PAPER I

1. The product, angular acceleration X time, has the dimensions of
(1) angular displacement. (2) angular velocity. (3) torque.
(4) moment of inertia. (5) work.

2. A mass attached to a string executes a uniform circular motion on a frictionless horizontal table. If the string breaks, the mass will.
(1) move on a straight line radially outwards. (2) move on a straight line radially inwards.
(3) move on a straight line tangential to the circle. (4) move away from the circle on a curved path.
(5) continue to move along the same circular path.

3. Stars may be formed when a huge rotating masses contract to small volumes. In such a contraction how will the moment of inertia and the angular velocity of the rotating mass change ?

	Moment of inertia	Angular velocity.
(1)	decreases	decreases
(2)	decreases	increases
(3)	increases	decreases
(4)	increases	increases
(5)	decreases	unchanged

4. The loudness of a sound wave depends on its
(1) wavelength. (2) frequency. (4) amplitude. (4) velocity. (5) harmonic content.

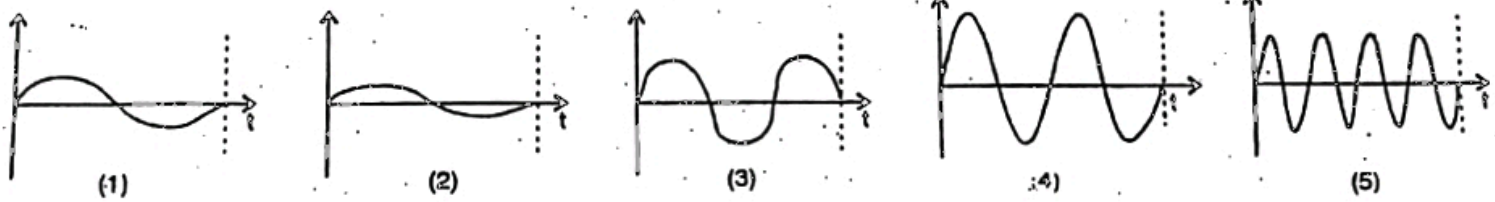
5. F, a, v and t in the following equation represent a force, an acceleration, a velocity and a time respectively.

$$F = c_1 a + c_2 \frac{v}{t}$$

The ratio $\frac{c_1}{c_2}$

(1) has the dimensions of acceleration. (2) has the dimensions of mass.
(3) has the dimensions of work. (4) has the dimensions of velocity.
(5) is dimensionless.

6. Which of the following waveforms has the highest frequency ?



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

7. Equal amounts of heat was given to two liquids A and B of mass m and $\frac{m}{2}$ respectively. The liquid A has one half the specific heat capacity of the liquid B. If the increase in the temperature of liquids A and B are θ_A and θ_B respectively, then

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

8. Which of the following is most suitable when connecting electrical components in a laboratory experimental setup?
(1) Thin short insulated wires. (2) Thick short insulated wires. (3) Thin long bare wires.
(4) Thick long bare wires. (5) Thick short bare wires

9. The material of the human bone has a Young's modulus of 10^{10} Nm^{-2} . It fractrues when the compressive strain exceeds 1% . The maximum load that can be sustained by a bone of cross-sectional area 3×10^{-4} m^2 is
(1) 3×10^2N (2) 3×10^4 N. (3) 3×10^6 N. (4) 3×10^8N. (5) 3×10^{10} N.

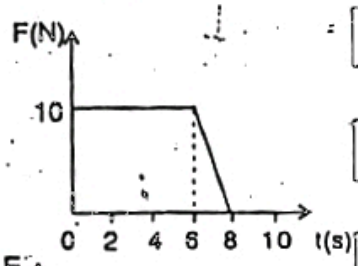
10. The fractional change in the volume of a solid when heated from 0 °C to 10 °C is 0.027. the linear expansivity of the material of the solid is
(1) 0.0003 °C^{-1} (2) 0.0009 °C^{-1} (3) 0.0027 °C^{-1}. (4) 0.003 °C^{-1} (5) 0.009 °C^{-1}

11. Consider the following statements made about a transistor and a transformer.
(A) Both devices can be used to increase the voltage of a small ac signal.
(B) Both devices can be used to increase the current of a small ac signal.
(C) None of the devices can be used to increase the power of a small ac signal.
Of the statements
(1) only A is true. (2) only B is true. (3) only A and B are true.
(4) only A and C are true. (5) all A,B and C are true.

