of e.m.f. 10 V and negligible internal resistance is connected in the loop. The magnetic field changes with time according to the relation B = (0.01 – 2t) tesla. The total e.m.f. of the battery will be

(a) 1
(b) 11
(c) 9
(d) 10

8. A square loop of side **a** is rotating about its diagonal with angular velocity ω in a perpendicular magnetic field as shown in the figure. If the number of turn in it is 50, then magnetic flux linked with the loop at any instant will be

(a) $50\ Ba^2 \cos \omega t$
(b) $50\ Ba^2 \sin \omega t$
(c) $Ba^2 \cos\omega t/50$
(d) $50\ Ba^2/\cos\omega t$



9. A small square loop of wire of side ℓ is placed inside a large square loop of wire of side L (>> ℓ). The loops are coplanar and their centres coincide. What is the mutual induction of the system

(a) $2\sqrt{2}\,\frac{\mu_0\,\ell^2}{\pi L}$ (b) $8\sqrt{2}\,\frac{\mu_0\,\ell^2}{\pi L}$ (c) $2\sqrt{2}\,\frac{\mu_0\,\ell^2}{2\pi L}$ (d) none of these

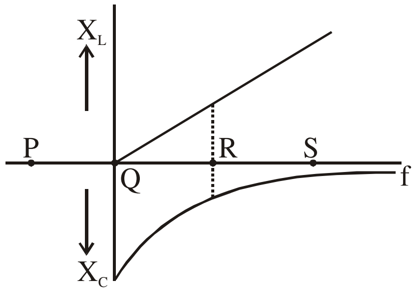
10. The resonance point in X_L – f and X_C –f curves is

(a) P

(b) Q

(c) R

(d) S



11. What must be the strength of a uniform electric field if it is to have the same energy density as that possessed by 5000 gauss magnetic field.

(a) 1.5×10^8 V/m (b) 3×10^8 V/m

(c) 1.5×10^7 V/m (d) 3×10^7 V/m

12. The time constant of an inductive coil is 2.5×10^{-3} s. When 80 Ω resistance is added in series, the time constant reduces to 0.5×10^{-3} sec. The inductance of coil is

(a) 2.5×10^{-2} H (b) 2.5×10^{-3} H

(c) 5.0×10^{-2} H (d) 5.0×10^{-3} H

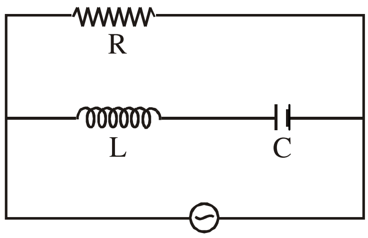
13. The current in resistance R at resonance is

(a) maximum but finite

(b) zero

(c) minimum but finite

(d) infinite



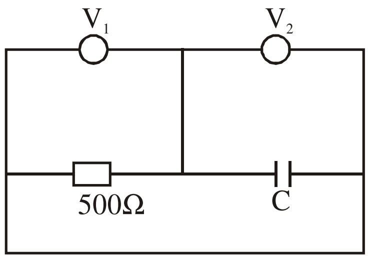
14. A 500Ω resistor and a capacitor C are connected in series across 50 Hz A.C. supply mains. The rm.s potential difference recorded on high impedance voltmeters V_1 and V_2 (V_1 = 120 V and V_2 = 160 V). What is the power taken from the supply mains

(a) 480 W

(b) 240 W

(c) 28.8 W

(d) 14.4 W



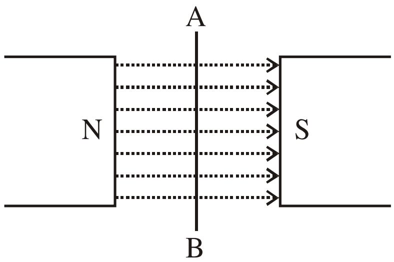
15. A conducting wire is stretched between the poles of a magnet. There is a strong uniform magnetic field in the region between the poles. If an A.C. current $I = I_0 \sin\omega t$ is passed through the wire AB, then wire will

(a) remain stationary.

(b) be pulled towards N pole.

(c) be pulled towards S pole.

(d) vibrate with frequency. $\left(\frac{\omega}{2\pi}\right)$



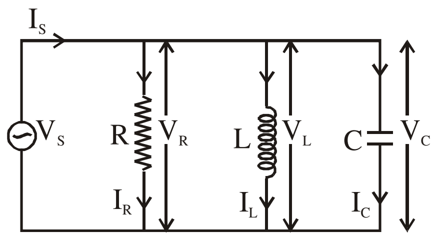
16. An A.C. source is connected in parallel with an L-C-R circuit as shown in the figure. Let I_S, I_R, I_L and I_C denotes currents and V_S, V_R, V_L and V_C the voltage across the corresponding components. Then

(a) $V_S = V_R + V_L + V_C$

(b) $I_S = I_R + I_L + I_C$

(c) $(I_R, I_L, I_C) < I_S$

(d) I_L, I_C may be I_S



17. Figure shows a parallel LCR circuit connected to a variable frequency 200V source. L = 5H, C = 80 μF and R = 40Ω. What is the r.m.s. current in the circuit at resonance?

(a) 5A (b) 10A (c) $\frac{5}{\sqrt{2}}$ A (d) $5\sqrt{2}$ A

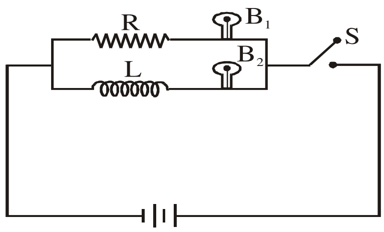
18. Figure represents two bulb B_1, and B_2 resistor R and inductor L. When the switch is turned off

(a) both B_1 and B_2 die out promptly

(b) both B_1 and B_2 die out with some delay

(c) B_1 die out promptly but B_2 with some delay

(d) B_2 die out promptly but B_1 with some delay



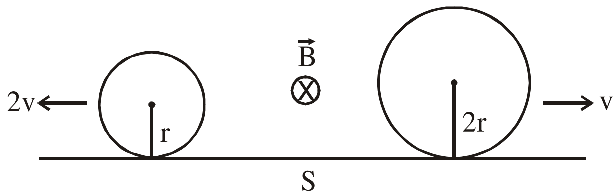
19. Two conducting rings of radii r and 2r move in opposite directions with velocity $2v$ and v respectively on a conducting surface S. There is a uniform magnetic field of magnitude B perpendicular to the plane of the rings. The potential difference between the highest points of the two rings is

(a) zero

(b) $2rvB$

(c) $4rvB$

(d) $8rvB$



20. In an oscillatory circuit, L = 0.2H, C = 0.0012 μF. Then maximum value of resistance so that the circuit may oscillate

(a) $5.28 \times 10^5 \Omega$ (b) $3.29 \times 10^3 \Omega$

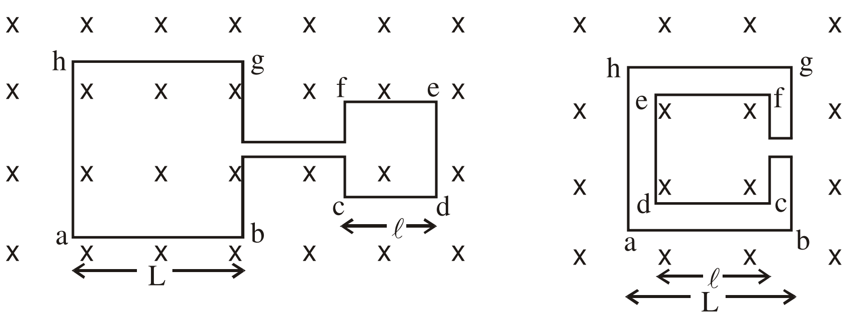
(c) $7.23 \times 10^5 \Omega$ (d) $2.58 \times 10^4 \Omega$

21. A capacitor is charged to 2 V and then connected to a pure inductor. How much charge is present on the capacitor when one-third of the total energy is in the electric field and rest in the magnetic field

(a) 5μC (b) 7μC

(c) 2μC (d) 9μC

22. Figure shows two different arrangements in which two square wire frames are placed in a uniform constantally decreasing magnetic field $\vec{B}$. The value of magnetic flux in each cases in given by



(I) (II)

(a) Case I ; $\phi = \pi(L^2 + \ell^2)$ B ; Case II ; $\phi = \pi(L^2 - \ell^2)$B

(b) Case I ; $\phi = \pi(L^2 + \ell^2)$ B ; Case II ; $\phi = \pi(L^2 + \ell^2)$B

(c) Case I ; $\phi = (L^2 + \ell^2)$ B ; Case II ; $\phi = (L^2 - \ell^2)$B

(d) Case I ; $\phi = (L^2 + \ell^2)$ B ; Case II ; $\phi = (L^2 + \ell^2)$B

23. In question 22 if I_1 and I_2 are the magnitude of induced current in the case I and II, respectively, then

(a) $I_1 = I_2$ (b) $I_1 > I_2$

(c) $I_1 < I_2$ (d) none of these

24. In an a.c. circuit a resistance R Ω is connected in series with an inductance L. If the phase difference between the voltage and current be 45°, then the value of inductive reactance will be

(a) $\frac{R}{4}$ (b) $\frac{R}{2}$

(c) R (d) can not be found from given data

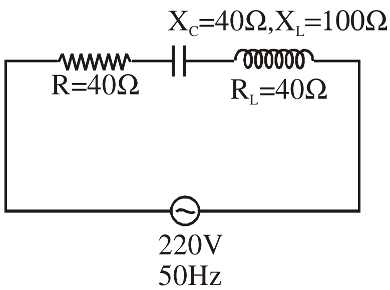
25. In an LCR resonance circuit, the capacitance is made one-fourth, what should be the change in inductance, so that circuit remains in resonance

(a) 4 times (b) $\frac{1}{4}$ times (c) 8 times (d) 2 times

26. The armature of D.C. motor has 20Ω resistance. If draws current of 2.5 A when run by 220 V of D.C. supply. The value of back e.m.f. induced in it will be

(a) 150 V (b) 170 V (c) 180 V (d) 190 V

27. The power factor of circuit shown in figure



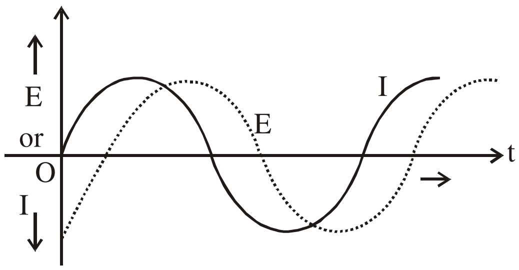
(a) 0.2

(b) 0.4

(c) 0.8

(d) 0.6

28. When an A.C. source of e.m.f. $E = E_0 \sin(100t)$ is connected across a circuit, the phase difference between the e.m.f. E and current I is observed to be $\frac{\pi}{4}$ as shown in the figure. If the circuit has only RC or RL or LC in series, the relationship between the two elements is



(a) R = 1 kΩ, C = 10μF
(b) R = 1 kΩ, C = 1 μF
(c) R = 1 kΩ, L = 10 H
(d) R = 1 kΩ, L = 1 H

29. A series LCR circuit containing a resistance of 120Ω has angular frequency 4×10^5 rad/s. At resonance, the voltage across resistance and inductance are 60V and 40V respectively. At what frequency the current in the circuit lags the voltage by 45^o

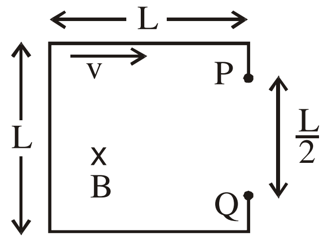
(a) 4×10^5 rad/s
(b) 4×10^8 rad/s
(c) 8×10^5 rad/s
(d) 8×10^8 rad/s

30. A 750 Hz, 20 V source is connected to a resistance of 100 Ω, an inductance of 0.1803 H and a capacitance of 10 μF all in series. Calculate the time in which the resistance (thermal capacity 2J/^{o}C) will get heated by 10^{o}C

(a) 2.8 min
(b) 4.7 min
(c) 5.8 min
(d) 8.3 min

SECTION – C

1. The loop shown in the figure, moves with a velocity v in a uniform magnetic field of magnitude B directed into the plane of paper. The potential difference between P and Q is e, then



(a) $e = \frac{1}{2} BLv$ (b) $e = BLv$

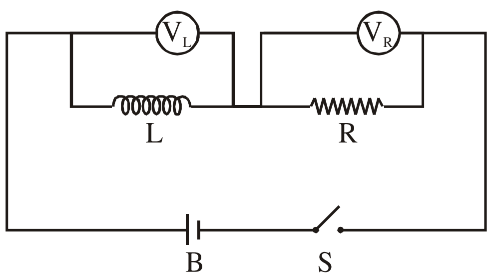
(c) P is positive with respect to Q (d) Q is positive with respect to P

2. Two different coils have self inductances L_1 = 8 mH, L_2 = 2mH. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coils is the same. At that time the current, induced voltage and the energy stored in the first coil are I_1, V_1 and W_1 respectively. Corresponding values for the second coil at the same instant are I_2, V_2 and W_2 respectively, then

(a) $\frac{I_1}{I_2} = \frac{1}{4}$ (b) $\frac{I_1}{I_2} = 4$

(c) $\frac{W_2}{W_1} = 4$ (d) $\frac{V_2}{V_1} = \frac{1}{4}$

3. An inductance L, resistance R, battery B and switch S are connected in series. Voltmeters V_L and V_R are connected across L and R respectively. When switch S is closed



(a) the initial reading in V_L will be more than V_R

(b) the initial reading in V_L will be less than V_R

(c) the initial readings in V_L and V_C will be same

(d) the reading in V_L will decrease with time while that in V_R will increases to a maximum value

4. An e.m.f. can be induced in a conductor

(a) by moving it in a magnetic field.

(b) by changing the magnetic field in the vicinity of the conductor.

(c) by placing it in a non-uniform magnetic field.

(d) by changing the current in the conductor.

5. An iron bar is falling vertically through the hollow region of a thick cylindrical shell made of copper, experiences a retarding force because iron bar

(a) induced current in the cylinder.

(b) is a magnet.

(c) is a positively charged conductor.

(d) is a negatively charged conductor.

6. The correct expression for motional e.m.f. across a conductor is given by

(a) $\int(\vec{v}\times\vec{B})\cdot d\vec{\ell}$ (b) $\int(d\vec{\ell}\times\vec{B})\cdot\vec{v}$

(c) $\int(d\vec{\ell}\times\vec{v})\cdot\vec{B}$ (d) $\int(\vec{B}\times d\vec{\ell})\cdot\vec{v}$

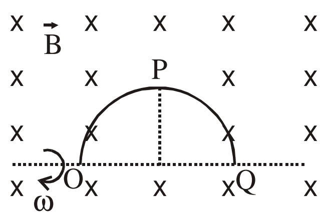
7. Figure shows a semi circular conducting ring of radius a, which is rotated with constant angular velocity ω about its diametric axis OQ in the uniform magnetic field B. Identify the correct values of potential difference(s)

(a) $V_P - V_Q = \frac{1}{2}B\omega a^2$

(b) $V_Q - V_O = 2B\omega a^2$

(c) $V_Q - V_O$ is a function of time

(d) the maximum value of $|V_Q - V_O| = \frac{\pi a^2 \omega B}{2}$



8. In an A.C. series circuit, the instantaneous current is zero, when the instantaneous voltage is maximum. If connected by a source it may act as a

(a) pure inductor.

(b) pure capacitor.

(c) pure resistor.

(d) combination of an inductor and a capacitor.

9. An A.C. source rated 100V(rms) supplies a current of 10A(rms) to a circuit. The average power delivered by the source

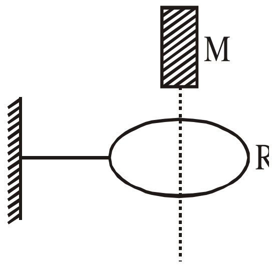
(a) must be 1000 W

(b) may be 1000 W

(c) may be greater than 1000W

(d) may be less than 1000W

10. A small magnet M is allowed to fall through a fixed horizontal conducting ring R. Let g be the acceleration due to gravity. The acceleration of M will be



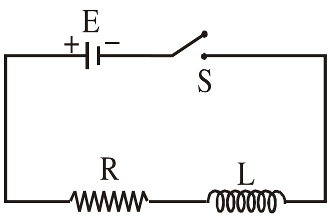
(a) less than g when it is above R and moving towards R.

(b) greater than g when it is above R and moving towards R.

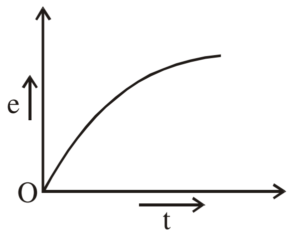
(c) less than g when it is below R and moving away from R.

(d) greater than g when it is below R and moving away from R.

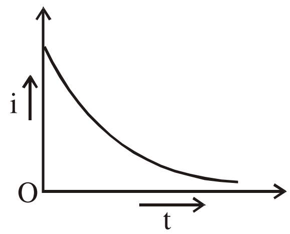
11. Switch S of the circuit shown in the figure is closed at t = 0. If **e** denotes the induced e.m.f. in **L** and **i** is the current flowing through the circuit at time t, then which of the following graph(s) is/are correct?



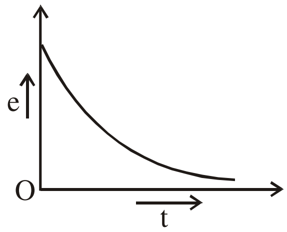
(a)



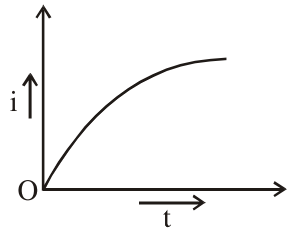
(b)



(c)



(d)



12. A constant current **i** is maintained in a solenoid. Which of the following quantities will increase if an iron rod is inserted in the solenoid along its axis?

(a) Magnetic field inside the solenoid.

(b) Magnetic flux linked with the solenoid.

(c) Self inductance of the solenoid.

(d) Rate of Joule heating.

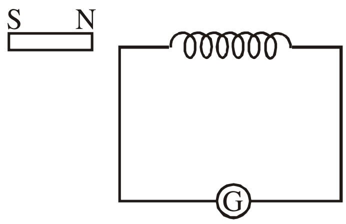
13. A magnet is moved with a high speed towards a coil at rest. Due to this, the induced e.m.f., induced current and induced charge in the coil are E, I and Q respectively. If the speed of the magnet is doubled, then

(a) E increases

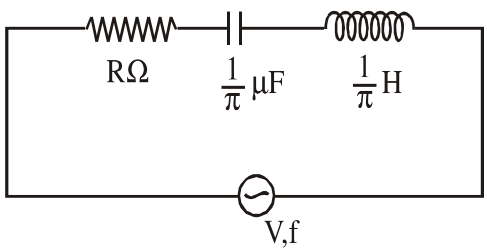
(b) I increases

(c) Q increases

(d) Q remains uncharged



14. In the A.C. circuit shown below, the supply voltage has a constant r.m.s. value V but variable frequency f. At resonance the circuit



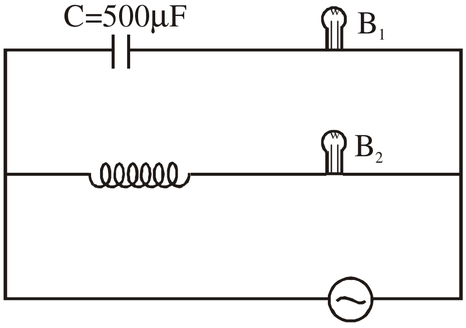
(a) has a current I given by $I = \frac{V}{R}$.

(b) has a resonance frequency 500 Hz.

(c) has a voltage across the capacitor which is 180° out of phase with that across the inductor.

(d) has a current I given by ; $I = \frac{V}{\sqrt{R^2 + \left(\frac{1}{\pi} + \frac{1}{\pi}\right)^2}}$.

15. In the circuit shown in the figure, if both the bulbs B_1 and B_2 are identical, then



(a) their brightness will be same.

(b) B_2 will be brighter than B_1.

(c) as frequency of supply voltage is increased, brightness of B_1 will increase and that of B_2 will decrease.

(d) only B_2 will glow because the capacitor has infinite resistance.

16. An inductor-coil having some resistance is connected to an A.C. source. Which of the following quantities have zero average value over a cycle?

(a) Current

(b) Induced e.m.f. in the conductor

(c) Joule heat

(d) Magnetic energy stored in the inductor

17. Choose the correct statement(s) related to induced electric field

(a) It is produced by time varying magnetic field.

(b) It is non-conservative.

(c) It is always form closed loops.

(d) It is always perpendicular to the time varying magnetic field.

18. Time constant of an LR circuit is defined as the time during which,

(a) current rises to 37 percent of its maximum value.

(b) current falls to 37 percent of its maximum value.

(c) current falls by 63 percent of its maximum value.

(d) current rises to 63 percent of its maximum value.

19. At resonance, the source current is

(a) maximum in series LCR-circuits.

(b) minimum in parallel LCR-circuits.

(c) maximum in both series and parallel LCR-circuits.

(d) minimum in both series and parallel LCR-circuits.

20. A resistance R = 12Ω, an inductance L = 2H and a capacitance C = 5μF are connected in series to an A.C. generator of frequency 50 Hz.

(a) At resonance, the circuit impedance is zero

(b) At resonance, the circuit impedance is 12 ohm

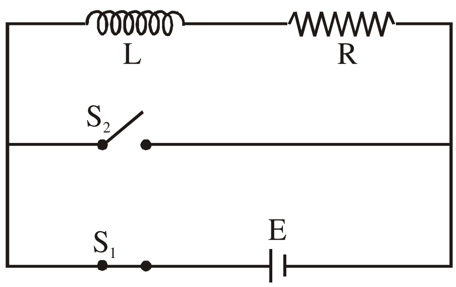
(c) The resonance frequency of the circuit is $\frac{1}{0.2\pi}$

(d) The inductive reactance is less than the capacitive reactance.

21. A circular conducting loop is placed in the XY-plane. It encloses a region of uniform magnetic field along the positive Z-axis. If no magnetic field lines exist outside the ring, then

(a) no e.m.f. is produced when the loop moves along the Z-axis
(b) current is induced when the loop moves in the XY-plane
(c) current is induced as the ring is pulled radially outwards in all directions
(d) current in induced as the ring is pushed radially inwards in all directions

22. Initially the switch S_1 is closed for a long time and the switch S_2 is open. At t = 0. If S_2 is suddenly closed and S_1 is opened. Then



(a) the rate of fall of current at t = 0 is maximum.

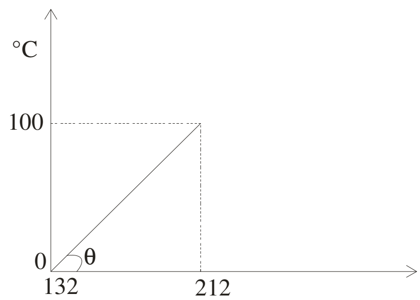
(b) voltage gain occurs across the inductor and voltage drop occurs across the resistor.

(c) voltage across inductor increases with time.

(d) voltage across inductor decreases with time.

HEAT & THERMODYNAMICS

1. A gas in an air tight container is heated from 25°C to 90°C. The density of gas will
   (a) increase slightly (b) increase considerably
   (c) remain the same (d) decrease slightly
2. One gram of ice at 0°C is added to 5 gm of water at 10°C. If the latent heat is 80 cal/gm, the final temperature of the mixture is
   (a) 5°C (b) 6°C
   (c) –5°C (d) none of these
3. The equation of state corisponding to 8 kg of O_2 is
   (a) PV = RT (b) PV = 8RT
   (c) $PV = \frac{RT}{2}$ (d) $PV = \frac{RT}{4}$
4. A constant volume gas thermometer shows pressure reading 50 cm and 90 cm of mercury at 0°C and 100°C respectively. When the pressure reading is 60 cm of mercury, the temperature is
   (a) 25°C (b) 40°C
   (c) 15° (d) 12.5°C
5. The freezing point of mater is marked in a faulty thermometer as 20°, and the boiling point as 150°. A temperature of 60°C will be shown on this thermometer as
   (a) 78° (b) 98°
   (c) 150° (d) 130°
6. The graph shown in the figure is a plot of the temperature of a body in 0° and °F. The value of sin θ is



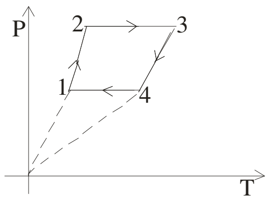
   (a) $\frac{5}{9}$ (b) $\frac{5}{\sqrt{86}}$
   (c) $\frac{9}{\sqrt{86}}$ (d) $\frac{5}{\sqrt{106}}$

7. Temperature of an ideal gas is 300K. The change in temperature of the gas when its volume changes from V to 2V in the process P = aV (Here, a is a positive constant) is

(a) 900 K (b) 1200 K

(c) 600 K (d) 300 K

8. There moles of an ideal monoatomic gas performs a cycle $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 1$ as shown in the figure. The gas temperatures in different states are $T_1 = 400K$, $T_2 = 800K$, $T_3 = 2400$ K and $T_4 = 1200K$. The work done by the gas during the cycle is



(a) 1200 R (b) 3600 R

(c) 2400 R (d) 2000 R

9. For an ideal monoatomic gas, the universal gas constant R is n times the molar heat capacity at constant pressure C_p. Here n is

(a) 0.67 (b) 1.4

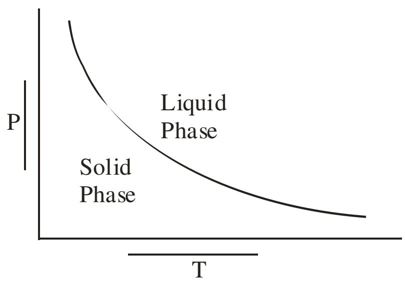
(c) 0.4 (d) 1.67

10. For a gas, the difference between the two specific heats is 4150 J/kg K. What is the specific heats at constant volume of gas if the ratio of specific heat is 1.4?

(a) 8475 J/kg K (b) 5186 J/kg K

(c) 1660 J/kg K (d) 10375 J/kg K

11. The pressure temperature (P – T) phase diagram shown in the figure. Corresponds to the



(a) Curve of a fusion of solids that expand on solidification

(b) Curve of sublimation of solids that directly go over to the vapour phase.

(c) Curve of fusion of solids that contract on solidification

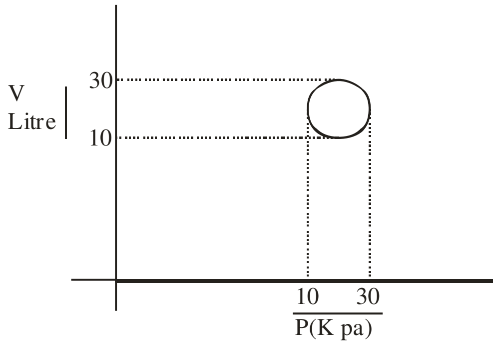
(d) Curve of fusion of solids that do not change in volume upon solidification

12. If a given mass of gas occupies a volume of 10 cc at 1 atmospheric pressure and temperature 100°C (373.15 K), what will be its volume at 4 atmospheric pressure. The temperature being the same

(a) 104 cc (b) 2.5 cc

(c) 400 cc (d) 100 cc

13. Heat energy observed by the system in going through a cyclic process is



(a) $10^7 \pi J$ (b) $10^4 \pi J$

(c) $10^2 \pi J$ (d) $10^{-3} \pi J$

14. The rate of cooling at 600 K, if surrounding temperature is 300 K is R. The state of cooling at 900 K is

(a) $\frac{16}{3}R$ (b) 2R

(c) 3R (d) $\frac{2}{3}R$

15. A molar-car tyre has a pressure 2 atm at 27°C. It suddenly bursts. If $C_p > C_v = 1.4$, for air, find the resulting temperature

(a) 27 K (b) 27°C

(c) –27°C (d) 246°C

16. 420 joule of energy supplied to 10 gm of water will raise its temperature by nearly

(a) 1°C (b) 4.2°C

(c) 10°C (d) 42°C

17. If the temperature scale is changed from 0°C to °F, numerical value of specific heat will

(a) increase (b) decrease

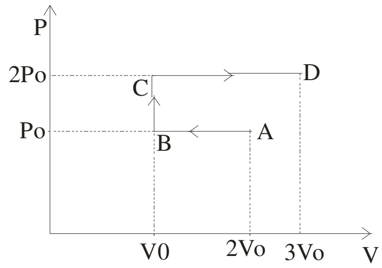
(c) remain unchanged (d) none of these

18. One kilogram of steam at 100°C can melt how much ice at 0°C?

(a) 8.0 kg (b) $\frac{8}{54}$ kg

(c) $\frac{54}{8}$ kg (d) 540 kg

19. P-V diagram of an ideal gas is as shown in figure. Work done by the gas in the process ABCD is



(a) 4 P_0V_0 (b) 2 P_0V_0

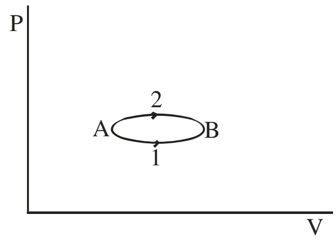
(c) 3 P_0V_0 (d) P_0V_0

20. A monoatomic gas undergoes a process given by 2 dV + 3 dW = 0, then the process is

(a) isobaric (b) adiabatic

(c) isothermal (d) none of these

21. The figure shows two paths for the change of state of a gas from A to B. The ratio of molar heat capacities in path 1 and 2 is



(a) more than one (b) less than one

(c) equal to one (d) data insufficient

22. At what temperature volume of an ideal of gas at 0°C becomes triple?

(a) 546°C (b) 182°C

(c) 819°C (d) 646°C

23. The temperature of 2 moles of a gas, which was held at constant volume, was changed from 100°C to 120°C. The change in internal energy was found to be 80J. The change in internal energy was found to be 80J. The heat capacity of the gas constant volume will be equal to

(a) 8 J/K (b) 4 J/K

(c) 40 J/K (d) 2 J/K

24. When an ideal monoatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increase the internal energy of the gas is

(a) $\frac{2}{5}$ (b) $\frac{3}{5}$

(c) $\frac{3}{7}$ (d) $\frac{5}{7}$

25. For an adiabatic expansion of a perfect gas, the value of $\frac{\Delta P}{P}$ is equal to

(a) $\frac{\Delta V}{V}$ (b) $\gamma\frac{\Delta V}{V}$

(c) $-\gamma\frac{\Delta V}{V}$ (d) $-\gamma^2\frac{\Delta V}{V}$

26. The temperature T_1 and T_2 of heat reservoirs in the ideal carnot engine are 1500°C and 500°C respecitvely. If T_1 increases by 100°C, what will be the efficiency of the engine?

(a) 62% (b) 59%

(c) 95% (d) 100%

27. In a given process on an ideal gas, $dW = 0$ and $dQ < 0$ then for the gas

(a) the temperature will decrease

(b) the volume will increase

(c) the pressure will remain constant

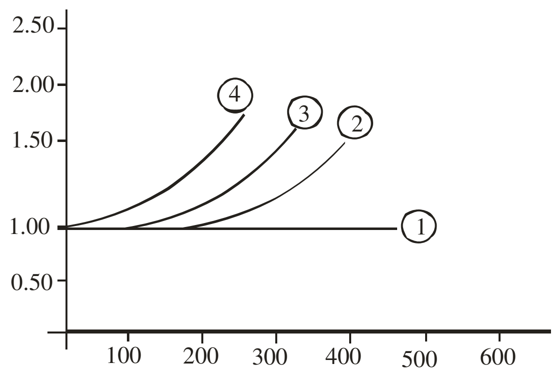
(d) the temperature will increase

28. Two metal strips that constitute a thermostat must necessarily differ in their

(a) mass (b) length

(c) resitivity (d) coefficient of linear expansion

29. A fixed amount of nitrogen gas (1 mole) taken and is subjected to pressure temperature variation. The experiment performed at high pressure as well as high temperatures. The results obtained are shown in the adjoining figure. The correct variation of $\frac{PV}{RT}$ with P will be exhibited by



(a) curve 4 (b) curve 3

(c) curve 2 (d) curve 1

30. When a gas filled in a closed vessel is heated through 1°C, its pressure increases by 0.4%. The initial temperature of the gas was

(a) 250 K (b) 2500 K

(c) 250°C (d) 25°C

31. An ideal gas expands isothermally from a volume V_1 to V_2 and then compressed to original volume V_1 adiabatically. Initial pressure is P_1 and final pressure is P_3. The total work done is W. Then

(a) $P_3 > P_1$, $W > 0$ (b) $P_3 < P_1$, $W < 0$

(c) $P_3 > P_1$, $W < 0$ (d) $P_3 = P_1$, $W = 0$

32. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in the three different ways, the work done by the gas is W_1 if the process is purily isothermal, W_2 if purely isobaric and W_3 is purely adiabatic, then

(a) $W_2 > W_1 > W_3$ (b) $W_2 > W_3 > W_1$

(c) $W_1 > W_2 > W_3$ (d) $W_1 > W_3 > W_2$

33. The relation between U, P and V for ideal gas is

$U = 2 + 3PV$, the gas is

(a) monoatomic (b) diatomic

(c) polyatomic (d) either a monoatomic or diatomic

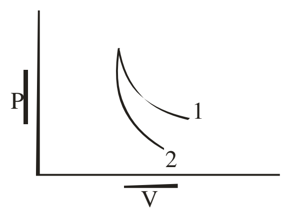
34. Let A and B the two gases. $\frac{T_A}{M_A} = 4\frac{T_B}{M_B}$, where T is temperature and M is molecular mass.

If C_A and C_B are the rms speed, then the ratio $\frac{C_A}{C_B}$ will be equal to

(a) 2 (b) 4

(c) 0.5 (d) 0.25

35. P–V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should correspond respectively to



(a) He and O_2 (b) O_2 and He

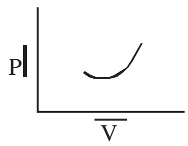
(c) He and Ar (d) O_2 and N_2

36. The internal energy of a gas during isothermal expansion

(a) increases (b) decreases

(c) becomes zero (d) remains constant

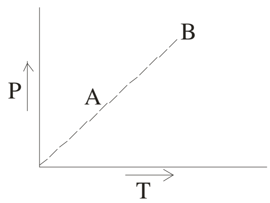
37. During a certain process, the pressure and volume both change as shown in the figure. If the molar heat capacity for this process is C, then



(a) C = 0 (b) $C = C_v$

(c) $C < C_v$ (d) $C > C_v$

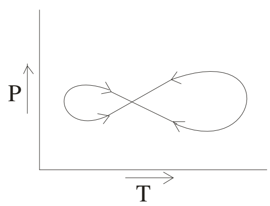
38. An ideal gas is carried from state A to state B as shown on the P–T diagram. The work done by the gas during the process is



(a) positive (b) negative

(c) z ero (d) infinite

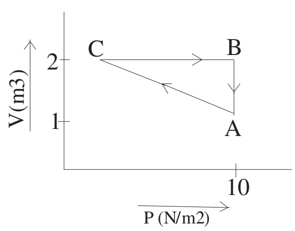
39. In the indicator diagram shown the net amount of work will be



(a) zero (b) positive

(c) negative (d) data insufficient

40. An ideal gas is taken through cycle $A \to B \to C \to A$, as shown in the figure. If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process $C \to A$ is



(a) – 5 J (b) – 10 J

(c) – 15 J (d) – 20 J

PHYSICS

41. A monoatomic ideal gas, initially at temperature T_1 is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the lengths of the gas column before and after expansion respectively, thin $\frac{T_1}{T_2}$ is given by

(a) $\left(\frac{L_1}{L_2}\right)^{2/3}$ (b) $\left(\frac{L_1}{L_2}\right)$

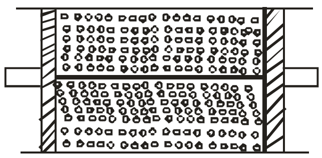
(c) $\left(\frac{L_2}{L_1}\right)$ (d) $\left(\frac{L_2}{L_1}\right)^{2/3}$

42. Slope of Pv and V for an isobaric process will be

(a) –1 (b) zero

(c) +1 (d) uRT

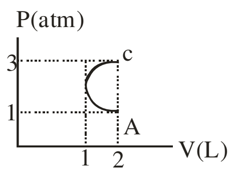
43. A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless piston. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas P_0 and temperature is T_0. Atmosphere pressure is also P_0. Now the temperature of the gas is increased to $2T_0$, the tension in the wire will be



(a) $2P_0A$ (b) P_0A

(c) $\frac{P_0A}{2}$ (d) 4 P_0A

44. In the P-V diagram shown in figure ABC is semicircle. The work done in the process ABC is



(a) zero (b) $\frac{\pi}{2}$ atm–L

(c) $-\frac{\pi}{2}$ atm–L (d) 4 atm–L

45. The molar heat capacity in a process of a diatomic gas if it does a work of $\frac{Q}{4}$ when a heat of Q is supplied to it is

(a) $\frac{2}{5}R$ (b) $\frac{5}{2}R$

(c) $\frac{10}{3}R$ (d) $\frac{6}{7}R$

46. A monoatomic gas undergoes a process given by $2dU + 3dW = 0$, then the process is

(a) isobaric (b) adiabatic

(c) isothermal (d) none of these

47. A metal ball immersed in water weights W_1 at 0°C and W_2 at 50°C. The coefficient of cubical expansion of metal is less than that of water. Then

(a) $W_1 < W_2$ (b) $W_1 > W_2$

(c) $W_1 = W_2$ (d) data is not sufficient

48. A motor-car tyre has a pressure of 2 atm at 27°C. It suddenly bursts. If

$C_p > C_v = 1.4$

For air, find the resulting temperature

(a) 27 K (b) 27°C

(c) –27°C (d) 246°C

49. A thermodynamic process is shown such that

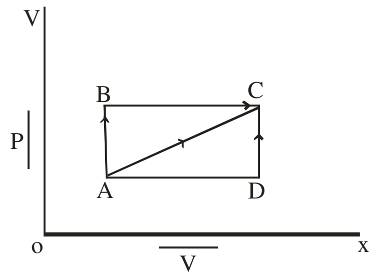
$P_A = 3 \times 10^4$ Pa

$P_B = 8 \times 10^4$ Pa

$V_A = 2 \times 10^{-3} m^3$

$V_D = 5 \times 10^{-3} m^3$

In process AB, 600 J of heat is added to the system and in process BC, 200 J of heat is added to the system. Then change in internal energy of the system in process AC is



(a) 560 J (b) 800 J

(c) 600 J (d) 640 J

50. When 300 J of heat is added to 25 gm of sample of a material, its temperature rises from 25°C to 45°C. The thermal capacity of the sample and specific heat of the material are respectively given by

(a) 15 J/°C, 600 J/kg°C (b) 600 J/°C, 15 J/kg°C

(c) 150 J/°C, 60 J/kg↑8C (d) none of these

51. Under steady state the temperature of a body

(a) increases with time

(b) decreases with time

(c) do not change with time and is same at all points of the body

(d) does not change with time but is different at different points

52. The coefficient of thermal conductivity of a metal depends upon

(a) Temperature difference between the two sides

(b) Thickness of the metal (C) Area of plate

(d) none of these

53. Two ends of rod of length L and radius of the same material are kept at the same temperature. Which of the following rods conducts most heat?

