PAPER I

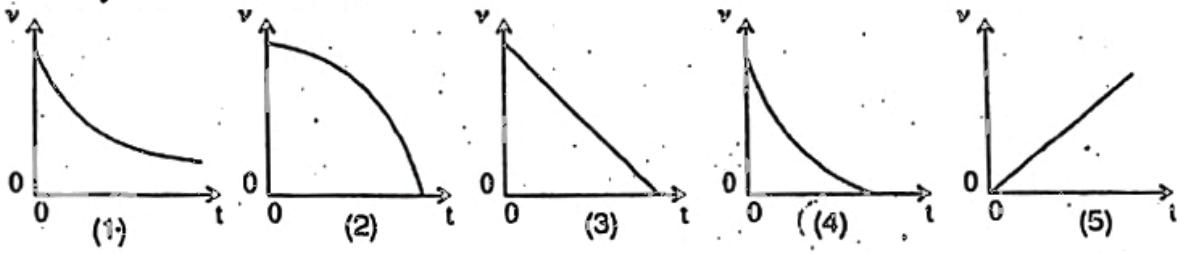
1. Unit of Planck constant (h) is
(1) Js^{-1} (2) Js. (3) Js^{-2}. (4) $J^{-1}s$. (5) $J^{-1}s^{-1}$

2. Angular velocity has the dimensions of
(1) LT^{-1}. (2) T^{-1}. (3) LT^{-2}. (4) T. (5) $L^{-1}T^{-1}$.

3. The saturated vapour pressure of water at 30 °C is 1.6 x 103 Pa. The partial of water vapour on a day °C is 1.2 x 10^{3} Pa. The relative humidity on that day is
(1) 50% (2) 60% (3) 75% (4) 80% (5) 85%.

4. The sun radiates energy at the rate of E per unit surface area. Assuming the sun to be a black bo surface temperature is given by (σ = Stefan constant)
(1) $\left(\frac{E}{\sigma}\right)^{1/4}$. (2) $\left(\frac{E}{\sigma}\right)^{1/2}$. (3) $\frac{E}{\sigma}$. (4) $\left(\frac{E}{\sigma}\right)^{2}$ (5) $\left(\frac{E}{\sigma}\right)^{4}$

5. Which of the following graphs best represents the variation of velocity, v, with time, t of an object brought to rest by a constant resultant force ?

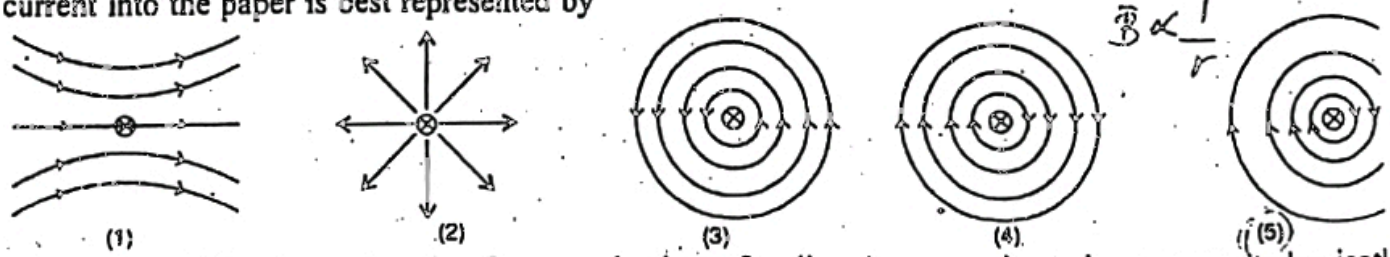


6. A string is stretched between two fixed supports 0.5 m apart and the tension is adjusted unt fundamental frequency of the string is 440 Hz. The speed of transverse waves along the string is
(1) 110 ms^{-1}. (2) 220 ms^{-1}. (3) 330 ms^{-1}. (4) 440 ms^{-1}. (5) 880 ms^{-1}.

7. A 240 V ac electric power source is used to run a 12 V , 60 W ac motor using an ideal transforme current in the primary winding of the transformer is
(1) 0.25 A. (2) 0.5 A. (3) $\sqrt{5}$ A. (4) 5 A. (5) 20 A.