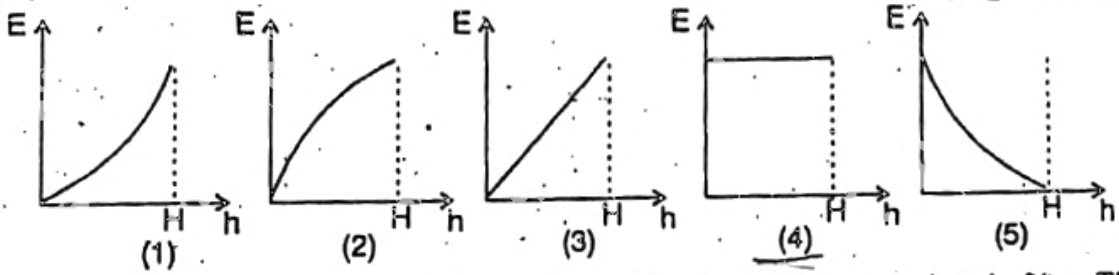
12. Which one of the following statements made about X-rays and Y-rays in not true ?
(1) Y-rays have shorter wavelengths than X-rays.
(2) Y-ray photons are charged whereas X-ray photons are neutral.
(3) Y-ray have more penetrating power than X-rays.
(4) Both Y and X-ray travel with the speed of light in vacuum.
(5) Both X-rays and Y-rays can be diffracted.

13. A particle moving in a circle of radius 2m at constant speed has a period of rotation 2s. Its acceleration towards the centre of the circle is
(1) 1/2 ms^{-2} (2) 2 ms^{-2} (3) 8 ms^{-2}. (4) 2 π^2 ms^{-2} (5) 8 π^2 ms^{-2}

14. A body of mass 5 kg is subjected to a force (F) which varies with time (t) as shown in the graph.
The momentum gained by the body is
(1) 350 N s. (2) 80 N s. (3) 70 N s.
(4) 40 N s. (5) 0.



15. A particle falls freely from a height H above the ground. Which of the following graphs represents the vbariation of its total energy (E) with the height (h) ?



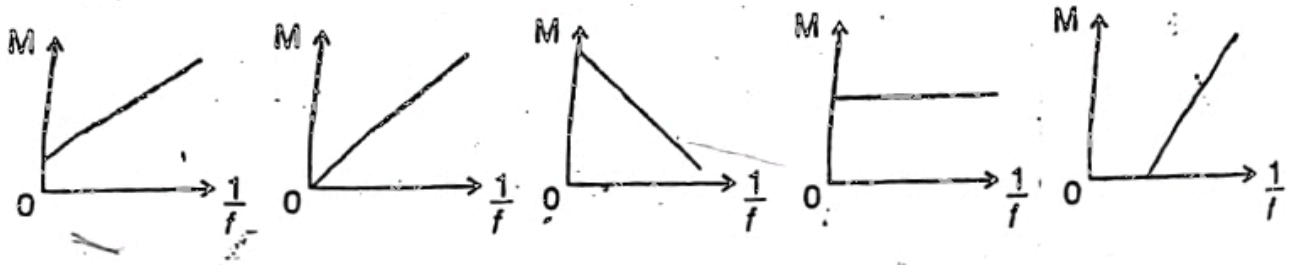
16. A wheel rotating at a speed of 600 revolutions per minute about its axis comes to rest in 20 s. The angular retardation in rad. s^{-2} is
(1) 60 π. (2) 30 π. (3) 10 π. (4) π. (5) $\pi/2$.