(a) L = 50 cm r = 1 cm (b) L = 100 cm r = 2 cm

(c) L = 25 cm r = 0.5 cm (d) L = 75 cm r = 1.5 cm

54. The SI unit of thermal conductivity is

(a) $Js^{-1}\ mK^{-1}$ (b) $Jsm^{-1}K^{-1}$

(c) $Jsm^{-1}\ K$ (d) $Js^{-1}m^{-1}K^{-1}$

55. Two spherical black bodies of radii R_1 and R_2 having surface temperature T_1 and T_2 respectively radiate the same powers then R_1/R_2 is equal to

(a) $\left(\frac{T_1}{T_2}\right)^4$ (b) $\left(\frac{T_2}{T_1}\right)^4$

(c) $\left(\frac{T_2}{T_1}\right)^2$ (d) $\left(\frac{T_1}{T_2}\right)^2$

56. Check the correct statement

(a) A body at °C units no heat energy

(b) A body at absolute zero units no heat energy

(c) Heat energy emitted by a body at 100°C is 16 times the amount of heat energy emitted at 50°C

(d) Two bodies leaving same temperature when placed near each of her neither unit nor any heat energy nor absorb

57. Stream is passed into 54 gm of water at 30°C till the temperature of the mixture becomes 90°C. If the latent heat of steam is 536 cal/g the mass of the mixture will be

(a) 80 gm (b) 60 gm

(c) 50 gm (d) 24 gm

58. When 0.93 watt hour of energy is supplied to a block of ice weight ng 10g it is found that

(a) Half of the melts

(b) The entire block melts

(c) The entire block melts and water attains at temperature at 4°C

(d) The block remains unchang ed

59. An ideal imagine exhausting heat at 27°C is to have 25% efficiency. It must take heat at

(a) 127°C (b) 227°C

(c) 327°C (d) 673°C

60. A monoatomic ideal gas initially at temperature 17°C is suddenly compressed to one-eight of its original volume. The temperature after compression is

(a) 17°C (b) 136°C

(c) 87°C (d) none of these

61. A thermodynamic system is taken through BCDA during the process

(a) system absorbs 20 J of heat

(b) system absorbs 40 J of heat

(c) system absorbs 40 J of heat during the cycle

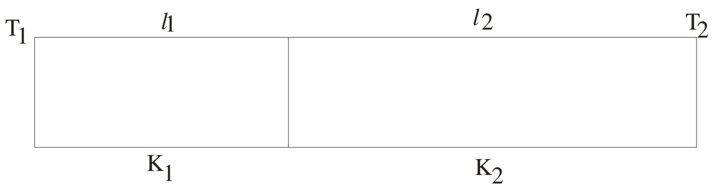
(d) system rejects 40 J of heat energy during the cycle

62. A carnot engine, having an efficiency of $\eta = 1/10$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is :

(a) 99 J (b) 90 J

(c) 1 J (d) 100 J

63. One end of a thermally insulated rod is kept at a temperature T_1 and the other at T_2. The rod is composed of two sections of lengths l_1 and l_2 and thermal conductivities K_1 and K_2 respectively. The temperature at the interface of the two sections is



(a) $(K_2 l_2 T_1 + K_1 l_1 T_2)/(K_1 l_1 + K_2 l_2)$ (b) $(K_2 l_1 T_1 + K_1 l_2 T_2)/(K_2 l_1 + K_1 l_2)$

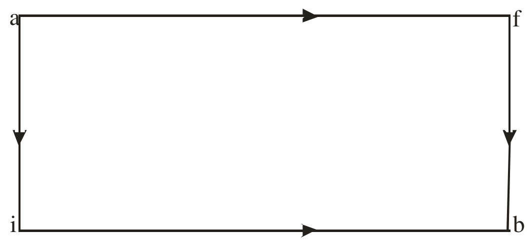
(c) $(K_1 l_2 T_1 + K_2 l_1 T_2)/(K_1 l_2 + K_2 l_1)$ (d) $(K_1 l_1 T_1 + K_2 l_2 T_2)/(K_1 l_1 + K_2 l_2)$

64. If C_P and C_V denote the specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then :

(a) $C_P - C_V = R/28$ (b) $C_P - C_V = R/14$

(c) $C_P - C_V = R$ (d) $C_P - C_V = 28R$

65. When a system is taken from state *i* to state *f* along the path iaf, it is found that Q = 50 cal and W = 20 cal. Along the path ibf Q = 36 cal. W along the path ibf is :



(a) 6 cal (b) 16 cal

(c) 66 cal (d) 14 cal

66. Which of the following is incorrect regarding the first law of thermodynamics?

(a) It is not applicable to any cyclic process

(b) It is a restatement of the principle of conservation of energy

(c) It introduces the concept of the internal energy

(d) It introduces the concept of the entropy

67. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is :

(a) 1.59 (b) 1.62

(c) 1.4 (d) 1.54

68. One mole of ideal monoatomic gas (γ = 5/3) is mixed with one mole of diatomic gas (γ = 7/5). What is γ for the mixture? γ denotes the ratio of specific heat at constant pressure, to that at constant volume :

(a) 3/2 (b) 23/15

(c) 35/23 (d) 4/3

69. If the temperature of the sun were to increase from T to 2T and its radius from R to 2R, then the ratio for the radiant energy received on earth to what it was previously, will be :

(a) 4 (b) 16

(c) 32 (d) 64

70. Which of the following statements is correct for any thermodynamic system?

(a) The internal energy changes in all processes

(b) Internal energy and entropy are state functions

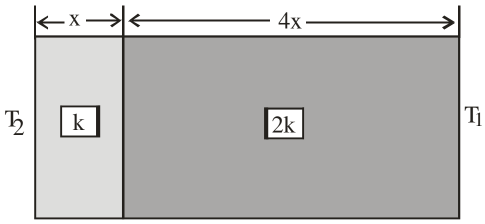
(c) The change in entropy can never be zero

(d) The work done in an adiabatic process is always zero

71. Two thermally insulated vessels 1 and 2 are filled with air at temperatures (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be :

(a) $T_1 + T_2$
(b) $\frac{(T_1 + T_2)}{2}$
(c) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$
(d) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_1 + P_2V_2T_2}$

72. The temperature of the two outer surface of a composite slab, consisting of two materials having coefficients of thermal conductivity K and 2K and thickness x and 4x, respectively are T_2 and $T_1(T_2 > T_1)$. The rate of heat transfer through the slab, in a steady state is $\left(\frac{A(T_2 - T_1)K}{x}\right)f$, with f equals to :



(a) 1
(b) ½
(c) 2/3
(d) 1/3

73. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_P/C_V for the gas is :

(a) 4/3
(b) 2
(c) 5/3
(d) 3/2

74. Which of the following parameters does not characterise the thermodynamic state of matter?

(a) Temperature
(b) Pressure
(c) Work
(d) Volume

75. A Carnot engine takes 3×10^6 cal of heat from a reservoir at 627°C and gives it to a sink at 27°C. The work done by the engine is :

(a) 4.2×10^6 J
(b) 8.4×10^6 J
(c) 16.8×10^6 J
(d) zero

KINEMATICS

1. A particle has an initial velocity of 5.5 ms^{-1} due east and a constant acceleration of 1 ms^{-2} due west. The distance covered by the particle in the sixth second of its motion would be

(a) 0 (b) 0.25 m

(c) 0.5 m (d) 0.75

2. A body starts from rest and moves with constant acceleration. The ratio of distance covered by the body in nth second to that covered in n seconds is

(a) 1 : n (b) $\frac{2n-1}{n^2}$

(c) $\frac{n^2}{2n-1}$ (d) $\frac{2n-1}{2n^2}$

3. A man in a balloon rising vertically with an acceleration of 4.9 ms^{-2} releases a ball 2 seconds after the balloon is released from the ground. The greatest height above the ground reached by the ball is : (g = 9.8 ms^{-2})

(a) 14.7 m (b) 19.6 m

(c) 9.8 m (d) 24.5 m

4. The relation between time t and distance x is t = $\alpha x^2 + \beta x$, where α and β are constants. The retardation is

(a) $2\alpha v^3$ (b) $2\beta v^3$

(c) $2\alpha\beta v^3$ (d) $2\beta^2 v^3$

5. A balloon is at a height of 81 metres and is ascending upwards with a velocity of 12 m/s. A body of 2 kg weight is dropped from it. If g = 10 m/s^2, the body will reach the surface of the earth in

(a) 1.5 s (b) 4.025 s

(c) 5.4 s (d) 6.75 s

6. A body starts from the origin and moves along the x-axis such that the velocity at any instant is given by $4t^3 - 2t$, where t is in seconds and velocity in metre per second. What is the acceleration of the particle when it is 2m from the origin?

(a) 28 ms^{-2} (b) 22 ms^{-2}

(c) 12 ms^{-2} (d) 10 ms^{-2}

7. The initial velocity of a particle is u, at, t = 0 and the acceleration f is given by at. Which of the following relations is valid?

(a) $v = u + at^2$ (b) $v = u + \frac{at^2}{2}$

(c) $v = u + at$ (d) $v = u$

8. A body curves 200 cm in the first 2 seconds and 220 cm in the next 4 seconds. The velocity at the end of 7^{th} second is

(a) 20 cm s^{-1} (b) 10 cm s^{-1}

(c) 115 cm s^{-1} (d) –10 cm s^{-1}

9. A locomotive begins to move with uniform acceleration at the moment when a boy runs past it with a uniform velocity of 2 ms^{-1}. The velocity of the locomotive when it overtakes the boy is

(a) 2 ms^{-1} (b) 4 ms^{-1}

(c) 6 ms^{-1} (d) 8 ms^{-1}

10. A train runs past a telegraph pole in 15 seconds, and through a tunnel 450 metres long in 45 seconds. When it meets another train 300 metres long both trains cross each other in 21 seconds, then the velocity of the second train is

(a) 10 ms^{-1} (b) 15 ms^{-1}

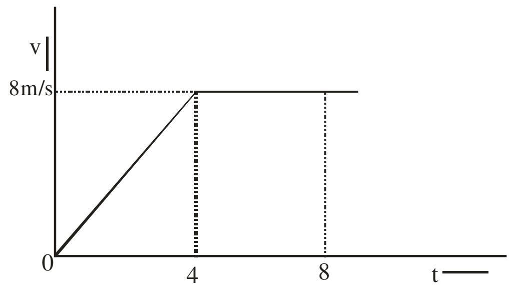
(c) 20 ms^{-1} (d) 30 ms^{-1}

11. A stone falls freely from rest and the total distance covered by it in the last second of its motion equals $\frac{9}{25}$ of its motion, the stone remains in air for

(a) 4s (2) 5s

(c) 6s (d) 7s

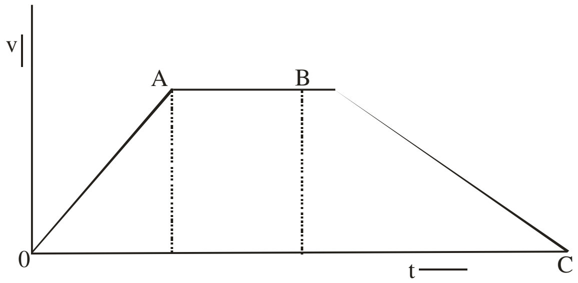
12. The figure shows velocity time graph for a particle moving along a straight line. The distance covered by the particle in time interval t = 1 to t = 8 sec is



(a) 49 m (b) 32 m

(c) 47 m (d) 15 m

13. The velocity time graph for a straight line motion is shown in the figure. If distances travelled from O to A, A to B and B to C are in the ratio 1 : 2 : 3, then the ratio of maximum velocity to average velocity is



(a) 5/2 (b) 5/3

(c) 5/4 (d) 7/6

14. A body is thrown vertically upwards in air. If air resistance is taken into consideration and if t_1 and t_2 represent time of ascent and time of descent respectively, then

(a) $t_1 = t_2$ (b) $t_1 > t_2$

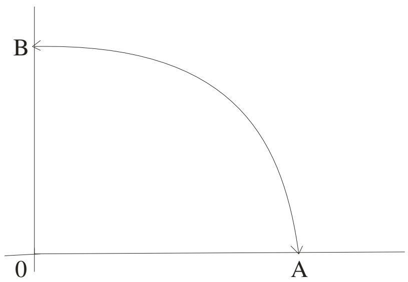
(c) $t_1 < t_2$ (d) $t_1 \geq t_2$

15. The velocity of a body depends upon time according to the equation $v = 20 + 10t^2$. The body is undergoing

(a) zero acceleration (b) uniform acceleration

(c) uniform retardation (d) non-uniform retardation

16. A particle goes along a quadrant circle of radius 15 cm with a constant speed 25 cm/s as shown. Find the average velocity over the interval AB



(a) 2.252 m/s (b) 22.25 m/s

(c) 4.49 m/s (d) 3.14 m/s

17. In the previous question. Find the average acceleration over the interval AB?

(a) 2.126 m/s^2 (b) 1.126 m/s^2

(c) 1.456 m/s^2 (d) zero

18. If a_r and a_t represent radial and tangential acceleration, the motion of a particle will be uniform circular motion if

(a) $a_r = 0, a_t = 0$ (b) $a_r = 0, a_t \neq 0$

(c) $a_r \neq 0, a_t = 0$ (d) $a_r \neq 0, a_t \neq 0$

19. Six particles situated at the corners of a regular hexagon of side 'a' move at a constant speed v. Each particle maintains a direction towards the other particle at the next corner. Calculate the time the particles will take to meet each other

(a) 3a/v (b) 2a/v

(c) 4a/v (d) 5a/v

20. In a projectile motion the velocity

(a) is always perpendicular to the acceleration

(b) is never perpendicular to the acceleration

(c) is perpendicular to the acceleration for one instant only

(d) none of these

21. A ball thrown vertically upwards returns to its starting point in 4s. Its initial speed was

(a) 23.5 m/s (b) 6 m/s

(c) 19/6 m/s (d) zero

22. If the displacement of a body is proportional to t^2, then which of the following statements is true?

(a) The body moves with uniform velocity

(b) The body moves with uniform acceleration

(c) The body moves with increase acceleration

(d) The body moves with decreases acceleration

23. An athlete completes one round of circular track of radius R in 40 sec. What will be his displacement at the end of 2 min 40 sec.

(a) zero (b) $7\pi R$

(c) $2\pi R$ (d) $3\pi R$

24. A particle is dropped under gravity from a height h and it travels a distance $\frac{9h}{25}$ in the last second, the height h is ($g = 9.8$ m/s^2)

(a) 100 m (b) 122.5 m

(c) 145 m (d) 167.5 m

25. A stone thrown upwards with a speed u from the top of the tower reaches the ground with a velocity 3u. The height of the tower is

(a) $\frac{3u^2}{g}$ (2) $\frac{4u^2}{g}$

(c) $\frac{6u^2}{g}$ (d) $\frac{9u^2}{g}$

26. An object may have

(a) varying speed without having varying velocity

(b) varying velocity without having varying speed

(c) non-zero acceleration without having varying velocity

(d) none of these

27. An object is projected upwards with a velocity of 50 m/s. It will strike ground after how much time?

(a) 10 s (b) 20 s

(c) 15 s (d) 5 s

28. Velocity time curve for a body projected vertically upwards is

(a) straight line (b) parabola

(c) ellipse (d) hyperbola

29. A body is projected vertically up with a velocity u. At a height equal to $\frac{1}{4}$ maximum height, its velocity is

(a) $\frac{u}{2}$ (b) $\frac{u}{4}$

(c) $\frac{3u}{4}$ (d) $\frac{\sqrt{3}u}{2}$

30. A ball is thrown up with a velocity of 49 m/s. After 2.5 seconds

(a) Its acceleration reduces to half (b) Its velocity reduces to two third

(c) Its velocity remains constant (d) Its kinetic energy reduces to $\frac{1}{4}$th

31. A ball is thrown vertically upwards from the ground with a speed of 25 m/s. The ball will be at a height of 30 m above the ground after time

(a) 2.0 s only (b) 2.0 and 3.0 s

(c) 3.0 s only (d) 1.0 sec and 2.0 s

32. A person travelling at 43.2 km/h applies the brake giving a deceleration of 6.0 m/s^2 to his scooter. How far will it travel before stopping?

(a) 14 m (b) 16 m

(c) 12 m (d) 10 m

33. A boy aims a gun at a bird from a point at a horizontal distance of 100 m. If the gun can impart a velocity of 500 m/s to the bullet, at what height above the bird must he aim his gun in order to hit it? (Take g = 10 m/s^2).

(a) 50 cm (b) 40 cm

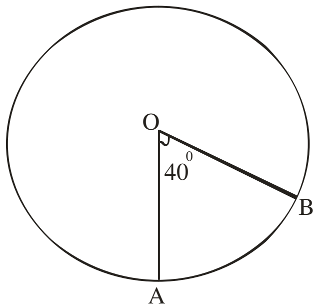
(c) 20 cm (d) 100 cm

34. The x and y co-ordinates of a particle at any time t i sgiven by $x = 7t + 4t^2$ and $y = 5t$ where x and y are in metres and t is in sec. The acceleration of a particle at t = 5s is

(a) zero (b) 8 m/s^2

(c) 20 m/s^2 (d) 40 m/s^2

35. A particle is moving in a circle of radius r centred at O with constant speed v. The change in velocity in moving from A to B is



(a) 2v cos 40° (b) 2v sin 40°

(c) 2v cos 20° (d) 2v sin 20°

36. The co-ordinates of a moving particle at any time t are given by $x = ct^2$ and $y = bt^2$. The speed of particle at time t is given by

(a) 2t(c – b) (b) $\sqrt{c^2 + b^2}$

(c) $2t\sqrt{c^2 + b^2}$ (d) $2t\sqrt{c^2 - b^2}$

37. A ball is shown up vertically with speed u. At the same instant another ball B is released from rest at height h. At time t the speed A relative to B is

(a) u (b) u – 2gt

(c) $\sqrt{u^2 - 2gh}$ (d) u – gt

38. Three balls are projected upwards with the same initial speed at angles 25°, 45° and 65° with the horizontal. If R_1, R_2, R_3 are the horizontal in the three cases respectively, then

(a) $R_1 > R_2 > R_3$ (b) $R_3 > R_2 > R_1$

(c) $R_2 > R_3$ or R_1 and $R_3 = R_1$ (d) $R_2 < R_1 = R_3$ and $R_3 = R_1$

39. A particle is projected vertically upwards and it reaches the maximum height H in time T sec. The height of the particle at any time t will be

(a) $g(t-T)^2$ (b) $H-\frac{1}{2}g(t-T)^2$

(c) $\frac{1}{2}g(t-T)^2$ (d) $H-g(t-T)^2$

40. Two particles are initially located at points A and B with distance d apart. They start moving at time t = 0 such that the velocity $\vec{u}$ of B is always along the horizontal velocity $\vec{v}$ of A is continually aimed at B. At t = 0, $\vec{u}$ is perpendicular to $\vec{v}$. The particles will meet after

(a) $\frac{ud}{v^2u^2}$ (b) $\frac{vd}{v^2-u^2}$

(c) $\frac{v^2-u^2}{vd}$ (d) $\frac{v^2-u^2}{ud}$

41. A point traversed half the distance with a velocity v_0. The remaining part of the distance was covered with velocity v_1 for half the time and with velocity v_2 for the other half of the time. The mean velocity of the point averaged over the whole time of motion is

(a) $\frac{v_0+v_1+v_2}{3}$ (b) $\frac{2v_0+v_1+v_2}{3}$

(c) $\frac{v_0+2v_1+2v_2}{3}$ (d) $\frac{2v_0(v_1+v_2)}{2v_0+v_1+v_2}$

42. Two cars A and B, each having a speed of 30 km hr^{-1} are heading towards each other along a straight path. A bird that can fly at 60 km hr^{-1} flies off car A when the distance between the cars is 60 km, heads directly towards car B, on reaching B, the bird directly flies back to A and so forth, then the total distance the bird travels till the cars meet is

(a) infinite (b) 30 km

(c) 60 km (d) 120 km

43. A car accelerates from rest at rate α for sometime after which it decelerates at rate β to come to rest. If the total time lapse is t seconds, then the total distance covered by the car is

(a) $\frac{1}{2}\left(\frac{\alpha+\beta}{\alpha\beta}\right)t^2$ (b) $\frac{1}{2}\frac{\alpha\beta}{\alpha-\beta}t^2$

(c) $\frac{1}{2}\left(\frac{\alpha-\beta}{\alpha\beta}\right)t^2$ (d) $\frac{1}{2}\left(\frac{\alpha\beta}{\alpha+\beta}\right)t^2$

44. Three tortoise are located at the vertices of an equilateral triangle whose side equals a. They all start moving simultaneously with velocity v constant in modulus with the first tortoise

heading continually for the second, the second for the third and the third for the first. They will meet after time

(a) $\frac{a}{3v}$ (b) $\frac{2a}{3v}$

(c) $\frac{3a}{v}$ (d) $\frac{a}{v}$

45. The position of a projectile is given by $x = v_0t - Kt^2$ where v_0 equals 250 m/s and t is measured in seconds. Given that the velocity of this projectile falls to a value of 150 ms^{-1} at t = 5s. The value of K is

(a) 5 ms^{-2} (b) 10 ms^{-2}

(c) 20 ms^{-2} (d) 50 ms^{-2}

46. The position of a point which moves in a straight line is given by $x = bt^3 - ct$, where x is in metre, t in seconds, and b and c are positive constants. When t = 2 seconds, the acceleration is 24 m/s^2, in the positive x-direction and at the same time the velocity is 8 m/s in the negative x-direction. Find the total time t required for the point to move away from and return to the origin at x = 0.

(a) 2s (b) 4s

(c) 6s (d) 8s

47. A man in a lift ascending with an upward acceleration 'a' throws a ball vertically upwards with a velocity v and catches it after t_1 seconds. Afterwards when the lift is descending with the same acceleration 'a' acting downwards the man again throws the ball vertically upwards with the same velocity and catches it after t_2 seconds?

(a) the acceleration of the lift is $g\left(\frac{t_1}{t_2}+\frac{t_2}{t_2}\right)$

(b) the velocity of the ball is $g\left(\frac{t_1+t_2}{t_1t_2}\right)$

(c) the acceleration of the lift is $g\left(\frac{t_2+t_1}{t_2-t_1}\right)$

(d) the velocity of the ball is $g\left(\frac{t_1t_2}{t_1+t_2}\right)$

48. A projectile is projected at an angle α with initial velocity v. At some instant its velocity vector makes an angle of 90° with initial direction of motion. Find the velocity at that instant

(a) $v\tan\alpha$ (b) $v\sec\alpha$

(c) $v\cos\alpha$ (d) none of these

49. A particle of mass m is projected from a point A at an angle of 45° with the horizontal with a speed v. If the time taken to reach the highest point B is t, what is the change in its velocity from its departure at A to its arrival at B?

(a) $\sqrt{2}v$ (b) $v/\sqrt{2}$

(c) gt (d) $\frac{1}{2}gt^2$

50. A particle is projected at an angle of elevation α and after t seconds it appears to have an angle of elevation β as seen from point of projection. The initial velocity will be

(a) $\frac{gt}{2\sin(\alpha-\beta)}$ (b) $\frac{gt\cos\beta}{2\sin(\alpha-\beta)}$

(c) $\frac{\sin(\alpha-\beta)}{2gt}$ (d) $\frac{2\sin(\alpha-\beta)}{gt\cos\rho}$

51. The height y and a distance x along the horizontal plane on a certain planet (with no surrounding atmosphere) are given by $y = 8t - 5t^2$ m and $x = 6t$ m, where t is in seconds. The angle with the horizontal at which the projectile is projected is

(a) $\tan^{-1}\frac{3}{4}$ (b) $\tan^{-1}\frac{4}{3}$

(c) $\tan^{-1}\frac{4}{5}$ (d) data not sufficient

52. A particle is moving eastward with a velocity of 5 m/s. In 10 seconds the velocity changes to 5 m/sec northward. The average acceleration in this time is

(a) $1/\sqrt{2}m/s^2$ towards north-west (b) $1/\sqrt{2}m/s^2$ towards north-east

(c) 1/2 m/s^2 towards north-west (d) 1/2 m/s^2 towards north

53. A car is travelling at 20 m/s on a circular road of radius 100 m. It is increasing in speed at a rate of 3 m/s^2. Its acceleration is

(a) 3 m/s^2 (b) 5 m/s^2

(c) 30 m/s^2 (d) 7 m/s^2

54. A projectile is launched with an initial velocity v_0 = 2m/s $\hat{i}$ + 3m/s $\hat{j}$. What is the velocity at the top of the trajectory?

(a) 2 m/s (b) – 2m/s

(c) 5 m/s (d) – 5m/s

55. A healthy young man standing at a distance of 7 m from a 11.8 m high building sees a kid slipping from the top floor. With what speed (assumed uniform) should he run to catch the kid at the arms height (1.8 m)?

(a) 6.9 m/s (b) 9.8 m/s

(c) 4.9 m/s (d) 10 m/s

56. A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flights in the two cases, then the product of the two times of fights is proportional to :

(a) R^2 (b) $\frac{1}{R^2}$

(c) $\frac{1}{R}$ (d) R

57. A car, starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate f/2 to come to rest. If the total distance travelled is 15 S, then :

(a) S = ft (b) $S = \frac{1}{6}ft^2$

(c) $S = \frac{1}{2}ft^2$ (d) $S = \frac{1}{4}ft^2$

58. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with a speed of 3 m/s. At what height, did he bail out?

(a) 91 m (b) 182 m

(c) 293 m (d) 111 m

59. The relation between time t and distance x is $t = ax^2 + bx$, where a and b are constants. The acceleration is :

(a) $-2abv^2$ (b) $2bv^3$

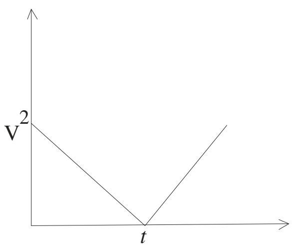
(c) $-2av^3$ (d) $2av^2$

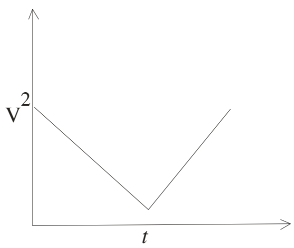
60. The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is x = 0 at t = 0, then its displacement after unit time (t = 1) is :

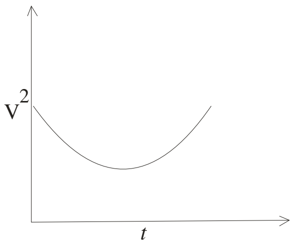
(a) $v_0 + 2g + 3f$ (b) $v_0 + g/2 + f/3$

(c) $v_0 + g + f$ (d) $v_0 + g/2 + f$

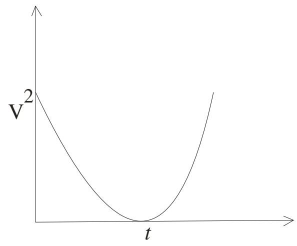
61. A particle is projected at t = 0 from a point at an angle θ with the horizontal. The graph of the square of the velocity i.e. v^2 against the time t is

(a) 

(b) 



(c)



(d)

Laws of Motion

1. A particle is moving along a curve. Then

   (a) if its speed is constant it has no acceleration

   (b) If its speed is increasing the acceleration of the particle is along its direction of motion

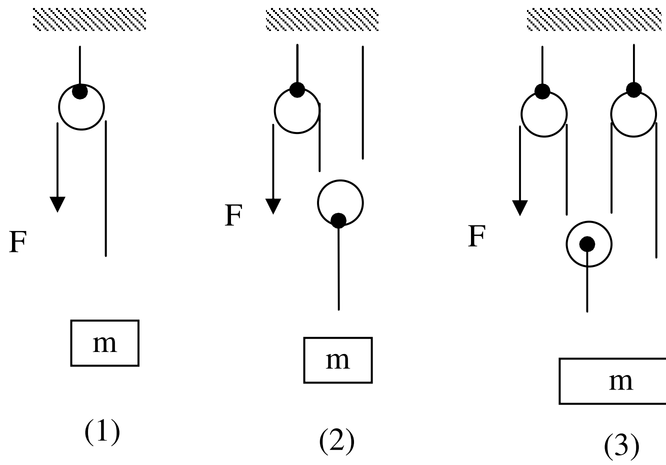
   (c) if its speed is constant the magnitude of its acceleration is proportional to its curvature

   (d) the direction of its acceleration cannot be along the tangent.

2. What should be the minimum force P to be applied to the string so that block of mass m just begins to move up the frictionless plane.

   (a) Mg tan θ/2   (b) Mg cot θ/2   (c) $\dfrac{Mg\cos\theta}{1+\sin\theta}$ (d) None

3. Equal force F(>mg) is applied to string in all the 3 cases. Starting from rest, the point of application of force moves a distance of 2 m down in all cases. In which case the block has maximum kinetic energy?

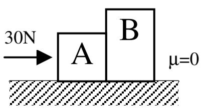


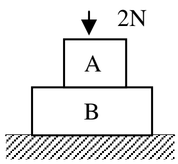
   (a) 1   (b) 2   (c) 3   (d) equal in all 3 cases

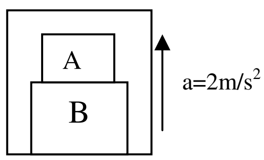
4. Both the blocks shown here are of mass m and are moving with constant velocity in direction shown in a resistive medium which exerts equal constant force on both blocks in direction opposite to the velocity. The tension in the string connecting both of them will be : (Neglect friction)   (a) mg   (b) mg/2   (c) mg/3

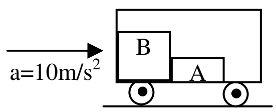
   (d) mg/4

5. In which of the following cases in the contact force between A and B maximum (m_A+m_B =1kg)

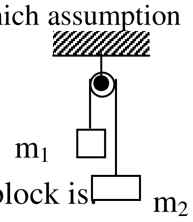
   (a)


   (b)


   (c)


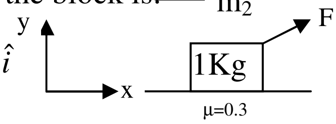
   (d)


6. A student calculates the acceleration of m_1 in figure shown as $a_1 \frac{(m_1 - m_2)g}{m_1 + m_2}$. Which assumption is not required to do this calculation.



(a) pulley is frictionless (b) string is massless
(c) pulley is massless (d) string is inextensible

7. A force $\vec{F} = \hat{i} + 4\hat{j}$ acts on block shown. The force of friction acting on the block is



(a) $-\hat{i}$ (b) -1.8 $\hat{i}$ (c) -2.4 $\hat{i}$ (d) – 3 $\hat{i}$

8. At a given instant, A is moving with velocity of 5m/s upwards. What is velocity of B at that time :

(a) $15m/s \downarrow$ (b) $15m/s \uparrow$ (c) $\frac{6m}{\mu+1}$ (d) $5m/s \uparrow$

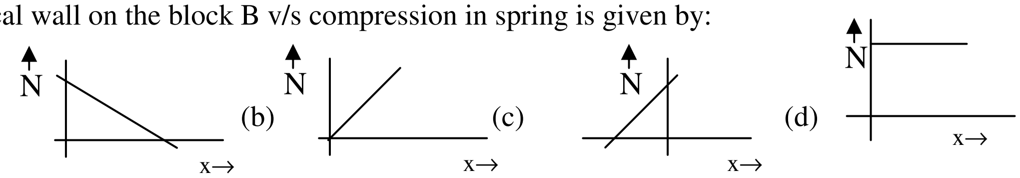
9. $F=2x^2-3x-2$. Choose correct option

(a) x=-1/2 is position of stable equilibrium (b) x=2 is position of stable equilibrium

(c) x=-1/s is position of unstable equilibrium (d) x=2 is position of neutral equilibrium

10. The block A is pushed towards the wall by a distance and released. The normal reaction by vertical wall on the block B v/s compression in spring is given by:

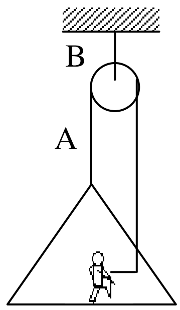
(a) (b) (c) (d)



11. A 1.0 kg block of wood sits on top of an identical block of wood. Which sits on top of a flat level able made of plastic. The coefficient of static friction between the wood surfaces is μ_1, and the coefficient of static friction between the wood and plastic is μ_2. A horizontal force F is applied to the top block only, and this force is increased until the top block starts to move. The bottom block will move with the top block if and only if

(a) $\mu < \frac{1}{2}\mu_2$ (b) $\frac{1}{2}\mu_2 < \mu_1 < \mu_2$ (c) $\mu_2 < \mu_1$ (d) $2\mu_2 < \mu_1$

12. To paint the side of a building, painter normally hoists himself up by pulling on the rope A as in figure .The painter and platform together weigh 200 N. The rope B can withstand 300N. Then



(a) The maximum acceleration that painter can have upwards is $5m/s^2$.

(b) To hoist himself up, rope B must withstand minimum 400 N force.

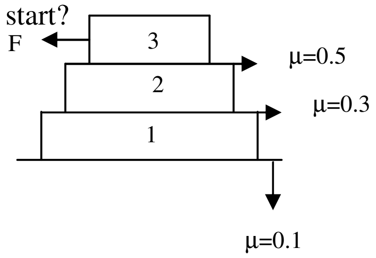
(c) Rope A will have a tension of 100 N when the painter is at rest.

(d) The painter must exert a force of 200 N on the rope A to go downwards slowly.

13. A block of mass 2 kg slides down an incline plane of inclination 30^0. The coefficient of friction between block and plane is 0.5. The contact force between block and plank is:

(a) 20 Nt (b) $10\sqrt{3}$ Nt (c) $3\sqrt{7}$ Nt (d) $5\sqrt{15}$ Nt

14. If force F is increasing with time and ………… Where will slipping first start?



(a) between 3 kg and 2 kg (b) between 2 kg and 1 kg

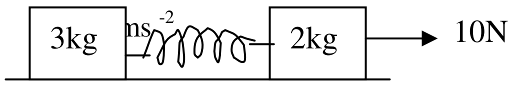
(c) between 1 kg and ground (d) Both (a) and (b)

15. Find the velocity of the hanging block if the velocities of the free ends of the rope are as indicated in the figure.

(a) $3/2 m/s \uparrow$ (b) $3/2 m/s \downarrow$ (c) $1/2 m/s \uparrow$ (d) ½ m/s ↓

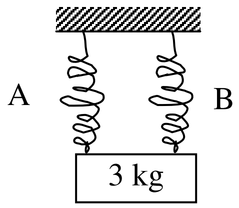
16. A rope of mass 5 kg is moving vertically in vertical position with an upwards force of 100 N acting at the upper end and a downwards force of 70 N acting at the lower end. The tension at midpoint of the rope is

(a) 3 ms^{-2}



(c) 0.5 ms^{-2} (d) zero

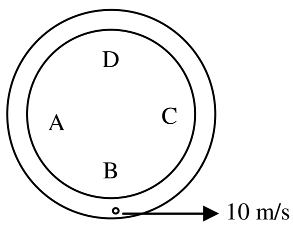
17. Block of 1 kg is initially in equilibrium and is hanging by two identical spring is shown in figures. If spring A is cut from lower point at t=0 then, find acceleration of block in ms^{-2} at t =0.



(a) 5 (b) 10

(c) 15 (d) 0

18. A ball whose size is slightly smaller than width of the tube of radius 2.5 m is projected from bottommost point of a smooth tube fixed in a vertical plane with velocity of 10 m/s. If N_1 and N_2 are the normal reactions exerted by inner side and outer side of the tube on the ball



(a) $N_1>0$ for motion in ABC, $N_2>0$ for motion in CDA

(b) $N_1>0$ for motion in CDA, $N_2 > 0$ for motion in ABC

(c) $N_2 > 0$ for motion in ABC & part of CDA

(d) N_1 is always zero.

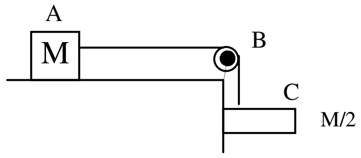
19. A man is standing on a rough (μ=0.5) horizontal disc rotating with constant angular velocity of 5 rad /sec. At what distance from centre should he stand so that the does not slip on the disc?

(a) $R \le 0.2$ m (b) $R > 0.2$ m (c) $R> 0.5$ m (d) $R> 0.3$ m

20. A road is banked at an angle of 30^0 to the horizontal for negotiating a curve of radius $10\sqrt{3}$ m. At what velocity will a car experience no friction while negotiating the curve?

(a) 54 km/hr (b) 72 km/hr (c) 36 km/hr (d) 18 km/hr

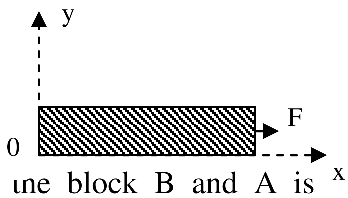
21. Block of mass M on a horizontal smooth surface is pulled by a load of mass M/2 by means of a rope AB and string BC as shown in the figure. The length & mass of the rope AB are L and M/2 respectively. As the block is pulled from AB=L to AB =0 its acceleration changes from



(a) $\frac{3g}{4}$ to g (b) $\frac{g}{4}$ to $\frac{g}{2}$

(c) $\frac{g}{4}$ to g (d) $\frac{3g}{2}$ to $2g$

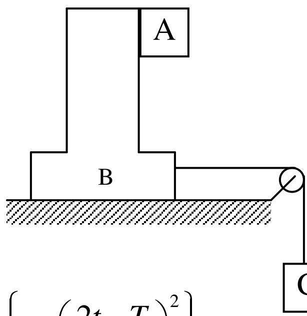
22. A uniformed rod of length L and mass M has been placed on a rough horizontal surface. The horizontal force F applied on the rod is such that the rod is just in the state of rest. If the coefficient of friction varies according to the relation μ=Kx where K is a +ve constant. Then the tension at mid point of rod is



(a) A/2 (b) F/4

(c) F/8 (d) None

23. In the arrangement shown in the figure, mass of the block B and A is m and m respectively. Surface between B and floor is smooth. The block B is connected to the block C by means of a string pulley system. If the whole system is released, then find the minimum value of mass of block C so that block A remains stationary w.r.t B. Coefficient of friction between A and B is μ:



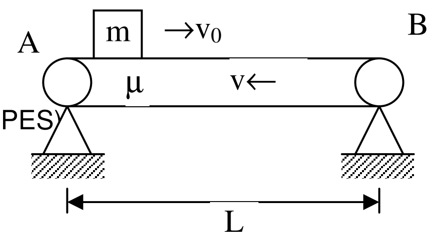
(a) $\frac{m}{\mu}$ (b) $\frac{2m+1}{\mu+1}$

(c) $\frac{3m}{\mu-1}$ (d) $\frac{6m}{\mu+1}$

24. A particle of mass m, initially at rest, is acted on by a force F = $F_0\left\{1-\left(\frac{2t-T}{T}\right)^2\right\}$ during the interval $0 \le t \le T$. The velocity of the particle a t the end of the interval is:

(a) $\frac{5F_0T}{6m}$ (b) $\frac{4F_0T}{3m}$ (c) $\frac{2F_0T}{3m}$ (d) $\frac{3F_0T}{2m}$

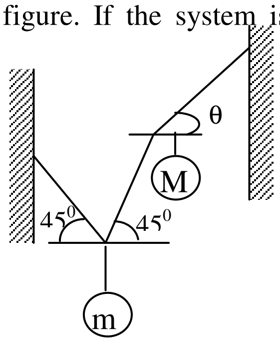
25. With what minimum velocity should block be projected from left end A towards end B such that it reaches the other end B of conveyer belt moving with constant velocity v. Friction coefficient between block and belt is μ.



(a) $\sqrt{\mu g L}$ (b) $\sqrt{2\mu g L}$

(c) $\sqrt{3\mu g L}$ (d) $2\sqrt{\mu g L}$

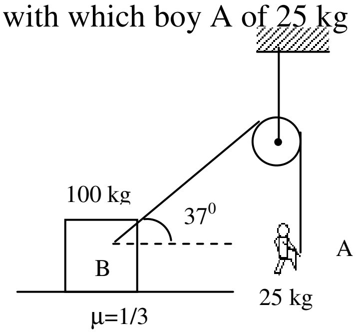
26. Two masses m and M are attached to the string as shown in the figure. If the system is in equilibrium, then



(a) $\tan\theta = 1+\frac{2M}{m}$ (b) $\tan\theta = 1+\frac{2m}{M}$

(c) $\cot\theta = 1+\frac{2M}{m}$ (d) $\cot\theta = 1+\frac{2m}{M}$

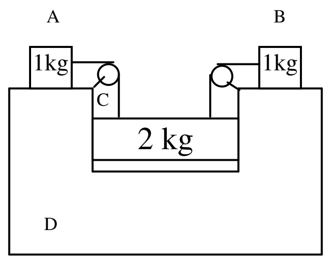
27. Block B of mass 100 kg rests on a rough surface of friction coefficient μ=1/3. A rope is tied to block B as shown in figure. The maximum acceleration with which boy A of 25 kg can climbs on rope without making block moves is:



(a) $\frac{4g}{3}$ (b) $\frac{g}{3}$

(c) $\frac{g}{2}$ (d) $\frac{3g}{4}$

28. In the system shown in the figure there is no friction anywhere. The block C goes down by a distance x_0=10 cm with respect to wedge D when system is released from rest. The velocity of A with respect to B will be (g=10 m/s^2)



(a) zero (b) 1 m/s

(c) 2 m/s (d) none of these

29. A car moves along a circular track of radius R banked at an angle of 30^0 to the horizontal. The coefficient of static friction between the wheels and the track is μ. The maximum speed with which the car can more without skidding out is

(a) $\left[2gR(1+\mu)/\sqrt{3}\right]^{1/2}$ (b) $\left[gR(1-\mu)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$

(c) $\left[gR\left(1+\mu\sqrt{3}\right)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$ (d) None

30. A particle initially at rest is subjected to two forces. One is constant, the other is a retarding force proportional to the particle velocity. In the subsequent motion of the particle :

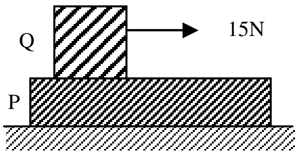
(a) The acceleration will increase from zero to a constant value.

(b) the acceleration will decreases from its initial value to zero

(c) the velocity will increase from zero to maximum & then decrease

(d) the velocity will increase from zero to a constant value.

31. A long plank P of the mass 5 kg is placed on a smooth floor. On P is placed a block Q of mass 2 kg. The coefficient of friction between P and Q is 0.5. If a horizontal force 15 N is applied to Q, as shown, and you may take gas 10 N/kg.



(a) The reaction force on Q due to P in 10 N

(b) The acceleration of Q relative to P is 2.5 m/s^2

(c) The acceleration of P relative to the Floor is 2.0 m/s^2

(d) The acceleration of centre of mass of P+Q system relative to the floor is (15/7) m/s^2

32. A particle is displaced from A ≡ (2, 2, 4) to B≡(5, -3, -1). A constant force of 34N acts in the direction of $\vec{AP}$. Where P ≡(10, 2, -11). (Coordinates are in m).

(i) Find the $(\vec{F})$.

(ii) Find the work done by the force to cause the displacement .