8. A sound source of intensity I is replaced by a sound source of intensity 100 I . The change in intensity at a given point is
(1) 1 dB. (2) 10 dB. (3) 20 dB. (4) 50 dB. (5) 100 dB

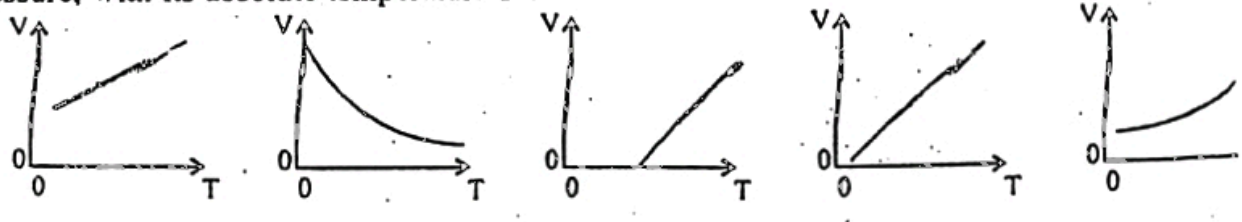
9. The magnetic field around a straight wire placed perpendicular to the plane of the paper and carr current into the paper is best represented by



10. Two soap bubbles, one of radius 3 cm and other of radius 4 cm, coalesce in vacuum under isot conditions. The radius of the bubble formed is
(1) 1 cm. (2) 2 cm. (3) 5 cm. (4) 6 cm. (5) 8 cm.

11. The objective of an astronomical telescope has a 60 cm focal length. When the telescope is adjusted t objects for a relaxed normal eye, the distance between the lenses is 65 cm. The angular magnification instrument is (1) 2.4. (2) 2.6. (3) 5. (4) 12. (5

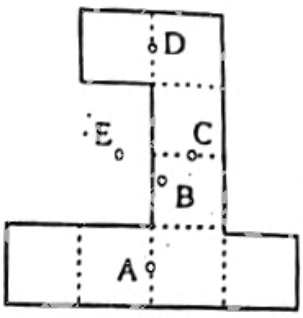
12. Which of the following graphs best represents the variation of volume V of a fixed mass of an ideal constant pressure, with its absolute temperature T ?



. Which one of the following properties is not a common one of all three α , β and γ radiations ?

(1) Carrying energy
(2) Show particle as well as wave nature.
(3) Ability of ionizing air
(4) Being emitted by the nucleus of an atom
(5) Having a charge

. The object in the shape shown is cut from a uniform sheet of metal. The centre of gravity of the object is most likely to be found at.



(1) A (2) B (3) C (4) D (5) E

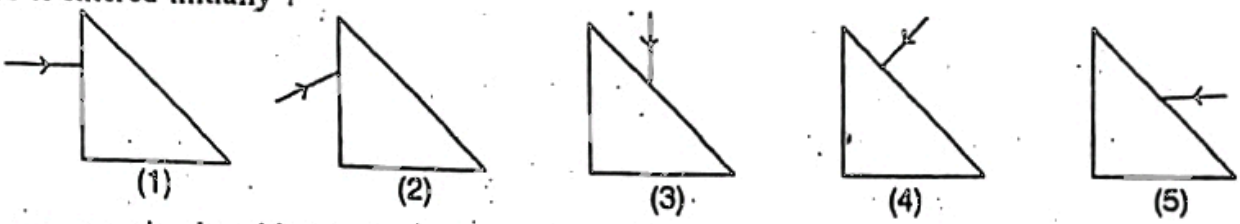
. A uniform solid cylinder of weight 6 N is floating vertically in a liquid with ¼ of its height above the liquid surface. The minimum vertical force required to immerse the cylinder fully in the liquid is

(1) 1.5 N. (2) 2 N. (3) 3 N.
(4) 4 N. (5) 12 N.

. An elastic string with spring constant k is cut into two parts of equal length. The spring constant of one part is

(1) $\frac{k}{2}$ (2) $\frac{1}{\sqrt{2}}k$. (3) k. (4) $\sqrt{2}\,k$. (5) $2k$.

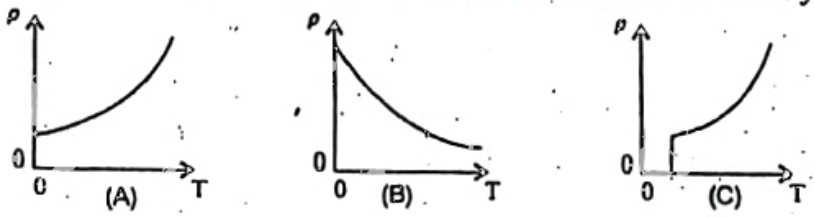
. The following diagrams represent five different ways of directing a narrow parallel beam of monochromatic light on to a right angled isoceles glass prism. Which arrangement would make the beam emerge from the face where it entered initially ?



. A person can see clearly, objects placed 25 cm from his eyes when he wears spectacles of power − 1.5 diopters. Without spectacles, he can see the objects most clearly at a minimum distance of

(1) 18 cm from his eyes. (2) 20 cm from his eyes. (3) 30 cm from his eyes.
(4) 40 cm from his eyes. (5) 50 cm from his eyes.