17. A light wave of wavelength 450 nm travelling with a speed of $3x10^8$ ms^{-1} in a certain medium enters another medium of refractive index 1.5 times that of the first medium. The speed (V) and the wavelength (λ) in the second medium are given by

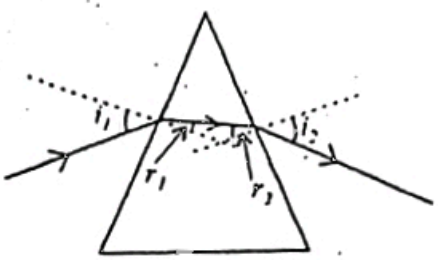
	V (ms^{-1})	λ (nm)
(1)	$3x10^8$	300
(2)	$2x10^8$	450
(3)	$2x10^8$	300
(4)	1.5×10^8	300
(5)	1.5×10^8	450

18. A certain mass performs simple harmonic motion about a point O with amplitude a and period T. Its displacement from O at time $t = \frac{T}{4}$ after passing through O is
(1) 0. (2) $\frac{a}{4}$ (3) $\frac{a}{2}$ (4) a (5) $\frac{5a}{4}$

19. Which of the following graphs best represents the variation of the magnifying power M of a simple microscope with the inverse of its focal length f ?



20. A monochromatic ray of light passes through a prism as shown in the figure.



Consider the following statements.

(A) The angle (i_1-r_1) is known as the angle of deviation produced by the prism.

(B) The angle i_2 always increases with i_1.

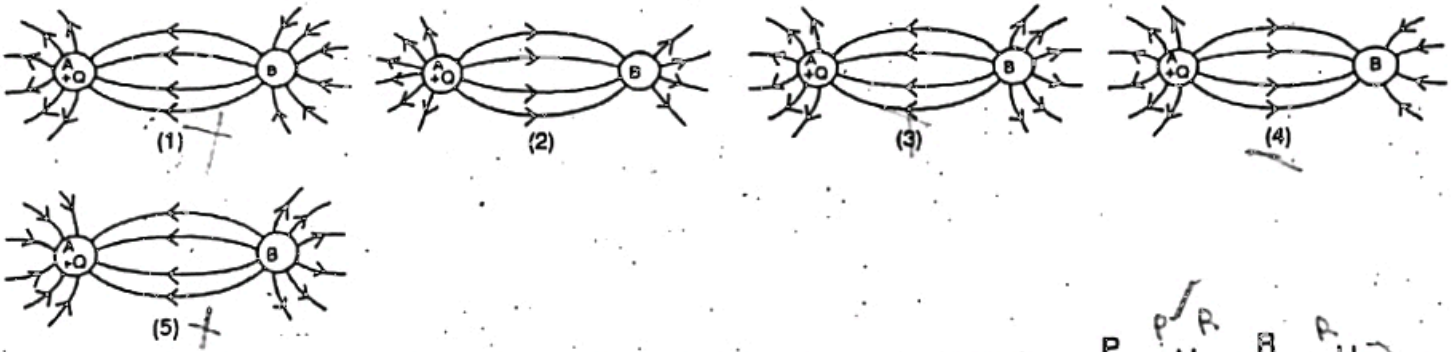
(C) At the minimum deviation $i_1 = i_2$.

Of the above statements.

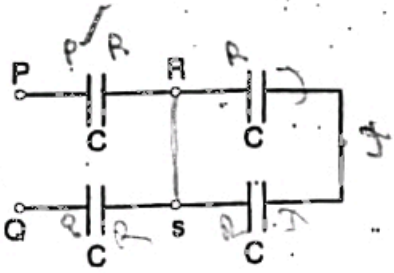
(1) only A is true. (2) only B is true. (3) only C is true.

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

21. A positively charged metal sphere A and an uncharged metal sphere B are placed close to each other. Which of the following diagrams correctly represents the electric field at the vicinity of the spheres ?



22. Four identical capacitors are connected as shown in the figure. The equivalent capacitance across PQ is 0.1 μF.

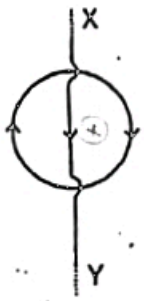


If the points R and S are connected by a wire the equivalent capacitance across PQ will become

(1) 0.05 μF. (2) 0.1 μF. (3) 0.2 μF.

(4) 0.3 μF. (5) 0.4 μF.