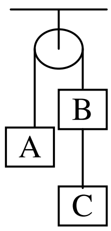
33. A man is standing in a lift which goes up and comes down with the same constant acceleration. If the ratio of the apparent weights in the two cases is 2:1, then the acceleration of the lift is

(a) 3.33 ms^{-2} (b) 2.50 ms^{-2} (c) 2.00 ms^{-2} (d) 1.67 ms^{-2}

34. Three equal weights of mass 2kg each are hanging by a string passing over a fixed pulley. The tension in the string (in N) connecting B and C is

(a) 4g/3 (b) g/3

(c) 2g/3 (d) g/2



35. A 10 kg monkey is climbing a massless rope attached to a 15 kg mass over a tree limb. The mass is lying on the ground. In order to raise the mass from the ground the must climb with

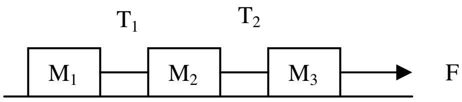
(a) uniform acceleration greater than 5m/sec^2 (b) uniform acceleration greater than 2.5 m/sec^2

(c) high speed (d) uniform acceleration greater than 10 m/sec^2

36. Three blocks are connected as shown in the figure, on a horizontal frictionless table and pulled to the right with a force at 60N. If M_1=10kg, M_2 =20kg and M_3=30 kg then the value of T_2 is

(a) 40 N (b) 30 N

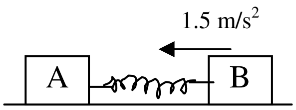
(c) 20N (d) 10 N



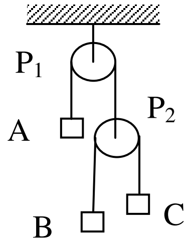
37. Two blocks A & B with mass 4 kg and 6 kg respectively are connected by a stretched spring of negligible mass as in figure. When the two blocks are released simultaneously the initial acceleration of B is 1.5 m/s^2 westward. The acceleration of A is:

(a) 1 m/s^2 westward (b) 2.25 m/s^2 eastward

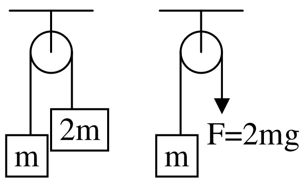
(c) 1 m/s^2 eastward (d) 2.75 m/s^2 westward



38. The three blocks shown move with constant velocities. Find the velocity of block A and B. Given V_{P2}=10 m/s↑, V_c =2m/s ↑



39. Fig shows two pulley arrangements for lifting a mass m. In (a) the mass is lifted by attaching a mass 2m while in (b) the mass is lifted by pulling the other end with a downward force F=2 mg, If f_a and f_b are the accelerations of the two masses then



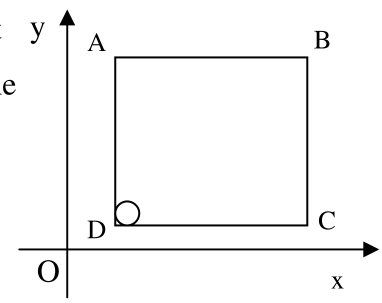
(a) $f_a=f_b$ (b) $f_a=f_b/2$

(c) $f_a=f_b/3$ (d) $f_a=2f_b$

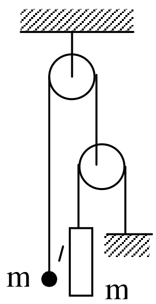
40. A solid sphere of mass 2kg is resting inside a cube as shown in the figure. V=$\left(5t\hat{i}+2t\hat{j}\right)m/s$. Here t is the time in second. All surfaces are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphere on the cube. (Take g=10m/s^2 & y-axis along vertical)

(a) $\sqrt{29}N$ (b) 29 N

(c) 26 N (d) $\sqrt{89}N$



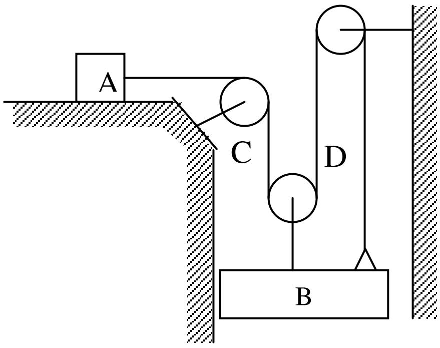
41. In the figure shown, all pulleys are massless and frictionless. The time taken by the ball to reach the upper end of the rod is:



(a) $\sqrt{\frac{10l}{3g}}$ (b) $\sqrt{\frac{5l}{3g}}$

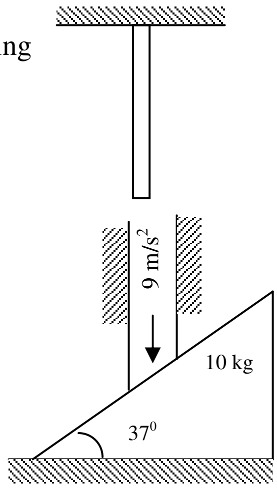
(c) $\sqrt{\frac{3l}{4g}}$ (d) $\sqrt{\frac{3l}{10g}}$

42. Slider block A move to the left with a constant velocity of 6 m/s. Determine
   (a) the velocity of block b,
   (b) the velocity of portion D of the cable.
   (c) the relative velocity of portion C of the cable with respect to portion D.



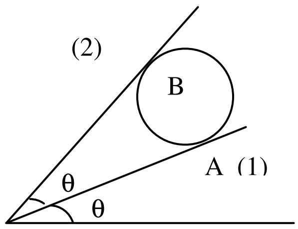
43. Two monkeys of masses 10 and 8 kg are moving along a vertical rope, the former climbing up with an acceleration of 2m/s^2 while the latter coming down with a uniform velocity of 2 m/s. Find the tension in the rope at the fixed support.

44. System is shown in figure. All the surfaces are smooth. Rod is moved by external agent with acceleration 9 m/s^2 vertically downwards. Force exerted on the rod by the wedge will be:



   (a) 120 N (b) 200 N
   (c) 135/2N (d) 225/2N

45. A sphere of mass m is kept between two inclined walls, as shown in the figure. If the coefficient of friction between each wall and the sphere is zero, then the ratio of normal reaction (N_1/N_2) offered by the walls 1 and 2 on the sphere will be



   (a) tan θ (b) tan 2θ (c) 2 cosθ (d) cos 2θ

46. How could a 10 kg object be lowered down form a height using a cord with a breakup strength of 80 N, without breaking the cord.
   (a) lowering the object very slowly
   (b) lowering it with an acceleration less than 2 m/s^2
   (c) lowering it with an acceleration greater than 2 m/s^2
   (d) object cannot be lowered down without breaking the cord

47. A block of weight 9.8 N is placed on a table. The table surface exerts an upward force of 10 N on the block. Assume g =9.8 m/s^2

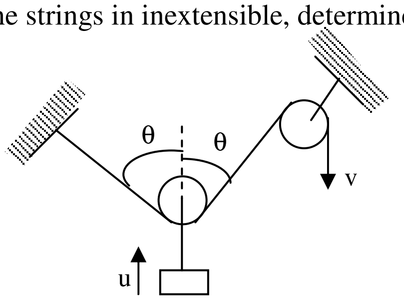
(a) The block exerts a force of 10 N on the table

(b) The block exerts a force of 19.8 N on the table

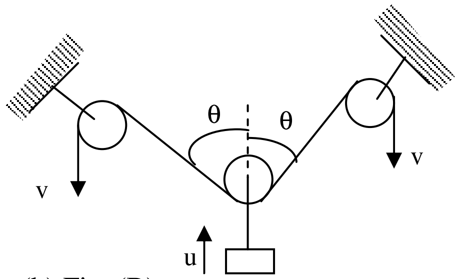
(c) The block exerts a force of 9.8 N on the table

(d) The block has an upward acceleration

48. If the strings in inextensible, determine the velocity u of each block in terms of v and θ.

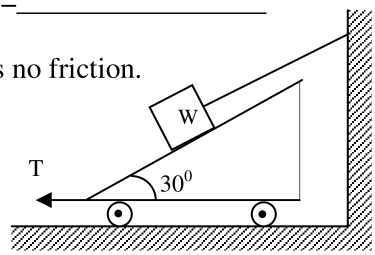


(a) Fig. (A) u =____________________

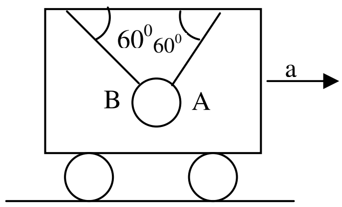


(b) Fig. (B) u–___________________

49. Find the tension T needed to hold the cart in equilibrium, if there is no friction.



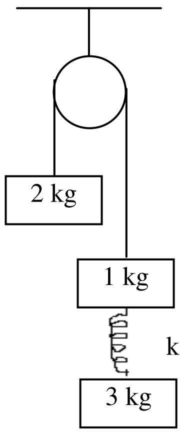
50. A steel ball is suspended from the ceiling of an acceleration carriage by means of two cords A and B. Determine the acceleration a of the carriage which will cause the tension in A to be twice that in B.



51. From the fixed pulley, masses 2 kg, 1 kg and 3 kg are suspended as shown in the figure. Find the extension in the spring if k=100 N/m. (Neglect oscillations due to spring)

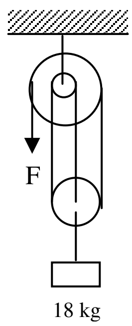
(a) 0.1 m (b) 0.2 m

(c) 0.3 m (d) 0



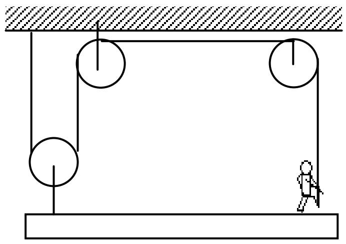
52. In the fig. at the free end of the light string, a force F is applied to keep the suspended mass of 18 kg at rest. Assuming pulley is light then the force exerted by the ceiling on the system is:

(a) 200N (b) 120 N



(c) 180 N (d) 240 N

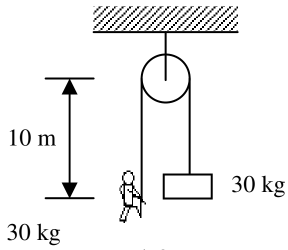
53. A 50 kg person stand on a 25 kg platform. He pulls on the rope which is attached to the platform via the frictionless pulleys as shown in the figure. The platform moves upwards at a steady rate if the force with which the person pulls the rope is



(a) 500 N (b) 250N

(c) 25 N (d) None

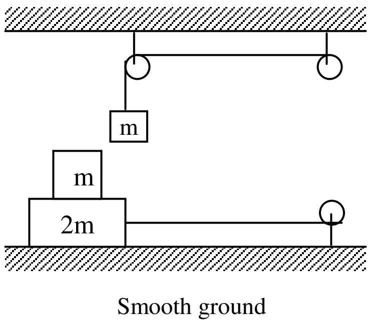
54. In the figure shown man is balanced by counter weight of same mass. He starts to climb the rope with an acceleration of 2 m/s^2 w.r.t. rope. The time after which he reaches the pulley will be



(a) $\sqrt{10}$ sec (b) $2\sqrt{5}$ sec

(c) infinity (d) none of these

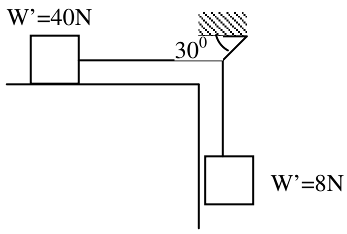
55. In the arrangement shown in figure, there is friction between the blocks of masses m and 2 m which are in contact. The ground is smooth. The mass of the suspended block is m. The block of mass m which is kept on mass 2m is stationary with respect to block of mass 2 m. The force of friction between m and 2m is (pulleys and strings are light and frictionless):



(a) $\frac{mg}{2}$ (b) $\frac{mg}{\sqrt{2}}$

(c) $\frac{mg}{4}$ (d) $\frac{mg}{3}$

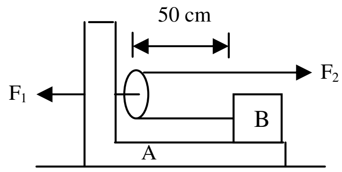
56. The system shown is just on the verge of slipping. The co-efficient of static friction between the block and the table top is:



(a) 0.5 (b) 0.95

(c) 0.15 (d) 0.35

57. A 1kg block 'B' rests as shown on a bracket 'A' of same mass. Constant forces F_1 =20N and F_2=8N start to act at time t=0 when the distance of block B from pulley is 50 cm. Time when block B reaches the pulley is ________



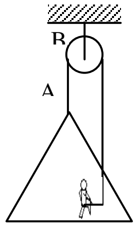
58. To point the side of a building, painter normally hoists himself up by pulling on the rope A as in figure. The painter and platform together weight 200 N. The rope B can withstand 300 N. Find

(a) the maximum acceleration of the painter.

(b) tension in rope a

(i) when painter is at rest

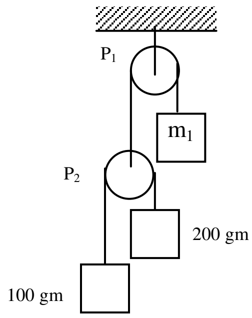
(ii) when painter moves up with an acceleration 2 m/s^2



60. In the system of pulleys shown what should be the value of m_1 such that 100 gm remains at rest w.r.t ground:

(a) 180 gm (b) 160 gm

(c) 100 gm (d) 200 gm



Work, Power, Energy

1. Work done by the conservative forces on a system is equal to :

   (a) the change in kinetic energy of the system

   (b) the change in potential energy of the system

   (c) the change in total mechanical energy of the system

   (d) none of the above

2. A 15 g ball is shot from a spring gun whose spring has a force constant of 600 N/m. The spring is compressed by 5 cm. The greatest possible horizontal range of the ball for this compression is : ($g = 10\ m/s^2$)

   (a) 6.0 m (b) 12.0 m

   (c) 10.0 m (d) 8.0 m

3. A ball is released from the top of a tower. The ratio of work done by force of gravity in first second and third second of the motion of ball is :

   (a) 1 : 2 : 3 (b) 1 : 4 : 16

   (c) 1 : 3 : 5 (d) 1 : 9 : 25

4. A particle is released from a height H. At certain height its kinetic energy is two times its potential energy. Height and speed of particle at that instant are :

   (a) $\frac{H}{3}, \sqrt{\frac{2gh}{3}}$ (b) $\frac{H}{3}, 2\sqrt{\frac{gh}{3}}$

   (c) $\frac{2H}{3}, \sqrt{\frac{2gh}{3}}$ (d) $\frac{H}{3}, \sqrt{2gH}$

5. The displacement of a body of mass 2 kg varies with time t as $s = t^2 + 2t$, where s is in metres and t is in seconds. The work done by all the forces acting on the body during the time interval t = 2 s to t = 4 is :

   (a) 36 J (b) 64 J

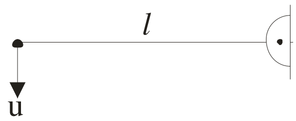
   (c) 100 J (d) 120 J

6. Kinetic energy of a particle moving in a straight line varies with time t as $K = 4t^2$. The force acting on the particle :

   (a) is constant (b) is increasing

   (c) is decreasing (d) first increases and then decreases

7. A ball of mass m is attached to one end of a light rod of length l, the other end of which is hinged. What minimum velocity v should be imparted to the ball downwards, so that it can complete the circle?



(a) $\sqrt{gl}$ (b) $\sqrt{5gl}$

(c) $\sqrt{3gl}$ (d) $\sqrt{2gl}$

8. A particle of mass 2 kg starts moving in a straight line with an initial velocity of 2 m/s at a constant acceleration of 2 m/s^2. Then rate of change of kinetic energy :

(a) is four times the velocity at any moment

(b) is two times the displacement at any moment

(c) is four times the rate of change of velocity at any moment

(d) is constant throughout

9. A particle moves on a rough horizontal ground with some initial velocity say v_0. If 3/4th of its kinetic energy is lost in friction in time t_0. Then coefficient of friction between the particle and the ground is :

(a) $\frac{v_0}{2gt_0}$ (b) $\frac{v_0}{4gt_0}$

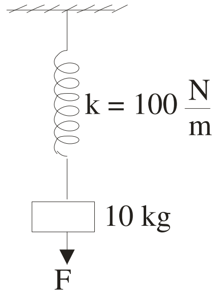
(c) $\frac{3v_0}{4gt_0}$ (d) $\frac{v_0}{gt_0}$

10. An object of mass m is allowed to fall from rest along a rough inclined plane. The speed of the object on reaching the bottom of the plane is proportional to :

(a) m^0 (b) m

(c) m^2 (d) m^{-1}

11. A vertical spring of force constant 100 N/m is attached with a hanging mass of 10 kg. Now an external force is applied on the mass so that the spring is stretched by additional 2m. The work done by the force F is : (g = 10 m/s^2)



(a) 200 J (b) 400 J

(c) 450 J (d) 600 J

12. Two masses of 1 g and 4 g are moving with equal kinetic energies. The ratio of the magnitudes of their momenta is :

(a) 4 : 1 (b) $\sqrt{2}:1$

(c) 1 : 2 (d) 1 : 16

13. A compressed spring has

(a) no energy stored in it

(b) negative mechanical energy stored in it

(c) positive mechanical energy stored it

(d) kinetic energy stored in it

14. If the force acting on a body is inversely proportional to its speed, the kinetic energy of the body is

(a) constant

(b) directly proportional to time

(c) inversely proportional to time

(d) directly proportional to square of time

15. A uniform force of 4 N acts on a body of mass 8 kg for a distance of 2.0 m. The K.E. acquired by the body is ($g = 10\ m/s^2$)

(a) 8 J (b) 64 J

(c) 4 J (d) 160 J

16. A body falls freely under gravity. If it's speed is v when it has lost an amount V of gravitational potential energy, then its mass is

(a) Vg/v^2 (b) V^2/g

(c) $2V/v^2$ (d) $2V/gv^2$

17. A uniform chain has a mass M and length l. It is placed on a frictionless table with a length l_0 hanging over the edge. The chain begins to slide down. Then the speed v with which the end slides away from the edge is given by

(a) $\sqrt{\frac{g}{l}(l^2-l_0^2)}$ (b) $\sqrt{\frac{g}{l}(l-l_0)}$

(c) $\sqrt{\frac{g}{l}(l+l_0)}$ (d) $\sqrt{2g(l-l_0)}$

18. The kinetic energy acquired by a body of mass m in travelling a certain distance starting from rest, under a constant force is

(a) directly proportional to m (b) directly proportional to $\sqrt{m}$

(c) inversely proportional to $\sqrt{m}$ (d) independent of m

19. An elastic string of unstrectched length L and force constant K is stretched by a small length x. It is further stretched by another small length y. The work done in second stretching is

(a) $\frac{1}{2}Ky^2$ (b) $\frac{1}{2}K(x^2+y^2)$

(c) $\frac{1}{2}K(x+y)^2$ (d) $\frac{1}{2}ky(2x+y)$

20. A car starts from rest and attains a kinetic energy K by accelerating without slipping along a horizontal road in 20 seconds. If air resistance is neglected, the work done by external forces which accelerate the car will be

(a) zero (b) K

(c) 2K (d) K/10

21. There will be an increase in potential energy of the system if work is done

(a) upon the system by a conservative force,

(b) upon the system by a non conservative force,

(c) upon the system by any conservative or non conservative force,

(d) by the system on conservative force

22. A rod of mass m and length l is lying on a horizontal table. Work done in making it stand on one end will be

(a) mg$l$ (b) mg$l$/2

(c) mg$l$/4 (d) 2mg$l$

23. In a elastic collision,

(a) the kinetic energy remains constant

(b) the linear momentum remains constant

(c) the final kinetic energy is equal to the initial kinetic energy

(d) the final linear momentum is equal to the initial linear momentum

24. Which of the following is not conserved in inelastic collision

(a) Momentum (b) Kinetic energy

(c) Both momentum and kinetic energy (d) Neither momentum kinetic energy

25. A bomb of mass 1 kg is thrown vertically upwards with a speed of 100 m/s. After 5 seconds, it explodes into two fragments. One fragment of mass 400 gm is found to go down with a speed of 25 m/s. What will happen to second fragment just after explosion? (g = 10 m/s^2)

    (a) it will go upwards with speed 100 m/s

    (b) it will go upwards with speed 40 m/s

    (c) it will go upwards with speed 60 m/s

    (d) it will go downwards with speed 40 m/s

26. A mass of 20 kg moving with a speed of 10 m/s collides with another stationary mass of 5 kg. As a result of collision, the two masses stick together. The K.E. of composite mass will be

    (a) 600 J (b) 800 J

    (c) 1000 J (d) 1200 J

27. A car moving with a velocity of 50 km/hr can be stopped by brakes after atleast 6 m. If the same car is moving at a speed of 100 km/hr, the minimum stopping distance is

    (a) 12 m (b) 6 m

    (c) 18 m (d) 24 m

28. A stationary particle explodes into two particles of masses m_1 and m_2, which move in opposite directions with velocities v_1 and v_2. The ratio of their kinetic energies (E_1/E_2) is

    (a) m_2/m_1 (b) m_1/m_2

    (c) 1 (d) m_1v_2/m_2v_1

29. When a force is applied on a moving body, its motion is retarded. Then the work done is

    (a) Positive (b) Negative

    (c) Zero (d) Positive and Negative

30. A gas expands from 5 litres to 105 litre at a constant pressure 100 N m^{-2}. The work done is

    (a) 1 joule (b) 4 joule

    (c) 8 joule (d) 10 joule

31. The momentum of a body having kinetic energy E is doubled. The new kinetic energy is

    (a) E (b) 4E

(c) 16E (d) 32E

32. If distance is plotted against x-axis and kinetic energy against y-axis, then the slope of the graph so obtained is proportional to

(a) distance (b) kinetic energy

(c) velocity (d) acceleration

33. A one kilowatt motor is used to pump water from a well 10 m deep. The quantity of water pumped out per second is nearly :

(a) 1 kg (b) 10 kg

(c) 100 kg (d) 1000 kg

34. A load of mass M is moved up a smooth inclined plane of inclination θ, height h and length *l*. The work done is

(a) Mg*l* (b) Mgh

(c) Mg cosθ (d) $\frac{M \tan \theta}{g}$

35. Which of the following statements is incorrect?

(a) The work done by Sun in rotating planets around it is zero

(b) Two vehicles having equal masses and equal speed moving in opposite directions possess equal kinetic energy

(c) Potential energy arising from attractive forces is always positive

(d) A particle is moving along the circumference of a circular track with variable speed. Some work is being done in this case

36. A crane can lift a body of mass 100 kg vertically upwards with a constant speed of 5 ms^{-1}. If the value of acceleration due to gravity is 10 ms^{-2}, then the power of the crane is

(a) $100 \times 10 \times 5$W (b) 100×5W

(c) $\frac{100}{5}$W (d) 100 W

37. Which of the following statements is incorrect?

(a) Kinetic energy may be zero, positive or negative

(b) Potential energy may be zero, positive or negative

(c) Power, Energy and Work are all scalars

(d) Ballistic pendulum is a device for measuring the speed of bullets

38. A simple pendulum of length *l* is hanging vertically. With what velocity, the bob must be struck, so as to make the string just horizontal?

(a) $\sqrt{(gl)}$ (b) $\sqrt{(2gl)}$

(c) $2\sqrt{(gl)}$ (d) $\sqrt{(0.5gl)}$

39. A body of mass 2kg is thrown up vertically with a kinetic energy of 490 J. If g = 9.8 m/s2, the height at which the kinetic energy becomes half of its original value is

(a) 10 m (b) 12.5 m

(c) 25 m (d) 50 m

40. A body of mass 10 kg is dropped to the ground from a height of 10 m. The work done by the gravitational force is ($g = 9.8\ m/s^2$)

(a) –490 J (b) + 490 J

(c) –980 J (d) + 980 J

Gravitation

1. A particle on earth's surface is given a velocity equal to its escape velocity. Its total mechanical energy will be

   (a) negative (b) positive

   (c) zero (d) infinite

2. Two earth-satellites are revolving in the same circular orbit round the centre of the earth. They must have the same :

   (a) mass (b) angular momentum

   (c) kinetic energy (d) velocity

3. Three particles each having a mass of 100 g are placed on the vertices of an equilateral triangle of side 20 cm. The work done in increasing the side of this triangle to 40 cm is : $\left(G = 6.67 \times 10^{-11} \frac{N-m^2}{kg^2}\right)$

   (a) 5.0×10^{-12} J (b) 2.25×10^{-10} J

   (c) 4.0×10^{-11} J (d) 6.0×10^{-15} J

4. The magnitude of gravitational potential energy of the earth-satellite system is U with zero potential energy at infinite separation. The kinetic energy of satellite is K. Mass of satellite << mass of earth. Then:

   (a) $K = 2U$ (b) $K = \frac{U}{2}$

   (c) $K = U$ (d) $K = 4U$

5. Three uniform spheres of mass M and radius R each are kept in such a way that each touches the other two. The magnitude of the gravitational force on any of the spheres due to the other two is :

   (a) $\frac{\sqrt{3}}{4}\frac{GM^2}{R^2}$ (b) $\frac{3}{2}\frac{GM^2}{R^2}$

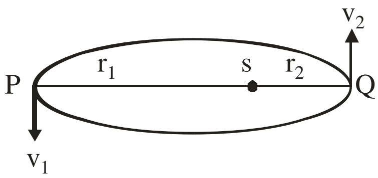
   (c) $\frac{\sqrt{3}\,GM^2}{R^2}$ (d) $\frac{\sqrt{3}\,GM^2}{2R^2}$

6. The minimum energy required to launch a satellite of mass m from the surface of earth of radius R in a circular orbit at an altitude 2R is : (mass of earth is M)

   (a) $\frac{5GmM}{6R}$ (b) $\frac{2GmM}{3R}$

   (c) $\frac{GmM}{2R}$ (d) $\frac{GmM}{3R}$

7. A planet is moving in an elliptical path around the sun as shown in figure. Speed of planet in positions P and Q are v_1 and v_2 respectively with SP = r_1 and SQ = r_2, then v_1/v_2 is equal to :



(a) $\frac{r_1}{r_2}$ (b) $\frac{r_2}{r_1}$

(c) constant (d) $\left(\frac{r_1}{r_2}\right)^2$

8. The acceleration due to gravity on the moon is only one sixth that of earth. FI the earth and moon are assumed to have the same density, the ratio of the radii of moon and earth will be :

(a) $\frac{1}{6}$ (b) $\frac{1}{(6)^{1/3}}$

(c) $\frac{1}{36}$ (d) $\frac{1}{(6)^{2/3}}$

9. For a given density of plane the orbital period of a satellite near the surface of planet of radius R is proportional to :

(a) $R^{1/2}$ (b) $R^{3/2}$

(c) $R^{-1/2}$ (d) R^0

10. The potential at the surface of a planet of mass M and radius R is assumed to be zero. Choose the most appropriate option:

(a) The potential at infinity is $\frac{GM}{R}$

(b) The potential at the center of plane is $-\frac{GM}{2R}$

(c) Both (a) and (b) are correct

(d) Both (a) and (b) are wrong

11. There is a spherical shell of mass M and radius R, the required energy to double its radius is :

(a) $\frac{GM^2}{R}$ (b) $\frac{3GM^2}{2R}$

(c) $\frac{GM^2}{4R}$ (d) $\frac{GM^2}{2R}$

12. The time period of an artificial satellite in a circular orbit of radius R is 2 days and its orbital velocity is v_0. If time period of another satellite in a circular orbit is 16 days then :

(a) its radius of orbit is 4R and orbit velocity is v_0

(b) its radius of orbit is 4R and orbital velocity is $\frac{v_0}{2}$

(c) its radius of orbit is 2R and orbital velocity is v_0

(d) its radius of orbit it 2R and orbital velocity is $\frac{v_0}{2}$

13. Two bodies of masses m_1 and m_2 are initially at rest placed infinite distance apart. They are then allowed to move toward each other under mutual gravitational attraction. Their relative velocity when they are r distance apart is :

(a) $\sqrt{\frac{2G(m_1+m_2)}{r}}$ (b) $\sqrt{\frac{2G\,m_1m_2}{(m_1+m_2)r}}$

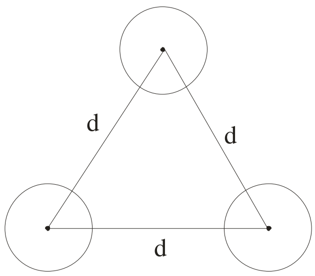
(c) $\sqrt{\frac{G(m_1+m_2)}{r}}$ (d) $\sqrt{\frac{G\,m_1+m_2}{(m_1+m_2)r}}$

14. If G is the universal gravitational constant and ρ is the uniform density of a spherical planet. Then shortest possible period of rotation of the planet can be :

(a) $\sqrt{\frac{\pi G}{2\rho}}$ (b) $\sqrt{\frac{3\pi G}{\rho}}$

(c) $\sqrt{\frac{\pi}{6G\rho}}$ (d) $\sqrt{\frac{3\pi}{G\rho}}$

15. Three solid spheres each of mass m and radius R are released from the position shown in figure. The speed of any one sphere at the time of collision would be :



(a) $\sqrt{Gm\left(\frac{1}{d}-\frac{3}{R}\right)}$ (b) $\sqrt{Gm\left(\frac{3}{d}-\frac{1}{R}\right)}$

(c) $\sqrt{Gm\left(\frac{2}{R}-\frac{1}{d}\right)}$ (d) $\sqrt{Gm\left(\frac{1}{R}-\frac{2}{d}\right)}$

16. If the angular velocity of a planet about its own axis is halved, the distance of geostationary satellite of this planet from the centre of the plane will become:

(a) $(2)^{1/3}$ times (b) $(2)^{3/2}$ times

(c) $(2)^{2/3}$ times (d) 4 times

17. A simple pendulum has a time period T_1 when on the earth's surface and T_2 when T_2 when taken to a height R above the earth's surface, where R is the radius of the earth. The value of T_2/T_1 is :

(a) 1 (b) $\sqrt{2}$

(c) 4 (2) 2

18. If the distance between the earth and the sun were half its present value, the number of days in a year would have been :

(a) 64.5 (b) 129

(c) 182.5 (d) 730

19. If the radius of the earth were to shrink by one percent, its mass remaining the same, the acceleration due to gravity on the earth's surface would :

(a) decrease (b) remain unchanged

(c) increase (d) be zero

20. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth, is :

(a) $\frac{1}{2}$mgR (b) 2 mgR

(c) mgR (d) $\frac{1}{4}$mgR

21. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$, then :

(a) T^2 is proportional to R^2

(b) T^2 is proportional to $R^{7/2}$

(c) T^2 is proportional to $R^{3/2}$

(d) T^2 is proportional to $R^{3.75}$

22. If the distance between the earth and the sun were half its present value, the number of days in a year would have been :

(a) 64.5 (b) 129

(c) 182.5 (d) 730

23. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth:

(a) the acceleration of S always directed towards the centre of the earth

(b) the angular momentum of S about the centre of the earth changes in direction, but its magnitude remain constant

(c) the total mechanical energy of S varies periodically with time

(d) the linear momentum of S remains constant in magnitude

24. A simple pendulum has a time period T_1 when on the earth's surface and T_2 when taken to a height R above the earth's surface, where R is the radius of the earth. The value of T_2/T_1 is

(a) 1 (b) $\sqrt{2}$

(c) 4 (d) 2

25. A geostationary satellite orbits around the earth in a circular orbit of radius 36,000 km. Then the time period of a spy satellite orbiting a few hundred km above the earth's surface (R_e = 6400 km) will approximately be :

(a) 1/2 h (b) 1 h

(c) 2 h (d) 4 h

ROTATIONAL MOTION

1. Two solid spheres (A and B) are made of metals of different densities p_A and p_B respectively. If their masses are equal, the ratio of their moments of inertia (I_B / I_A) about their respective diameter is

(a) $\left(\frac{p_B}{p_A}\right)^{2/3}$ **(b)** $\left(\frac{p_A}{p_B}\right)^{2/3}$ **(c)** $\frac{p_A}{p_B}$ **(d)** $\frac{p_B}{p_A}$

2. A uniform rod of length $8a$ and mass $6m$ lies on a smooth horizontal surface. Two point masses m and $2m$ moving in the same plane with speed $2v$ and v respectively strike the rod perpendicularly at distances a and $2a$ from the mid point of the rod in the opposite directions and stick to the rod. The angular velocity of the system immediately after the collision is:

(a) $\frac{6v}{32a}$ **(b)** $\frac{6v}{33a}$ **(c)** $\frac{6v}{40a}$ **(d)** $\frac{6v}{41a}$

3. Assume the earth's orbit around the sun as circular and the distance between their centres as D. Mass of the earth is M and its radius is R. If earth has an angular velocity ω_0 with respect to its centre and ω with the respect to the centre of the sun, the total kinetic energy of earth is:

(a) $\frac{MR^2\omega_0^2}{5}\left[1+\left(\frac{\omega}{\omega_0}\right)^2+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

(b) $\frac{MR^2\omega_0^2}{5}\left[1+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

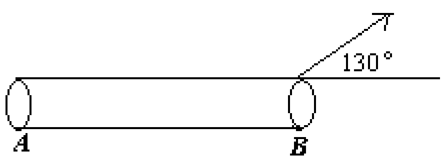
(c) $\frac{2}{5}MR^2\omega_0^2\left[1+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

(d) $\frac{2}{5}MR^2\omega_0^2\left[1+\left(\frac{\omega}{\omega_0}\right)^2+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

4. The centre of mass of three particles of masses 1kg, 2 kg and 3 kg is at $(2,2,2)$. The position of the fourth mass of 4 kg to be placed in the system as that the new centre of mass is at $(0,0,0)$ is :

(a) $(-3,-3,-3)$ **(b)** $(-3,3,-3)$ **(c)** $(2,3,-3)$ **(d)** $(2,-2,3)$

5. The instantaneous velocity of a point B of the given rod of length 0.5 m is $3m/s$ in the represented direction. The angular velocity of the rod for minimum velocity of end A is :



(a) $1.5\, rad/s$ **(b)** $5.2\, rad/s$
(c) $2.5\, rad/s$ **(d)** none of these

6. Identify the increasing order of the angular velocities of the following :
1. earth rotating about its own axis **2.** Hour's hand of a clock
3. Second's hand of a cloc
4. Flywheel of radius 2 making $300\, rpm$

(a) $1,2,3,4$ **(b)** $2,3,4,1$ **(c)** $3,4,1,2$ **(d)** $4,1,2,3$

7. A thin uniform square lamina of side a is placed in the $xy-plane$ with its sides parallel to x and $y-axes$ and with its centre coinciding with origin. It moment of inertia about an axis passing through a point of the $y-axes$ at a distance $y=2a$ and parallel to $x-axis$ is equal to its moment of inertia about an axis passing through a point on the $x-axis$ at a distance $x=d$ and perpendicular to $xy-plane$. Then value of d is:

(a) $\frac{7}{3}a$ **(b)** $\sqrt{\frac{47}{12}}a$ **(c)** $\frac{9}{5}a$ **(d)** $\sqrt{\frac{51}{12}}a$

8. The velocities of three particles of masses $20\,g, 30\,g$ and $50\,g$ are $10\hat{i}, 10\hat{j}$ and $10\hat{k}$ respectively. The velocity of the centre of mass of the three particles is :

(a) $2\hat{i}+3\hat{j}+5\hat{k}$ **(b)** $10(\hat{i}+\hat{j}+\hat{k})$
(c) $20\hat{i}+30\hat{j}+5\hat{k}$ **(d)** $2\hat{i}+30\hat{j}+50\hat{k}$

9. A uniform metal rod of length $'L'$ and mass $'M'$ is rotating about an axis passing through one of the ends & perpendicular to the rod with angular speed $'\omega'$. If the temperature increases by $t°C$, then the change in its angular velocity is proportional to which of the following ?
(Coefficient of linear expansion of rod $=\alpha$)

(a) $\sqrt{\omega}$ **(b)** ω **(c)** ω^2 **(d)** $\frac{1}{\omega}$

10. From a uniform wire, two circular loops are made (i) P of radius $'r'$ and (ii) Q of nr. If the moment of inertia of Q about an axis passing through its centre and perpendicular to its plane is 8 times that of P about a similar axis, the value of $'n'$ is (diameter of the wire is very much smaller than i or nr):

(a) $\frac{1}{2}$ **(b)** $\frac{3}{5}$ **(c)** 1 **(d)** 2

11. A body is executing simple harmonic motion. At a displacement x its potential energy is E_1 and at a displacement y it potential energy is E_2. The potential energy (E) at displacement $(x+y)$ is :

(a) $\sqrt{E}=\sqrt{E_1}-\sqrt{E_2}$ **(b)** $\sqrt{E}=\sqrt{E_1}+\sqrt{E_2}$
(c) $E=E_1+E_2$ **(d)** $E=E_1+E_2$

12. The particles of mass $1\,kg$ and $3\,kg$ have position vectors $2\hat{i}+3\hat{j}+4\hat{k}$ and $-2\hat{i}+3\hat{j}-4\hat{k}$ respectively. The centre of mass, has a position vector :

(a) $\hat{i}+3\hat{j}-2\hat{k}$ **(b)** $-\hat{i}-3\hat{j}-2\hat{k}$

(c) $-\hat{i}+3\hat{j}+2\hat{k}$ **(d)** $-\hat{i}+3\hat{j}-2\hat{k}$

13. A particle of mass m is projected with a velocity v making an angle of $45°$ with the horizontal. The magnitude of the angular momentum of the projectile about the point of projection when the particle is at its maximum height h is:

(a) zero **(b)** $mv^3/(4\sqrt{2}g)$ **(c)** $mv^3/(\sqrt{2}g)$ **(d)** $m\sqrt{2gh^3}$

14. A mass m is moving with a constant velocity along a line parallel to the $x-axis$, away from the origin. Its angular momentum with respect to the origin :

(a) is zero **(b)** remains constant

(c) goes on increasing **(d)** goes on decreasing

15. A smooth sphere A is moving on a frictionless horizontal plane with angular velocity ω and centre of mass velocity v. It collides elastically and head on with an identical sphere B at rest. Neglect friction everywhere. After the collision their angular speeds are ω_A and ω_B respectively. Then :

(a) $\omega_A < \omega_B$ **(b)** $\omega_A = \omega_B$ **(c)** $\omega_A < \omega$ **(d)** $\omega_B < \omega$

PROPERTIES OF MATTER

1. When a wire of length $10m$ is subjected to a force of $100N$ along its length, the lateral strain produced is $0.01\times10^{-3}\,m$. The posisson's ratio was found to be 0.4. If the area of cross-section of wire is $0.025m^2$, is Young's modulus is

(a) $1.6\times10^{8}N/m^2$ **(b)** $2.5\times10^{10}N/m^2$

(c) $1.25\times10^{11}N/m^2$ **(d)** $16\times10^{9}N/m^2$

2. A liquid does not wet the solid surface if the angle of contact is

(a) zero **(b)** equal to $45°$

(c) equal to $90°$ **(d)** greater than $90°$.

3. A horizontal pipe of non-uniform cross-section allows water to flow through it with a velocity $1ms^{-1}$ when pressure is $50kPa$ at a point. If the velocity of flow has to be $2ms^{-1}$ at some other point, the pressure at that point should be

(a) $50kPa$ **(b)** $100kPa$

(c) $48.5kPa$ **(d)** $24.25kPa$

4. The soap bubbles combine to form a single bubble. In this process, the change in volume and surface area are respectively V and A. If P is the atmospheric pressure, and T is the surface tension of the soap solution, the following relation is true.

(a) $4PV+3TA=0$ **(b)** $3PV-4TA=0$

(c) $4PV-3TA=0$ **(d)** $3PV+4TA=0$

5. An air bubble of radius $1cm$ rises from the bottom portion through a liquid of density $1.5\,g/cc$ at a constant speed of $0.25\,cm\,s^{-1}$. If the density of air is neglected, the coefficient of viscosity of the liquid is approximately , Then (Pas):

(a) 13000 **(b)** 1300 **(c)** 130 **(d)** 13

6. The heat evolved for the rise of water when one end of the capillary tube of radius r is immersed vertically into water is : (Assume surface tension $=T$ and density of water to be ρ)

(a) $\frac{2\pi T}{\rho g}$ **(b)** $\frac{\pi T^2}{\rho g}$ **(c)** $\frac{2\pi T^2}{\rho g}$ **(d)** none of these

7. An iron sphere of mass $20\times10^{-3}kg$ falls through a viscous liquid with terminal velocity $0.5ms^{-1}$. The terminal velocity $(in\ ms^{-1})$ of another iron sphere of mass $54\times10^{-2}kg$ is:

(a) 4.5 **(b)** 3.5 **(c)** 2.5 **(d)** 1.5

8. A metallic ring of radius r and cross sectional area A is fitted into a wooden circular disc of radius $R(R>r)$. If the Young's modulus of the material of the ring is Y, the force with which the metal ring expands is :

(a) $\frac{AYR}{r}$ **(b)** $\frac{AY(R-r)}{r}$ **(c)** $\frac{Y(R-r)}{Ar}$ **(d)** $\frac{YR}{AR}$

Punjab Edusat Society

9. One end of a uniform glass capillary tube of radius $r = 0.025\,cm$ is immersed vertically in water to a depth $h = 1\,cm$. The excess pressure in N/m^2 required to blow an air bubble out of the tube :
(Surface tension of water $= 7\times10^{-2}\,N/m$
Density of water $= 10^3\,kg/m^3$
Acceleration due to gravity $= 10\,m/s^2$)

(a) 0.0048×10^5 (b) 0.0066×10^5
(c) 1.0048×10^5 (d) 1.0066×10^5

10. Water in a river $20\,m$ deep is flowing at a speed of $10\,ms^{-1}$. The shearing stress between the horizontal layers of water in the river in Nm^{-2} is : (Coefficient of viscosity of water $= 10^{-3}$ SI units)

(a) 1×10^{-2} (b) 0.5×10^{-2} (c) 1×10^{-3} (d) 0.5×10^{-3}

11. There are two holes one each along the opposite sides of a wide rectangular tank. The cross- section of each hole is $0.01m^2$ and one metre. The tank is filled with water. The net force on the tank in newton when the water flows out of the holes is :
(Density of water $= 1000kg/m^3$)

(a) 100 (b) 200 (c) 300 (d) 400

12. Bulk modulus of water is 2×10^9 N/m^2. The pressure required to increase the volume of water by 0.1% in N/m^2 is:

(a) 2×10^9 (b) 2×10^0 (c) 2×10^6 (d) 2×10^4

13. The spherical soap bubbles of radii r_1 and r_2 in vacuum combine under isothermal conditions. The resulting bubble has a radius equal to :

(a) $\frac{r_1+r_2}{2}$ (b) $\frac{r_1 r_2}{r_1+r_2}$ (c) $\sqrt{r_1 r_2}$ (d) $\sqrt{r_1^2\, r_2^2}$

14. The rate of steady volume flow of water through a capillary tube of length l and radius r, under a pressure difference of P is V. Thus tube is connected with another tube of the same length but half the radius , in series. Then the rate of steady volume flow through them is :
(The pressure difference across the combination is P.)