. The three graphs A,B and C show variations in electrical resistivity, ρ, with temperature, T, of three materials.



Which of the following combinations correctly represents the above cruves ?

	A	B	C
(1)	metallic -conductor	super-conductor	semi-conductor
(2)	metallic - conductor	semi-conductor	super- conductor
(3)	semi-conductor	metallic-conductor	super-conductor
(4)	semi- conductor	super- conductor	metallic - conductor
(5)	super - conductor	metallic - conductor	Semi - conductor

0. Consider the following statements made about the root mean square value, $I_{r.m.s}$ of an alternating current.

(A) $I_{r.m.s}$ is related to the peak current I_0 by $I_{r.m.s} = \frac{I_0}{\sqrt{2}}$

(B) $I_{r.m.s}$ is the average value of the current over a cycle.

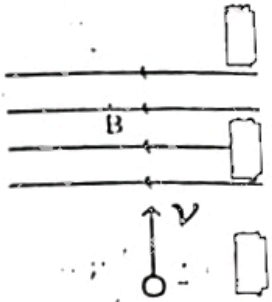
(C) $I_{r.m.s}$ is the equivalent dc current that would produce the same average power loss in a resistor as the alternating current.

Of the above statements

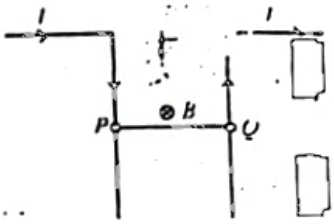
(1) only (A) is true. (2) only (A) and (B) are true.
(3) only (A) and (C) are true. (4) only (B) and (C) are true.
(5) all (A) , (B) and (C) are true.

21. An isotope of uranium, $^{239}_{92}U$, decays by the emission of a β^- particle. Which of the following response gives the correct mass number and atomic number for the new nucleus formed ?

	Mass Number (A)	Atomic Number (Z)
(1)	235	90
(2)	240	92
(3)	239	91
(4)	239	93
(5)	239	90

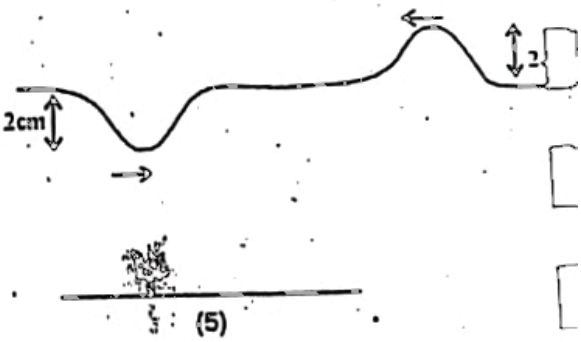


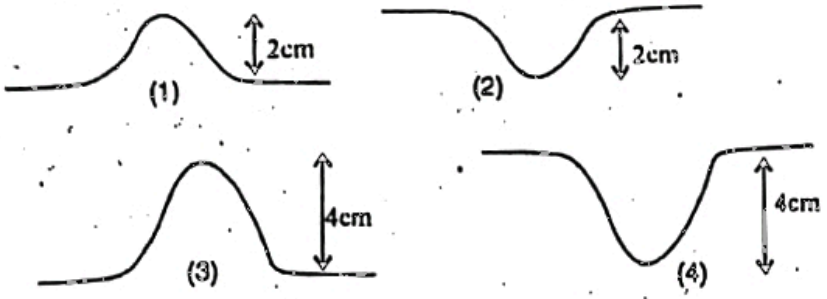
22. In vacuum, a beam of electrons is projected into a region of uniform magnetic field B as shown in the figure. If both the electron beam and the magnetic field are in the plane of the paper, then the path of the electrons is
(1) not affected y the magnetic field. (2) bent towards the left.
(3) bent towards the right. (4) bent upwards out of the paper.
(5) bent downwards into the paper.



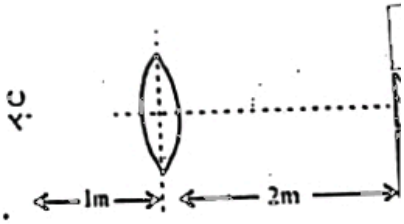
23. A wire PQ of length 0.15 m and mass 0.015 kg is free to slide on two smooth vertical wires, as shown in the diagram. If a magnetic field of flux density 1.0 T is applied into the paper, the current I required to keep the wire PQ in equilibrium is
(1) 1 A. (2) 3 A. (3) 5 A.
(4) 10 A. (5) 15 A.