23 A circular coil of wire carries a current as shown in the diagram XY is a part of a long straight wire carrying a current and passing over the coil through its centre. The direction of the force acting on XY due to the current in the coil is



(1) normal to the plane of the coil and into the page.

(2) normal to the plane of the coil and out of the page.

(3) parallel to XY and towards Y.

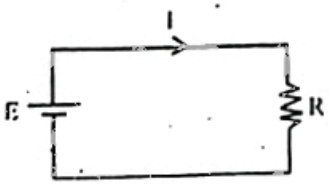
(4) at right angles to XY and to the right.

(5) at right angles to XY and to the left.

24. An alternating voltage of peak value 10 V is applied to an electric bulb. Which of the following direct voltages would make the bulb light with the same brightness ?

(1) 14.1 V (2) 10 V (3) 7.07 V (4) 5 V (5) 3.3 V

25. In the circuit shown, the cell has an e.m.f. E and internal resistance r. If I is the current in the circuit, EI represents



(1) the energy dissipated inside the cell. (2) the power dissipated in R.

(3) the power dissipated in r. (4) the energy dissipated in R.

(5) the power dissipated in the circuit.

26. Consider the following statements made about the photoelectric effect.

(A) Number of electrons emitted increases with the intensity of the incident light.

(B) Maximum velocity of the electrons emitted increases with the intensity of the incident light.

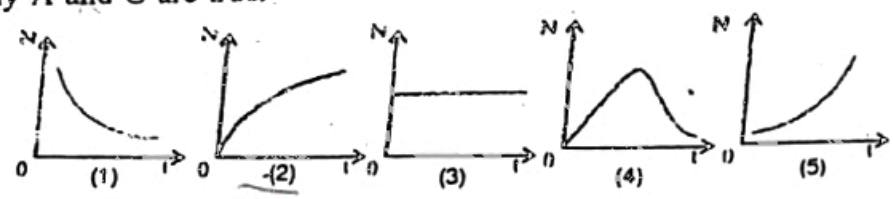
(C) Maximum velocity of the electrons emitted increases with the wavelength of the incident light.

Of the above statements

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

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

... a radioactive sample (with A decays to a stable nuclei B. The variation of the number of atoms (N) of B formed with time (t) is best represented by



28. A thin glass slide of mass M and length l hung from a sensitive balance is partially dipped in water of surface tension T as shown in the figure. If the balance is raised gently, the maximum reading indicated by the balance would be

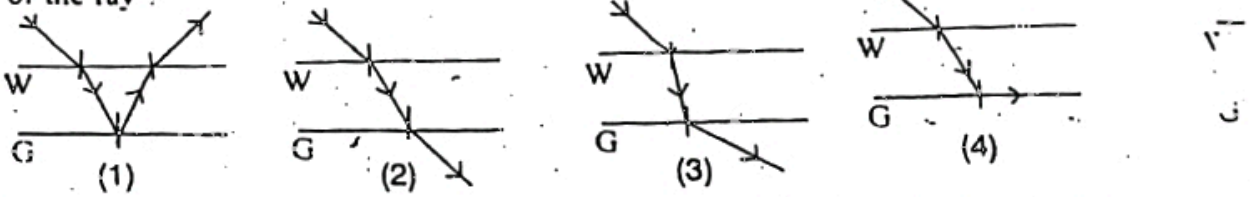
(1) $M - 2lT$ (2) $M + lT$ (3) $M + 2lT$

(4) $M + \frac{lT}{g}$ (5) $M + \frac{2lT}{g}$

29. Two small metal spheres of equal radii, but different densities ρ_1 and ρ_2 are released from vassel filled with a liquid of density ρ. If the terminal velocities reached by the spheres ar respectively, the ratio $\frac{v_1}{v_2}$ is equal to

(1) 1 (2) $\frac{\rho_1}{\rho_2}$ (3) $\frac{\rho_2}{\rho_1}$ (4) $\frac{\rho_1 - \rho}{\rho_2 - \rho}$ (5

30. A ray of monochromatic light travelling in air bis incident on a layer of water (W), which surface of a glass block (G), which of the following ray diagrams correctly rerpresents th of the ray ?