(a) $\frac{V}{16}$ (b) $\frac{V}{17}$ (c) $\frac{16V}{17}$ (d) $\frac{17V}{16}$

15. A large tank filled with water to a height h is to be emptied through a small hole at the bottom. The ratio of times taken for the level of water to fall from h to $h/2$ and $h/2$ to zero is:

(a) $\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\sqrt{2}-1$ (d) $\frac{1}{\sqrt{2}-1}$

16. The densities of a liquid of $0°C$ and $100°C$ are respectively 1.0127 and 1. A specific gravity bottle is filled with $300g$ of the liquid at $0°C$. Then the mass of the liquid expelled in grams is :

(a) $\frac{3}{10.1}$ (b) $\frac{3}{1.01}$ (c) $\frac{3.81}{1.0127}$ (d) $\frac{3.81}{0.0127}$

17. The length of an elastic string is $'a'$ metres when the longitudinal tension is $4N$ and $'b'$ meters when the longitudinal tension is $5N$. The length of the string in metres when the longitudinal tension is $9N$ is :

(a) $a-b$ **(b)** $5b-4a$ **(c)** $2b-\frac{1}{4}a$ **(d)** $a-b$

18. Water is conveyed through a uniform tube of $8cm$ in diameter and 3140 m in length at the rate $2\times10^{-3}m^3$ per second. The pressure required in maintain the flow is : (Viscosity of water $=10^{-3}SI$ units)

(a) $6.25\times10^3\,Nm^{-2}$ **(b)** $0.625\,Nm^{-2}$ **(c)** $0.0625Nm^{-2}$ **(d)** $0.00625Nm^{-2}$

19. A tank with vertical walls is mounted so that its base is at a height H above the horizontal ground. The tank is filled with water to a depth $'h'$. A hole is punched in the side wall of the tank at a depth $'x'$ below the water surface. To have maximum range of the emerging stream, the value of x is :

(a) $\frac{H+h}{4}$ **(b)** $\frac{H+h}{2}$ **(c)** $\frac{H+h}{3}$ **(d)** $\frac{3(H+h)}{4}$

20. When a uniform wire of radius r, is stretched by a $2kg$ weight the increase in its length is $2.00\,mm.$ If the radius of the wire is $\frac{r}{2}$ and other conditions remaining the same, the increase in its length is :

(a) $2.00\,mm$ **(b)** $4.00\,mm$ **(c)** $6.00\,mm$ **(d)** $8.00\,mm$

21. The elongation of a steel wire stretched by a force is $e.$ If a wire of the same material of double the length, and half the diameter is subjected to double the force, its elongation will be :

(a) $16e$ **(b)** $4e$ **(c)** $\frac{e}{4}$ **(d)** $\frac{e}{16}$

Modern Physics

1. When white light (violet to red) is passed through hydrogen gas at room temperature, absorption lines will be observed in the

(a) Lyman series
(b) Balmer series
(c) Both (a) and (b)
(d) Neither (a) or (b)/None

2. A sample of radioactive material has mass m, decay constant λ, and molecular weight M. Avogadro constant = N_A. The initial activity of the sample is

(a) λm
(b) $\frac{\lambda m}{M}$
(c) $\frac{\lambda m N_A}{M}$
(d) $m N_A e^{\lambda}$

3. In the previous question, the activity of the sample after time t will be

(a) $\left(\frac{mN_A}{M}\right)e^{-\lambda t}$
(b) $\left(\frac{mN_A\lambda}{M}\right)e^{-\lambda t}$
(c) $\left(\frac{mN_A}{M\lambda}\right)e^{-\lambda t}$
(d) $\frac{M}{\lambda}(1-e^{-\lambda t})$

4. When a nucleus with atomic number Z and mass number A undergoes a radioactive decay process

(a) both Z and A will decrease, if the process is α decay

(b) Z will decrease, but A will not change, if the process is β^+ decay

(c) Z will increase but A will not change, if the process is β^- decay

(d) Z and A will remain unchanged, if the process is γ decay

5. When the nucleus of an electrically neutral atom undergoes a radioactive decay process, it will remain neutral after the decay if the process is

(a) An α decay
(b) A β^- decay
(c) A γ decay
(d) A K-capture process

6. If the potential difference applied across a Coolidge tube is increased

(a) The wavelength of the K_α line will increase

(b) The wavelength of the K_β line will decrease

(c) The difference in wavelength between the $K\alpha$ and $K\beta$ lines will decrease

(d) None of the above

7. The minimum wavelength of X-ray that can be produced in a coolidge tube depends on

(a) The metal used as the target

(b) The intensity of the electron beam striking the target

(c) The current flowing through the filament

(d) The potential difference between the cathode and the anode

8. Which of the following assertions are correct?

(a) A neutron can decay to a proton only inside a nucleus

(b) A proton can change to a neutron only inside a nucleus

(c) An isolated neutron can change into a proton

(d) An isolated proton can change into a neutron

9. A and B are isotopes. B and C are isobars. All three are radioactive

(a) A, B and C must belong to the same element

(b) A, B and C may belong to the same element

(c) It is possible that A will change to B through a radioactive-decay process

(d) It is possible that B will change to C through a radioactive-decay process

10. A fractional f_1 of a radioactive sample decays in one mean life, and a fraction f_2 decays in one half-life

(a) $f_1 > f_2$

(b) $f_1 < f_2$

(c) $f_1 = f_2$

(d) May be (a), (b) or (c) depending on the values of the mean life and half-life.

11. Cathode rays enter a magnetic field making an oblique angle with the lines of force. Then their path in the magnetic field is

(a) Straight line (b) Helix

(c) Circle (d) Parabola

12. An electron moving in a variable magnetic field B having a variable linear velocity V, will remain rotating in a circle of constants radius r only when

(a) B is constant (b) V is constant

(c) V and B both are constant

(d) Angular velocity is constant

13. If a potential difference of 20,000 volts is applied across an X-ray tube, the cut-off wavelength will be

(a) 6.21×10^{-10} m

(b) 6.21×10^{-11} m

(c) 6.21×10^{-12} m

(d) 3.1×10^{-11} m

14. The Kα X-ray emission line of tungsten occurs at λ = 0.021 nm. The energy difference between K and L levels in this atom is about

(a) 0.51 MeV

(b) 1.2 MeV

(c) 59 keV

(d) 13.6 eV

15. In the Bohr model of the hydrogen atom, let R, V and E represent the radius of the orbit, speed of the electron and the total energy of the electron respectively. Which of the following quantities are proportional to the quantum number n ?

(a) VR

(b) RE

(c) $\frac{V}{E}$

(d) $\frac{R}{E}$

16. Whenever a hydrogen atom emits a photon in the Balmer series,

(a) It may emit another photon in the Balmer series

(b) It must emit another photon in the Lyman series

(c) The second photon, if emitted, will have a wavelength of about 122 nm

(d) It may emit a second photon, but he wavelength of this photon cannot be predicted

17. Which of the following pairs consitute very similar radiations?

(a) Hard ultraviolet rays and soft X-rays

(b) Soft ultraviolet rays and hard X-rays

(c) Very and X-rays and low-frequency γ-rays

(d) Soft X-rays and γ-rays

18. The count rate from 100 cm^3 of a radioactive liquid is c. Some of this liquid is now discarded. The count rate of the remaining liquid is found to be c/10 after three half-lives. the volume of the remaining liquid, in cm^3, is

(a) 20

(b) 40

(c) 60

(d) 80

19. In a sample of radioactive material, what percentage of the initial number of active nuclei will decay during one mean life?

(a) 37% (b) 50%

(c) 63% (d) 69.3%

20. Three-fourths of the active nuclei present in a radioactive sample decay in 3/4 s. the half-life of the sample is

(a) 1s (b) $\frac{1}{2}$s

(c) $\frac{3}{4}$s (d) $\frac{3}{8}$s

21. In a radioactive series, $^{238}U_{92}$ changes to $^{206}Pb_{82}$ through n_1 α decay process and n_2 β-decay process

(a) $n_1 = 8, n_2 = 8$ (b) $n_1 = 6, n_2 = 6$

(c) $n_1 = 8l\ n_2 = 6$ (d) $n_1 = 6, n_2 = 8$

22. Two nucleons are at a separation of 1 fm. the net force between them is F_1 if both are neutrons, F_2 if both are protons, and F_3 if one is a proton and the other is a neutron.

(a) $F_1 > F_2 > F_3$ (b) $F_2 > F_1 > F_3$

(c) $F_1 = F_3 > F_2$ (d) $F_1 = F_2 > F_3$

23. The activity of a sample of radioactive material is A_1 at time t_1 and A_2 at time $t_2(t_2 > t_1)$. Its mean life is T. Then

(a) A1t1 = A2t2 (b) $\frac{A_1 - A_2}{t_2 - t_1}$ = constant

(c) $A_2 = A_1 e^{(t_1 - t_2/T)}$ (d) $A_2 = A_1 e^{(t_1/Tt_2)}$

24. 90% of the active nuclei present in a radioactive sample are found to remain undecayed after 1 day. The percentage of undecayed nuclei left after two days will be

(a) 85% (b) 81%

(c) 80% (d) 79%

25. A radioactive nuclide can decay simultaneously by two different process which have decay constants λ_1 and λ_2. the effective decay constant of the nuclide is λ

(a) $\lambda = \lambda_1 + \lambda_2$ (b) $\lambda = \frac{1}{2}(\lambda_1 + \lambda_2)$

(c) $\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ (d) $\lambda = \sqrt{\lambda_1, \lambda_2}$

26. An orbital electron in the ground state of hydrogen has an angular momentum L_1, and an orbital electron in the first orbit in the ground state of lithium has an angular momentum L_2.

(a) $L_1 = L_2$ (b) $L_1 = 3L_2$

(c) $L_2 = 3L_1$ (d) $L_2 = 9L_1$

27. If radiation of all wavelengths from ultraviolet to infrared is passed through hydrogen gas at room temperature absorption lines will be observed in the

(a) Lyman series (b) Balmer series

(c) Both (a) and (b) (d) Neither (a) or (b)

28. A photon of energy 10.2 eV corresponds to light of wavelength λ0. Due to an electron transition from n = 2 to n = 1 in a hydrogen atom, light of wavelength λ is emitted. If we take into account the recoil of the atom when the photon is emitted,

(a) $\lambda = \lambda_0$

(b) $\lambda < \lambda_0$

(c) $\lambda > \lambda_0$

(d) The data is not sufficient to reach a conclusion

29. Two identical nuclei A and B of the same radioactive element undergo β decay. A emits a β-particle and changes to A′. B emits a β-particle and then a γ-ray photon immediately afterwards and changes to B′

(a) A′ and B′ have the same atomic number and mass number

(b) A′ and B′ have the same atomic number but different mass numbers

(c) A′ and B′ have different atomic numbers but the same mass number

(d) A′ and B′ are isotopes

30. The decay constant of a radioactive sample is λ. Its half-life is $T_{1/2}$ and mean life is T

(a) $T_{1/2} = \frac{1}{\lambda}, T = \frac{\ln 2}{\lambda}$ (b) $T_{1/2} = \frac{\ln 2}{\lambda}, T = \frac{1}{\lambda}$

(c) $T_{1/2} = \lambda \ln 2, T = \frac{1}{\lambda}$ (d) $T_{1/2} = \frac{\lambda}{\ln 2}, T = \frac{\ln 2}{\lambda}$

31. Let v_1 be the frequency of the series limit of the Lyman series, v_2 be the frequency of the first line of the Lyman series, and v_3 be the frequency of the series limit of the Balmer series

(a) $v_1 - v_2 = v_3$ (b) $v_2 - v_1 = v_3$

(c) $v_3 = \frac{1}{2}(v_1 + v_2)$ (d) $v_1 + v_2 = v_3$

32. An electron with kinetic energy = E eV collides with a hydrogen atom in the ground state. The collision will be elastic

(a) For all value of E (b) For E < 10.2 eV

(c) For E < 13.6 eV (d) Only for E < 3.4 eV

33. An electron is in an excited state in a hydrogen-like atom. It has a total energy of −3.4 eV. The kinetic energy of the electron is E and its de Broglie wavelength is λ

(a) $E = 6.8$ eV, $\lambda \sim 6.6 \times 10^{-10}$ m (b) $E = 3.4$ eV, $\lambda \sim 6.6 \times 10^{-10}$ m

(c) $E = 3.4$ eV, $\lambda \sim 6.6 \times 10^{-11}$ m (d) $E = 6.8$ eV, $\lambda \sim 6.6 \times 10^{-11}$ m

34. An electron in a hydrogen atom makes a transition from $n = n_1$ to $n = n_2$. The time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are

(a) $n_1 = 4, n_2 = 2$ (b) $n_1 = 8, n_2 = 2$

(c) $n_1 = 8, n_2 = 1$ (d) $n_1 = 6, n_2 = 3$

35. A beam of ultraviolet light of all wavelengths passes through hydrogen gas at room temperature, in the x-direction. Assume that all photons emitted due to electron transitions inside the gas emerge in the y-direction. Let A and B denote the light emerging from the gas in the x- and y-directions respectively. Then

(a) Some of the incident wavelengths will be absent in A

(b) Only those wavelength will be present in B which are absent in A

(c) B will contain some visible light

(d) B will contain some infrared light

36. Let λ_α, λ_β and λ'_α denote the wavelengths of the X-rays of the K_α, K_β and L_α lines in the characteristic X-rays for a metal. Here

(a) $\lambda'_\alpha > \lambda_\alpha > \lambda_\beta$ (b) $\lambda'_\alpha > \lambda_\beta > \lambda_\alpha$

(c) $\frac{1}{\lambda_\beta} = \frac{1}{\lambda_\alpha} + \frac{1}{\lambda'_\alpha}$ (d) $\frac{1}{\lambda_\alpha} + \frac{1}{\lambda_\beta} = \frac{1}{\lambda'_\alpha}$

37. In a Coolidge tube, the potential difference across the tube is 20 kV, and 10 mA current flows through the voltage. Only 0.5% of the energy carried by the electrons striking the target is coverted into X-rays. The X-ray beam carries a power of

(a) 0.1 W (b) 1 W

(c) 2 W (d) 10 W

38. When an electron moving at a high speed strikes a metal surface, which of the following are possible?

(a) The entire energy of the electron may be converted into an X-ray photon

(b) Any fraction of the energy of the electron may be converted into an X-ray photon

(c) the entire energy of the electron may get converted to heat

(d) The electron may undergo elastic collision with the metal surface

39. When a metal of atomic number Z is used as the target in a Coolidge tube, let v be the frequency of the K_α line. Corresponding values of Z and v are known for a number of metals. Which of the following plots will give a straight lien?

(a) v against Z

(b) 1/v against Z

(c) $\sqrt{v}$ against Z

(d) v against $\sqrt{Z}$

40. A 60 w bulb is hung over the centre of a table $4' \times 4'$ at height of 3. The ratio of the intensities of illumination at a point on the centre of the edge and on the corner of the table is

(a) 17/13

(b) 2/1

(c) $(17/13) \times 60$

(d) $\left(\frac{17}{13}\right)^{3/2}$

Answer

(Modern Physics)

1. (d)
2. (c)
3. (b)
4. (a,b,c,d)
5. (c,d)
6. (d)
7. (d)
8. (b,c)
9. (d)
10. (a)
11. (b)
12. (c)
13. (b)
14. 9c)
15. (a,c)
16. (b,c)
17. (a,c)
18. (d)
19. (c)
20. (d)
21. (c)
22. (c)
23. (c)
24. (b)
25. (a)

26. (a)
27. (a)
28. (c)
29. (b)
30. (b)
31. (a)
32. (b)
33. (b)
34. (a,d)
35. (a,b,c)
36. (a,c)
37. (b)
38. (a,b,c)
39. (c)
40. (d)

Punjab Edusat Society

Optics

SECTION – A

1. A plane mirror is approaching you at a speed of 10cm/sec, you can see your image in it. At what speed will your image approach you?

(a) 10 cm/sec (b) 5 cm/sec

(c) 20 cm/sec (d) 15 cm/sec

2. A man 180 cm high stands in front of a plane mirror. His eyes are at a height of 170cm from the floor, then the lower edge of the mirror should be above the ground at a height of

(a) 85 cm (b) 170 cm

(c) 180 cm (d) 90 cm

3. The light reflected by a plane mirror may form a real image

(a) if the rays incident on the mirror are diverging

(b) if the rays incident on the mirror are converging

(c) if the object is placed very close to the mirror

(d) under no circumstance

4. At what angle must two plane mirrors be placed so that the incident and resulting reflected rays are always parallel to each other?

(a) 0^o (b) 30^o

(c) 60^o (d) 90^o

5. Given a point source of light, which of the following can produce a parallel beam of light?

(a) convex mirror

(b) concave mirror

(c) concave lens

(d) two plane mirrors inclined at 90^o to each other

6. The sun (diameter D) subtends an angle θ radians at the pole of a concave mirror of focal length f. The diameter of the image of the sun formed by the mirror is

(a) f θ (b) 2 f θ

(c) $\frac{f \cdot 2\theta}{D}$ (d) Dθ

7. A convex mirror and a concave mirror each of focal length 5 cm, are placed at a distance 15cm apart facing each other. A point object is placed midway between them. If reflection first takes place at the concave mirror and then at the convex mirror, then final image is formed at

(a) 15 cm behind the convex mirror.

(b) 10 cm from the concave mirror and between the two mirror.

(c) at the pole of the concave mirror.

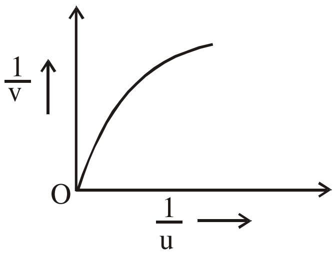
(d) at the pole of the convex mirror.

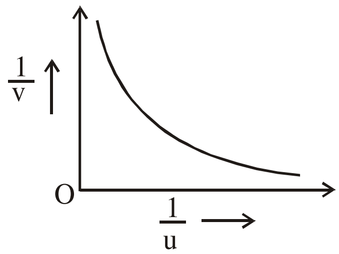
8. A thin rod of length f/3 is placed along the optic axis of a concave mirror of focal length f such that its image which is real and elongated just touches the rod. Then magnification produced by mirror is

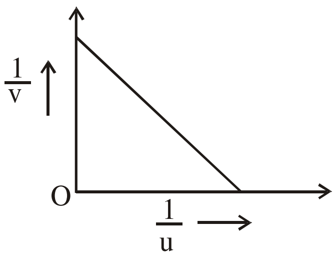
(a) 1.5 (b) 2.0

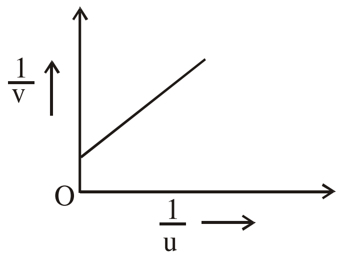
(c) 3.0 (d) 2.5

9. An object is placed at a distance u cm from a concave mirror of focal length f cm. The real image of the object is received on a screen placed at a distance of v cm from the mirror. The values of u are changed and the corresponding values of v are measured. Which one of the graphs represents the variation of $\frac{1}{v}$ with $\frac{1}{u}$?

(a)


(b)


(c)


(d)


10. The linear magnification m of the image in Q.9 is given by

(a) $m = \frac{1}{f}(f - v)$ (b) $m = \frac{1}{v}(v + f)$

(c) $m = \frac{1}{v}(v - f)$ (d) $m = \frac{1}{f}(v + f)$

11. The refractive index of water is 1.33, what will be the speed of light in water?

(a) 3×10^8 m/s (b) 2.25×10^8 m/s

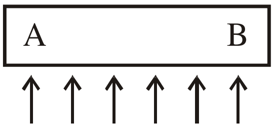
(c) 4×10^8 m/s (d) 1.33×10^8 m/s

12. A mark at the bottom of a liquid appears to rise by 0.1m. the depth of the liquid is 1m. The refractive index of the liquid is

(a) $\frac{4}{3}$ (b) $\frac{9}{10}$

(c) $\frac{10}{9}$ (d) $\frac{3}{2}$

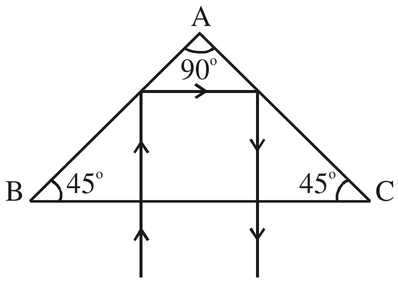
13. Rays of light fall one a glass slab ($\mu > 1$) as shown in the figure. If μ at A is maximum and at B is minimum, then what will happen to these rays

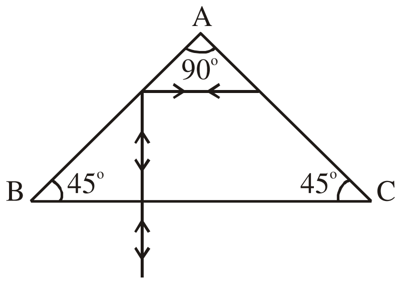


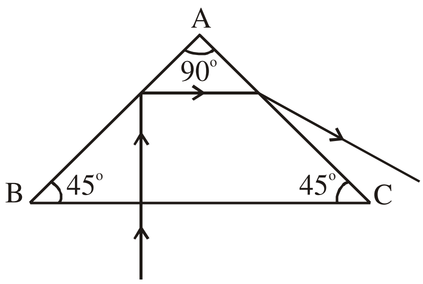
(a) They will tilt towards A (b) They will tilt towards B

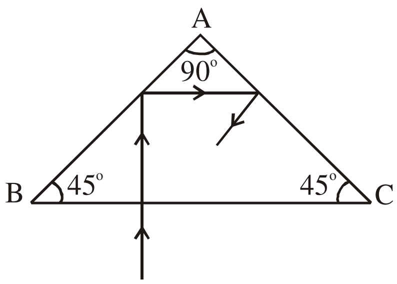
(c) They will not deviate (d) There will be total internal reflection

14. Refractive index of the material of a prism of angles 45° – 45° –90° is 1.5. The path of the ray of light incident normally on the hypotenuse side is shown in the figure

(a)


(b)


(c)


(d)


15. A rectangular block of glass (refractive index $\frac{3}{2}$) is kept in water (refractive index $\frac{4}{3}$). The critical angle for total internal reflection is

(a) $\sin^{-1}(8/9)$ for a ray of light passing from glass to water.

(b) $\sin^{-1}(8/9)$ for a ray of light passing from water to glass.

(c) $\sin^{-1}(2/3)$ for a ray of light passing from water to glass.

(d) $\sin^{-1}(8/9)$ for a ray of light passing from glass to air.

16. If ${}_i\mu_j$ represents refractive index when a light ray goes from medium i to medium j, then the product ${}_2\mu_1 \times {}_3\mu_2 \times {}_4\mu_3$ is equal to

(a) ${}_3\mu_1$ (b) ${}_3\mu_2$

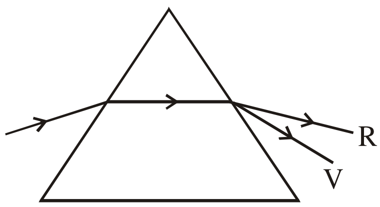
(c) $\frac{1}{{}_1\mu_4}$ (d) ${}_4\mu_2$

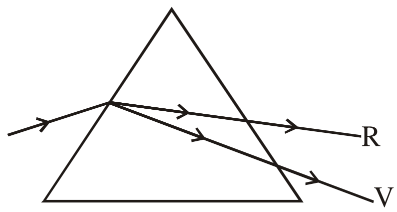
17. A ray of light is incident normally on one of the faces of a prism of apex angle 30^o and refractive index $\sqrt{2}$. The angle of deviation for the ray of light is

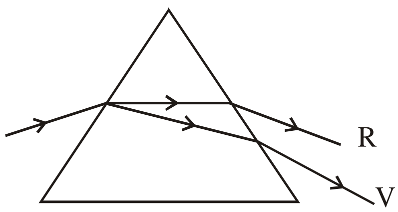
(a) 45^o (b) 30^o

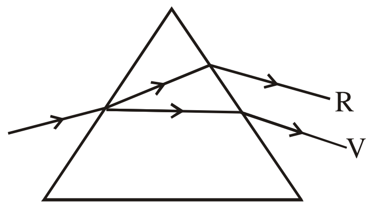
(c) 60^o (d) 15^o

18. Which of the following diagram is a correct presentation of deviation and disperision of light by prism?

(a)


(b)


(c)


(d)


19. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at a point O and PO = OQ. The distance PO is equal to

(a) 5R (b) 3R

(c) 2R (d) 1.5 R

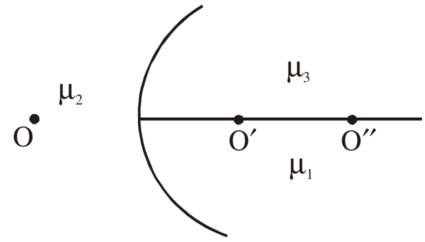
20. Figure shows three transparent media of refractive indices μ_1, μ_2 and μ_3. A point object O is placed in the medium of refractive index μ_2. If the entire medium on the right of the spherical surface has refractive index μ_1, the image forms at O′. If this entire medium has refractive index μ_3, the image forms at O″. In the situation shown

(a) the image forms between O′ and O″

(b) the image forms to the left of O′

(c) the image forms to the right of O″

(d) two images are formed, one at O′ and other at O″



21. There is an equiconvex glass lens with radius of curvature of each face as R and ${}_a\mu_g = \frac{3}{2}$ and ${}_a\mu_\omega = \frac{4}{3}$. If there is water in object space and air in image space, then the focal length of lens is

(a) 2R (b) R

(c) $\frac{3}{2}R$ (d) R^2

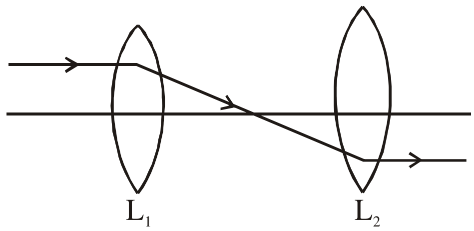
22. In the figure given below there are two convex lens L_1 and L_2 having focal lengths F_1 and F_2 respectively. The distance between L_1 and L_2 will be

(a) F_1

(b) F_2

(c) $F_1 + F_2$

(d) $F_1 - F_2$



23. A symmetrical convex lens is floated on mercury. It is found that if a pin is held horizontally at a height of 25 cm above the lens, the image of the pin formed by reflection from the lower surface of the lens shows no parallax with the pin itself. If μ for lens is 1.5, the focal length of the lens is

(a) 50 cm (b) 25 cm

(c) 37.5 cm (d) 16.67 cm

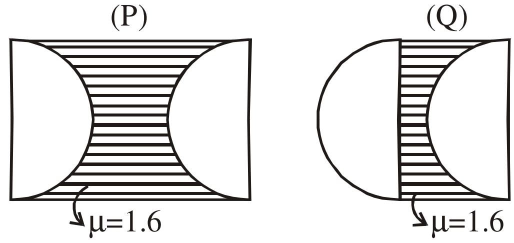
24. A liquid of refractive index 1.6 is introduced between two identical plano-convex lenses in two ways P and Q as shown in the figure. If the lens material has refractive index 1.5, the combination is

(a) convergent in both

(b) divergent in both

(c) convergent in Q only

(d) convergent in P only



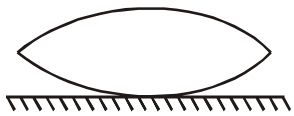
25. A convex lens is placed in contact with a mirror as shown. If the space between them is filled with water, its power

(a) decreases

(b) increases

(c) remains unchanged

(d) can increase or decrease depending on the focal length



26. The focal length of a convex lens is 30cm and the size of the image is half of the object. The object distance is

(a) 60 cm (b) 90 cm

(c) 30 cm (d) 40 cm

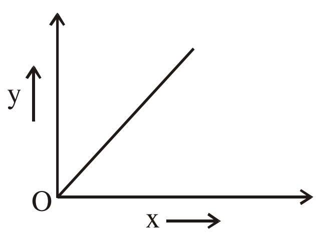
27. A lens is placed between a source of light and a wall. It forms images of area A_1 and A_2 on the wall, for its two different positions, the area of source is

(a) $\frac{A_1 + A_2}{2}$ (b) $\sqrt{A_1 A_2}$

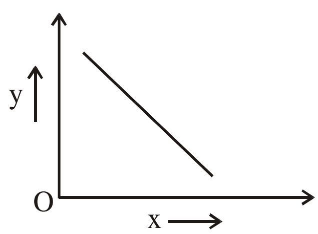
(c) $\left[\frac{1}{A_1} + \frac{1}{A_2}\right]^{-1}$ (d) $\left[\frac{\sqrt{A_1} + \sqrt{A_2}}{2}\right]^2$

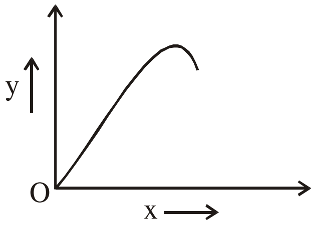
28. The distance y of the real image formed by convex lens is measured for various object distance x. A graph is plotted between y and x. Which one of the following graph is correct?

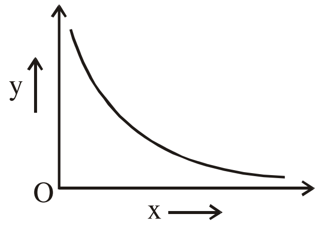
(a)



(b)



(c) 

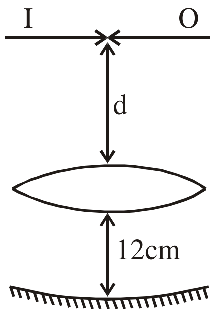
(d) 

29. The greatest thickness of a plano convex glass lens appears to be 2cm. When observed normally through the plane face, and when observation is taken through the curved face the greatest thickness appears to be $\frac{20}{9}$ cm. If real thickness is 3cm then the refractive index of glass is

(a) 1.35 (b) 1.50

(c) 1.11 (d) 1.20

30. A convex lens of focal length 40cm is held co-axially and 12cm above a concave mirror of focal length 18cm. A luminous point object placed at d cm above the lens on its axis gives rise to an image coincident with itself. Then d is equal to



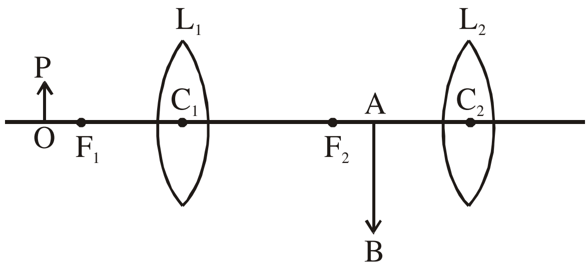
(a) 15 cm

(b) 18 cm

(c) 40 cm

(d) 30cm

31. Two convex lenses L_1 and L_2 are coaxially placed with respect to each other as shown in the adjoining figure which also shows the position F_1 and F_2 of their focal points. An object OP placed in front of the lens L_1 forms an image AB closed to F_2 between C_2F_2. The final image as seen by the eye will be



(a) inverted and formed beyond the object at a distance greater than C_1C_2

(b) inverted and formed at infinity

(c) erect and formed between C_1 and C_2

(d) inverted and formed between C_1 and C_2

32. An astronomical telescope has two lenses of power 0.5D and 20D. Its magnifying power will be

(a) 40 (b) 10

(c) 100 (d) 35

33. A compound microscope has a magnification 95. The focal length of the objective is $\frac{1}{4}$cm. If the object is $\frac{1}{3.8}$cm from the objective, the magnification of eyepiece is

(a) 5 (b) 10

(c) 38 (d) 19

34. The resolving power of a telescope can be increased if we

(a) decrease the focal length of the objective

(b) increase the focal length of the objective

(c) decrease the aperture diameter of the objective

(d) increase the aperture diameter of the objective

35. The angular magnification of a telescope which contains an objective of focal length f_1 and eyepiece of focal length f_2 is

(a) $\frac{f_2}{f_1}$ (b) $\frac{f_1 + f_2}{2}$

(c) $\frac{f_1}{f_2}$ (d) $\frac{f_1 f_2}{f_1 + f_2}$

36. When light wave suffers reflection at the interface from air to glass, the change in phase of the reflected wave is equal to

(a) 0 (b) $\frac{\pi}{2}$

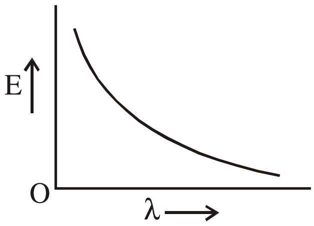
(c) π (d) 2π

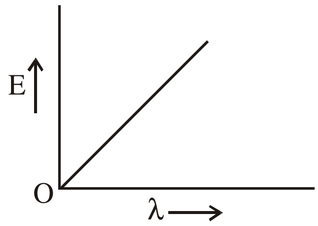
37. Two coherent waves are represented by $y_1 = a_1 \cos\omega t$ and $y_2 = a_2 \sin\omega t$. The resultant intensity due to interference will be

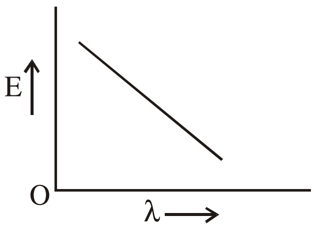
(a) $(a_1 + a_2)$ (b) $(a_1 - a_2)$

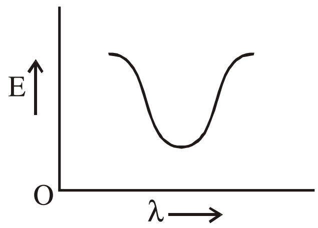
(c) $(a_1^2 + a_2^2)$ (d) $(a_1^2 - a_2^2)$

38. The correct curve between the energy of photon (E) and its wave length (λ) is

(a) 

(b) 

(c) 

(d) 

39. In Young's double slit experiment the width of the two slits are not equal. The amplitude of the waves are in the ratio 3 : 1, the ratio of the amplitudes at the maxima and minima in interference pattern is

(a) 3 : 2 (b) 2 : 3

(c) 4 : 1 (d) 1 : 4

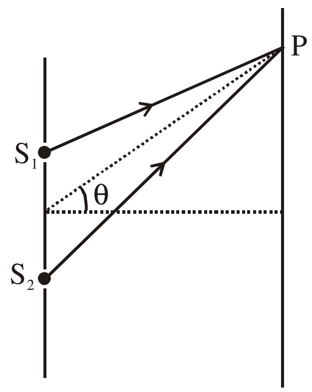
40. Two coherent sources emitting light of wave length λ and $\frac{\lambda}{4}$ apart. I_0 is the intensity due to either of the two sources. The intensity at a point in a direction making an angle θ as shown in figure.

(a) $4I_0 \cos^2 \frac{\theta}{2}$

(b) $4I_0 \cos^2 \theta$

(c) $4I_0 \cos^2 \left(\frac{\pi}{4} \sin\theta\right)$

(d) $4I_0 \cos^2 \left(\frac{\pi}{2} \sin\theta\right)$



41. The Young's double slits experiment is performed with blue and green light of wavelengths 4360A° and 5460A° respectively. If x is the distance of 4th maxima from the central one, then

(a) x (blue) = x (green)

(b) x (blue) > x (green)

(c) x (blue) < x (green)

(d) $\frac{x\,(blue)}{x\,(green)} = \frac{5460}{4360}$

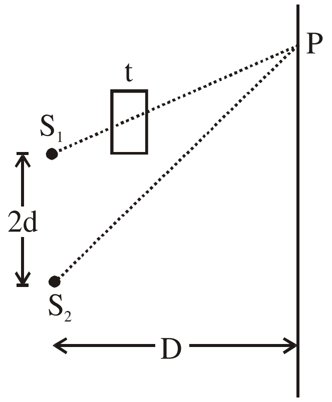
42. If a thin mica sheet of thickness t and refractive index μ = (5/3) is placed in the path of one of the interfering beams as shown in the figure, then displacement of the fringe system is

(a) $\frac{Dt}{3d}$

(b) $\frac{Dt}{5d}$

(c) $\frac{Dt}{4d}$

(d) $\frac{2Dt}{5d}$



43. In Young's double slit interference experiment if the slit separation is made 3 folds, the fringe width becomes

(a) 6 fold

(b) 3 fold

(c) $\frac{3}{6}$ fold

(d) $\frac{1}{3}$ fold

44. In Young's double slit experiment, the intensity of central maxima is I_0. If one slit is closed, the intensity at same site is

(a) I_0

(b) $\frac{I_0}{16}$

(c) $\frac{I_0}{4}$

(d) $\frac{I_0}{2}$

45. The penetration of light into the region of geometrical shadow is called

(a) polarisation

(b) interference

(c) diffraction

(d) refraction

46. The first diffraction minima due to a single slit diffraction is at θ = 30° for a light of wavelength 500 $\mathring{A}$. The width of the slit is

(a) 5×10^{-5} cm (b) 1×10^{-5} cm

(c) 2.5×10^{-5} cm (d) 1.25×10^{-5} cm

47. The Fraunhoffer diffraction pattern of a single slit is formed in the focal plane of a lens of focal length 1m. The width of slit is 0.3mm. If third minimum is formed at a distance of 5 mm from central maximum, then wavelength of light will be

(a) $5000\,\mathring{A}$ (b) $2500\,\mathring{A}$

(c) $7500\,\mathring{A}$ (d) $8500\,\mathring{A}$

48. The aperture of the largest telescope in the world is 5m. If the separation between the moon and the earth is 4×10^5 km and wavelength of visible light is $5000\,\mathring{A}$ then the minimum separation between objects on the surface of moon which can be just resolved is nearly equal to

(a) 1m (b) 10m

(c) 50m (d) 200m

49. A screen is placed at a certain distance from a narrow slit which is illuminated by a parallel beam of monochromatic light. If the wavelength of light used in the experiment is λ and d is the width of the slit, then angular width of central maximum will be

(a) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ (b) $2\sin^{-1}\left(\frac{\lambda}{d}\right)$

(c) $\sin^{-1}\left(\frac{2\lambda}{d}\right)$ (d) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

SECTION – B

1. Choose the correct statement in the following

(a) The virtual image formed in a plane mirror can be photographed.

(b) Given a point source of light, a convex mirror can produce a parallel beam of light.

(c) Concave mirror can give diminished virtual image.

(d) An object situated at the principal focus of a concave lens will have its image formed at infinity

2. A ray reflected successively from two plane mirrors inclined at a certain angle undergoes a deviation of 300^o. Then the number of images observed are

(a) 60 (b) 12

(c) 11 (d) 5

3. Two mirrors are kept at 60^o to each other and a body is placed at middle. The total number of images formed is

(a) six (b) four

(c) five (d) three

4. The speed of light in air is 3×10^8 m/s. What will be its speed in diamond whose refractive index is 2.4 ?

(a) 3×10^8 m/s (b) 332 m/s

(c) 1.25×10^8 m/s (d) 7.2×10^8 m/s

5. In a concave mirror an object is placed at a distance x from the focus, and the image is formed at a distance y from the focus. The focal length of the mirror is

(a) xy (b) $\sqrt{xy}$

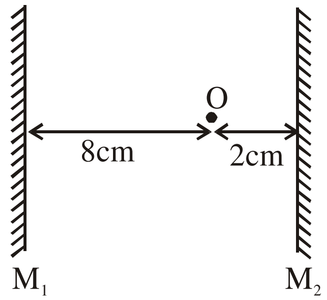
(c) $\frac{x+y}{2}$ (d) $\sqrt{\frac{x}{y}}$

6. A perfectly reflecting mirror has an area of 1 cm^2. Light energy is allowed to fall on it for one hour at the rate of 10 W/cm^2. The force that act on the mirror is

(a) 3.35×10^{-8}N (b) 6.7×10^{-8} N

(c) 3.35×10^{-7} N (d) 6.7×10^{-7} N

7. Figure below shows two plane mirrors and an object O placed between them. What will be distance of the first three images from the mirror M_2



(a) 2 cm, 8 cm, 14 cm

(b) 2 cm, 12 cm, 18 cm

(c) 2 cm, 18 cm, 22 cm

(d) 2 cm, 24 cm, 38 cm

8. Critical angle for total internal reflection will be smallest for light travelling from

(a) water to glass (b) glass to air

(c) glass to water (d) water to air

9. A double convex lens of refractive index μ_1 is immersed in a liquid of refractive index μ_2. This lens will act as

(a) diverging lens if $\mu_1 > \mu_2$ (b) diverging lens if $\mu_1 < \mu_2$

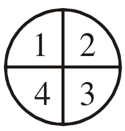
(c) converging lens if $\mu_1 = \mu_2$ (d) converging lens if $\mu_1 < \mu_2$

10. A lens is formed by pressing mutually the plane faces of two identical plano convex lenses each of focal length 40 cm. It is used to obtain a real inverted image of the same size as the object. The object is placed from the lens at a distance of

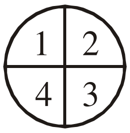
(a) 80 cm (b) 40 cm

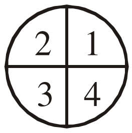
(c) 20 cm (d) 160 cm

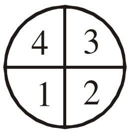
11. A convex lens is used to form a real image of the object shown in the following figure

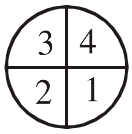


Then the real inverted image is as shown in the following figure

(a) 

(b) 

(c) 

(d) 

12. In a plano-convex lens the radius of curvature of its convex surface is 10cm and its focal length is 30 cm. The refractive index of a substance of which the lens is made is

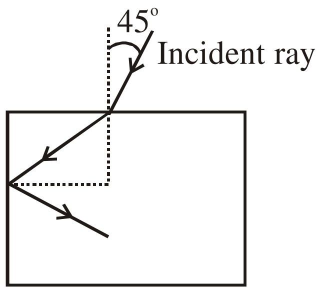
(a) 1.55 (b) 1.66

(c) 1.33 (d) 3.6

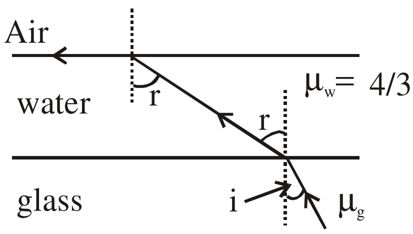
13. For the given incident ray as shown in the figure, for the condition of total internal reflection of this ray, the required refractive index of prism will be

(a) $\frac{\sqrt{3}+1}{2}$ (b) $\frac{\sqrt{2}+1}{\sqrt{2}}$

(c) $\sqrt{\frac{3}{2}}$ (d) $\sqrt{\frac{7}{6}}$



14. A ray of light is incident at the glass-water interface at an angle i as shown in the figure



It imerges finally parallel to the surface of water, then the value of μ_g will be

(a) 1 (b) sin i

(c) $\frac{1}{\sin i}$ (d) $\frac{4}{3}\sin i$

15. A plano-convex lens of focal length 20 cm silvered at plane surface. Now the focal length will be ($\mu = 1.5$)

(a) 20 cm (b) 40 cm

(c) 30 cm (d) 10 cm

16. Light travels through a glass plate of thickness t and having refractive index n. If c is the velocity of light in vacuum, the time taken by the light to travel this thickness of glass is

(a) $\frac{t}{nc}$ (b) t n c

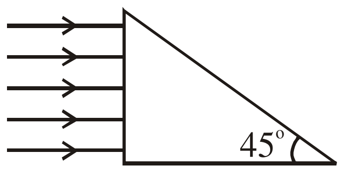
(c) $\frac{nt}{c}$ (d) $\frac{tc}{n}$

17. The maximum value of index of refraction of a material of prism which allows the passage of light through it when the refracting angle of the prism is A is

(a) $\sqrt{1+\sin\left(\frac{A}{2}\right)}$ (b) $\sqrt{1+\cos\left(\frac{A}{2}\right)}$

(c) $\sqrt{1+\tan^2\left(\frac{A}{2}\right)}$ (d) $\sqrt{1+\cot^2\left(\frac{A}{2}\right)}$

18. A beam of light consisting of red, green and blue colours is incident on an isosceles right angled prism as shown in the figure. The refractive indices of the material of the prism for red, green and blue colours are 1.39, 1.43 and 1.47 respectively. The prism will be



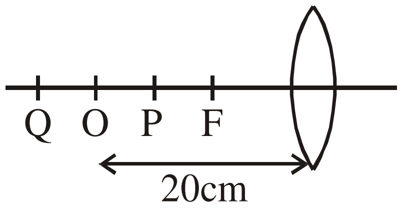
(a) separate red colour from green and blue colours

(b) separate blue colour from red and green colours

(c) separate green colour from red and blue colours

(d) separate all the three colours from one another.