24. As shown in the figure two pulses of identical shape with amplitude 2cm are travelling along a string in opposite directions with the same speed 2 cm s^{-1} If the pulses are 8 cm apart intially, wave patern after 2 s is given by





25. As shown in the figure, a small object O and a plane mirror are kept on the opposite sides of a convex lens of focal length 0.5 m. Regarding the number of images formed and their nature, which of the following statements is correct ?
(1) Three images of which two are real. (2) Three images of which one is real.
(3) Two real images. (4) Two images of which one is real.
(5) only one real image.



26. An elastic string has a length of 30 cm when the tension on it is 3 N. When the tension is 4 N the len becomes 32 cm. If the tension is increased to 7 N, the length of the string will be
(1) 34 cm. (2) 38 cm. (3) 40 cm. (4) 42 cm. (5) 44 cm.

27. A liquid flows through two capillary tubes which are not connected to each other, under the same pres difference. The internal diameter of the two tubes are in the ratio of 2 : 1 and the lengths are in the rati 1 : 2 The ratio of th rate of flow of the liquid through the two tubes is equal to
(1) 32 :1 (2) 16 :1 (3) 8 : 1 (4) 4:1 (5) 2:1.

28. Two equal resistors connected in series across a battery of negligible internal resistance, togther dissipa power of 10 W. If the same resistors are connected in parallel across the same battery. the total p dissipated is
(1) 5 W. (2) 10 W. (3) 20 W. (4) 40 W. (5) 60 W.

29. Two particles A and B are moving in concentric circles of radii R_A and R_B such that their periods of rotation are same. The ratio $\frac{\text{centripetal acceleration of } A}{\text{centripetal acceleration of } B}$ is

(1) $\frac{R_A}{R_B}$ (2) $\frac{R_A^2}{R_B^2}$ (3) $\frac{R_A^3}{R_B^3}$ (4) $\frac{R_B}{R_A}$ (5) $\frac{R_B^3}{R_A^3}$

30. When, two objects A and B move with uniform speeds toward each other along a staight line, they get 5 m closer to each other every second. If they move in the same direction along a straight line with the original speeds they get 1 m closer, to each other every second. The speeds of A and B are respectively

(1) 5ms^{-1} and 4 ms^{-1} (2) 5 ms^{-1} and 10 ms^{-1} (3) 3 ms^{-1} and 2 ms^{-1}
(4) 3 ms^{-1} and 1 ms^{-1} (5) 2 ms^{-1} and 1 ms^{-1}

31. Which one of the following cannot be explained using the Bernoulli's principle ?

(1) Curving of the path of a spinning ball while moving in air
(2) Upward lift on an aeroplane (3) Action of a spray pump
(4) Motion of a rocket in space (5) Rise of smoke through a tall chimney

32. A small mass is kept on a horizontal circular table which can rotate about a vertical axis passing through the centre of the table. The mass starts to slip when the angular velocity of the table becomes ω. If the distance to the mass from the centre of the table is doubled the minimum angular velocity required for the mass to start slipping is

(1) $\frac{\omega}{\sqrt{2}}$. (2) $\frac{\omega}{2}$. (3) ω. (4) $\sqrt{2}\,\omega$. (5) $2\,\omega$.

33. A small glass tube closed at one end is half-filled with mercury at room temperature. The volume expansivities of glass and mercury are γ_g and γ_m respectively. The mercury will occupy the full volume of the tube when the temperature is increased by

(1) $\frac{1}{\gamma_g}$. (2) $\frac{1}{\gamma_m}$. (3) $\frac{1}{\gamma_g - \gamma_m}$. (4) $\frac{1}{\gamma_m - \gamma_g}$. (5) $\frac{1}{\gamma_g + \gamma_m}$.

34. A tube of length l, closed at one end is slowly lowered vertically into a liquid bath so that the open end first dips in the liquid. The air inside the tube does not escape. If the length of the air column inside the tube becomes $\frac{l}{2}$ when the liquid meniscus inside the tube is at a depth H from the liquid surface of the bath, the atmospheric pressure expressed in terms of the height of the liquid column is

(1) $\frac{H}{2}$. (2) H. (3) $2H$. (4) $3H$. (5) $4H$.

35. Under constant environmental conditions, the time taken by a liquid to cool from 65 °C to 55 °C in a room at 30 °C is 5.0 minutes. The time taken by the liquid to cool from 55 °C to 45 °C is

(1) 5.0 min. (2) 6.5 min. (3) 7.5 min. (4) 8.0 min. (5) 10.0 min.

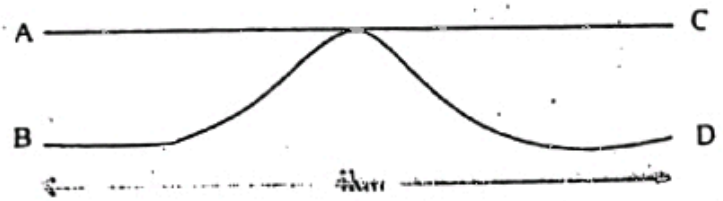
36. Two spherical conductors with radii R_1 and R_2 are separated by a very large distance and connected by a thin conducting wire. If ϵ_o is the permittivity of free space, the capacitance of the system is

(1) $4\pi\epsilon_o(R_1 + R_2)$. (2) $4\pi\epsilon_o \frac{R_1 R_2}{R_1 + R_2}$. (3) $4\pi\epsilon_o \frac{R_1^2}{R_2}$.
(4) $4\pi\epsilon_o(R_1 - R_2)$. (5) $\frac{4\pi\epsilon_o R_1 R_2}{R_1 - R_2}$.

37. A charge is distributed uniformly with density σ over the surface of an isolated conducting sphere of radius a. The electric potential at the centre of the sphere is

(1) $\frac{a\sigma}{\epsilon_o}$. (2) $\frac{a^2\sigma}{\epsilon_o}$. (3) $\frac{a^2\sigma^2}{\epsilon_o}$. (4) $\frac{\sigma}{2\epsilon_o}$. (5) 0.

38. An underground cable of length 4 km, consisting a pair of identical conducting wires, has short some where along its length as shown in the figure.



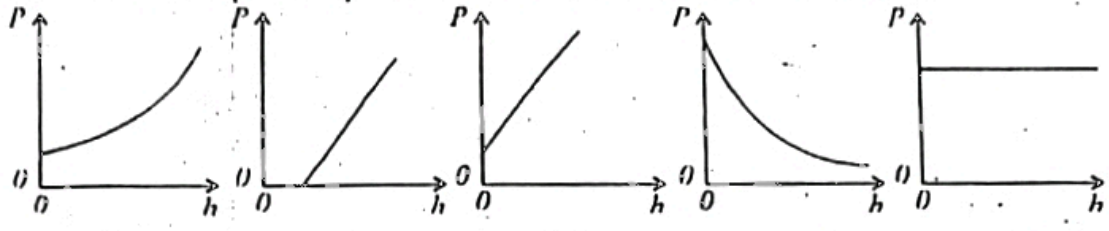
A person detects that the resistance across A-B and C-D are 30Ω and 70Ω respectively. The distance to the shorted position from A is

(1) 1 km. (2) 1.2 km. (3) 1.7 km. (4) 2 km. (5) 3 km.

47 When a bottle of soda water is opened gas bubbles rise in the soda water. Assume that the initial acceleration of all the gas bubbles is a. When the bottle falls freely, then with respect to the bottle the gas bubbles

(1) will rise with the same acceleration a.
(2) will rise with an acceleration of $(a + g)$
(3) will rise with an acceleration of $(a - g)$
(4) will remain stationary
(5) will move down with an acceleration a.

48. A vertical capillary tube is partially immersed in water and the pressure inside the tube is gradually increased by pumping air into it. The lower end of the tube is at a depth h beneath the water surface. As h is varied the maximum pressure p that can exist inside the tube varies with h as



(1) (2) (3) (4) (5)

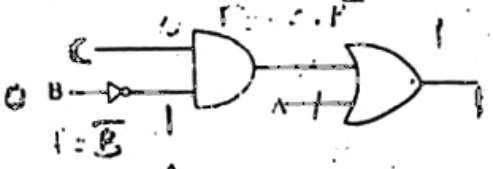
49. A train travelling with uniform velocity and sounding its whistle passes a stationary observer. The ratio of the frequencies heard by the observer before and after the train passes him is 6 : 5. If the speed of the sound in air is 330 ms^{-1} the speed of the train is

(1) 10 ms^{-1}. (2) 15 ms^{-1}. (3) 20 ms^{-1}. (4) 25 ms^{-1} (5) 30 ms^{-1}

50. If A.B and C are three Boolean variables, the output. F. is given by

(1) $F = A + \bar{B}C$ (2) $F = (\bar{B} + C)A$.

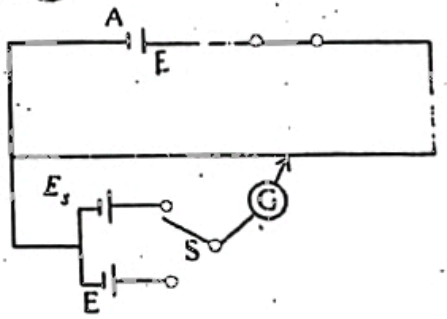
(3) $F = (A + \bar{B})C$ (4) $F = \overline{(C+\bar{B})}A$ (5) $F = A + BC$.