19. A needle 10 cm long is placed along the axis of a convex lens of focal length 10 cm such that the middle point of the needle is at 20 cm distance from the lens. The length of the image of needle is



(a) 13.33 cm (b) 20 cm

(c) 1 cm (d) 10 cm

20. A bulb is situated at the base of a swimming pool of depth 10 m. If the refractive index of water is 1.33 then surface area of water illuminated will be

(a) 300 m^2 (b) 404 m^2

(c) 150 m^2 (d) 270 m^2

21. The diameter of a plano convex lens is 6 cm and thickness at the centre is 3 mm. The speed of the light in the material of the lens is 2×10^8 m/s. Focal length of the lens is

(a) 10 cm (b) 20 cm

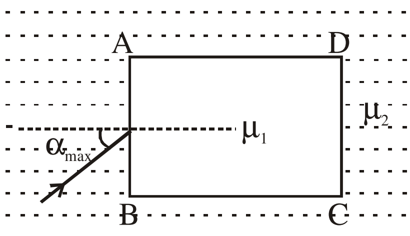
(c) 15 cm (d) 30 cm

22. The diameter of the moon is 3.5×10^3 km and its distance from the earth is 3.8×10^5 km. It is seen by a telescope having the focal lengths of the objective and the eyepiece as 4m and 10 cm respectively. The diameter of the image of the moon will be approximately

(a) 2^o (b) 20^o

(c) 40^o (d) 50^o

23. A rectangular glass slab ABCD of refractive index μ_1 is immersed in water of refractive index μ_2 ($\mu_1 > \mu_2$). A ray of light is incident at the surface AB of the slab as shown in the figure. The maximum value of angle of incidence α_{max} such that the ray comes out only from the other surface CD is given



(a) $\sin^{-1}\left[\frac{\mu_1}{\mu_2}\cos\left\{\sin^{-1}\left(\frac{\mu_2}{\mu_1}\right)\right\}\right]$ (b) $\sin^{-1}\left[\mu_1\cos\left\{\sin^{-1}\left(\frac{1}{\mu_2}\right)\right\}\right]$

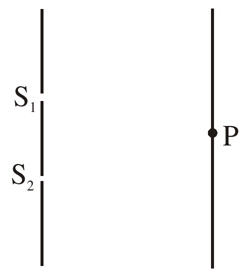
(c) $\sin^{-1}\left(\frac{\mu_1}{\mu_2}\right)$ (d) $\sin^{-1}\left(\frac{\mu_2}{\mu_1}\right)$

24. Monochromatic green light of wavelength 5×10^{-7}m, illuminates a pair of slits, 1mm apart. The separation of bright lines on the interference pattern formed on the screen 2 m away is

(a) 0.25 mm (b) 0.1 mm

(c) 1.0 mm (d) 0.01 mm

25. Coherent light is incident on two fine parallel slits S_1 and S_2 as shown in the figure. A dark fringe occurs at P. When the phase difference between the waves from S_1 and S_2 is (n being an integer)



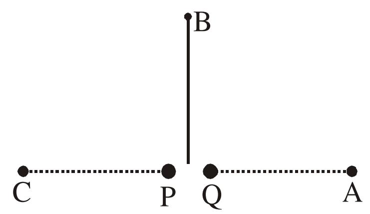
(a) $\left(n + \frac{1}{2}\right)\pi$ rad

(b) $2n\pi$ rad

(c) $\left(2n + \frac{1}{2}\right)\pi$ rad

(d) $(2n + 1)\pi$ rad

26. In the given figure below, P and Q are two equally intense coherent sources emitting radiations of wavelength 20m. The separation between P and Q is 5.0m and phase of P is ahead of the phase of Q by 90°. A, B and C are three distant points of observation, equidistant from the mid point of PQ. The intensity of radiation at A, B and C will bear the ratio



(a) 0 : 1 : 4

(b) 4 : 1 : 0

(c) 0 : 1 : 2

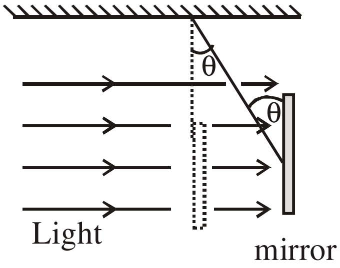
(d) 2 : 1 : 0

27. A small mirror of area of *a* and mass *m* is suspended by means of massless thread in vertical plane. When a beam of light of intensity I is made incident normally on this mirror it gets displaced so that the thread makes angle θ with the vertical. Assume the mirror is perfectly reflecting the value of θ is

Punjab Edusat Society

(a) $\frac{2Im}{cag}$ (b) $\frac{2Ic}{mag}$

(c) $\frac{2Ig}{mca}$ (d) $\frac{2Ia}{cmg}$



28. Two waves $y_1 = A_1 \sin(\omega t - \beta_1)$ and $y_2 = A_2 \sin(\omega t - \beta_2)$ superimpose to form a resultant wave whose amplitude is

(a) $[A_1^2 + A_2^2 + 2A_1A_2 \cos(\beta_1 - \beta_2)]^{1/2}$

(b) $[A_1^2 + A_2^2 + 2A_1A_2 \sin(\beta_1 - \beta_2)]^{1/2}$

(c) $(A_1 - A_2)$

(d) $(A_1 + A_2)$

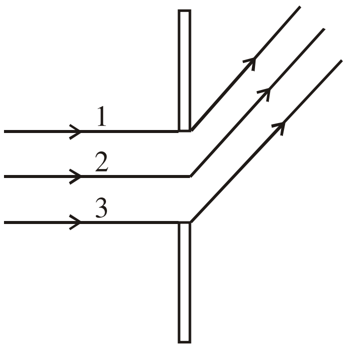
29. The figure shows Fraunhoffer's diffraction due to a single slit. If first minimum is obtained in the direction shown then the path difference between ray 1 and 3 is

(a) 0

(b) $\frac{\lambda}{4}$

(c) $\frac{\lambda}{2}$

(d) λ



30. Which one of the following phenomena is not explained by Huygen's construction of wave front?

(a) Refraction (b) Reflection

(c) Diffraction (d) Origin of spectra

31. The two coherent sources of intensity ratio β interfere then ratio $\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ will be

(a) β (b) $\frac{2\beta}{\beta + 1}$

(c) $\frac{2\sqrt{\beta}}{\beta+1}$ (d) $\frac{\sqrt{\beta}}{\beta+1}$

32. Wavelength of light recieved from the far off star is 0.5% more than that coming from a source on the earth. The velocity of the star is

(a) 1.5×10^8 m/s (b) 3×10^8 m/s

(c) 1.5×10^6 m/s (d) 1.5×10^{10} m/s

33. Four different independent waves are represented by

(i) $y_1 = a_1 \sin \omega t$

(ii) $y_2 = a_2 \sin 2\omega t$

(iii) $y_3 = a_3 \cos \omega t$

(iv) $y_4 = a_4 \sin\left(\omega t + \frac{\pi}{3}\right)$

with which two waves interference is possible

(a) in (i) and (ii) (b) in (i) and (iv)

(c) in (iii) and (iv) (d) not possible with any combination

34. In the Young's double slit experiment the interference pattern is found to have an intensity ratio between bright and dark fringes as 9. This implies that

(a) the intensities at the screen due to the two slits are 5 units and 4 units respectively

(b) the intensity at the screen due to the two slits are 4 units and 1 unit respectively

(c) the amplitude ratio is 3

(d) the amplitude ratio is 5

35. Light of wavelength λ is incident on a slit of width d. The resulting diffraction pattern is observed on a screen at a distance D. The linear width of the principal maximum is then equal to the width of the slit if D equals

(a) $\frac{d}{\lambda}$ (b) $\frac{2\lambda}{d}$

(c) $\frac{d^2}{2\lambda}$ (d) $\frac{2\lambda^2}{d}$

36. A screen is placed at a certain distance from a narrow slit which is illuminated by a parallel beam of monochromatic light. If the wavelength of light used in the

experiment is λ and d is the width of the slit, then angular width of central maximum will be

(a) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ (b) $2\sin^{-1}\left(\frac{\lambda}{d}\right)$

(c) $\sin^{-1}\left(\frac{2\lambda}{d}\right)$ (d) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

37. Three waves of equal frequency having amplitudes 10µm, 4µm, 7µm arrive at a given point with successive phase difference of $\frac{\pi}{2}$, the amplitude of the resulting wave in µm is given by

(a) 4 (b) 5

(c) 6 (d) 7

38. In Young's double slit experiment using sodium light (λ = 5898 $\mathring{A}$), 92 fringes are seen. If given colour (λ = 5461) is used, how many fringes will be seen

(a) 62 (b) 67

(c) 85 (d) 99

39. The ratio of intensities of consecutive maxima in the diffraction pattern due to single slit is

(a) 1 : 4 : 9 (b) 1 : 2 : 3

(c) $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$ (d) $1:\frac{4}{\pi^2}:\frac{9}{\pi^2}$

40. Path difference between two interfering waves at a point on the screen is $\frac{\lambda}{8}$. The ratio of intensity at this point and that at the central fringe will be

(a) 0.853 (b) 8.53

(c) 85.3 (d) 853

41. Air has refractive index 1.0003. The thickness of air column, which will have one more wavelength of yellow light (6000 $\mathring{A}$) than in the same thickness of vacuum is

(a) 2 mm (b) 2 cm

(c) 2m (d) 2 km

42. Interference takes place due to change in

(a) phase difference (b) amplitude

(c) velocity (d) intensity

SECTION – C

1. A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen

(a) half the image will disappear (b) complete image will be formed

(c) intensity of image will increase (d) intensity of image will decrease

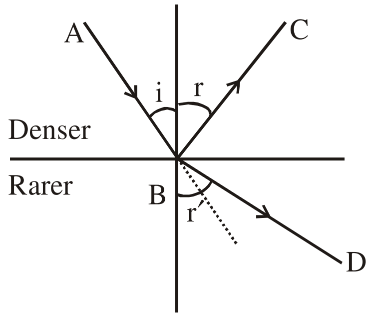
2. A ray of light from denser medium strikes a rarer medium at an angle of incidence i as shown in the figure. The reflected and refracted rays make an angle 90^o with each other. The angles of reflection and refraction are r and r′. The critical angle is

(a) $\sin^{-1}(\tan r)$

(b) $\sin^{-1}(\tan i)$

(c) $\sin^{-1}(\tan r')$

(d) $\tan^{-1}(\tan i)$



3. The focal length of a plano-convex lens is 20 cm. Its plane side is silvered. Mark correct statement/s

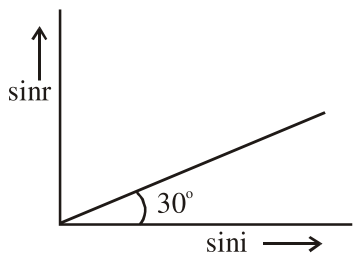
(a) An object placed at 15 cm on the axis with the convex side gives rise to an image at a distance of 30 cm from it.

(b) An object placed at 20 cm on the axis with the convex side gives rise to an image at a distance of 40 cm from it.

(c) It acts as a convex mirror.

(d) It acts as a concave mirror.

4. When light is incident on a medium at an angle i and refracted into a second medium at an angle r, the graph of sin i versus sin r is as shown. From this one can conclude that



(a) the velocity of light in second medium is $\sqrt{3}$ times the velocity of light in the first medium.

(b) the velocity of light in the first medium is $\sqrt{3}$ times the velocity of light in second medium.

(c) the critical angle of the two media is given by $\sin i_c = \frac{1}{\sqrt{3}}$

(d) the critical angle of the two media is given by $\sin i_c = \frac{1}{\sqrt{2}}$

5. The image of an extended object, placed perpendicular to the principle axis of a mirror will be erect if

(a) the object and the image both are real.

(b) the object and the image both are virtual.

(c) the object is real but the image is virtual.

(d) the object is virtual but the image is real.

6. A hollow double convex lens is made of very thin transparent material. It can be filled with air or either of the two liquids L_1 or L_2 having refractive index μ_1 and μ_2 respectively ($\mu_2 > \mu_1 > 1$). The lens will diverge a parallel beam of light if it is filled with

(a) air and placed in air

(b) air and immersed in L_1

(c) L_1 and immersed in L_2

(b) L_2 and immersed in L_1

7. A thin concavo – convex lens has two surfaces of radii of curvature R and 2R. The material of the lens has a refractive index μ. When kept in air, the focal length of the lens

(a) will depend on the direction from which light is incident on it.

(b) will be same, irrespective of the direction from which light is incident on it.

(c) will be equal to $\frac{R}{\mu - 1}$

(d) will be equal to $\frac{2R}{\mu - 1}$

8. A double convex lens of refractive index μ_1 is immersed in a liquid of refractive index μ_2. This lens will act as

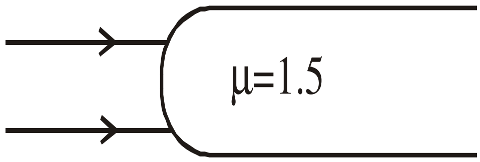
(a) diverging lens if $\mu_1 > \mu_2$

(b) diverging lens if $\mu_1 < \mu_2$

(c) converging lens if $\mu_1 > \mu_2$

(d) converging lens if $\mu_1 < \mu_2$

9. Parallel rays of light are falling on convex spherical surface of radius of curvature R = 20 cm as shown in the figure. Refractive index of the medium is μ = 1.5. After refraction from the spherical surface parallel rays



(a) actually meet at some point.

(b) appear to meet after extending the refracted rays backwards.

(c) meet (or appear to meet) at a distance of 30 cm from the spherical surface.

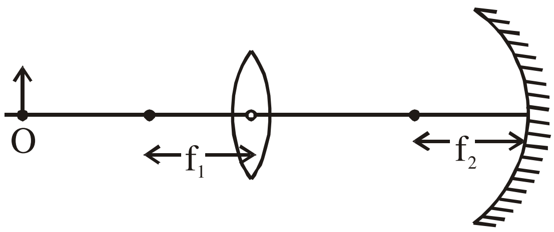
(d) meet (or appear to meet) at a distance of 60 cm from the spherical surface.

10. For which of the pairs of u and f for a mirror image is smaller in size

(a) u = –10 cm, f = 20 cm (b) u = –20 cm, f = –30 cm

(c) u = –45 cm, f = –10 cm (d) u = –60 cm, f = 30 cm

11. An object is placed in front of a converging lens at a distance equal to twice the focal length f_1 of the lens. On the other side of the lens is a concave mirror of focal length f_2 separated from the lens by a distance $2(f_1 + f_2)$. Light from the object passes rightward through the lens, reflects from the mirror, passes leftward through the lens, and forms a final image of object, then



(a) the distance between the lens and the final image is equal to $2f_1$

(b) the distance between the lens and the final image is equal to $2(f_1 + f_2)$

(c) the final image is real, inverted and of the same size as that of the object.

(d) the final image is real, erect and of same size as that of the object.

12. From a concave mirror of focal length f image is 2 times larger than the object. Then the object distance from the mirror is

(a) $\frac{f}{2}$ (b) $\frac{3f}{2}$

(c) $\frac{f}{4}$ (d) $\frac{4f}{3}$

13. For a mirror linear magnification m comes out to be +2. What conclusion can be drawn from this?

(a) Mirror is concave

(b) Mirror can be convex or concave but it can not be plane.

(c) Object lies between pole and focus.

(d) Object lies beyond focus.

14. A light ray is not deviated at the interface between two medium,

(a) if the refractive indices between the two media are equal.

(b) if the light ray is normal to the boundary.

(c) if the light ray is parallel to the boundary.

(d) all the above.

15. Identify the correct statement(s)

(a) Larger the wavelength of light in medium, greater the value of critical angle.

(b) Larger the wavelength of light in medium, smaller the value of critical angle.

(c) Larger the refractive index, greater the critical angle.

(d) Large the refractive index, smaller the critical angle.

16. Which of the following form(s) a virtual and erect image for all positions of the object?

(a) convex lens (b) concave lens

(c) convex mirror (d) concave mirror

17. A convex lens made of glass (μ_g = 3/2) has focal length f in air. The image of an object placed infront of it is inverted real and magnified. Now the whole arrangement is immersed in water (μ_w = 4/3) without changing the distance between object and lens. Then

(a) the new focal length will become 4 f

(b) the new focal length will become $\frac{f}{4}$

(c) new image will be virtual and magnified.

(d) new image will be real inverted and smaller in size.

18. The image of an object kept at a distance 20cm in front of a concave mirror is found to coincide with itself. If a glass slab (μ_g = 1.5) of thickness 3 cm is introduced between the mirror and object then in order that the final image again coincides with the object

(a) the mirror should be displaced away from the object.

(b) the mirror should be displaced towards the object.

(c) the magnitude of displacement is 1 cm.

(d) the magnitude of displacement is 0.5cm.

19. A light ray is incident at an angle i on a prism of angle A = 90^o and refractive index $\mu = \frac{3}{2}$.

(a) The light ray will not emerge out of it only if $i > 45^o$.

(b) The light ray will not emerge out of it whatever be the angle of incidence.

(c) The light ray will not emerge out of it only if the angle of incidence is more than the critical angel i.e. $i > \sin^{-1}\left(\frac{2}{3}\right)$.

(d) none of these.

20. A light ray traveling from a denser medium to a rarer medium is transmitted

(a) at all the angles

(b) only at the critical angle

(c) only at angle less than and equal to critical angle

(d) only at angle more than the critical angle

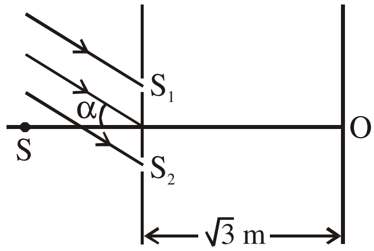
21. A parallel beam of light ($\lambda = 5000\,\overset{o}{A}$) is incident at an angle $\alpha = 30^o$ with the normal to the slit plane in a Young's double slit experiment. Assume that the intensity due to each slit at any point on the screen is I_0. Point O is equidistant from S_1 and S_2. The distance between slits is 1mm, then

(a) the intensity at O is $4I_0$

(b) the intensity at O is zero

(c) the intensity at a point on the screen 1m below O is $4I_0$

(d) the intensity at a point on the screen 1m below O is zero



22. In Young's double slit experiment, slits are arranged in such a way that besides central bright fringes, there is only one bright fringe on either side of it. Slit separation d for the given condition can not be (if λ is wavelength of the light used)

(a) λ

(b) $\frac{\lambda}{2}$

(c) 2λ

(d) $\frac{3\lambda}{2}$

23. In Young's double slit experiment, white light is used. The separation between the slits is b. The screen is at a distance d(d >> b) from the slits. Some wavelengths are missing exactly infront of one of slits. These wavelength are

(a) $\lambda = \frac{b^2}{d}$

(b) $\lambda = \frac{2b^2}{d}$

(c) $\lambda = \frac{b^2}{3d}$

(d) $\lambda = \frac{2b^2}{3d}$

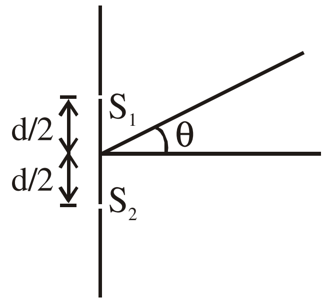
24. In an interference arrangement similar to Young's double-slit experiment, the slits S_1 and S_2 are illuminated with coherent microwave sources, each of frequency 10^6 Hz. The sources are synchronized to have zero phase difference. The slits are separated by a distance d = 150.0 m. The intensity I(θ) is measured as a function of θ, where θ is defined as shown. If I_0 is the maximum intensity, then I(θ) for $0 \le \theta \le 90^o$ is given by

(a) $I(\theta) = \frac{I_0}{2}$ for $\theta = 30^o$

(b) $I(\theta) = \frac{I_0}{4}$ for $\theta = 90^o$

(c) $I(\theta) = I_0$ for $\theta = 0^o$

(d) I(θ) is constant for all values of θ

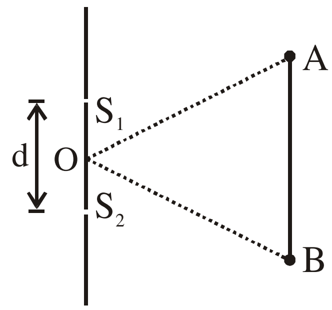


25. If the first minima in a Young's double slit experiment occurs directly in front of one of the slits, (distance between slit and screen D = 12 cm and distance between slits d = 5 cm) then the wavelength of the radiation used can be

(a) 2 cm (b) 4 cm

(c) $\frac{2}{3}$ cm (d) $\frac{4}{3}$ cm

26. Figure shows two coherent sources S_1 and S_2 vibrating in same phase. AB is an irregular wire lying at a far distance from the sources S_1 and S_2. Let $\frac{\lambda}{d} = 10^{-3}$, $\angle BOA = 0.12^o$. How many bright spots will be seen on the wire, including points A and B



(a) 2 (b) 3

(c) 4 (d) more than 4

27. Two beams of light having intensities I and 4I interfere to produce a fringe pattern on a screen. The phase difference between the beam is $\frac{\pi}{2}$ at a point A and π at point B. Then the difference between resultant intensities at A and B is

(a) 2I (b) 4I

(c) 5I (d) 7I

28. In Young's double slit experiment intensity at a point is $\frac{1}{4}$ of the maximum intensity. Angular position of this point is

(a) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ (b) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

(c) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$ (d) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

29. A monochromatic visible light consists of

(a) a single ray of light.

(b) light of a single wavelength.

(c) light of a single wavelength with all the colours of the spectrum of white light.

(d) light consisting of many wavelengths with a single colour.

30. In Young's double slit experiment using light of wavelength $5800\,\overset{o}{A}$, the angular width of a fringe formed on a distant screen is 1^o. The angular width will be

(a) increased if λ increases

(b) increased if distance of the screen from the slits increases

(c) remain the same if slit separation increases

(d) The slit separation is 3.32×10^{-5} m.

SECTION – A

1.	(c)	2.	(a)	3.	(b)
4.	(d)	5.	(b)	6.	(a)
7.	(d)	8.	(a)	9.	(c)
10.	(a)	11.	(b)	12.	(c)
13.	(c)	14.	(a)	15.	(a)
16.	(c)	17.	(d)	18.	(c)
19.	(a)	20.	(d)	21.	(c)
22.	(c)	23.	(a)	24.	(c)
25.	(b)	26.	(b)	27.	(b)
28.	(d)	29.	(b)	30.	(a)
31.	(d)	32.	(a)	33.	(a)
34.	(d)	35.	(c)	36.	(c)
37.	(c)	38.	(a)	39.	(c)
40.	(c)	41.	(c)	42.	(a)
43.	(d)	44.	(c)	45.	(c)
46.	(b)	47.	(a)	48.	(c)
49.	(b)				

SECTION – B

1.	(a)	2.	(c)	3.	(c)
4.	(c)	5.	(b)	6.	(a)
7.	(c)	8.	(b)	9.	(b)
10.	(b)	11.	(d)	12.	(c)
13.	(b)	14.	(c)	15.	(c)
16.	(c)	17.	(d)	18.	(a)

19.	(a)	20.	(b)	21.	(d)
22.	(b)	23.	(a)	24.	(c)
25.	(d)	26.	(d)	27.	(d)
28.	(a)	29.	(d)	30.	(d)
31.	(c)	32.	(c)	33.	(c)
34.	(d)	35.	(b)	36.	(c)
37.	(b)	38.	(b)	39.	(d)
40.	(c)	41.	(a)	42.	(a)
43.	(a)				

SECTION – C

1.	(b,d)	2.	(a,b)	3.	(a,d)
4.	(b,c)	5.	(c,d)	6.	(b,c)
7.	(b,d)	8.	(b,c)	9.	(a,d)
10.	(a,c,d)	11.	(b,c)	12.	(a,b)
13.	(a,c)	14.	(a,b)	15.	(a,d)
16.	(b,c)	17.	(a,c)	18.	(a,c)
19.	(b)	20.	(c)	21.	(a,c)
22.	(b)	23.	(a,c)	24.	(a,c)
25.	(a)	26.	(b)	27.	(b)
28.	(c)	29.	(b)	30.	(a,d)

Simple Harmonic Motion

1. The graph between restoring force and time in case of simple harmonic motion is

(a) a straight line (b) a circle

(c) a parabola (d) a sine curve

2. The angle between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is

(a) zero (b) $\frac{\pi}{2}$

(c) π (d) zero or π

3. In simple harmonic motion the particle is

(a) always accelerated (b) always retarded

(c) alternately accelerated and retarded (d) neither accelerated nor retarded

4. If E is the total energy of a particle executing simple harmonic motion and A be the amplitude of the vibratory motion, then E and A are related as

(a) $E \alpha A$ (b) $E \alpha \frac{1}{A}$

(c) $E \alpha A^2$ (d) $E \alpha \frac{1}{A^2}$

5. A mass of 1 kg is suspended from a spring. Its time period of oscillation on earth is T. What will be its time period at the centre of the earth?

(a) zero (b) T

(c) 2T (d) Infinity

6. A mass is attached to a vertically held light spring. The spring extends by 1 mm due to the weight of the mass. the time period (in sec) of oscillation of the mass will be

(a) 1 (b) π

(c) 2π (d) none of these

7. The dimensions of mass/force constant is

(a) time (b) $(\text{time})^2$

(c) acceleration (d) $\frac{1}{\text{acceleration}}$

8. What is the number of degrees of freedom of an oscillating pendulum?

(a) One (b) Two

(c) Three (d) More than three

9. The force constant of a simple pendulum is

(a) directly proportional to the mass of the bob

(b) directly proportional to the length of the pendulum

(c) inversely proportional to both mass of bob and length of pendulum

(d) independent of mass of bob as well as length of pendulum

10. The phase angle between the projections of uniform circular motion on two mutually perpendicular diameters is

(a) zero (b) $\frac{\pi}{2}$

(c) $\frac{3\pi}{4}$ (d) π

11. In simple harmonic motion the acceleration of the particle is zero when its

(a) velocity is zero

(b) displacement is zero

(c) both velocity and displacement are zero

(d) both velocity and displacement are maximum

12. In simple harmonic motion, the variation of which of the following is not a sine curve?

(a) displacement (b) velocity

(c) acceleration (d) time period

13. A particle executing a vibratory motion while passing through the mean position has

(a) maximum potential energy and minimum kinetic energy

(b) maximum potential energy and maximum kinetic energy

(c) maximum kinetic energy and minimum potential energy

(d) minimum kinetic energy and minimum potential energy

14. A simple pendulum of period T has a metal bob which is negatively charged. If it is allowed to oscillate above a positively charged plate, its period

(a) remains same (b) decreases

(c) increases (d) it will not vibrate

15. A particle is moving in a circle with uniform speed. Its motion is

(a) periodic and simple harmonic motion

(b) periodic but not simple harmonic motion

(c) a periodic

(d) none of these

16. A mass m oscillates with simple harmonic motion with a frequency $f = \frac{\omega}{2\pi}$ and amplitude A on a spring with constant k. Therefore

(a) the total energy of the system is $1/2\ kA^2$

(b) the frequency is $\frac{1}{2\pi}\left(\frac{k}{m}\right)^{1/2}$

(c) the maximum velocity occurs when $x = 0$

(d) all the above are correct

17. A particle moves so that its acceleration 'a' is given by $a = bx$ where x is displacement from equilibrium and b is a constant. The period of oscillation is

(a) $2\pi\sqrt{6}$ (b) $\frac{2\pi}{\sqrt{6}}$

(c) $\frac{2\pi}{b}$ (d) $2\left(\frac{\pi}{b}\right)^{1/2}$

18. A watch based on an oscillating spring is taken to the moon. It will

(a) become slow (b) become fast

(c) give the same time as on earth (d) none of these

19. If a hole is bored along the diameter of the earth and a stone is dropped into the hole

(a) stone reaches the centre of the earth and stops there

(b) stone reaches the other side of the earth and stops there

(c) stone executes simple harmonic motion about the centre of the earth

(d) stone reaches the other side of the earth and escapes into space

20. A pendulum suspended from the ceiling of a train has a period T when the train is at rest. When the train is accelerating with uniform acceleration, T will

(a) increase (b) decrease

(c) remain unaffected (d) become infinite

21. A body of mass 5 gm is executing simple harmonic motion about a point with amplitude of 10 cm. Its maximum velocity is 100 cm/sec. Its velocity will be 50 cm/sec at a distance

(a) 5 (b) $5\sqrt{2}$

(c) $5\sqrt{3}$ (d) $10\sqrt{2}$

22. The time period of a second's pendulum is 2 sec. The spherical bob which is empty from inside has a mass of 50 gm. This is now replaced by another solid bob of same radius but having a different mass of 100 gm. The new time period will be

(a) 4 sec (b) 1 sec

(c) 2 sec (d) 8 sec

23. The equation of motion of a particle is $\frac{d^2y}{dt^2} + ky = 0$ where k is a positive constant. The time period of motion is given by

(a) $\frac{2\pi}{k}$ (b) $2\pi k$

(c) $\frac{2\pi}{\sqrt{k}}$ (d) $2\pi\sqrt{k}$

24. A particle of mass m is hanging vertically by an ideal spring of force constant 'k'. If the mass is made to oscillate vertically its total energy is

(a) maximum at extreme position (b) maximum near equilibrium

(c) minimum at near equilibrium (d) same at all positions

25. A mass m is suspended from a string of length 1 and force constant k. The frequency of vibration of the mass is f_1. The spring is cut into two equal parts and the same mass is suspended from one of the parts. The new frequency of vibration of mass is f_2. Which of the following relation between frequencies is correct?

(a) $f_2 = \frac{f_1}{\sqrt{2}}$ (b) $f_1 = f_2$

(c) $f_1 = 2f_2$ (d) $f_2 = \sqrt{2}\, f_1$

26. A man measures the period of a simple pendulum inside a stationary lift and finds it to be T sec. If the lift accelerates upwards with an acceleration of g/4 then the period of the pendulum will be

(a) T (b) T/4

(c) $\frac{2T}{\sqrt{5}}$ (d) $2T\sqrt{5}$

27. A simple harmonic oscillator has a period of 0.01 sec and an amplitude of 0.2 m. The magnitude of the velocity in m/sec at the centre of oscillation is

(a) 20π (b) 100

(c) 40π (d) 100π

28. A mass at the end of a spring undergoes simple harmonic motion with frequency of 0.5 Hz. If the attached mass is reduced to one quarter of its value, the new frequency in Hz is

(a) 0.25 (b) 1

(c) 2 (d) 4.5

29. A simple pendulum is suspended from the ceiling of a train. When the train moves with a constant acceleration 'a' the direction of the strap from the vertical is

(a) 0^o (b) $\tan^{-1}\left(\frac{a}{g}\right)$

(c) $\sin^{-1}\left(\frac{a}{g}\right)$ (d) $\cos^{-1}\left(\frac{a}{g}\right)$

30. The work done by the string of a simple pendulum during one complete oscillation is equal to

(a) Total energy of the pendulum (b) Kinetic energy of the pendulum

(c) Potential energy of the pendulum (d) Zero

31. A simple pendulum is suspended from the roof of the train which is moving with an acceleration of 49 cm/sec^2. By what angle to the vertical its string will be inclined?

(a) 20^o (b) 30^o

(c) 0^o (d) 3^o

32. A mass m is suspended from the two coupled springs connected in series. The force constants for the springs are k_1 and k_2. The time period will be

(a) $T = 2\pi\left(\frac{m}{k_1 - k_2}\right)^{1/2}$ (b) $T = 2\pi\left(\frac{m}{k_1 + k_2}\right)^{1/2}$

(c) $T = 2\pi\left(\frac{m(k_1 + k_2)}{k_1 k_2}\right)^{1/2}$ (d) $T = 2\pi\left(\frac{m k_1 k_2}{k_1 + k_2}\right)^{1/2}$

33. A particle executes simple harmonic motion with a period of 6 sec and amplitude of 3 cm. Its maximum speed in cm/s is

(a) $\frac{\pi}{2}$ (b) π

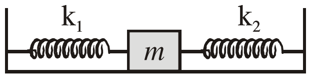
(c) 2π (d) 3π

34. The amplitude of vibration of a particle is given by am = $a_0(a\omega^2 - b\omega + c)$ where a_0, a, b and c are positive. The condition for a single resonant frequency is

(a) $b^2 < 4ac$ (b) $b^2 > 4ac$

(c) $b^2 = 5ac$ (d) $b^2 = 4ac$

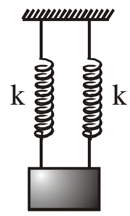
35. Two light springs of force constants k_1 and k_2 are connected to a mass m placed on a horizontal frictionless surface as shown in the figure, the time period of horizontal oscilltions will be



(a) $2\pi\left(\frac{m}{k_1+k_2}\right)^{1/2}$ (b) $2\pi\left(\frac{mk_2}{k_1^2}\right)^{1/2}$

(c) $2\pi\left(\frac{m(k_1+k_2)}{k_1k_2}\right)^{1/2}$ (d) $2\pi\left(\frac{m}{k_2-k_1}\right)^{1/2}$

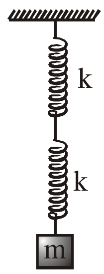
36. A mass m is suspended from two identical springs, each of force constant k as shown in the figure. The time period of vertical oscillations of the mass will be



(a) $2\pi\left(\frac{m}{k}\right)^{1/2}$ (b) $2\pi\left(\frac{m}{2k}\right)^{1/2}$

(c) $\frac{1}{2\pi}\left(\frac{2k}{m}\right)^{1/2}$ (d) $\frac{1}{2\pi}\left(\frac{2m}{k}\right)^{1/2}$

37. A mass m is suspended from two identical springs each of force constant k as shown in figure. The frequency of vertical oscillations of the mass will be



(a) $2\pi\left(\frac{k}{m}\right)^{1/2}$ (b) $2\pi\left(2\frac{m}{k}\right)^{1/2}$

(c) $\frac{1}{2\pi}\left(\frac{2k}{m}\right)^{1/2}$ (d) $\frac{1}{2\pi}\left(\frac{k}{2m}\right)^{1/2}$

38. Two light springs of force constants k_1 and k_2 are connected to a mass 'm' placed on a horizontal frictionless surface as shown in the fig. The time period of horizontal oscillations will be

(a) $2\pi\left(\frac{m}{k_1+k_2}\right)^{1/2}$ (b) $2\pi\left(\frac{mk_2^2}{k_1}\right)^{1/2}$

(c) $2\pi\left(\frac{m(k_1+k_2)}{k_1k_2}\right)^{1/2}$ (d) $2\pi\left(\frac{m}{k_2-k_1}\right)^{1/2}$

39. A simple pendulum is suspended from the roof of a lift. When the lift is moving upwards with an acceleration a (a < g) then the time period is given by $T=2\pi\left(\frac{1}{g'}\right)^{1/2}$ where g' is equal to

(a) g (b) g – a

(c) g + a (d) $(g^2 + a^2)^{1/2}$

40. A simple pendulum is suspended from the roof of a trolley. When the trolley moves in a horizontal direction with an acceleration 'a' then the time period is given $T=2\pi\left(\frac{1}{g'}\right)^{1/2}$, where g' is equal to

(b) g (b) g – a

(c) (g + a) (d) $(g^2 + a^2)^{1/2}$

41. A simple pendulum of length L, mass of bob M is oscillating in a plane about a vertical line between angular limits (–φ) to (+φ). For an angular displacement θ [|θ| < φ] the tension in the string and the velocity of the bob are T and V respectively. The following relation holds good under the above conditions

(a) $T\cos\theta = Mg$

(b) $T - Mg\cos\theta = \frac{MV^2}{L}$

(c) the magnitude of the tangential acceleration of bob $|a_T| = g\cos\theta$

(d) $T = Mg\cos\theta$

42. A particle executes simple harmonic motion with a frequency f. The frequency with which its kinetic energy and total energy oscillates is

(a) f/2, f/2 (b) 2f, 0

(c) 2f, ∞ (d) 2f, 2f

43. The phase difference between two similar pendulums is 90^o. When the bob of pendulum A has maximum velocity V_0 the bob of pendulum B will be

(a) stationary

(b) moving with velocity V_0

(c) moving with a velocity $2V_0$

(d) moving with a velocity of $\frac{V_0}{2}$

44. A cylindrical piston of mass M slides smoothly inside a long cylinder closed at one end, enclosing a certain mass of gas. The cylinder is kept with its axis horizontal. If the piston is disturbed from its equilibrium position, it oscillates simple harmonically. The period of oscillation will be

(a) $T = 2\pi\left(\frac{MV_0}{PA^2}\right)^{1/2}$

(b) $T = 2\pi\left(\frac{MA^2}{PV_0}\right)^{1/2}$

(c) $T = 2\pi\left(\frac{M}{PA^2V_0}\right)^{1/2}$

(d) $T = 2\pi\sqrt{MPV_0A^2}$

45. A sphere of radius r is kept on a concave mirror of radius of curvature R. The arrangement is kept on a horizontal table. If the sphere is displaced from its equilibrium position and left, then it executes simple harmonic motion. The period of oscillation will be

(a) $2\pi\left(\frac{(R-r)1.4}{g}\right)^{1/2}$

(b) $2\pi\left(\frac{r-R}{g}\right)^{1/2}$

(c) $2\pi\left(\frac{rR}{g}\right)^{1/2}$

(d) $2\pi\left(\frac{R}{gr}\right)^{1/2}$

46. A simple pendulum consists of a small sphere of mass m suspended by a thread of length L. The sphere carries a positive charge q. The pendulum is placed in a uniform electric field of srength E directed vertically upwards. With what period will the pendulum oscillate if the electrostatic force on the sphere is less than the gravitational force. Assuming small oscillations the period is given by

(a) $T = 2\pi\left(\frac{L}{g-E}\right)^{1/2}$

(b) $T = 2\pi\left(\frac{L}{g-\frac{qE}{m}}\right)^{1/2}$

(c) $T = 2\pi\left(\frac{L}{g+\frac{qE}{m}}\right)^{1/2}$

(d) $T = 2\pi\left(\frac{L}{g-qE}\right)^{1/2}$

47. The length of a second's pendulum is increased by 0.1 %. The clock

(a) gains 43.2 sec per day

(b) loses 43.2 sec per day

(c) neither loses nor gains

(d) loses 86.4 sec per day

48. For an oscillating simple pendulum, the tension in the string is

(a) same through out the oscillation

(b) least at the end points and greatest at mean position

(c) least at the mean position and greatest at the end points

(d) greatest at the mid point between the end point and the mean position

49. The length of a pendulum is increased by 44%. The percentage increase in the time period is

(a) 10% (b) 20%

(c) 40% (d) 44%

50. An electrically driven tuning fork with a constant amplitude is an example of

(a) free vibration (b) damped vibration

(c) maintained vibration (d) forced vibration

51. Resonant vibration is a special case of

(a) forced vibrations (b) free vibration

(c) damped vibrations (d) natural vibrations

52. A test tube of cross sectional area A has some lead shots in it. The total mass is M. It floats upright in a liquid of density σ. When pushed down a little and released it oscillates up and down with a period given by

(a) $T = 2\pi\left(\frac{MA}{g\sigma}\right)^{1/2}$ (b) $T = 2\pi\left(\frac{Mg}{A\sigma}\right)^{1/2}$

(c) $T = 2\pi\left(\frac{M\sigma}{Ag}\right)^{1/2}$ (d) $T = 2\pi\left(\frac{M}{A\sigma g}\right)^{1/2}$

53. The time period of a simple pendulum of length equal to the radius or the earth is

(a) $2\pi\left(\frac{R_e}{g}\right)^{1/2}$ (b) $2\pi\left(\frac{2R_e}{g}\right)^{1/2}$

(c) $2\pi\left(\frac{R_e}{g}\right)$ (d) infinite

54. The period of oscillation of a physical pendulum is (I = moment of inertia about the axis of rotation, M = mass and d is the distance of the centre of gravity from pivot)

(a) $T = 2\pi\left(\frac{I}{Mgd}\right)^{1/2}$

(b) $T = \frac{1}{2\pi}\left(\frac{I}{mgd}\right)^{1/2}$

(c) $T = 2\pi\left(\frac{Mgd}{I}\right)^{1/2}$

(d) $T = \frac{1}{2\pi}\left(\frac{Mgd}{I}\right)^{1/2}$

55. A point mass M is suspended at the end of a massless wire of length L and area of cross section A. If Y is the Young's modulus of elasticity for the wire, the frequency of oscillation for simple harmonic motion along the vertical line is

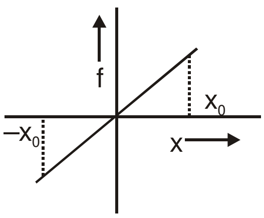
(a) $n = \frac{1}{2\pi}\left(\frac{ML}{YA}\right)^{1/2}$

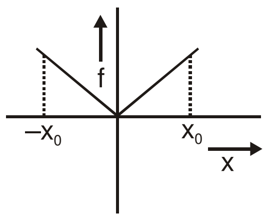
(b) $n = \frac{1}{2\pi}\left(\frac{M}{LYA}\right)^{1/2}$

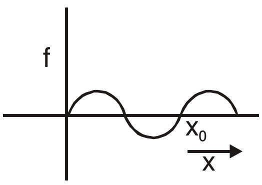
(c) $n = \frac{1}{2\pi}\left(\frac{YA}{ML}\right)^{1/2}$

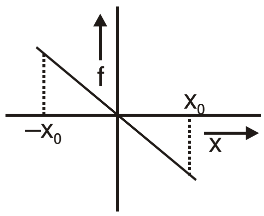
(d) $n = \frac{1}{2\pi}\left(\frac{Y}{AML}\right)^{1/2}$

56. A particle of mass 10 gm is describing simple harmonic motion along a straight line with a period of 2 sec and an amplitude of 10 cm. The kinetic energy when it is at 2 cm from its equilibrium position is

(a) 

(b) 

(c) 

(d) 

(a)

(b)

(c)

(d)

57. A small body of mass 0.1 kg is undergoing simple harmonic motion of amplitude 1 m and period 0.2 s. The maximum value of force acting on it is

(a) π

(b) 2π

(c) $2\pi^2$

(d) $10\ \pi^2$

58. The displacement x(in metres) of a particle in simple harmonic motion is related to time 't' as $x = 0.01 \text{ Cos}\left(\pi t + \frac{\pi}{4}\right)$ frequency is

(a) π Hz | (b) $\frac{\pi}{2}$ Hz

(c) 1 Hz | (d) 0.5 Hz

59. The displacement of a particle executing simple harmonic motion is $y = 5 \sin 20 \pi t$. Its frequency is

(a) 10 Hz | (b) 20π Hz

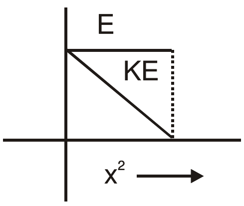
(c) 0.01 Hz | (d) 20 Hz

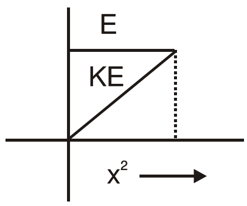
60. A simple harmonic oscillator has amplitude A and time period T. Its maximum speed is

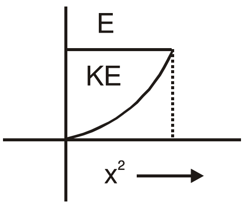
(a) $\frac{4A}{T}$ | (b) $\frac{2A}{T}$

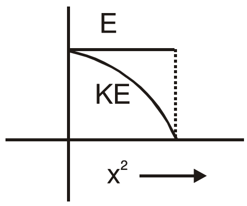
(c) $\frac{4\pi A}{T}$ | (d) $\frac{2\pi A}{T}$

61. The variation of the acceleration (f) of the particle executing simple harmonic motion with displacement (x) is as shown in figure

(a)


(b)


(c)


(d)


62. Which one of the following is SHM?

(a) Motion of a particle in a wave moving through a string fixed at both ends

(b) Earth spinning about its own axis

(c) Ball bouncing between tow rigid vertical walls

(d) Particle moving in a circle with uniform speed

63. Which of the following expressions does not represent SHM?

(a) $A \cos\omega t$ | (b) $A \sin^2 \omega t$

(c) $A \sin \omega t + B \cos \omega t$ | (d) $A (\sin^2 \omega t + \sin^3 \omega t)$

64. Two SHM are given by

$y_1 = a \sin[(\pi/2)\, t + \varphi]$ and $y_2 = b \sin[(2\pi t/3) + \varphi]$. The phase difference between these after 1 sec is

(a) π (b) $\pi/2$

(c) $\pi/4$ (d) $\pi/6$

65. A particle is subjected to two mutually perpendicular SHM such that $x = 2 \sin \omega t$ and $y = 2 \sin[\omega t + (\pi/4)]$. The path of the particle will be

(a) an ellipse (b) a straight line

(c) a parabola (d) a circle

66. A simple pendulum of length L has been set up inside a railway wagon sliding down a frictionless inclined plane having an angle of inclination θ with the horizontal. What will be its period of oscillation as recorded by an observer inside the wagon?

(a) $2\pi\sqrt{L/g\cos\theta}$ (b) $2\pi\sqrt{L/g}$

(c) $2\pi\sqrt{L/g\sin\theta}$ (d) $2\pi\sqrt{L\cos\theta/g}$

67. The time period of a simple pendulum is T. The pendulum is charged positively and is made to oscillate while a negatively charged plate is placed below it. The time period of the pendulum is now:

(a) $> T$ (b) $< T$

(c) $= T$ (d) ∞

68. The work done by the string of a simple pendulum during one complete oscillation is equal to

(a) total energy of pendulum (b) KE of pendulum

(c) PE of pendulum (d) zero

69. The phase difference between two similar pendulum A and B is 90^o. When the bob of the pendulum A has maximum velocity V_0, the bob of the pendulum B will be

(a) stationary (b) moving with velocity (V_0)

(c) moving with velocity $(-V_0)$ (d) moving with velocity $(V_0/2)$

70. If the length of a simple pendulum is equal to the radius of the earth its time period will be

(a) $2\pi\sqrt{R/g}$ (b) $2\pi\sqrt{R/2g}$

(c) $2\pi\sqrt{2R/g}$ (d) indeterminate

71. Two masses m_1 and m_2 are suspended together by a massless spring of spring constant k. When the masses are in equilibrium m1 is removed without disturbing the system. The angular frequency of oscillations is

(a) $\sqrt{k/m_1}$
(b) $\sqrt{k/m_2}$
(c) $1/2\sqrt{m_1/k}$
(d) $1/2\sqrt{m_2/k}$

72. Mkg weight is suspended from weightless spring and it has time period T. If now 4 M kg weight is suspended from the same spring, the new time period will be

(a) T
(b) 2T
(c) T/2
(d) 4T

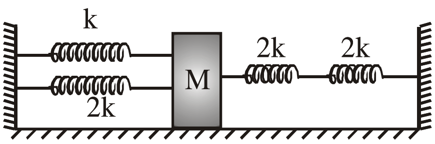
73. A force of 6.4 N stretches a vertical spring by 0.1 m. The mass that must be suspended form the spring so that it oscillates with a period of (π/4) sec is

(a) (π/4) kg
(b) 1 kg
(c) (1/π) kg
(d) 10 kg

74. Two bodies M and N of equal masses are suspended from two separate massless springs of spring constant k_1 and k_2 respectively. If the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude of vibration of M to that of N is

(a) k_1/k_2
(b) $\sqrt{k_1/k_2}$
(c) k2/k1
(d) $\sqrt{k_2/k_1}$

75. Four massless springs whose force constnat are 2k, 2k, k and 2k respectively are attached to mass M kept on a frictionless plane (as shown in the fig). If the mass M is displaced in the horizontal direction, then the frequency of the system:



(a) $\frac{1}{2\pi}\sqrt{\frac{k}{4M}}$
(b) $\frac{1}{2\pi}\sqrt{\frac{4k}{M}}$
(c) $\frac{1}{2\pi}\sqrt{\frac{k}{7M}}$
(d) $\frac{1}{2\pi}\sqrt{\frac{7k}{M}}$

Wave Motion

1. The velocity of sound in air at 4 atm that at 1 atm pressure would be

   (a) 1 : 1 (b) 4 : 1

   (c) 1 : 4 (d) 3 : 1

2. Sound waves are travelling in a medium whose adiabatic elasticity is E and isothermal elasticity is E′. The velocity of sound is proportional to

   (a) E′ (b) $\sqrt{E}$

   (c) $\sqrt{E'}$ (d) $\frac{E}{E'}$

3. The Laplace's correction in the expression for the velocity of sound given by Newton is needed because sound waves

   (a) are longitudinal (b) propagate isothermally

   (c) propagate adiabatically (d) are of long wavelenghts

4. The ratio of velocity of the body to the velocity of sound is

   (a) Mach no. (b) Wood no.

   (c) Laplace no. (d) Natural no.

5. A wave of frequency 500 Hz has a velocity of 350 m/s. The distance between two nearest points 60^o out of phase will be

   (a) 0.7 cm (b) 12 cm

   (c) 70 cm (d) 12 cm

6. Sound wave is passing through an air column during the consequent compression and rarefaction

   (a) Boyle's law is obeyed (b) total amount of energy remains constant

   (c) density of air remains constant (d) bulk modulus of air remains constant

7. With sound one cannot observe the phenomenon of

   (a) refraction (b) interference

   (c) diffraction (d) polarisation

8. Standing stationary waves can be obtained in air column even if the interfering waves are

   (a) of different pitches (b) of different amplitude

   (c) of different qualities (d) moving with different velocities

9. In stationary waves the distance between two consecutive nodes is

(a) $\frac{\lambda}{4}$ (b) $\frac{\lambda}{2}$

(c) $\frac{\lambda}{3}$ (d) λ

10. Which one of the following does not represent a travelling wave?

(a) $y = f(x - vt)$ (b) $y = y_m \sin k(x + vt)$

(c) $y = y_m \log(x - vt)$ (d) $y = f(x^2 - vt^2)$

11. The rms velocity of molecules of gas is c and velocity of sound in this gas is v. The relation between v and c is

(a) $\frac{v}{c} = \frac{\gamma}{3}$ (b) $\frac{v}{c} = 3\gamma$

(c) $\frac{v}{c} = \sqrt{3r}$ (d) $\frac{v}{c} = \left(\frac{\gamma}{3}\right)^{1/2}$

12. A stone is dropped into a well. If the depth of water below the top be h and velocity of sound is v then the splash in water is heared after T sec, then

(a) $T = \left(\frac{2h}{g}\right)^{1/2} + \frac{h}{v}$ (b) $T = \frac{2h}{v}$

(c) $T = 2\left(\frac{2h}{g}\right)^{1/2}$ (d) $T = 2\left(\frac{2h}{g}\right)^{1/2} \times \frac{h}{v}$

13. Ultrasonic infrasonic and audible waves travel through a medium with speeds V_u, V_i and V_a respectively then,

(a) V_u, V_i and V_a are nearly equal (b) $V_u \geq V_a \geq V_i$

(c) $V_u \geq V_a \leq V_i$ (d) $V_a \geq V_u$ and $V_u \equiv V_i$

14. The square of speed of sound in a gas is proportional to

(a) density (b) pressure

(c) temperature in degree celcius (d) temperature in degree kelvin

15. When a tuning fork sounds and pressure of air decreases then there is a change in

(a) frequency only (b) velocity only

(c) loudness only (d) frequency and loudness only

16. In a stationary wave

(a) all the particles perform S.H.M with a frequency which is twice that of the two component waves

(b) all the particles between two adjacent nodes vibrate in phase

(c) the amplitude of particle vibration at an antinode is equal to that of either component wave

(d) particles on opposite sides of a node vibrate with a phase difference of π

17. A simple sound wave of frequency 440 Hz is passing through air. An oxygen molecule (mass = 5.3×10^{-26} kg) is set in oscillation with an amplitude of 10^{-6} m. Its speed at the centre of its oscillation is

(a) 1.7×10^{-5} m/s (b) 17×10^{-5} m/s

(c) 2.76×10^{-3} m/s (d) 2.77×10^{-5} m/s

18. A thin plane membrane separates hydrogen at 7°C form hydrogen at 47°C, both being at the same pressure. If a colimated sound beam travelling from cooler gas makes an angle of incidence of 30° at the membrane, the angle of refraction is

(a) $\sin^{-1}\left(\frac{7}{32}\right)^{1/2}$ (b) $\sin^{-1}\left(\frac{2}{7}\right)^{1/2}$

(c) $\sin^{-1}\left(\frac{4}{7}\right)^{1/2}$ (d) $\sin^{-1}\left(\frac{4}{7}\right)^{1/2}$

19. A tuning fork whose frequency as given by the manufacturer is 512 Hz is being tested with an accurate oscillator. It is found that the fork produces a beat of 2 Hz when the oscillator reads 514 Hz but produce a beat of 6 Hz when the oscillator reads 510 Hz. The actual frequency of the fork is

(a) 508 Hz (b) 512 Hz

(c) 516 Hz (d) 518 Hz

20. When beats are produced by two progressive waves of same amplitude and of nearly the same frequencies then the maximum loudness heard corresponding to each of its constituent waves is

(a) two times (b) four times

(c) same (d) eight times

21. The end correction of resonance column is 1.0 cm. If the shortest length resonating with a tuning fork is 15.0 cm, the next resonating length is

(a) 31 cm (b) 45 cm

(c) 46 cm (d) 47 cm

22. A piano wire having a diameter of 0.90 mm is replaced by another wire of the same material but with a diameter 0.93 mm. If the tension of the wire is kept the same, then the percentage change in the frequency of the fundamental tone is

(a) + 3% (b) +3.2 %

(c) –3.2 % (d) –3 %

23. A transverse wave is described by the equation $Y = Y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$. The maximum particle velocity is equal to four times the wave velocity if

(a) $\lambda = \frac{\pi y_0}{4}$ (b) $\lambda = \frac{\pi y_0}{2}$

(c) $\lambda = \pi y_0$ (d) $\lambda = 2\pi y_0$

24. A wave equation which give the displacement along the y-direction is given by $y = 10^{-4}\sin(cot + 2x)$ (where x and y are metre and t is time in seconds. Which of the following is incorrect?

(a) travelling with a velocity of 30 m/s in the negative x-direction

(b) of wavelength π metre

(c) of frequency 30/π Hz

(d) of amplitude 10^{-4} metre travelling along negative –x direction

25. A resonating column of air contains

(a) stationary longitudinal waves (b) stationary transverse wave

(c) transverse progressive wave (d) longitudinal progressive waves

26. With an open end organ pipe of length l, the fundamental tone has frequency

(a) $\frac{v}{2\ell}$ and only even harmonics are present

(b) $\frac{v}{2\ell}$ only odd harmonics are present

(c) $\frac{v}{2\ell}$ and even as well as odd harmonics are present

(d) $\frac{v}{4\ell}$ and odd harmonics are present

27. With a closed end organ pipe of length l, the fundamental tone has frequency

(a) $\frac{v}{2\ell}$ and all harmonic are present

(b) $\frac{v}{4\ell}$ and all harmonics are present

(c) $\frac{v}{4\ell}$ and only odd harmonics are present

(d) $\frac{v}{4\ell}$ and only even harmonics are present

28. When both source and listener move in the same direction with a velocity equal to half the velocity of sound, the change in the frequency of sound as detected by the listener is

(a) 0% (b) 25%

(c) 50% (d) none of these

29. When both source and listner approach each other with a velocity equal to half the velocity of sound, the change in frequency of sound as detected by the listener is

(a) 0% (b) 25%

(c) 50% (d) none of these

30. The frequency of waves emitted from a radar is 750 MHz. The frequency of the reflected wave from the aeroplane as observed at the radar station is increased 2.5 KHz. What is the velocity of the aeroplane?

(a) 4 km/s (b) 3 km/s

(c) 1 km/s (d) 0.5 km/s

31. There are following four possible relative motions between the source of sound and the listener

I. Source moves towards stationary listener

II. Listener moves towards stationary source

III. Listener moves towards stationary source

IV. Listener moves away from stationary source

In which of the case, the change of frequency is the same, the magnitude of velocity of source of source or listener being the same

(a) I and II (b) II and III

(c) III and IV (d) none of these

32. A source of sound waves towards a stationary listener. The apparent pitch of the sound is found to be higher than its actual value. This happens because

(a) wavelength of sound decreases

(b) wavelength of sound increases

(c) the number of waves received by listener increases

(d) the number of waves received by listener decreases

33. Values of the shortest length L of a closed pipe which resounds to a series of tuning forks giving notes of frequency f are determined. In order to allow the reflection of sound waves a short distance beyond the open end of the tube, the speed of sound in air should be calculated from

(a) the slope of a graph of L against f^{-1} (b) the slope of a graph of f against L^{-1}

(c) the slope of a graph of f against L
(d) the slope of a graph of f against log L

34. A wave travelling in a stretched string is described by the equation $y = A \sin(kx - \omega t)$. The maximum particle velocity is

(a) $A\omega$
(b) ω/k
(c) $d\omega/dk$
(d) x/t

35. A metal string is fixed between two rigid supports. It is initially at negligible tension. Its Youngs modulus is Y, density is ρ and coefficient of thermal expansion is α. If it is now cooled through a temperature = t, transverse waves will move along it with speed

(a) $Y = \sqrt{\alpha t/\rho}$
(b) $\alpha t\sqrt{Y/\rho}$
(c) $\sqrt{Y\alpha t/\rho}$
(d) $t\sqrt{Y\alpha/\rho}$

36. In a sonometer wire, the tension is maintained by suspending a 50.7 kg mass from the free bend of the wire. The suspended mass has a volume of 0.0075 m^3. The fundamental frequency of the wire is 260 Hz. If the suspended mass is completely submerged in water, the fundamental frequency will become

(a) 200 Hz
(b) 220 Hz
(c) 230 Hz
(d) 240 Hz

37. A string of length 0.4 m and mass 10^{-2} kg is clamped at its ends. The tension in the string is 1.6 N. When a pulse travels along the string, the shape of the string is found to be the same at times t and $t + \Delta t$. The value of Δt is

(a) 0.05 s
(b) 0.1 s
(c) 0.2 s
(d) 0.4 s

38. A string A has double the length, double the tension, double the diameter and double the density as another string B. Their fundamental frequencies of vibration are n_A and n_B respectively. The ratio n_A/n_B is equal to

(a) 1/4
(b) 1/2
(c) 2
(d) 4

39. A cylindrical resonance tube, open at both ends, has a fundamental frequency F in air. Half of the length of the tube is dipped vertically in water. The fundamental frequency of the air column now is

(a) 4F
(b) 2F
(c) F
(d) F/2

40. An open pipe is suddenly closed at one end, as a result of which the frequency of the third harmonic of the closed pipe is found to be higher by 100 Hz than the fundamental frequency of the open pipe. The fundamental frequency of the open pipe is

(a) 200 Hz
(b) 300 Hz

(c) 240 Hz (d) 480 Hz

41. The third overtone of an open organ pipe of length 1_0 has the same frequency as the third overtone of a closed pipe of length 1c. The ratio 1o/1c is equal to

(a) 2 (b) 3/2

(c) 5/3 (d) 8/7

42. A pipe of length 1m is closed at one end. The velocity of sound in air is 300 m/s. The air column in the pipe will not resonate for sound of frequency

(a) 75 Hz (b) 225 Hz

(c) 300 Hz (d) 375 Hz

43. A sine wave has an amplitude A and a wavelength λ. Let V be the wave velocity, and v be maximum velocity of a particle in the medium

(a) V cannot be equal to v (b) V = v, if $A = \lambda/2\pi$

(c) V = v, if $A = 2\pi\lambda$ (d) V = v, if $\lambda = A/\pi$

6. A particle is moving along a curve. Then

   (a) if its speed is constant it has no acceleration

   (b) If its speed is increasing the acceleration of the particle is along its direction of motion

   (c) if its speed is constant the magnitude of its acceleration is proportional to its curvature

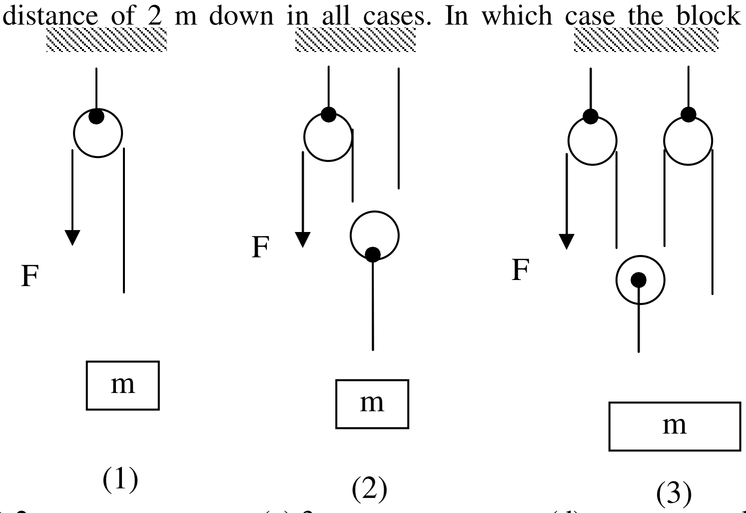
   (d) the direction of its acceleration cannot be along the tangent.

7. What should be the minimum force P to be applied to the string so that block of mass m just begins to move up the frictionless plane.

   (a) Mg tan θ/2 (b) Mg cot θ/2 (c) $\frac{Mg\cos\theta}{1+\sin\theta}$

   (d) None

8. Equal force F(>mg) is applied to string in all the 3 cases. Starting from rest, the point of application of force moves a distance of 2 m down in all cases. In which case the block has maximum kinetic energy?

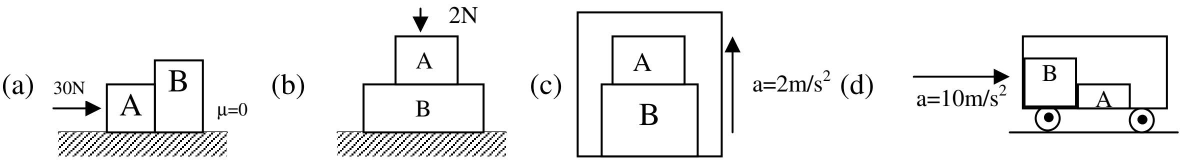


   (a) 1 (b) 2 (c) 3 (d) equal in all 3 cases

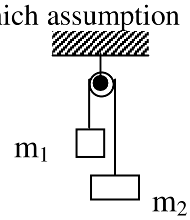
9. Both the blocks shown here are of mass m and are moving with constant velocity in direction shown in a resistive medium which exerts equal constant force on both blocks in direction opposite to the velocity. The tension in the string connecting both of them will be : (Neglect friction) (a) mg (b) mg/2 (c) mg/3

   (d) mg/4

10. In which of the following cases in the contact force between A and B maximum (m_A+m_B =1kg)

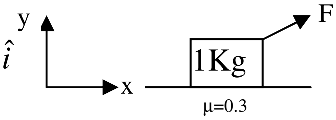


6. A student calculates the acceleration of m_1 in figure shown as $a_1 \frac{(m_1 - m_2)g}{m_1 + m_2}$. Which assumption is not required to do this calculation.



(a) pulley is frictionless (b) string is massless
(c) pulley is massless (d) string is inextensible

7. A force $\vec{F} = \hat{i} + 4\hat{j}$ acts on block shown. The force of friction acting on the block is:



(a) $-\hat{i}$ (b) -1.8 $\hat{i}$ (c) -2.4 $\hat{i}$ (d) – 3 $\hat{i}$

8. At a given instant, A is moving with velocity of 5m/s upwards. What is velocity of B at that time :

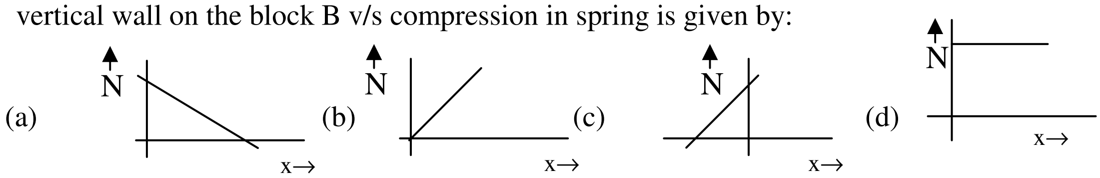
(a) $15m/s \downarrow$ (b) $15m/s \uparrow$ (c) $\frac{6m}{\mu+1}$ (d) $5m/s \uparrow$

9. $F=2x^2-3x-2$. Choose correct option

(a) x=-1/2 is position of stable equilibrium (b) x=2 is position of stable equilibrium

(c) x=-1/s is position of unstable equilibrium (d) x=2 is position of neutral equilibrium

10. The block A is pushed towards the wall by a distance and released. The normal reaction by vertical wall on the block B v/s compression in spring is given by:

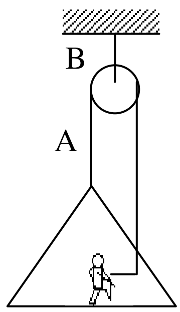


11. A 1.0 kg block of wood sits on top of an identical block of wood. Which sits on top of a flat level able made of plastic. The coefficient of static friction between the wood surfaces is μ_1, and the coefficient of static friction between the wood and plastic is μ_2. A horizontal force F is applied to the top block only, and this force is increased until the top block starts to move. The bottom block will move with the top block if and only if

(a) $\mu < \frac{1}{2}\mu_2$ (b) $\frac{1}{2}\mu_2 < \mu_1 < \mu_2$ (c) $\mu_2 < \mu_1$ (d) $2\mu_2 < \mu_1$

12. To paint the side of a building, painter normally hoists himself up by pulling on the rope A as in figure .The painter and platform together weigh 200 N. The rope B can withstand 300N. Then

(a) The maximum acceleration that painter can have upwards is $5 m/s^2$.



(b) To hoist himself up, rope B must withstand minimum 400 N force.

(c) Rope A will have a tension of 100 N when the painter is at rest.

(d) The painter must exert a force of 200 N on the rope A to go downwards slowly.

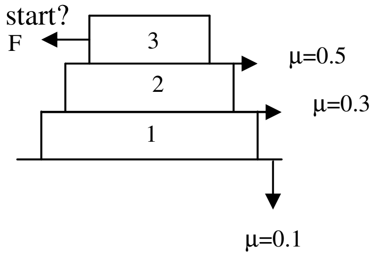
13. A block of mass 2 kg slides down an incline plane of inclination 30^0. The coefficient of friction between block and plane is 0.5. The contact force between block and plank is:

(a) 20 Nt (b) $10\sqrt{3}$ Nt (c) $3\sqrt{7}$ Nt (d) $5\sqrt{15}$ Nt

14. If force F is increasing with time and ………… Where will slipping first start?

(a) between 3 kg and 2 kg (b) between 2 kg and 1 kg

(c) between 1 kg and ground (d) Both (a) and (b)



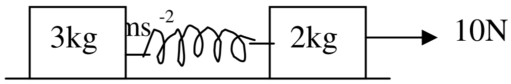
15. Find the velocity of the hanging block if the velocities of the free ends of the rope are as indicated in the figure.

(a) $3/2 m/s \uparrow$ (b) $3/2 m/s \downarrow$ (c) $1/2 m/s \uparrow$ (d) ½ m/s ↓

16. A rope of mass 5 kg is moving vertically in vertical position with an upwards force of 100 N acting at the upper end and a downwards force of 70 N acting at the lower end. The tension at midpoint of the rope is

(a) 3 ms^{-2}

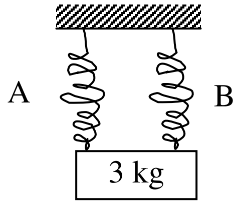
(c) 0.5 ms^{-2} (d) zero



17. Block of 1 kg is initially in equilibrium and is hanging by two identical spring $2ms^{-2} \rightarrow$ is shown in figures. If spring A is cut from lower point at t=0 then, find acceleration of block in ms^{-2} at t =0.

(a) 5 (b) 10

(c) 15 (d) 0

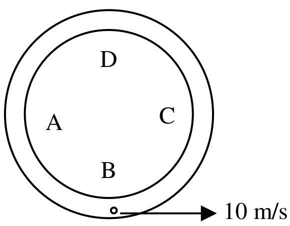


18. A ball whose size is slightly smaller than width of the tube of radius 2.5 m is projected from bottommost point of a smooth tube fixed in a vertical plane with velocity of 10 m/s. If N_1 and N_2 are the normal reactions exerted by inner side and outer side of the tube on the ball

(a) $N_1>0$ for motion in ABC, $N_2>0$ for motion in CDA

(b) $N_1>0$ for motion in CDA, $N_2 > 0$ for motion in ABC

(c) $N_2 > 0$ for motion in ABC & part of CDA



(d) N_1 is always zero.

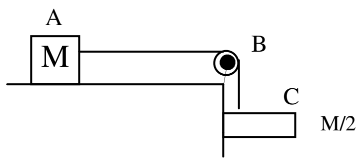
19. A man is standing on a rough (μ=0.5) horizontal disc rotating with constant angular velocity of 5 rad /sec. At what distance from centre should he stand so that the does not slip on the disc?

(a) R ≤ 0.2 m (b) R > 0.2 m (c) R> 0.5 m (d) R> 0.3 m

20. A road is banked at an angle of 30^0 to the horizontal for negotiating a curve of radius $10\sqrt{3}$ m. At what velocity will a car experience no friction while negotiating the curve?

(a) 54 km/hr (b) 72 km/hr (c) 36 km/hr (d) 18 km/hr

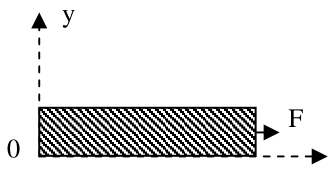
21. Block of mass M on a horizontal smooth surface is pulled by a load of mass M/2 by means of a rope AB and string BC as shown in the figure. The length & mass of the rope AB are L and M/2 respectively. As the block is pulled from AB=L to AB =0 its acceleration changes from



(a) $\frac{3g}{4}$ *to* g (b) $\frac{g}{4}$ *to* $\frac{g}{2}$

(c) $\frac{g}{4}$ *to* g (d) $\frac{3g}{2}$ *to* $2g$

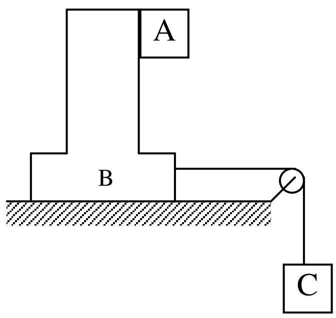
22. A uniformed rod of length L and mass M has been placed on a rough horizontal surface. The horizontal force F applied on the rod is such that the rod is just in the state of rest. If the coefficient of friction varies according to the relation μ=Kx where K is a +ve constant. Then the tension at mid point of rod is



(a) A/2 (b) F/4

(c) F/8 (d) None

23. In the arrangement shown in the figure, mass of the block B and A is m and m respectively. Surface between B and floor is smooth. The block B is connected to the block C by means of a string pulley system. If the whole system is released, then find the minimum value of mass of block C so that block A remains stationary w.r.t B. Coefficient of friction between A and B is μ:



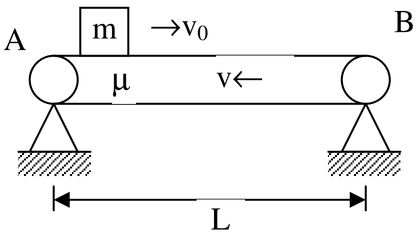
(a) $\frac{m}{\mu}$ (b) $\frac{2m+1}{\mu+1}$

(c) $\frac{3m}{\mu-1}$ (d) $\frac{6m}{\mu+1}$

24. A particle of mass m, initially at rest, is acted on by a force F = $F_0\left\{1-\left(\frac{2t-T}{T}\right)^2\right\}$ during the interval $0 \le t \le T$. The velocity of the particle a t the end of the interval is:

(a) $\frac{5F_0T}{6m}$ (b) $\frac{4F_0T}{3m}$ (c) $\frac{2F_0T}{3m}$ (d) $\frac{3F_0T}{2m}$

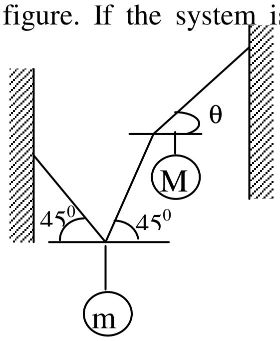
25. With what minimum velocity should block be projected from left end A towards end B such that it reaches the other end B of conveyer belt moving with constant velocity v. Friction coefficient between block and belt is μ.



(a) $\sqrt{\mu gL}$ (b) $\sqrt{2\mu gL}$

(c) $\sqrt{3\mu gL}$ (d) $2\sqrt{\mu gL}$

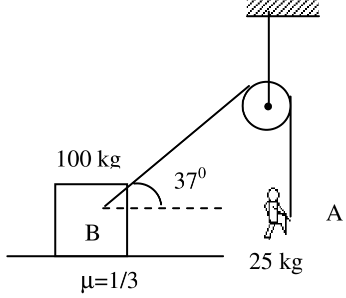
26. Two masses m and M are attached to the string as shown in the figure. If the system is in equilibrium, then



(a) tan θ $=1+\frac{2M}{m}$ (b) $\tan\theta=1+\frac{2m}{M}$

(c) cot θ$=1+\frac{2M}{m}$ (d) $\cot\theta=1+\frac{2m}{M}$

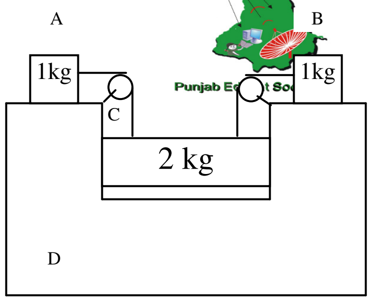
27. Block B of mass 100 kg rests on a rough surface of friction coefficient μ=1/3. A rope is tied to block B as shown in figure. The maximum acceleration with which boy A of 25 kg can climbs on rope without making block moves is:



(a) $\frac{4g}{3}$ (b) $\frac{g}{3}$

(c) $\frac{g}{2}$ (d) $\frac{3g}{4}$

28. In the system shown in the figure there is no friction anywhere. The block C goes down by a distance x_0=10 cm with respect to wedge D when system is released from rest. The velocity of A with respect to B will be (g=10 m/s^2)



(a) zero (b) 1 m/s

(c) 2 m/s (d) none of these

29. A car moves along a circular track of radius R banked at an angle of 30^0 to the horizontal. The coefficient of static friction between the wheels and the track is μ. The maximum speed with which the car can more without skidding out is

(a) $\left[2gR(1+\mu)/\sqrt{3}\right]^{1/2}$ (b) $\left[gR(1-\mu)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$

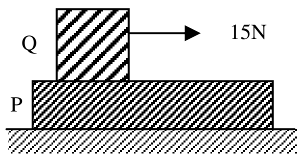
(c) $\left[gR\left(1+\mu\sqrt{3}\right)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$ (d) None

30. A particle initially at rest is subjected to two forces. One is constant, the other is a retarding force proportional to the particle velocity. In the subsequent motion of the particle : (a) The acceleration will increase from zero to a constant value. (b) the acceleration will decreases from its initial value to zero

(c) the velocity will increase from zero to maximum & then decrease

(d) the velocity will increase from zero to a constant value.

31. A long plank P of the mass 5 kg is placed on a smooth floor. On P is placed a block Q of mass 2 kg. The coefficient of friction between P and Q is 0.5. If a horizontal force 15 N is applied to Q, as shown, and you may take gas 10 N/kg.



(a) The reaction force on Q due to P in 10 N

(b) The acceleration of Q relative to P is 2.5 m/s^2

(c) The acceleration of P relative to the Floor is 2.0 m/s^2

(d) The acceleration of centre of mass of P+Q system relative to the floor is (15/7) m/s^2

32. A particle is displaced from A ≡ (2, 2, 4) to B≡(5, -3, -1). A constant force of 34N acts in the direction of $\vec{AP}$. Where P ≡(10, 2, -11). (Coordinates are in m).

(i) Find the $\left(\vec{F}\right)$. (ii) Find the work done by the force to cause the displacement .

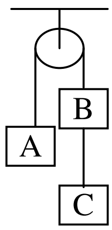
33. A man is standing in a lift which goes up and comes down with the same constant acceleration. If the ratio of the apparent weights in the two cases is 2:1, then the acceleration of the lift is

(a) 3.33 ms^{-2} (b) 2.50 ms^{-2} (c) 2.00 ms^{-2} (d) 1.67 ms^{-2}

34. Three equal weights of mass 2kg each are hanging by a string passing over a fixed pulley. The tension in the string (in N) connecting B and C is

(a) 4g/3 (b) g/3

(c) 2g/3 (d) g/2



35. A 10 kg monkey is climbing a massless rope attached to a 15 kg mass over a tree limb. The mass is lying on the ground. In order to raise the mass from the ground the must climb with

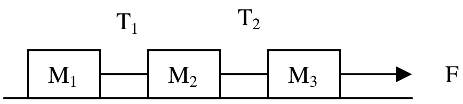
(a) uniform acceleration greater than 5m/sec^2 (b) uniform acceleration greater than 2.5 m/sec^2

(c) high speed (d) uniform acceleration greater than 10 m/sec^2

36. Three blocks are connected as shown in the figure, on a horizontal frictionless table and pulled to the right with a force at 60N. If M_1=10kg, M_2 =20kg and M_3=30 kg then the value of T_2 is

(a) 40 N (b) 30 N

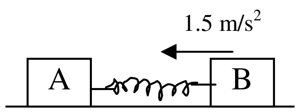
(c) 20N (d) 10 N



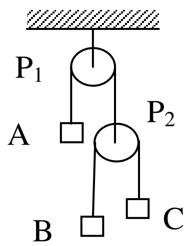
37. Two blocks A & B with mass 4 kg and 6 kg respectively are connected by a stretched spring of negligible mass as in figure. When the two blocks are released simultaneously the initial acceleration of B is 1.5 m/s^2 westward. The acceleration of A is:

(a) 1 m/s^2 westward (b) 2.25 m/s^2 eastward

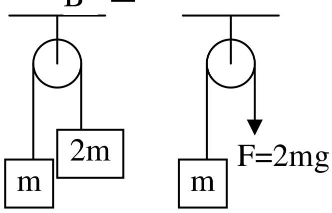
(c) 1 m/s^2 eastward (d) 2.75 m/s^2 westward



38. The three blocks shown move with constant velocities. Find the velocity of block A and B. Given V_{P2}=10 m/s↑, V_c =2m/s ↑



39. Fig shows two pulley arrangements for lifting a mass m. In (a) the mass is

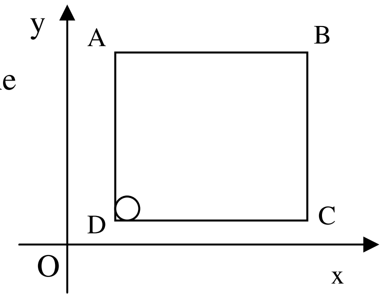


lifted by attaching a mass 2m while in (b) the mass is lifted by pulling the other end with a downward force F=2 mg, If f_a and f_b are the accelerations of the two masses then

(a) $f_a=f_b$ (b) $f_a=f_b/2$

(c) $f_a=f_b/3$ (d) $f_a=2f_b$

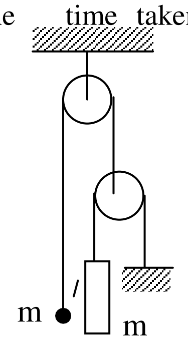
40. A solid sphere of mass 2kg is resting inside a cube as shown in the figure. V=$\left(5t\hat{i}+2t\hat{j}\right)m/s$. Here t is the time in second. All surfaces are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphere on the cube. (Take g=10m/s^2 & y-axis along vertical)



(a) $\sqrt{29}N$ (b) 29 N

(c) 26 N (d) $\sqrt{89}N$

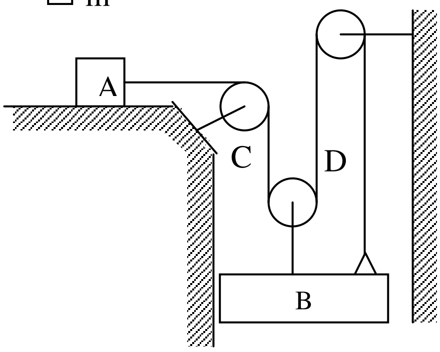
41. In the figure shown, all pulleys are massless and frictionless. The time taken by the ball to reach the upper end of the rod is:



(a) $\sqrt{\dfrac{10l}{3g}}$ (b) $\sqrt{\dfrac{5l}{3g}}$

(c) $\sqrt{\dfrac{3l}{4g}}$ (d) $\sqrt{\dfrac{3l}{10g}}$

42. Slider block A move to the left with a constant velocity of 6 m/s. Determine



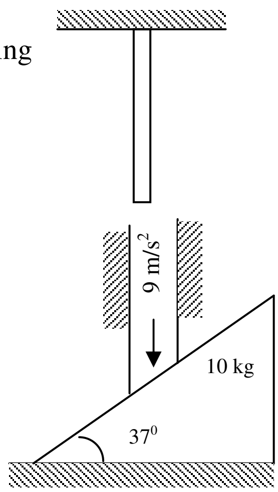
(a) the velocity of block b,

(b) the velocity of portion D of the cable.

(c) the relative velocity of portion C of the cable with respect to portion D.

43. Two monkeys of masses 10 and 8 kg are moving along a vertical rope, the former climbing up with an acceleration of 2m/s^2 while the latter coming down with a uniform velocity of 2 m/s. Find the tension in the rope at the fixed support.

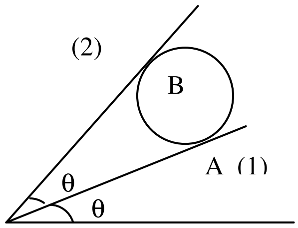
44. System is shown in figure. All the surfaces are smooth. Rod is moved by external agent with acceleration 9 m/s^2 vertically downwards. Force exerted on the rod by the wedge will be:



(a) 120 N (b) 200 N

(c) 135/2N (d) 225/2N

45. A sphere of mass m is kept between two inclined walls, as shown in the figure. If the coefficient of friction between each wall and the sphere is zero, then the ratio of normal reaction (N_1/N_2) offered by the walls 1 and 2 on the sphere will be



(a) tan θ (b) tan 2θ (c) 2 cosθ (d) cos 2θ

46. How could a 10 kg object be lowered down form a height using a cord with a breakup strength of 80 N, without breaking the cord.

(a) lowering the object very slowly

(b) lowering it with an acceleration less than 2 m/s^2

(c) lowering it with an acceleration greater than 2 m/s^2

(d) object cannot be lowered down without breaking the cord

47. A block of weight 9.8 N is placed on a table. The table surface exerts an upward force of 10 N on the block. Assume g =9.8 m/s^2

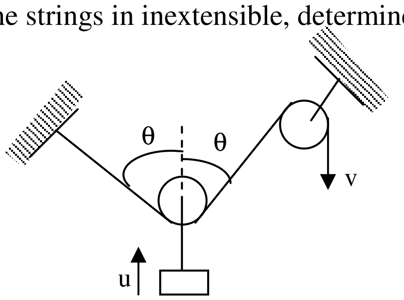
(a) The block exerts a force of 10 N on the table

(b) The block exerts a force of 19.8 N on the table

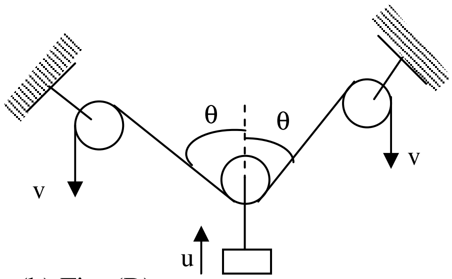
(c) The block exerts a force of 9.8 N on the table

(d) The block has an upward acceleration

48. If the strings in inextensible, determine the velocity u of each block in terms of v and θ.

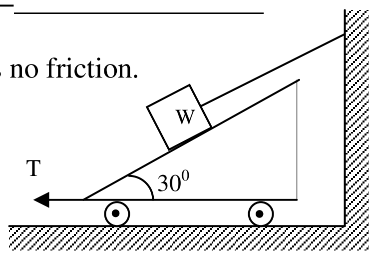


(a) Fig. (A) u =___________________

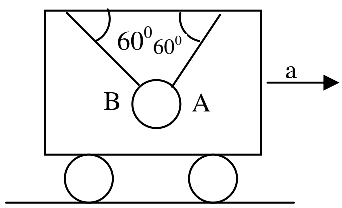


(b) Fig. (B) u–___________________

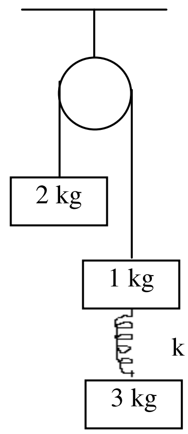
49. Find the tension T needed to hold the cart in equilibrium, if there is no friction.