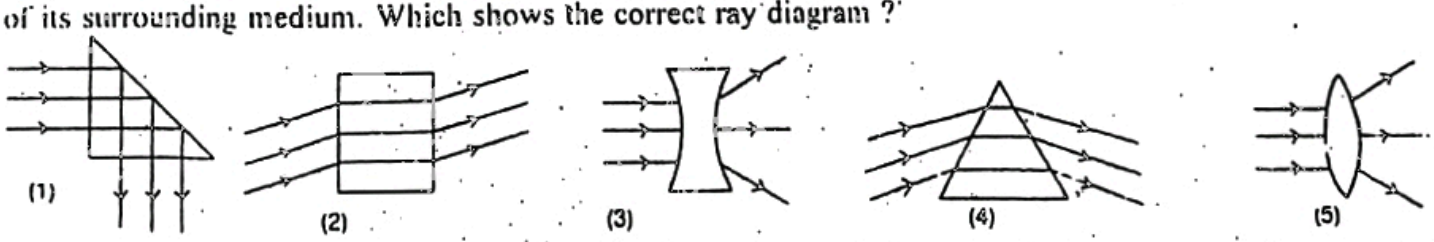
51. The figure shows a potentiometer circuit which can be used to determine the e.m.f. E. of a cell E_s is the e.m.f of the standard cell.

Which of the following statement is incorrect regarding the propere function of the circuit ?

(1) E_s should be greater than E.
(2) The internal resistance of the standard cell is not important
(3) The balance points depend on the internal resistance of the cell A.
(4) The terminals of all the cells shown are connected correctly.
(5) The cell A should supply a steady current to the slide wire.



52. Refractive index of the material of each optical element shown in the following diagrams is less than that of its surrounding medium. Which shows the correct ray diagram ?

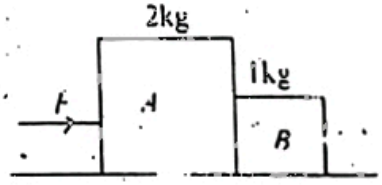


53. When two organ pipes of lengths 50 cm and 50.5 cm are sounded together 3 beats per second are heard. If the end corrections ate neglected, the frequencies of the pipes are respectively.

(1) 303 Hz and 300 Hz. (2) 300 Hz and 303 Hz. (3) 150 Hz and 153 Hz.
(4) 153 Hz and 150 Hz. (5) 203 Hz and 200 Hz.

54. Two blocks A and B of masses 2 kg and 1 kg respectively are in contact on a frictionless table. when a horizontal force F is applied on A as shown in the figure. the force exerted by B on A is 1 N. If instead the same force is applied to B in the opposite direction. the force exerted by A on B is

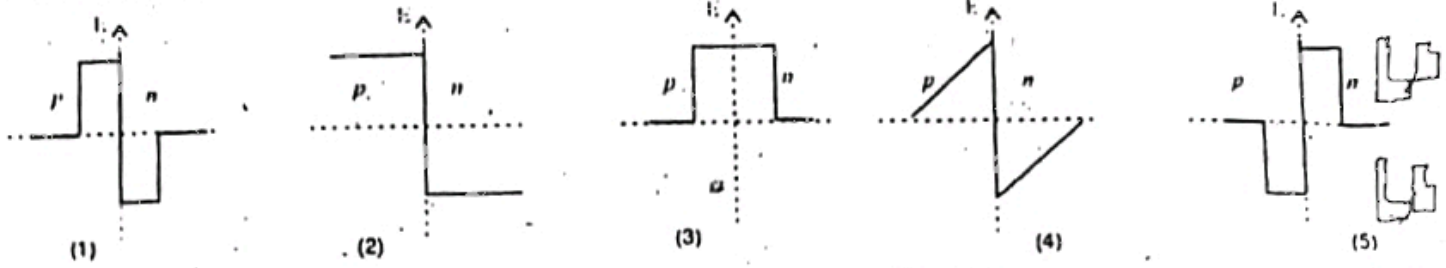
(1) 0.5 N. (2) 1 N. (3) 2 N. (4) 4N. (5) 5 N.



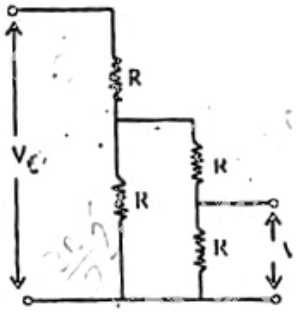
55. A ring, a disc and a sphere, all of the same mass and radius with moments of inertia I_r, I_d and I_s ($I_R > I_D > I_S$) respectively about their axes, roll down without slipping on an inclined plane from a given height. If the times taken for the ring, disc and sphere to reach the bottom of the plane are t_r, t_d, and t_s respectively . then.