50. A steel ball is suspended from the ceiling of an acceleration carriage by means of two cords A and B. Determine the acceleration a of the carriage which will cause the tension in A to be twice that in B.

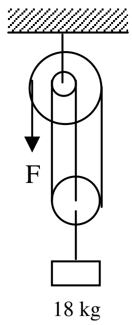


51. From the fixed pulley, masses 2 kg, 1 kg and 3 kg are suspended as shown in the figure. Find the extension in the spring if k=100 N/m. (Neglect oscillations due to spring)



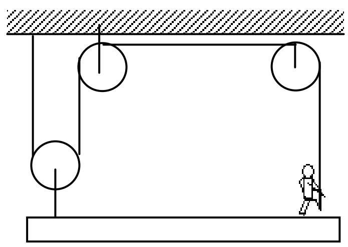
(a) 0.1 m (b) 0.2 m
(c) 0.3 m (d) 0

52. In the fig. at the free end of the light string, a force F is applied to keep the suspended mass of 18 kg at rest. Assuming pulley is light then the force exerted by the ceiling on the system is:



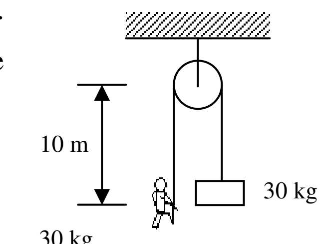
(a) 200N (b) 120 N
(c) 180 N (d) 240 N

53. A 50 kg person stand on a 25 kg platform. He pulls on the rope which is attached to the platform via the frictionless pulleys as shown in the figure. The platform moves upwards at a steady rate if the force with which the person pulls the rope is



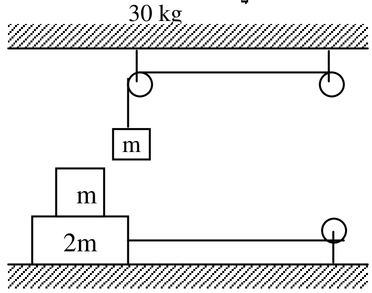
(a) 500 N (b) 250N
(c) 25 N (d) None

54. In the figure shown man is balanced by counter weight of same mass. He starts to climb the rope with an acceleration of 2 m/s^2 w.r.t. rope. The time after which he reaches the pulley will be



(a) √10 sec (b) 2√5 sec
(c) infinity (d) none of these

55. In the arrangement shown in figure, there is friction between the blocks of masses m and 2 m which are in contact. The

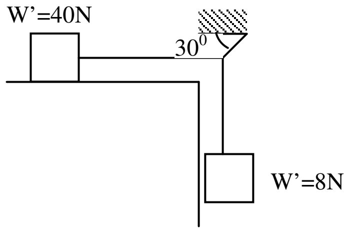


Smooth ground

ground is smooth. The mass of the suspended block is m. The block of mass m which is kept on mass 2m is stationary with respect to block of mass 2 m. The force of friction between m and 2m is (pulleys and strings are light and frictionless):

(a) $\frac{mg}{2}$ (b) $\frac{mg}{\sqrt{2}}$

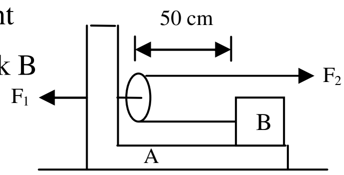
(c) $\frac{mg}{4}$ (d) $\frac{mg}{3}$



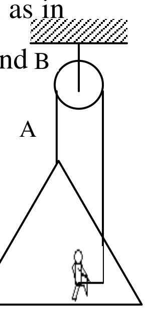
56. The system shown is just on the verge of slipping. The co-efficient of static friction between the block and the table top is:

(a) 0.5 (b) 0.95

(c) 0.15 (d) 0.35



57. A 1kg block 'B' rests as shown on a bracket 'A' of same mass. Constant forces F_1 =20N and F_2=8N start to act at time t=0 when the distance of block B from pulley is 50 cm. Time when block B reaches the pulley is ________



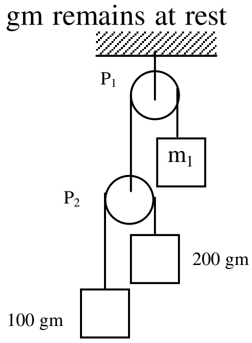
58. To point the side of a building, painter normally hoists himself up by pulling on the rope A as in figure. The painter and platform together weight 200 N. The rope B can withstand 300 N. Find

(a) the maximum acceleration of the painter.

(b) tension in rope a

(i) when painter is at rest

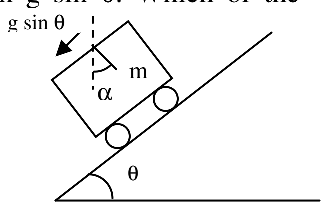
(ii) when painter moves up with an acceleration 2 m/s^2



60. In the system of pulleys shown what should be the value of m_1 such that 100 gm remains at rest w.r.t ground:

(a) 180 gm (b) 160 gm

(c) 100 gm (d) 200 gm



61. A trolley is accelerating down an incline of angle θ with acceleration g sin θ. Which of the following is correct. (α is the angle made by the string with vertical).

(a) α=θ (b) $\alpha=0^0$

(c) Tension in the string, T=mg

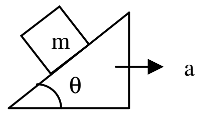
(d) Tension in the string, T=mg secθ

62. The force required just to move a body up an inclined plane is double the force required just to prevent the body from sliding down. If μ is the coefficient of friction, the inclination of plane to the horizontal is

(a) $\theta=\tan^{-1}(3\mu)$ (b) $\theta=\tan^{-1}(2\mu)$

(c) $\theta=\tan^{-1}(4\mu)$ (d) $\theta=\tan^{-1}(\mu)$

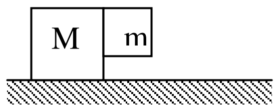
63. A block of mass m is stationary relative to the wedge when the wedge is accelerated with acceleration a. The friction force acting on the block is [μ= coefficient of friction between wedge and block]



(a) μm (g cosθ) -asinθ) (b) m (g sinθ-a cosθ)

(c) m (g sinθ+a cosθ) (d) ma sin θ

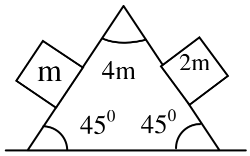
64. With what minimum acceleration mass M must be moved on frictionless surface so that m remains stick to it as shown. The coefficient of friction between M & m is μ.



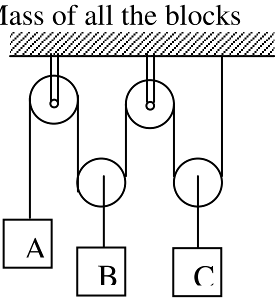
(a) μg (b) $\frac{g}{\mu}$

(c) $\frac{\mu mg}{M+m}$ (d) $\frac{\mu mg}{M}$

65. Find the acceleration of wedge of mass 4m placed on smooth horizontal surface as two blocks of masses m and 2 m slide over it.



66. In the pulley system shown here pulleys are ideal and string is inextensible. Mass of all the blocks is M.

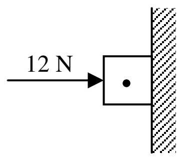


(a) Draw the free body diagram for all the blocks

(b) Find the constraint relationship between acceleration of the masses

(c) Find the acceleration of all the three masses and tension in the string.

67. A block of weight 5 N is pushed against a vertical wall by a force 12 N. The coefficient of friction between the wall and block is 0.6. Find the magnitude of the force exerted by the wall on the block..



68. A bead of mass 'm' can slide on a thin vertical rod, with sliding friction coefficient between them=μ. The rod is translated horizontally with a constant acceleration 'a'.

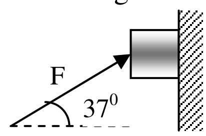
For what value of 'a' will an Earth observer see equal horizontal and vertical components of the acceleration of the bead?

(a) $g/(1+\mu)$ (b) $g/(1-\mu)$ (c) μg (d) none

69. The rear side of a truck is open and a box of mass 20 kg is placed on the truck 4 meters away from the open end μ =0.15 and g= 10 m/sec^2. The truck starts from rest with an acceleration of 2m/sec^2 on a straight road. The box will fall off the truck when truck is at a distance from the starting point equal to:

(a) 4 meters (b) 8 meters (c) 16 meters (d) 32 meters

70. A 1 kg block is being pushed against a wall by a force F=75 N as shown in the Figure. The coefficient of friction is 0.25. The magnitude of acceleration of the block is

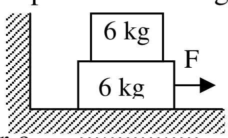


(a) 10 m/s^2 (b) 20 m/s^2

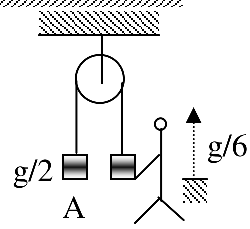
(c) 5 m/s^2 (d) None

71. A block is given certain upward velocity along the incline of elevation α. The time of ascent to upper point was found to be half the time of descent to initial point. Find the co-efficient of friction between block and incline.

72. If the coefficient of friction at all surfaces is 0.4, then find the force required to pull out the 6 kg block with an acceleration of 1.5 m/s^2.



73. Block A of mass m/2 is connected to one end of light rope which passes over a pulley as shown in the Fig. Man of mass m climbs the other end of rope with a relative acceleration of g/6 with respect to rope find acceleration of block A and tension in the rope.



74. A boat is moving towards east with velocity 4 m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is:

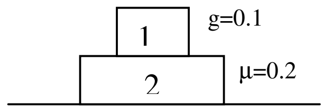
(a) north-west (b) south-east (c) $\tan^{-1}$ (1/2) with east (d) north

75. A plank of mass 2kg and length 1 m is placed on a horizontal floor. A small block of mass 1 kg is placed on top of the plank, at its right extreme end. The coefficient of friction between plank and floor is 0.5 and that between plank and block is 0.2.If a horizontal force =30 N starts acting on the plank to the right, the time after which the block will fall off the plank is (g=10m/s^2)

(a) (2/3) s (b) 1.5 s (c) 0.75 s (d) (4/3)s

76. For the two block s initially at rest under constant ext. forces of mass 1 kg and 2kg shown a_1= 5 m/s^2 →, a_2=2m/s^2 ←. Which of the following is correct?

(a) Force of friction on 1 due to 2 is 1 N to right. (b) force of friction on 2 due to 1 is 1 N to right



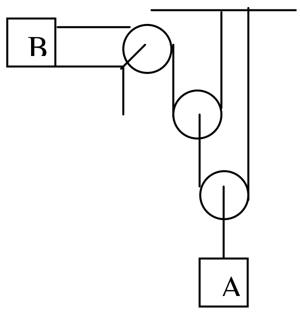
(c) Force of friction on 2 due to ground is 4 N to right.

(d) Force of friction on 2 due to ground is 6 N to right.

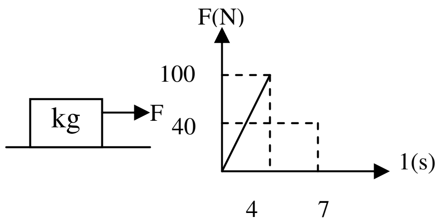
77. The upper portion of an inclined plane of inclination α is smooth and the lower portion is rough. A particle slides down from rest from the top and just comes to rest at the foot. If the ratio of smooth length to rough length is m m, find the coefficient of friction.

78. Determine the acceleration of the 5 kg block A. Neglect the mass of the pulley and cords. The block B has a mass of 10 kg. The coefficient of kinetic friction between block B and the surface is μ_1=0.1.

(Take g= 10 m/s^2)



79. The 110 kg block is resting on the horizontal surface when the force F is applied to it for 7 seconds. The variation of F with time is shown. Calculate the maximum velocity reached by the block and the total time t during which the block is in motion. The coefficient of static and kinetic friction are both 0.50.



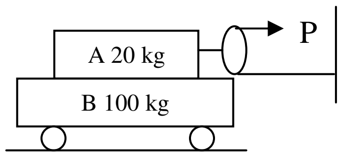
80. A block is to be raised a height h from rest to rest. If the rope used to lift the block can bear a maximum tension of λ mg (λ>1), where m is the mass of the block, the find the minimum time in which we can raise the block

81. Block A is placed on cart B as shown id figure. If the coefficients of static and kinetic friction between the 20 kg block A and 100 kg cart B are both essentially the same value of 0.5 [g=10 m/s^2]

(a) The blocks A and B will have a common acceleration if P = 60 N

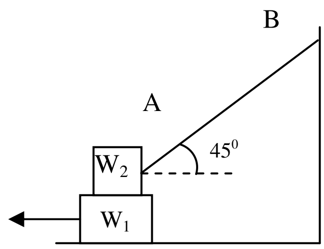
(b) Acceleration of cart B is 0.98 m/s^2 if P =40 N

(c) Acceleration of cart B is greater than that of A if P=60 N

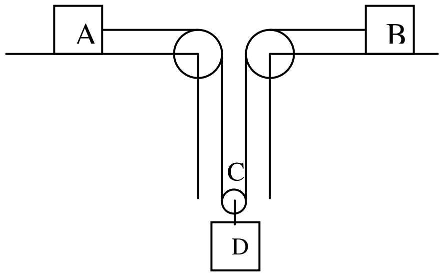


(d) The common acceleration of both the blocks is 0.667 m/s^2 if P=40 N

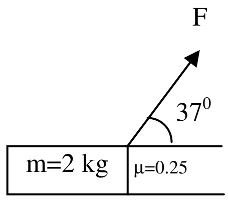
82. Calculate the force P required to cause the block of weight W_1 =200 N just to slide under the block of weight W_2=100 N. What is the tension in the string AB ? [Coefficient of friction μ =0.25 for all surfaces in contact].



83. Particles A and B of mass 5 kg and 3 kg are connected by a light inextensible string passing under a smooth light pulley C which carries a particle D of mass 4 kg. A and B rest on a horizontal rough surfaces as shown in the diagram. The coefficient of friction is same for both A and B and is just sufficient to prevent A, but not B, from moving. Find the coefficient of friction.

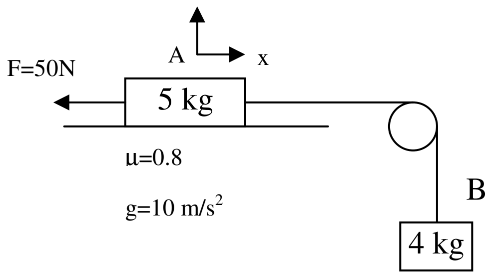


84. A force F =20 N is applied to a block (at rest) as shown in fig. After the blocks has moved a distance of 8m to the right, the direction of horizontal component of the force F is reversed. Find the velocity with which block arrives at its starting point.



85. Find the acceleration of the blocks and magnitude & direction of frictional force between block A and table, if block a is pulled towards left with a force of 50 N

86. The acceleration of end B when it has been displaced by distance x, is



(a) $\frac{x}{L}g$ (b) $\frac{2x}{L}g$ (c) $\frac{x}{2}g$ (d) g

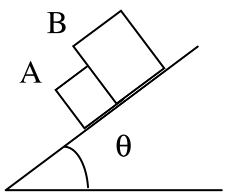
87. The two blocks A and B of equal mass are initially in contact when released from rest on the inclined plane. The coefficients of friction between the inclined plane A and B are μ_1 and μ_2 respectively

(a) If $\mu_1 > \mu_2$, the blocks will always remain in contact.

(b) If $\mu_1 < \mu_2$ the blocks will slide down with different acceleration (if blocks slide)

(c) If $\mu_1 > \mu_2$, the blocks will have a common acceleration $\frac{1}{2}(\mu_1 + \mu_2) g \sin\theta$

(d) If $\mu < \mu_2$, the blocks will have a common acceleration $\frac{\mu_1 \mu_2 g}{\mu_1 + \mu_2} \sin\theta$

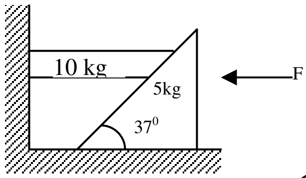


88. The system is in equilibrium

(a) Draw FBD of 10 kg block.

(b) Draw FBD of 5 kg wedge

(c)Find "F" so that the system is in equilibrium Neglect friction

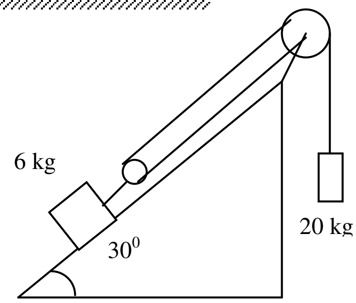


89. (a) Draw the FBD of 20 kg block.

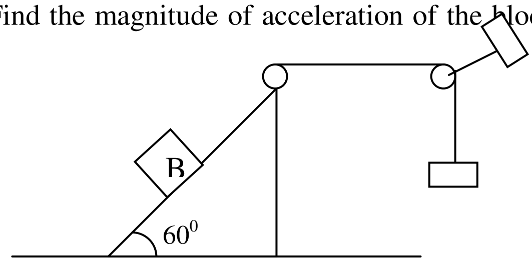
(b) Draw the FBD of 6 kg block

(c) Find the acceleration of the masses

Neglect friction, masses of pulleys and strings. Strings are inextensible



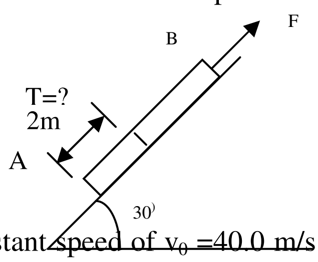
90. If acceleration of wedge =5 m/s^2 to the right. Find the magnitude of acceleration of the block B. The string is inextensible



91. A uniform string of length 10 m and mass 20 kg lies on a smooth frictionless inclined plane. A force of 200 N is applied as shown in the figure.

(a) Find the acceleration of string

(b) Find the tension in the string at 2m from end A



92. A police officer sits on a parked motorcycle. A car traveling at a constant speed of v_0 =40.0 m/s passes by at t=0. At that instant, the officer accelerates the motorcycle at a constant rate, and at time t_1 =20.0s overtakes the speeder .

(a) (i) Find the acceleration the motorcycle

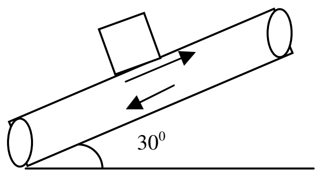
(ii) Find the speed of the motorcycle at the instant it overtakes the car.

(b) In the same graph, sketch the position-time graph of the car and that of the motorcycle. Label clearly.

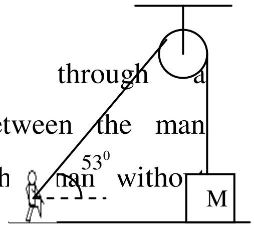
Particle Dynamics

21.2.08

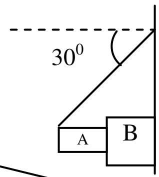
93. A block of mass 1 kg is stationary with respect to a conveyor belt that is accelerating with 1 m/s^2 upwards at an angle of 30^0 as shown in figure. Determine force of friction on block and contact force between the block & bell



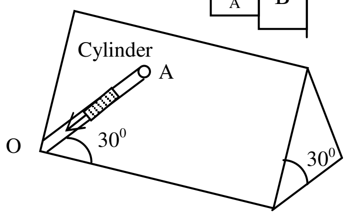
94. A man of mass 63 kg is pulling a mass M by an inextensible light rope passing through a smooth and massless pulley as shown in figure. The coefficient of friction between the man and the ground is μ 3/5. Find the maximum value of M that can be pulley by the man without slipping on the ground.



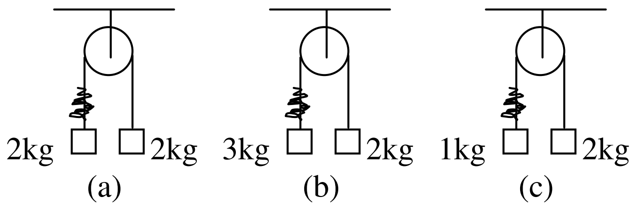
95. Two blocks A and B of mass m 10 kg and 20 kg respectively are placed as shown in figure. Coefficient of friction between all the surfaces is 0.2. Then find tension in string and acceleration of block B. ($g=10\ m/s^2$)



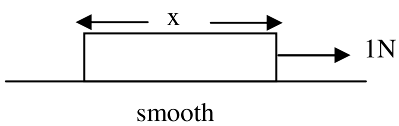
96. An inclined plane makes an angle 30^0 with the horizontal. A groove OA =5 c cut in the plane makes an angle 30^0 with OX. A short smooth cylinder is free to slide down the influence of gravity. Find the time taken by the cylinder to reach from A to O. ($g= 10\ m/s^2$)



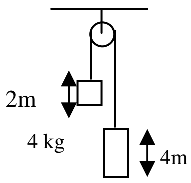
97. Same spring is attached with 2 kg, 3 kg and 1 kg blocks in three different cases as shown in figure. If x_1, x_2 and x_3 be the constant extensions in the spring in these three cases then find the ratio of their extensions



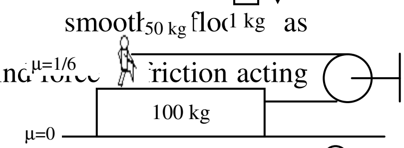
98. A rope of length L has its mass per unit length λ varies according to the function $\lambda\ (x) = e^{x/L}$. The rope is pulled by a constant force of 1 N on a smooth horizontal surface. Find the tension in the rope at x=L/2



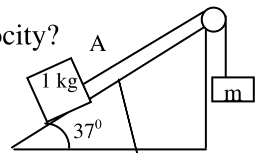
99. In figure shown, both blocks are released from rest. Find the time to cross each other ?

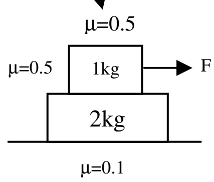


100. A man of mass 50 kg is pulling on a plank of mass 100 kg kept on a smooth floor as shown with force of 100 N. If both man & plank move together, find force of friction acting on man.



101. In the figure, what should be mass m so that block A slide up with a constant velocity?

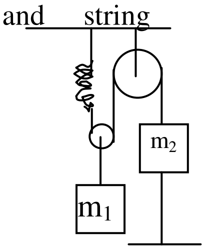




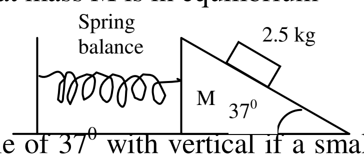
PHYSICS

102. What should be minimum value of F so that 2 kg slides on ground but 1 kg does not slide on it? [g=10 m/sec^2]

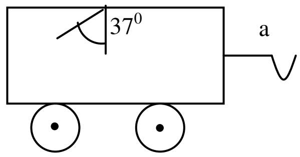
103.In figure shown, pulley are ideal m_1>2 m_2, Initially the system is sin equilibrium and string connecting m_2 to rigid support below is cut. Find the initial acceleration of m_2?



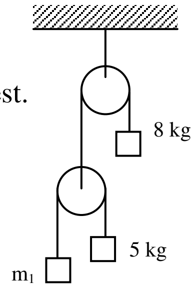
104. Find the reading of spring balance as shown in figure. Assume that mass M is in equilibrium



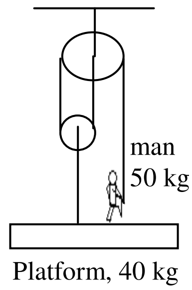
105. At what acceleration of the trolley will the string makes an angle of 37^0 with vertical if a small mass is attached to bottom of string.



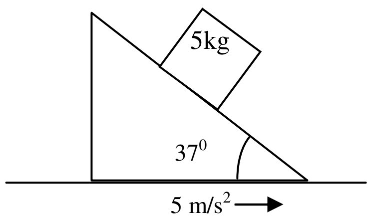
106. At what value of m_l will 8 kg mass be at rest.



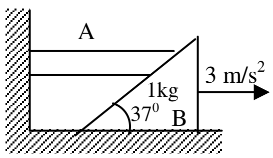
107. What force must man exert on rope to keep platform in equilibrium?



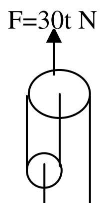
108. Inclined plane is moved towards right with an acceleration of 5 ms^{-2} as shown in figure. Find force in Newton which block of mass 5 kg exerts on the incline plane.



109.Find force in Newton which mass A exerts on mass B if B is moving towards right with 3 ms^{-2}. Also find mass of A.

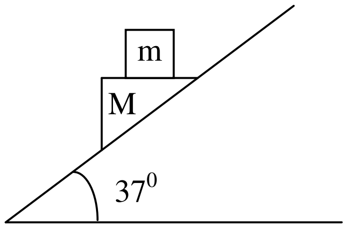


110. Force F is applied on upper pulley. If F = 30 t where t is time in second. Find the time when m_l loses contact with floor.

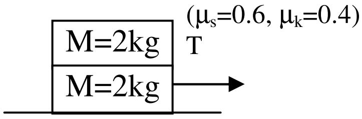


111. A block of mass 1 kg is horizontally thrown with a velocity of 10 m/s on a stationary long plank of mass 2 kg whose surface has a μ=0.5. Plank rests on frictionless surface. Find the time when m_1 comes to rest w.r.t plank.

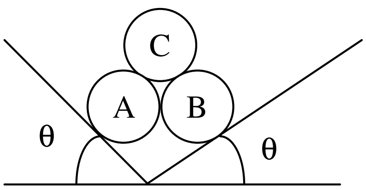
112. Block M slides down on frictionless incline as shown. Find the minimum friction coefficient so that m does not slide with respect to M.



113. The coefficient of static and kinetic friction between the two blocks and also between the lower block and the ground are μ_s=0.6 and μ_k =0.4. Find the value of tension T applied on the lower block at which the upper block begins to slip relative to lower block.



114. Three identical rigid circular cylinders A, B and C are arranged on smooth inclined surfaces as shown in figure. Find the least value of θ that prevent the arrangement from collapse.

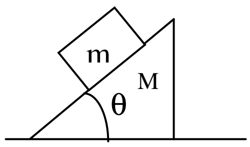


115. Two men A and B of equal mass held on to the free ends of a massless rope which passes over a frictionless light pulley. Man A climbs up the rope with acceleration a relative to the rope while man B hangs on without climbing. Find the acceleration of the man B with respect to ground.

116. A thin rod of length 1 m is fixed in a vertical position inside a train, which is moving horizontally with constant acceleration 4 m/s^2. A bead can slide on the rod, and friction coefficient between them is ½. If the bead is released from rest at the top of the rod, find the time when it will reach at the bottom.

117.A body of mass M=5kg rests on a horizontal plane having coefficient of fiction μ =0.5. At t=0 a horizontal force F is applied that varies with time as F =5t. Find the time instant t_0 at which motion starts and also find the distance of particle from starting point at t =6 second.

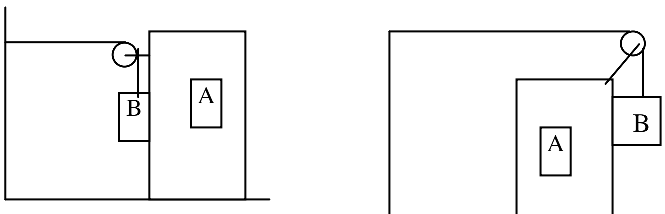
118. A block of mass m lies on wedge of mass M as shown in figure. Answer following parts separately.



(a)With what minimum acceleration must the wedge be moved towards right horizontally so that block m falls freely.

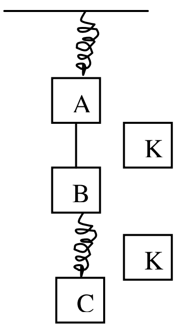
(b) Find the minimum friction coefficient required between wedge M and ground so that it does not move while block m slips down on it.

119. A 20 kg block B is suspended from a cord attached to a 40 kg cart A. Find the ratio of the acceleration of the block in cases (i) & (ii) shown in figure immediately after the system is released from rest. (Neglect friction)



Case (i) Case (ii)

120. The system shown adjacent is in equilibrium. Find the acceleration of the blocks A, B & C all of equal masses m at the instant when (Assume springs to be ideal)



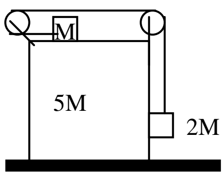
(a) The spring between ceiling & A is cut.

(b) The string (inextensible) between A & B is cut.

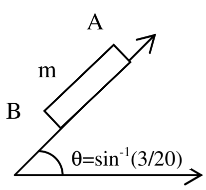
(c) The spring between B & C is cut.

Also find the tension in the string when the system is at rest and in the above 3 cases.

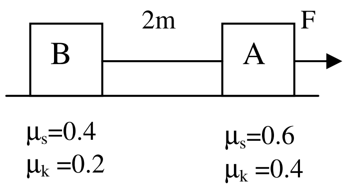
121. In the system shown. Find the initial acceleration of the wedge of mass 2 M. The pulleys are ideal and the cords are inextensible. (There is no friction anywhere)



122. A plank of mass m is kept on a smooth inclined plane. A man of mass η times the mass of plank moves on the plank, starts from A, such that the plank is at rest, w.r.t. the inclined plane. It he reaches the other end B of the plank in t=5 sec. Then find the acceleration & the value of η, if the length of the plank is 50m.



123. Two horizontal blocks each of mass ½ kg are connected by a massless, inextensible string of length 2m and placed on a long horizontal table. The



coefficient of static & kinetic friction are shown in the figure. Initially the blocks are at rest. If the leading block is pulled with a time dependent horizontal force $F=kt\hat{i}$ where k=1 N/sec, determine

(a) The plots of acceleration of each block with time front t=0 to t=10 sec.

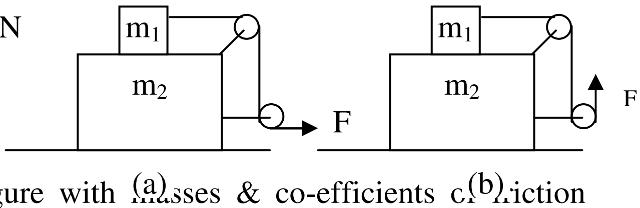
(b) Velocity of blocks at t=10 sec.

(c) Distance transversed by the blocks in the time interval t=0 to t=10 sec.

(d) If F stops acting at t=10 sec. Find after how much further time would B collide with A.

124. m_1=20 kg, m_2= 30 kg, m_2 is on smooth surface. Surface between m_1 and m_2 has μ_s=0.5 and μ_k=0.3. Find the acceleration of m_1 and m_2 for the following cases

(a) (i) F=160 N, (ii) F=175N; (b) F=160 N



125. A system of masses is shown in the figure with masses & co-efficients of friction indicated. Calculate:

(i) the maximum value of F for which there is no slipping anywhere.

(ii) the minimum value of F for which B slides on C

(iii) the minimum value of F for which A slips on B

Diagram

126. A car begins to move at time t=0 and then accelerates along a straight track with a speed given by $V(t) = 2t^2\ ms^{-1}$ for $0 \le t\eta\ 2$

After the end of acceleration, the car continues to move at a constant speed. A small block initially at rest on the floor of the car begins to slip at t=1 sec. and stops slipping at t=3sec.Find the coefficient of static and kinetic friction between the block and the floor.

127. A smooth right circular cone of semi vertical angle $\alpha=\tan^{-1}(5/12)$ is at rest on a horizontal plane. A rubber ring of mass 2.5 kg which requires a force of 15 N for an extension of 10 cm is placed on the cone. Find the increase in the radius of the ring in equilibrium.

128. A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5N on the block. If the coefficient of friction between the block and the wall is 0.5, the magnitude of the frictional force acting on the block is

(a) 2.5 N (b) 0.98 N (c) 4.9 N (d) 0.49 N

129. Block A of mass m and block B of mass 2m are placed on a fixed triangular wedge by means of a massless inextensible string and a frictionless pulley as shown in the figure. The wedge is inclined at 45^0 to the horizontal on both sides. The coefficient of friction between block A and the wedge is 2/3 and that between block B and the wedge is 1/3. If the system A and B is released from rest, find (i) the acceleration of A, (ii) tension in the string, (iii) the magnitude and the direction of friction acting on A.

Diagram

130. A spring of force constant k is cut into two pieces such that one piece such that one is piece is double the length of the other. Then the long piece will have a force constant of

(a) (2/3) k (b) (3/2) k (c) 3k (d) 6k

131. In the figure masses m_1, m_2 and M are 20 kg, 5 kg and 50 kg respectively. The co-efficient of friction between M and ground is zero. The co-efficient of friction between M and ground is zero. The co-efficient of friction between m_1 and M and that between m_2 and ground is 0.3. The pulleys and the string are massless. The string is perfectly horizontal between P_1 and m_1 and also between P_2 and m_2. The string is perfectly vertical between P_1 and P_2. An external horizontal force F is applied to the mass M. Take g=10 m/s^2.

(a) Draw a free-body diagram for mass M, clearly showing all the forces.

(b) Let the magnitude of the force of friction between m_1 and M be f_1 and that between m_2 and ground be f_2. for a particular F it is found that f_1=2f_2. Find f_1 and f_2. Write down equations of motion of all the masses. Find F, tension in the string and accelerations of the masses.

Diagram

132. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be

(a) 0^0 (b) 30^0 (c) 45^0 (d) 60^0

Diagram

133. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given

(a) $\sqrt{2}Mg$ (b) $\sqrt{2}mg$ (c) $\sqrt{(M+m)^2+m^2g}$ (d) $\sqrt{(M+m)^2+M^2}g$

Diagram

134. A block of mass √3 kg is placed on a rough horizontal surface whose coefficient of friction is ½ √3 minimum value of force F (shown in figure) of which the block starts to slide on the surface ($g=10m/s^2$)

(a) 20 N (b) 20√3 N (c) 10 √3 N (d) none of these

Diagram

135. Two blocks A and B of equal masses are released from an inclined plane of inclination 45^0 at t=0. Both the blocks are initially at rest. The coefficient of kinetic friction between the block A and the inclined plane is 0.2 while it is 0.3 for block B. Initially, the block A is √2 m behind the block B. When and where their front faces will come in a line.

[Take $g= 10\ m/s^2$]

Diagram

136. Two blocks A and B of masses 2m and m, respectively, are connected by massless and inextensible string. The whole system is suspended by a massless spring as shown in the figure. The magnitudes of acceleration of A and B, immediately after the string is cut, are respectively

a) g, g (b) g, g/2 (c) g/2, g (d) g/2, g/2

Diagram

137. A circular disc with a groove along its diameter is placed horizontally A block of mass 1 kg s placed as shown . The co-efficient of friction between the block and all surfaces of groove n contact is μ =2/5. The disc has an acceleration of 25 m/s^2. Find the acceleration of the lock with respect to disc.

Diagram

138. In a tug of war, three men pull on a rope to the left at A and three men pull to the right at B with forces of equal magnitude. Now a weight of 5.0 lb is hung vertically from the centre of the rope.

(a) Can the men get the rope AB to be horizontal ?

(b) If not, explain. If so, determine the magnitude of the forces required at A and B to do this.

139. A massless rope is strung over a frictionless pulley. A monkey holds onto one end of the rope and a mirror, having the same weight as the monkey, is attached to the other end of the rope at the monkey's level . Can the monkey get away from his image seen in the mirror.

(a) by climbing up the rope

(b) by climbing down the rope

(c) by releasing the rope?

140. A student standing on the large platform of a spring scale notes his weight. He then takes a step on this platform and noticed that the scale reads less than his weight at the beginning of the step and more than his weight at the end of the step. Explain.

141. An object is placed far away from all the objects that can exert force on it. A frame of reference is constructed by taking the origin and axes fixed in this object. Will the frame be necessarily inertial?

142. The acceleration of a particle is zero as measured from an inertial frame of refrence. Can we conclude that no forces acts on the particle?

143. Two blocks of unequal masses are tied by a spring. The blocks are pulled stretching the spring slightly and the system is released on a frictionless horizontal platform. Are the forces due to the spring on the two blocks equal and opposite? If yes, is it an example of Newton's third law?

144. How could a person who is at rest on completely frictionless ice covering a pond reach shore? Could he do this by walking, rolling, swinging his arms, or kicking his feet? How could a person be placed in such a position in the first place?

145. If you want to stop the car in the shortest distance on an ice road, should you

(a) push hard on the brakes to lock the wheels, (b) push just hard enough to prevent slipping, or (c) "pump" the breaks?

146.How does the earth's rotation affect the apparent weight of a body a body at the equator?

147. Suppose you need to measure whether a table top in a train is truly horizontal. If you use a spirit level can you determine this when the train is moving down or up a grade? When the train is moving along a curve?

148. A classroom demonstration of Newton's first laws is as follows: A glass is covered with a plastic card and a coin is placed on the card. The card is given a quick strike and the coin falls in the glass.

(a) Should the friction coefficient between the card and the coin be small or large?

Punjab Edusat Society

(b) should the coin be light or heavy?

(c) Why does the experiment fail if the card is gently pushed?

149. Why is it difficult to walk on sand?

150. Explain why a man getting out of a moving train must run in the same direction for a certain distance .

151. During a high jump event, it hurts less when an athlete lands on a heap of sand. Explain.

152. A rod not reaching the rough floor is inserted between two identical blocks. A horizontal force F is applied to the upper end of the rod. Which of the blocks will move first?

Diagran

153. A woman is an elevator lets go of her briefcase but it does not fall to the floor. How is the elevator moving?

154. You take two identical tennis balls and fill one with water. You release both balls simultaneously from the top of a tall building. If air resistance is negligible, which ball strikes the ground first? Explain. What is the answer if air resistance is not negligible?

155. "A ball is thrown from the edge of a high cliff. No matter what the angle at which it is thrown, due to air resistance, the ball will eventually end up moving vertically downward. " Justify this statement.

156. In the figure shown the block B moves down with a velocity 10 m/s. The velocity of A in the position shown is:

(a) 12.5 m/s (b) 25 m/s (c) 6.25 m/s (d) none of these

DIAGRAM

157. In the figure shown the velocity of different blocks is shown. The velocity of C is

(a) 6 m/s (b) 4 m/s (c) 0 m/s (d) none of these

DIAGRAM

158. Two identical mass m mar connected to a massless string is hung over two frictionless pulleys as shown in figure. If everything is at rest, what is the tension in the cord?

(a) less than mg (b) exactly mg (c) more than mg but less than 2 mg

DIAGRAM

159.A flexible chain of weight W hangs between two fixed points A & B which are at the same horizontal level. The inclination of the chain with the horizontal at both the points of support is θ. What is the tension of the chain at the mid point?

(a) W/2 cosec θ (b) W/2 tanθ (c) W/2 cot θ (d) none

160.Two blocks are connected by a spring. The combination is suspended, at rest, from a string attached to the ceiling, as shown in the figure. The string breaks suddenly. Immediately after the string breaks, what is the initial downward acceleration of the upper block of mass 2 m?

(a) 0 (b) 3g/2 (c) g (d) 2g

DIAGRAM

161. Two blocks A and B each of same mass are attached by a thin inextensible string through an ideal pulley. Initially block B is held in position as shown in fig. Now the block B is eleased. Block A will slide to right and hit the pulley in time t_A. Block B will swing and hit he surface in time t_B. Assume the surface as frictionless. [Hint: Tension T in the string acting n both blocks is same in magnitude. Acceleration needed for horizontal motion is from T.]

(a) $t_A=t_B$ (b) $t_A<t_B$ (c) $t_A>t_B$

d) data are not sufficient to et relationship between t_A and t_B

DIAGRAM

162. A body is placed on a rough inclined plane of inclination θ. As the angle θ is increased from 0^0 to 90^0 the contact force between the block and the plane

(a) remains constant (b) first remains constant than decreases

(c) first decreases then increases (d) first increases then decreases

163. A force $\hat{F} = \hat{i} + 4\hat{j}$ acts on block shown. The force of friction acting on the block is:

(a) $-\hat{i}$ (b) -1.8 $\hat{i}$ (c) $-2.4\hat{i}$ (d) $-3\hat{i}$

Diagram

164. A 1.0 kg block of wood sits on top on an identical block of wood, which sits on top of a flat level table made of plastic. The coefficient of static friction between the wood surfaces is μ_1, and the coefficient of static friction between the wood and plastic is μ_2.

A horizontal fore F is applied to the top block only, and this force is increased until the top block starts to move. The bottom block will move with the top block if and only if

(a) $\mu_1 < \frac{1}{2}\mu_2$ (b) $\frac{1}{2}\mu_2 < \mu_1 < \mu_2$ (c) $\mu_2 < \mu_1$ (d) $2\mu_2 < \mu_1$

165. A block of mass 2 kg slides down an incline plane of inclination 30^0 .The coefficient of friction between block and plane is 0.5. The contact force between block and plank is ;

(a) 20 Nt (b) 10√3 Nt (c) 5√7 Nt (d) 5√15 Nt

166. If force F is increasing with time and at t=0, F=0 where will slipping first start?

(a) between 3 kg and 2 kg (b) between 2kg and 1 kg

(c) between 1 kg and ground (d) both (a) and (b)

Diagram

167. A man is standing on a rough (μ=0.5) horizontal disc rotating with constant angular velocity of 5 rad/sec. At what distance from centre should he stand so that he does not slip on the disc?

(a) R≤ 0.2m (b) R>0.2 m (c) R>0.5 m (d) R>0.3 m

168.A uniform rod of length L and mass M has been placed on a rough horizontal surface. The horizontal force F applied on the rod is such that the rod is just in the state of rest. If the coefficient of friction varies according to the relation μ =Kx where K is a +ve constant . Then the tension at mid point of rod is

(a) F/2 (b) F/4 (c) F/8 (d) none

Diagram

169. In the arrangement shown in the figure, mass of the block B and A is 2m and m respectively. Surface between B and floor is smooth. The block B is connected to the block C by means of a string pulley system. If the whole system is released, then find the minimum value of mass of block C so that block A remains stationary w.r.t. B. Coefficient of friction between A and B is μ:

(a) $\frac{m}{\mu}$ (b) $\frac{2m+1}{\mu+1}$ (c) $\frac{3m}{\mu-1}$ (d) $\frac{6m}{\mu\_+1}$

Diagram

170. With what minimum velocity should block be projected from left end A towards end B such that it reaches the other end B of conveyer belt moving with constant velocity v. Friction coefficient between block and belt is μ.