(1) $t_r < t_d < t_s$ (2) $t_r = t_d = t_s$. (3) $t_r > t_d > t_s$. (4) $t_r > t_d = t_s$. (5) $t_r > t_d < t_s$.

39. The variation of the electric field intensity, E, across an ideal p-n junction is best represented by



40. The ratio $\frac{V}{V_0}$ for the given voltage divider circuit is equal to



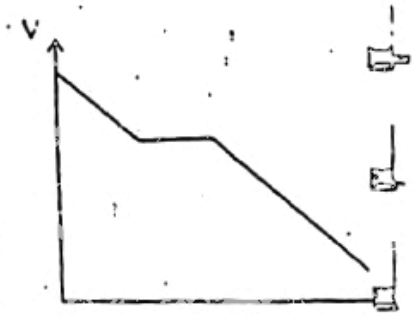
(1) $\frac{1}{6}$ (2) $\frac{1}{5}$ (3) $\frac{1}{4}$

(4) $\frac{1}{3}$ (5) $\frac{1}{2}$

41. Angular momentum of a system is
(A) conserved only when the resultant force on it is zero.
(B) in the same direction as its angular velocity.
(C) independent of the mass distribution of the system.
Of the above statements.
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (B) and (C) are true. (5) all (A), (B) and (C) are true.

42. The distances travelled by an object falling freely from rest during first, second and third seconds are in ratio
(1) 1: 2 : 3 : (2) 1: 4: 9: (3) 1: 2: 9: (4) 1: 1: 1: (5) 1: 3: 5:

43. The figure shows the variation of the electric potential (V) of a system along a particular direction x.
The system can be a charged
(1) Parallel plate capacitor with air between the plates.
(2) Parallel plate capacitor with a metal slab in between the plates.
(3) Parallel plate capacitor with a dielectric slab in between the plates.
(4) conducting sphere.
(5) Conducting sphere situated inside a charged concentric spherical conducting shell.



44. The radius of the earth is R and g is the acceleration due to gravity at the earth's surface. The gain in potential energy of an object of mass m raised from the surface of the earth to a height R is

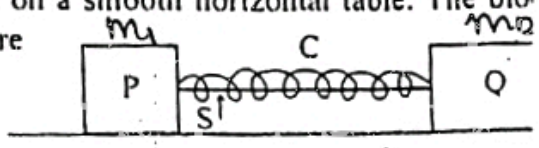
(1) $\frac{1}{4}mgR$. (2) $\frac{1}{2}mgR$. (3) mgR. (4) $2mgR$. (5) $4mgR$.

45. One end of a metal wire of length L and cross-sectional area A is tied to the ceiling. The other end is connected to a massless spring of spring constant k. A body of mass m hangs from the free end of the spring. If the Young's modulus of the material of the wire is Y, the total extension of the system is

(1) $\frac{mgL}{YA}$ (2) $\frac{mg}{k}$ (3) $mg\left[\frac{L}{YA}+\frac{1}{k}\right]$

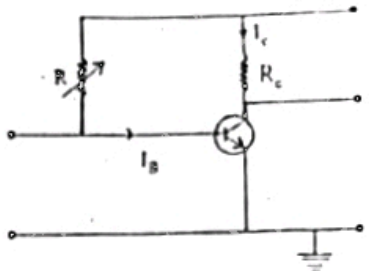
(4) $mg\left[\frac{L}{YA}+\frac{2}{k}\right]$ (5) $mg\left[\frac{1}{k}-\frac{L}{YA}\right]$

46. Two blocks P and Q of masses m_1 and m_2 ($m_2 > m_1$) are kept on a smooth horizontal table. The blocks are attached to the ends of a compressed light spring C, and are held stationary by a string S as shown in the figure.
When the string is cut,
(A) the total momentum of the blocks remains zero.
(B) the forces on the blocks exerted by the spring are equal in magnitude.
(C) initially the block P moves faster than Q.
Of the above statements.



(1) only (A) is true. (2) only (B) is ture. (3) only (A) and (B) are true.
(4) only (B) and (C) are true (5) all (A), (B) and (C) are true.

56. In the circuit shown R is a variable resistor and R_C has a fixed value. When R is at its maximum value, the transistor is biased in the active region. When R is gradually decreased



(A) the base current I_B increases.

(B) the collector current I_C decreases.

(C) the output voltage V_{out} decreases.

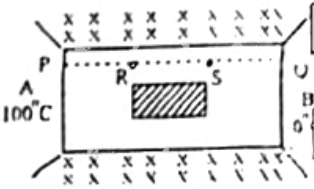
Of the above statements.