(a) $\sqrt{\mu gL}$ (b) $\sqrt{2\mu gL}$ (c) $\sqrt{3\mu gL}$ (d) $2\sqrt{\mu gL}$

Diagram

171. Block B of mass 100 kg rests on a rough surface of friction coefficient μ=1/3. A rope is tied to block B as shown in figure. The maximum acceleration with which boy A of 25 kg can climbs on rope without making block move is:

(a) $\frac{4g}{3}$ (b) $\frac{g}{3}$ (c) $\frac{g}{2}$ (d) $\frac{3g}{4}$

Diagram

172. A car moves along a circular track of radius R banked at an angle of 30^0 to the horizontal. The coefficient of static friction between the wheels and the track is μ. The maximum speed with which the car can move without skidding out is

(a) $\left[2gR(1+\mu)/\sqrt{3}\right]^2$ (b) $\left[gR(1-\mu)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$

(c) $\left[gR(1+\mu\sqrt{3})\left(\mu+\sqrt{3}\right)\right]^{1/2}$ (d) None

Diagram

173. The system shown in figure is released

(a) a_1=0.35 m/s^2; a_2= 4.5 m/s^2 (b) a_1=3m/s^2; a_2=0.5 m/s^2

(c) a_1=2 m/s^2; a_2=2 m/s^2 (d) a_1 =0.5 m/s^2; a_2=3m/s^2

Diagram

174. A block placed on a rough inclined plane of inclination ($\theta=30^0$) can just be pushed upwards by applying a force "F" as shown. It the angle of inclination of the inclined plane is increased to (θ-60^0), the same block can just be prevented from sliding down by application of a force of same magnitude. The coefficient of friction between the block and the inclined plane is

(a) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$ (b) $\frac{2\sqrt{3}-1}{\sqrt{3}+1}$ (c) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ (d) none of these

Diagram

175. When F =2N, the frictional force between 5 kg block and ground is

(a) 2N (b) 0 (c) 8 N (d) 10 N

Diagram

176. When F =2N, the frictional force between 10 kg block and 5 kg block is

(a) 2N (b) 15 N (c) 10 N (d) None

177. The maximum "F" which will not cause motion of any of the blocks.

(a) 10 N (b) 15 N (c) data insufficient (d) None

178. The maximum acceleration of 5 kg block

(a) 1 m/s^2 (b) 3 m/s^2 (c) 0 (d) None

179. The acceleration of 10 kg block, when F=30 N

(a) 2 m/s^2 (b) 3 m/s^2 (c) 1 m/s^2 (d) None

180. The blocks are in equilibrium. The friction force acting on 10 kg block is :

(a) 10 N down the plane (b) 40 N up the plane (c) 10 N up the plane (d) none

Diagram

181. A truck starting from rest moves with an acceleration of 5 m/s^2 for 1 sec and then moves with constant velocity. The velocity w.r.t. ground v/s time graph for block in truck is (Assume that block does not fall off the truck)

(a) …….

Diagram

182. A small block of mass m is projected horizontally with speed u where friction coefficient between block and plane is given by μ=cx, where x is displacement of the block on plane. Find maximum distance covered by the block

(a) $\frac{u}{\sqrt{cg}}$ (b) $\frac{u}{\sqrt{2cg}}$ (c) $\frac{2x}{L}g$ (d) $\frac{u}{2\sqrt{cg}}$

183. Equal force F(>mg) is applied to string in all the 3 cases. Starting from rest, the point of application of force moves a distance of 2 m down in all cases. In which case the block has maximum kinetic energy .

(a) 1 (b) 2 (c) 3 (d) equal in all 3 cases

DIAGRAM

184. In the system shown in the figure there is no friction anywhere. The block C goes down by a distance x_0 =10 cm with respect to wedge D when system is released from rest. The velocity of A with respect to B will be (g=10 m/s^2)

(a) zero (b) 1 m/s (c) 2 m/s (d) none of these

Diagram

185. In the figure shown all the surfaces are frictionless, and mass of the block, m=1kg. The block and wedge are held initially at rest. Now wedge is given a horizontal acceleration of

10 m/s^2 by applying a force on the wedge, so that the block does not slip on the wedge. Then work done by the normal force in ground frame on the block in √3 seconds is

(a) 30 J (b) 60 J (c) 150 J (d) 100 √3 J

Diagram

186. A hollow vertical cylinder of radius R is rotated with angular velocity ω about an axis through its center. What is the minimum coefficient of static friction necessary to keep the mass M suspended on the inside of the cylinder as it rotates?

(a) $\mu\frac{gR}{\omega^2}$ (b) $\mu\frac{\omega^2 g}{R}$ (c) $\mu\frac{\omega^2 R}{g}$ (d) $\mu\frac{g}{\omega^2 R}$

Diagram

187. The acceleration of end B when it has been displaced by distance x, is

(a) $\frac{x}{L}g$ (b) $\frac{2x}{L}g$ (c) $\frac{x}{2}g$ (d) g

Diagram

188. In the diagram shown, no friction at any contact surface. Initially, the spring has no deformation. What will be the maximum deformation in the spring ? Consider all the string to be sufficiency large. Consider the spring constant to be K.

(a) 4F/3K (b) 8F/3K (c) F/3K (d) nond

Diagram

189. Which graph shows best the velocity-time graph for an object launched vertically into the air when air resistance is given by |D| =bv? The dashed line shows the velocity graph if the were no air resistance.

Diagram

190. To paint the side of a building, painter normally hoists himself up by pulling on the rope A as in figure. The painter and platform together weight 200 N. The rope B can withstand 300N. Then.

(a) The maximum acceleration that painter can have upwards is 5 m/s^2

(b) To hoist himself up, rope B must withstand minimum 400N force.

(c) Rope A will have a tension of 100 N when the painter is at rest.

(d) The painter must exert a force of 200N on the rope A to go downwards slowly.

Diagram

191. Two men of unequal masses hold on to the two sections of a light rope passing over a smooth light pulley. Which of the following are possible?

(a) The lighter man is stationary while the heavier man slides with some acceleration

(b) The heavier man is stationary while the lighter man climbs with some acceleration

(c) The two men slide with the same acceleration in the same direction

(d) The two men move with accelerations of the same magnitude in opposite directions.

Diagram

192. Adjoining figure shows a force of 40 N acting 30^0 to the horizontal on a body of mass 5 kg resting on a smooth horizontal surface. Assuming that the acceleration of free-fall is 10 ms^{-2}m, which of the following statements A, B, C, D, E is (are) correct?

(a) The horizontal force acting on the body is 20 N

(b) The weight of the 5 kg mass acts vertically downwards

(c) The net vertical force acting on the body is 30 N

(d) 1, 2, 3 (b) 1, 2 (c) 2 only (d) 1 only

Diagram

193. An iron sphere weighing 10 N rests in a V shaped smooth trough whose sides form an angle of 60^0 as shown in the figure. Then the reaction forces are

(a) R_A =10 N & R_B =0 in case (i)

(b) R_A =10 N & R_B =10 N in case (ii)

(c) $R_A = \frac{20}{\sqrt{3}}$ N & $R_B = \frac{10}{\sqrt{3}}$ N in case (iii)

(d) R_A = 10 N & R_B = 10 N in all the three cases

Diagram

(For 3 Q) **Imagine the situation in which the given arrangement is placed inside a trolley that can move only in the horizontal direction, as shown in figure. If the trolley is acceleration horizontally along the positive x-axis with a_0. then**

Diagram

194. Choose the correct statement(s).

(a) There exists a value of $a_0 = \beta$ at which friction force on block M becomes zero

(b) There exists two values of $a_0 = (\beta+\alpha)$ and $(\beta-\alpha)$ at which the magnitudes of friction acting on block M are equal

(c) The maximum value of static friction force acts on the block M at two acceleration a_1 and a_2 such that $a_1+a_2=2\beta$

(d) The maximum value of friction is independent of the acceleration a_0

195. If a_{min} and a_{max} are the minimum and maximum values of a_0 for which the blocks remain stationary with respect to the surface, then identify the correct statements

(a) If $a_0<a_{min}$, the block m accelerates downward (b) If $a_0>a_{max}$, the block m accelerates upward

(c) The block m does not accelerate up or down when $a_{min}\leq a_0\leq max$

(d) The friction force on the block M becomes zero when $a_0 \frac{a_{min}+a_{max}}{2}$

196. Identify the correct statement(s0 related to the tension T in the string

(a) No value of a_0 exists at which T is equal to zero

(b) There exists a value of a_0 at which T =mg

(c) If T< mg, then it must be more than μMg

(d) If T> mg, then it must be less than μMg

(Question No. first 4)

In figure, two blocks M and m are tied together with an inextensible and light string. The mass M is placed on a rough horizontal surface with coefficient of friction μ and the mass m is hanging vertically against a smooth vertical wall. The pulley is frictionless.

Diagram

197. Choose the correct statement(s)

(a) the system will accelerate for any value of m

(b) the system will accelerate only when m>M

(c) the system will accelerate only when m>μM

(d) nothing can be said

198. Choose the correct statement(s) related to the tension T in the string

(a) when m<μM, T=mg (b) when m<μM, T=Mg

(c) when m>μM, μMg< T<mg (d) when m> μM, mg < T < μ Mg

199. Imagine a situation in which the given arrangement is placed inside an elevator that can move only in the vertical direction and compare the situation with the case when it is placed on the ground. When the elevator accelerates downward with a_0 (<g), then

(a) the limiting friction force between the block M and the surface decreases

(b) the system can accelerate with respect to the elevator even when m < μM

(c) the system does not accelerate with respect to the elevator unless m> μM

(d) the tension in the string decreases.

Diagram

200. When the downward acceleration of the elevator becomes equal to g, then

(a) both the blocks remain stationary with respect to the elevator

(b) both the blocks accelerate vertically downwards with g with respect to ground

(c) the tension in the string becomes equal to zero

(d) the friction force between the block M and the surface is zero

(first seven Questions)

A block of mass M is placed on a horizontal surface and it is tied with an inextensible string to a block of mass, as shown in figure. A block of mass m_0 is also placed on M

Diagram

201. If there is no friction between any two surfaces, then

(a) the downward acceleration of the block m is $\frac{mg}{m+m_0+M}$

(b) the acceleration of m_0 is zero

(c) if the tension in the string is T then Mg < T<mg

(d) all the above

If a friction force exist between block M and the horizontal surface with the coefficient of friction μ.

202. The minimum value of μ for which the block remains stationary is

(a) $\frac{m}{M}$ (b) $\frac{m}{M+m_0}$ (c) $\frac{M+m_0}{M}$ (d) $\frac{M}{M+m_0}$

203. If $\mu<\mu_{min}$ (the minimum friction required to keep the block m stationary), then the downward acceleration of m is

(a) $\left[\dfrac{m-\mu M}{m+M}\right]g$ (b) $\left[\dfrac{m-\mu(m_0+M)}{m+m_0+M}\right]g$

(c) $\left[\dfrac{m-\mu(m_0+M)}{m+M}\right]g$ (d) $\left[\dfrac{m-\mu M}{m+m_0+M}\right]g$

204. In previous problem, the tension in the string will be

(a) $\dfrac{mM}{m+M}g$ (b) $\dfrac{m(m_0+M)}{m+m_0+M}g$

(c) $\left[\dfrac{m+\mu(m_0+M}{m+M}\right]Mg$ (d) $\left[\dfrac{mM+\mu m(m_0+M)}{m+M}\right]g$

205. If μ_0 be the coefficient of friction between the block M and the horizontal surface then the minimum value of m_0 required to keep the block m stationary is

(a) $\dfrac{m}{\mu}M$ (b) $\dfrac{m-M}{\mu}$ (c) $\dfrac{m}{\mu}+M$ (d) $\dfrac{m+M}{\mu}$

206. If friction force exists between the block M and the block m_0 and not between the block M and the horizontal surface, then the minimum value of μ of which the block m remains stationary is

(a) $\dfrac{m}{m_0}$ (b) $\dfrac{m}{m_0+M}$ (c) $\dfrac{m_0}{m+m_0+M}$ (d) none of these

(first 4 Question s)]

Imagine a situation in which the horizontal surface of block M_0 is smooth and its vertical surface is rough with a coefficient of friction μ

Diagram

207. Identify the correct statement(s)

(a) If F =0, the blocks cannot remain stationary

(b) For one unique value of F, the blocks M and m remain stationary with respect to M_0

(c) The limiting friction between m and M_0 is independent of F

(d) There exist a value of F at which friction force is equal to zero.

208. In above problem, choose the correct value(s) of F which the blocks M and m remain stationary with respect to M_0

(a) $(M_0+M+m)\,\dfrac{g}{\mu}$ (b) $\dfrac{m(M_0+M+m)g}{M-\mu m}$

(c) $(M_0+M+m)\dfrac{mg}{M}$ (d) none of these

209. Consider a special situation in which both the faces of the block M_0 are smooth, as shown in adjoining figure. Mark out the correct statement(s)

(a) If F =0, the blocks cannot remain stationary

(b) For one unique value of F, the blocks M and m remain stationary with respect to block M_0

(c) There exists a range of F for which blocks M and m remain stationary with respect to block M_0

(d) Since there is no friction, therefore, blocks M and m cannot be in equilibrium with respect to M_0

210. In above problem the value(s) of F for which M and m are stationary with respect to M_0

(a) (M_0+M+m) g (b) (M_0+M+m) mg/M

(c) $M_0+M+m)$ Mg/m (d) none of these

211. A particle with constant total energy E moves in one dimension in a region where the potential energy is U(x). The speed of the particle is zero where.

(a) U(x)=E (b) U(x) =0 (c) $\dfrac{dU(x)}{dx}=0$ (d) $\dfrac{d^2U(x)}{dx^2}=0$

Total Qs. 211

PHYSICS

Laws of Motion

1. Suppose a particle is moving on a curved trajectory. Then

   (a) if its speed is constant it has no acceleration

   (b) If its speed is increasing the acceleration of the particle is same as direction of motion

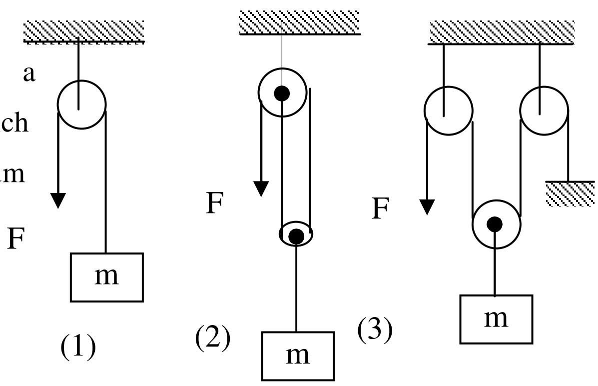
   (c) if its speed is constant the magnitude of its acceleration is proportional to its curvature

   (d) if the speed the particle is none zero at all time then the direction of its acceleration cannot be along the direction of motion.

2. Suppose you have given a block which is to be pulled using a light string on a rough floor for which the coefficient of friction is μ. What should be the minimum force F to be applied on the string so that block of mass M move with uniform velocity.

   (a) Mg tan $\theta/2$ (b) Mg cot $\theta/2$ (c) $\dfrac{Mg\cos\theta}{1+\sin\theta}$ (d) None

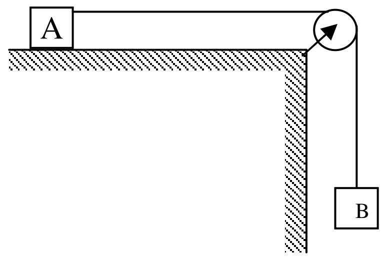
3. Force F is applied to string as shown. Point of application of force moves a distance of 6 m down in all cases. In which case mass m has the has maximum acceleration ?



(a) 1 (b) 2

(c) 3 (d) equal in all 3 cases

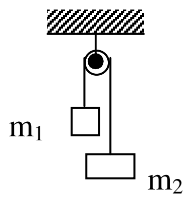
4. Block A is place on smooth floor but in a viscous medium. It is observed that block A is moving with uniform velocity v as shown. The tension in the string will be (given $m_a = m_b = m$):



(a) mg (b) mg/2

(c) mg/3 (d) mg/4

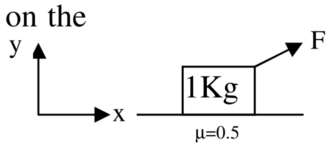
5. Let you have been given that acceleration of both the blocks have magnitude $\dfrac{(m_1-m_2)g}{m_1+m_2}$, $(m_1>m_2)$ than which of the following are assumption(s) made to arrive at the given result.



(a) pulley is frictionless (b) string is massless

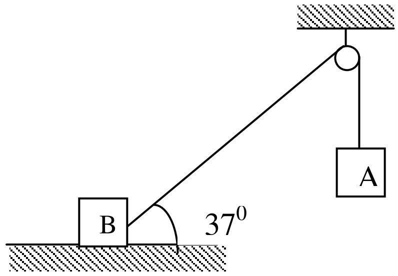
(c) pulley is massless (d) string is inextensible

6. A force $\vec{F} = 1.3\hat{i} + 5\hat{j}$ acts on block shown. The force of friction acting on the block is:



(a) $-1.3\hat{i}$ (b) -2.5 $\hat{i}$ (c) -5 $\hat{i}$ (d) None of these

7. At a given instant, A is moving with velocity of 4m/s upwards. What is velocity of B at that time :



(a) $5m/s$ (b) $15m/s\uparrow$

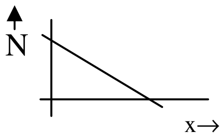
(c) $4m/s$ (d) $5m/s\uparrow$

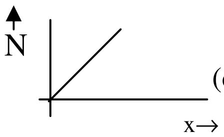
9. $F=2x^2-3x-2$. Choose correct option

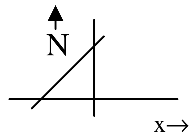
(a) x=-1/2 is position of stable equilibrium (b) x=2 is position of stable equilibrium

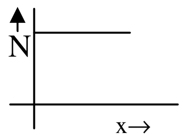
(c) x=-1/s is position of unstable equilibrium (d) x=2 is position of neutral equilibrium

10. The block A is pushed towards the wall by a distance and released. The normal reaction by vertical wall on the block B v/s compression in spring is given by:

(a) 

(b) 

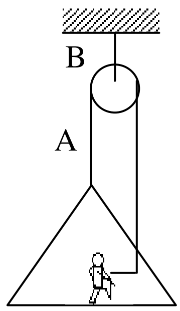
(c) 

(d) 

11. A 1.0 kg block of wood sits on top of an identical block of wood. Which sits on top of a flat level able made of plastic. The coefficient of static friction between the wood surfaces is μ_1, and the coefficient of static friction between the wood and plastic is μ_2. A horizontal force F is applied to the top block only, and this force is increased until the top block starts to move. The bottom block will move with the top block if and only if

(a) $\mu < \frac{1}{2}\mu_2$ (b) $\frac{1}{2}\mu_2 < \mu_1 < \mu_2$ (c) $\mu_2<\mu_1$ (d) $2\mu_2 < \mu_1$

12. To paint the side of a building, painter normally hoists himself up by pulling on the rope A as in figure .The painter and platform together weigh 200 N. The rope B can withstand 300N. Then



(a) The maximum acceleration that painter can have upwards is 5m/s^2.

(b) To hoist himself up, rope B must withstand minimum 400 N force.

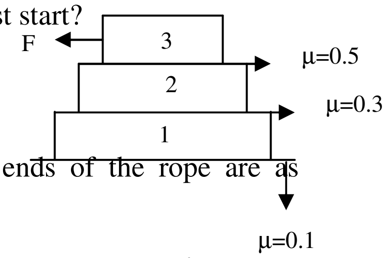
(c) Rope A will have a tension of 100 N when the painter is at rest.

(d) The painter must exert a force of 200 N on the rope A to go downwards slowly.

13. A block of mass 2 kg slides down an incline plane of inclination 30^0. The coefficient of friction between block and plane is 0.5. The contact force between block and plank is:

(a) 20 Nt (b) $10\sqrt{3}$ Nt (c) $3\sqrt{7}$ Nt (d) $5\sqrt{15}$ Nt

14. If force F is increasing with time and ………… Where will slipping first start?



(a) between 3 kg and 2 kg (b) between 2 kg and 1 kg

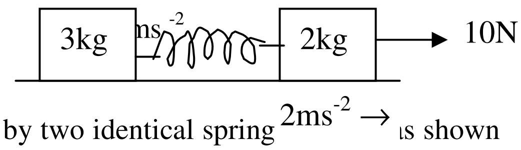
(c) between 1 kg and ground (d) Both (a) and (b)

15. Find the velocity of the hanging block if the velocities of the free ends of the rope are as indicated in the figure.

(a) $3/2m/s\uparrow$ (b) $3/2m/s\downarrow$ (c) $1/2m/s\uparrow$ (d) ½ m/s $\downarrow$

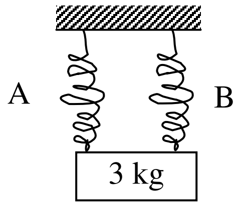
16. A rope of mass 5 kg is moving vertically in vertical position with an upwards force of 100 N acting at the upper end and a downwards force of 70 N acting at the lower end. The tension at midpoint of the rope is

(a) $3\ ms^{-2}$



(c) $0.5\ ms^{-2}$ (d) zero

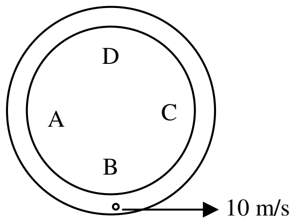
17. Block of 1 kg is initially in equilibrium and is hanging by two identical spring is shown in figures. If spring A is cut from lower point at t=0 then, find acceleration of block in ms^{-2} at t =0.



(a) 5 (b) 10

(c) 15 (d) 0

18. A ball whose size is slightly smaller than width of the tube of radius 2.5 m is projected from bottommost point of a smooth tube fixed in a vertical plane with velocity of 10 m/s. If N_1 and N_2 are the normal reactions exerted by inner side and outer side of the tube on the ball



(a) $N_1>0$ for motion in ABC, $N_2>0$ for motion in CDA

(b) $N_1>0$ for motion in CDA, $N_2>0$ for motion in ABC

(c) $N_2>0$ for motion in ABC & part of CDA

(d) N_1 is always zero.

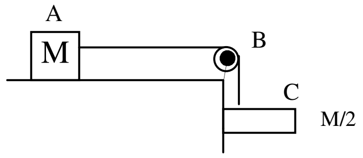
19. A man is standing on a rough (μ=0.5) horizontal disc rotating with constant angular velocity of 5 rad /sec. At what distance from centre should he stand so that the does not slip on the disc?

(a) $R \le 0.2$ m (b) $R > 0.2$ m (c) $R> 0.5$ m (d) $R> 0.3$ m

20. A road is banked at an angle of 30^0 to the horizontal for negotiating a curve of radius $10\sqrt{3}$ m. At what velocity will a car experience no friction while negotiating the curve?

(a) 54 km/hr (b) 72 km/hr (c) 36 km/hr (d) 18 km/hr

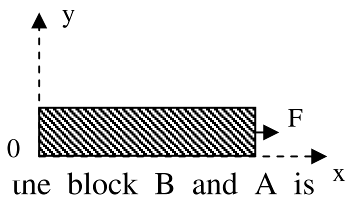
21. Block of mass M on a horizontal smooth surface is pulled by a load of mass M/2 by means of a rope AB and string BC as shown in the figure. The length & mass of the rope AB are L and M/2 respectively. As the block is pulled from AB=L to AB =0 its acceleration changes from



(a) $\frac{3g}{4}$ *to* g (b) $\frac{g}{4}$ *to* $\frac{g}{2}$

(c) $\frac{g}{4}$ *to* g (d) $\frac{3g}{2}$ *to* $2g$

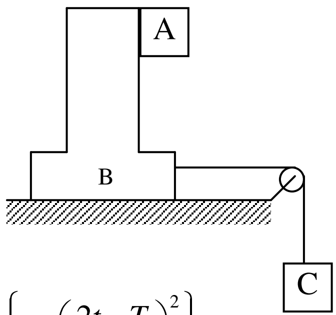
22. A uniformed rod of length L and mass M has been placed on a rough horizontal surface. The horizontal force F applied on the rod is such that the rod is just in the state of rest. If the coefficient of friction varies according to the relation μ=Kx where K is a +ve constant. Then the tension at mid point of rod is



(a) A/2 (b) F/4

(c) F/8 (d) None

23. In the arrangement shown in the figure, mass of the block B and A is m and m respectively. Surface between B and floor is smooth. The block B is connected to the block C by means of a string pulley system. If the whole system is released, then find the minimum value of mass of block C so that block A remains stationary w.r.t B. Coefficient of friction between A and B is μ:



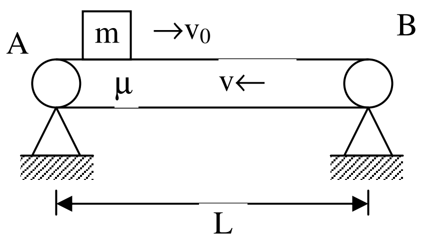
(a) $\frac{m}{\mu}$ (b) $\frac{2m+1}{\mu+1}$

(c) $\frac{3m}{\mu-1}$ (d) $\frac{6m}{\mu+1}$

24. A particle of mass m, initially at rest, is acted on by a force F = $F_0\left\{1-\left(\frac{2t-T}{T}\right)^2\right\}$ during the interval $0 \le t \le T$. The velocity of the particle a t the end of the interval is:

(a) $\frac{5F_0T}{6m}$ (b) $\frac{4F_0T}{3m}$ (c) $\frac{2F_0T}{3m}$ (d) $\frac{3F_0T}{2m}$

25. With what minimum velocity should block be projected from left end A towards end B such that it reaches the other end B of conveyer belt moving with constant velocity v. Friction coefficient between block and belt is μ.

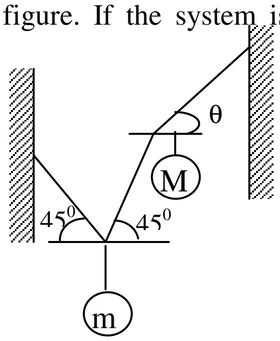


(a) $\sqrt{\mu gL}$ (b) $\sqrt{2\mu gL}$

(c) $\sqrt{3\mu gL}$ (d) $2\sqrt{\mu gL}$

PHYSICS

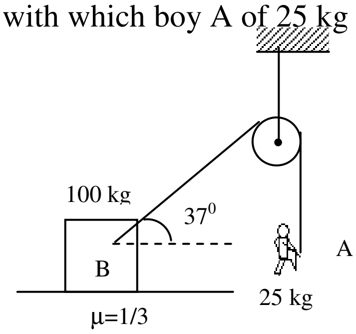
26. Two masses m and M are attached to the string as shown in the figure. If the system is in equilibrium, then



(a) tan θ $=1+\frac{2M}{m}$ (b) $\tan\theta=1+\frac{2m}{M}$

(c) cot θ$=1+\frac{2M}{m}$ (d) $\cot\theta=1+\frac{2m}{M}$

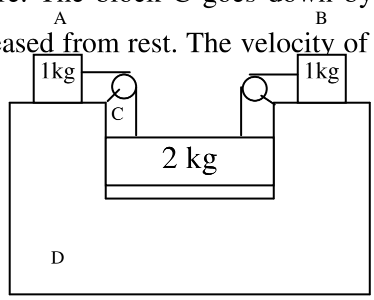
27. Block B of mass 100 kg rests on a rough surface of friction coefficient μ=1/3. A rope is tied to block B as shown in figure. The maximum acceleration with which boy A of 25 kg can climbs on rope without making block moves is:



(a) $\frac{4g}{3}$ (b) $\frac{g}{3}$

(c) $\frac{g}{2}$ (d) $\frac{3g}{4}$

28. In the system shown in the figure there is no friction anywhere. The block C goes down by a distance x_0=10 cm with respect to wedge D when system is released from rest. The velocity of A with respect to B will be (g=10 m/s^2)



(a) zero (b) 1 m/s

(c) 2 m/s (d) none of these

29. A car moves along a circular track of radius R banked at an angle of 30^0 to the horizontal. The coefficient of static friction between the wheels and the track is μ. The maximum speed with which the car can more without skidding out is

(a) $\left[2gR(1+\mu)/\sqrt{3}\right]^{1/2}$ (b) $\left[gR(1-\mu)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$

(c) $\left[gR\left(1+\mu\sqrt{3}\right)/\left(\mu+\sqrt{3}\right)\right]^{1/2}$ (d) None

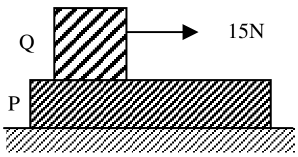
30. A particle initially at rest is subjected to two forces. One is constant, the other is a retarding force proportional to the particle velocity. In the subsequent motion of the particle : (a) The acceleration will increase from zero to a constant value.

(b) the acceleration will decreases from its initial value to zero

(c) the velocity will increase from zero to maximum & then decrease

(d) the velocity will increase from zero to a constant value.

31. A long plank P of the mass 5 kg is placed on a smooth floor. On P is placed a block Q of mass 2 kg. The coefficient of friction between P and Q is 0.5. If a horizontal force 15 N is applied to Q, as shown, and you may take gas 10 N/kg.



(a) The reaction force on Q due to P in 10 N

(b) The acceleration of Q relative to P is 2.5 m/s^2

(c) The acceleration of P relative to the Floor is 2.0 m/s^2

(d) The acceleration of centre of mass of P+Q system relative to the floor is (15/7) m/s^2

32. A particle is displaced from A ≡ (2, 2, 4) to B≡(5, -3, -1). A constant force of 34N acts in the direction of $\vec{AP}$. Where P ≡(10, 2, -11). (Coordinates are in m).

(i) Find the $(\vec{F})$. (ii) Find the work done by the force to cause the displacement .

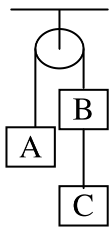
33. A man is standing in a lift which goes up and comes down with the same constant acceleration. If the ratio of the apparent weights in the two cases is 2:1, then the acceleration of the lift is

(a) 3.33 ms^{-2} (b) 2.50 ms^{-2} (c) 2.00 ms^{-2} (d) 1.67 ms^{-2}

34. Three equal weights of mass 2kg each are hanging by a string passing over a fixed pulley. The tension in the string (in N) connecting B and C is

(a) 4g/3 (b) g/3

(c) 2g/3 (d) g/2



35. A 10 kg monkey is climbing a massless rope attached to a 15 kg mass over a tree limb. The mass is lying on the ground. In order to raise the mass from the ground the must climb with

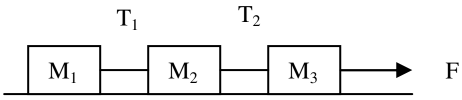
(a) uniform acceleration greater than 5m/sec^2 (b) uniform acceleration greater than 2.5 m/sec^2

(c) high speed (d) uniform acceleration greater than 10 m/sec^2

36. Three blocks are connected as shown in the figure, on a horizontal frictionless table and pulled to the right with a force at 60N. If M_1=10kg, M_2 =20kg and M_3=30 kg then the value of T_2 is

(a) 40 N (b) 30 N

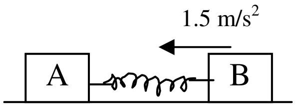
(c) 20N (d) 10 N



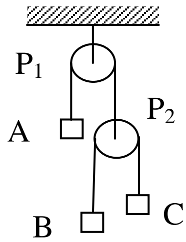
37. Two blocks A & B with mass 4 kg and 6 kg respectively are connected by a stretched spring of negligible mass as in figure. When the two blocks are released simultaneously the initial acceleration of B is 1.5 m/s^2 westward. The acceleration of A is:

(a) 1 m/s^2 westward (b) 2.25 m/s^2 eastward

(c) 1 m/s^2 eastward (d) 2.75 m/s^2 westward



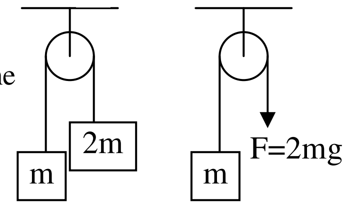
38. The three blocks shown move with constant velocities. Find the velocity of block A and B. Given V_{P2}=10 m/s↑, V_c =2m/s ↑



39. Fig shows two pulley arrangements for lifting a mass m. In (a) the mass is lifted by attaching a mass 2m while in (b) the mass is lifted by pulling the other end with a downward force F=2 mg, If f_a and f_b are the accelerations of the two masses then

(a) $f_a=f_b$ (b) $f_a=f_b/2$

(c) $f_a=f_b/3$ (d) $f_a=2f_b$

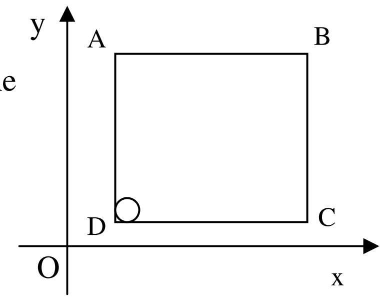


40. A solid sphere of mass 2kg is resting inside a cube as shown in the figure. V=$\left(5t\hat{i}+2t\hat{j}\right)m/s$.

Here t is the time in second. All surfaces are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphere on the cube. (Take g=10m/s^2 & y-axis along vertical)

(a) $\sqrt{29}N$ (b) 29 N

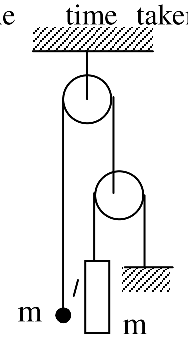
(c) 26 N (d) $\sqrt{89}N$



41. In the figure shown, all pulleys are massless and frictionless. The time taken by the ball to reach the upper end of the rod is:

(a) $\sqrt{\frac{10l}{3g}}$ (b) $\sqrt{\frac{5l}{3g}}$

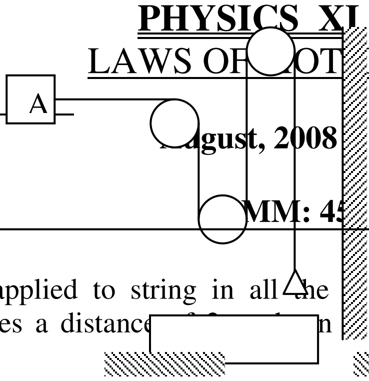
(c) $\sqrt{\frac{3l}{4g}}$ (d) $\sqrt{\frac{3l}{10g}}$



42. Slider block A move to the left with a constant velocity of 6 m/s. Determine

    (a) the velocity of block b, (b) the velocity of portion D of the cable.

    (c) the relative velocity of portion C of the cable with respect to portion D.



PHYSICS XI

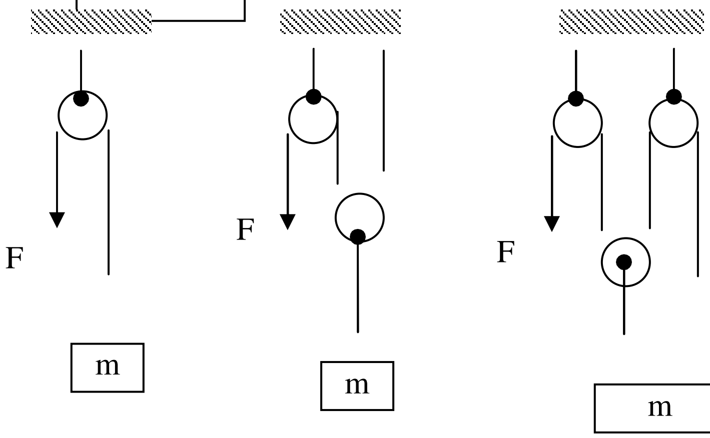
LAWS OF MOTION

Name :________________ **Date: 31st August, 2008**

Time: 1 Hr. **MM: 45**

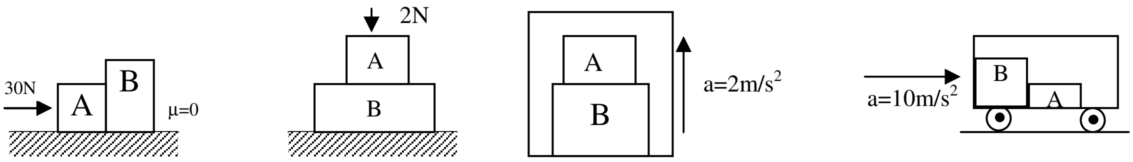
---

1. Equal force F(>mg) is applied to string in all the 3 cases. Starting from rest, the point of application of force moves a distance of 2 m down in all cases. In which case the block has maximum kinetic energy?



(a) 1 (b) 2 (c) 3 (d) equal in all 3 cases

2. In which of the following cases in the contact force between A and B maximum ($m_A + m_B = 1kg$)

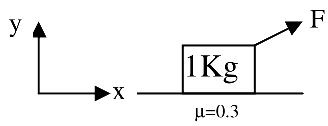


(a) (b) (c) (d)

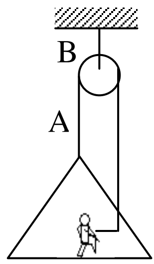
3. A force $\vec{F} = \hat{i} + 4\hat{j}$ acts on block shown. The force of friction acting on the block is:

    (a) $-\hat{i}$ (b) -1.8 $\hat{i}$

    (c) -2.4 $\hat{i}$ (d) $-3\ \hat{i}$

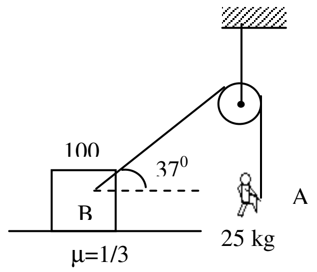


4. To paint the side of a building, painter normally hoists himself up by pulling on the rope A as in figure .The painter and platform together weigh 200 N. The rope B can withstand 300N. Then
(a) The maximum acceleration that painter can have upwards is $5 m/s^2$.
(b) To hoist himself up, rope B must withstand minimum 400 N force.
(c) Rope A will have a tension of 100 N when the painter is at rest.
(d) The painter must exert a force of 200 N on the rope A to go downwards slowly.



5. A block of mass 2 kg slides down an incline plane of inclination 30^0. The coefficient of friction between block and plane is 0.5. The contact force between block and plank is:
(a) 20 Nt (b) $10\sqrt{3}$ Nt
(c) $3\sqrt{7}$ Nt (d) $5\sqrt{15}$ Nt

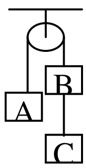
6. Block B of mass 100 kg rests on a rough surface of friction coefficient $\mu=1/3$. A rope is tied to block B as shown in figure. The maximum acceleration with which boy A of 25 kg can climbs on rope without making block moves is:



(a) $\frac{4g}{3}$ (b) $\frac{g}{3}$ (c) $\frac{g}{2}$ (d) $\frac{3g}{4}$

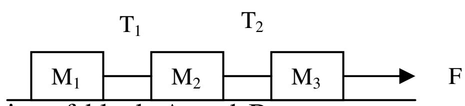
7. A man is standing in a lift which goes up and comes down with the same constant acceleration. If the ratio of the apparent weights in the two cases is 2:1, then the acceleration of the lift is
(a) $3.33 ms^{-2}$ (b) $2.50 ms^{-2}$ (c) $2.00 ms^{-2}$ (d) $1.67 ms^{-2}$

8. Three equal weights of mass 2kg each are hanging by a string passing over a fixed pulley. The tension in the string (in N) connecting B and C is
(a) 4g/3 (b) g/3
(c) 2g/3 (d) g/2

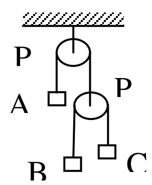


9. A 10 kg monkey is climbing a massless rope attached to a 15 kg mass over a tree limb. The mass is lying on the ground. In order to raise the mass from the ground the must climb with
(a) uniform acceleration greater than $5 m/sec^2$ (b) uniform acceleration greater than $2.5 m/sec^2$
(c) high speed (d) uniform acceleration greater than $10 m/sec^2$

10. Three blocks are connected as shown in the figure, on a horizontal frictionless table and pulled to the right with a force at 60N. If M_1=10kg, M_2 =20kg and M_3=30 kg then the value of T_2 is
(a) 40 N (b) 30 N
(c) 20N (d) 10 N



11. The three blocks shown move with constant velocities. Find the velocity of block A and B. Given V_{P2}=10 m/s↑, V_c =2m/s ↑



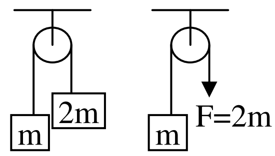
(a) $f_a = f_b$ (b) $f_a = f_b/2$

(c) $f_a = f_b/3$ (d) $f_a = 2f_b$

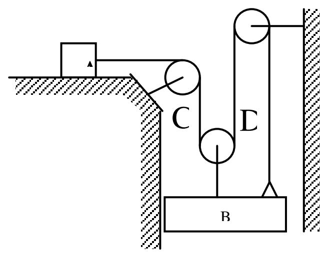
12. Fig shows two pulley arrangements for lifting a mass m. In (a) the mass is lifted by attaching a mass 2m while in (b) the mass is lifted by pulling the other end with a downward force F=2 mg, If f_a and f_b are the accelerations of the two masses then

(a) $f_a = f_b$ (b) $f_a = f_b/2$

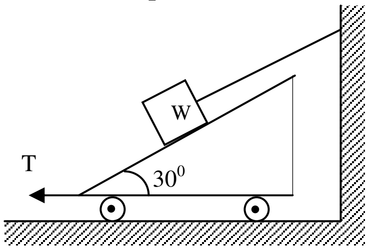
(c) $f_a = f_b/3$ (d) $f_a = 2f_b$



13. Slider block A move to the left with a constant velocity of 6 m/s. Determine (a) the velocity of block b, (b) the velocity of portion D of the cable. (c) the relative velocity of portion C of the cable with respect to portion D.



14. Find the tension T needed to hold the cart in equilibrium, if there is no friction.



15. In the fig. at the free end of the light string, a force F is applied to keep the suspended mass of 18 kg at rest. Assuming pulley is light then the force exerted by the ceiling on the system is:

(a) 200N (b) 120 N

(c) 180 N (d) 240 N