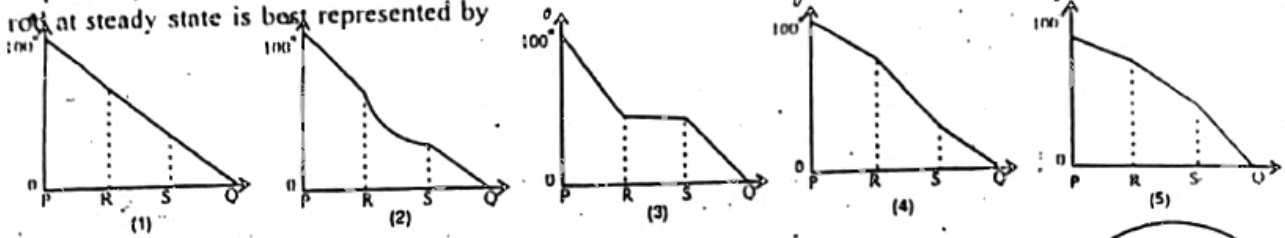
(1) only (A) is true. (2) only (B) is true.

(3) only (C) is true. (4) only (A) and (B) are true.

(5) only (A) and (C) are true.

57. As shown in the figure, a well lagged metal rod AB has a cylindrical cavity at its centre. The cavity is filled with a thermal insulating material. If the two ends A and B of the rod are maintained at the temperatures 100 °C and 0 °C respectively the variation of temperature (θ) along the dotted line PQ of the rod at steady state is best represented by

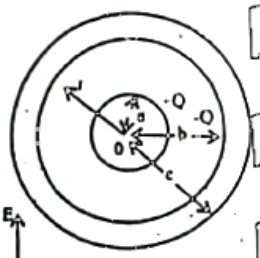


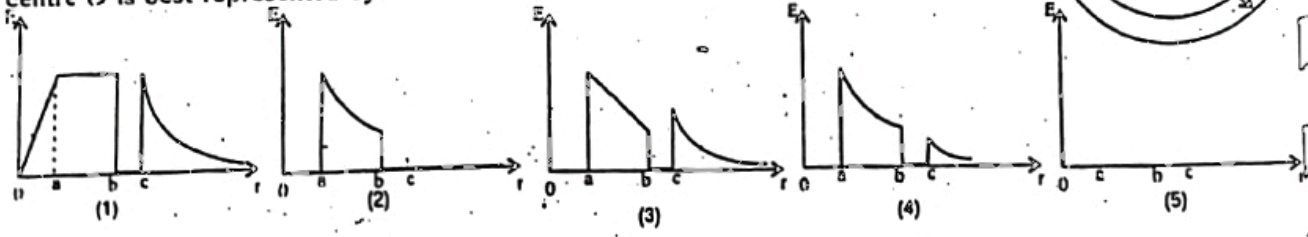


(1) (2) (3) (4) (5)

58. A conducting sphere and a concentric conducting spherical shell carry charges +Q and -Q respectively , as shown in the figure.

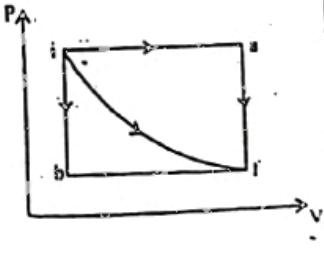
The variation of the electric field intensity E, with radial distance r from the centre O is best represented by.





(1) (2) (3) (4) (5)

59. An ideal gas can be taken from an initial state i to a final state f by the processes $i \to f$ or $i \to a \to f$ or $i \to b \to f$ as shown on the P – V diagram.



Consider the following statements:

(A) Maximum work is done by the system during the process *iaf*.

(B) The change in internal energy of the system is the same for all three processes.

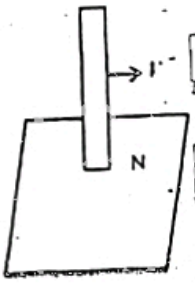
(C) The maximum heat absorption occurs during the process *ibf*.

Of the above statements.

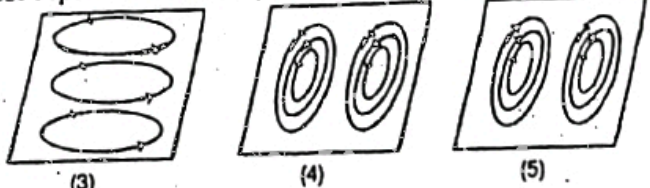
(1) only (A) is true. (2) only (B) is ture. (3) only (C) is true.

(4) only (A) and (B) are true. (5) all (A), (B) and (C) are true.

60. A long bar magnet is held vertically and made to move with a constant velocity, V, in the direction shown so that its north pole is very close to a horizontal conducting sheet.



Which of the following diagrams best represents the eddy currents induced in the sheet ?



(3) (4) (5)