31. The frequency of the fundamental note of a transverse vibration of a stretched wire. 1 m The fundamental frequency of a second wire of the same material of length 1 m under the sam having a diameter 4 times larger is

(1) 80 Hz. (2) 160 Hz. (3) 320 Hz. (4) 640 Hz. (5)

32. On a certain day it was found that the velocity of sound in air was less near the sea level th altitude. Consider the reasons given below to explain the above observation.

(A) more water vapour being present in air at the sea level

(B) atmospheric pressure being higher at the sea level.

(C) the temperature of air being lower at the sea level.

Of the above explanations.

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

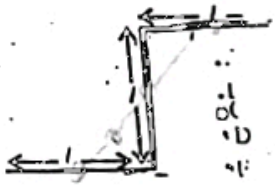
(4) only B and C are true. (5) all A,B and C are true.

33. Figure shows four coplanar forces A,B C and D (drawn to the scale) acting on a point object O. The resultant force R acting on O will most likely to be along the direction

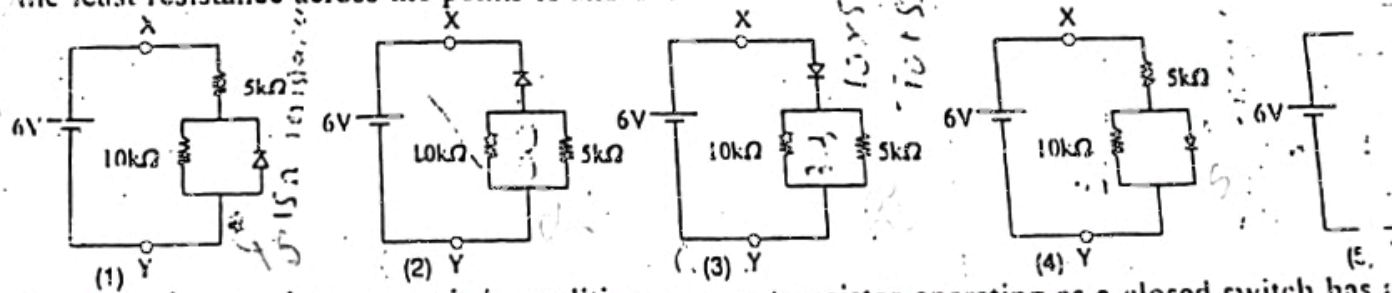
(1) ↖R (2) ↗R (3) $\underrightarrow{R}$ (4) ↘R (5) ↙R

34. A uniform wire is bent as shown in the figure. The centre of gravity of the whole wire is most likely to be found at

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



35. Which of the following combinations of resistances and diode produces the least resistance across the points X and Y ?

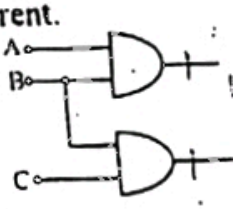


36. In comparison to the open switch condition, an npn transistor operating as a closed switch has a

(1) base current (2) collector current. (3) emitter current.

(4) emitter - base voltage. (5) collector-emitter voltage.

37. In the circuit shown ABC represents a binary number, for the output F to be binary 1, ABC should be

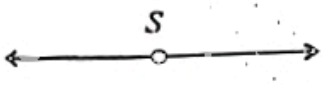


(1) 0 0 0 (2) 0 1 0 (3) 1 0 0

(4) 1 0 1 (5) 1 1 0

38. A vessel of volume V contains a mixture of an ideal gas and a saturated vapour. If the mixture is slowly compressed while keeping the temperature constant until the volume is reduced to $\frac{V}{2}$, then
(1) the vapour pressure and the gas pressure are both doubled.
(2) the vapour pressure is reduced and the gas pressure is doubled.
(3) the vapour pressure is doubled and the gas pressure remains constant.
(4) the vapour pressure remains constant and the gas pressure is doubled.
(5) both the vapour pressure and the gas pressure remains constant

39. In a certain process 500 J of heat is supplied to a system while 100 J of work is done on the system. As a result of this process the internal energy of the system will
(1) increase by 600 J. (2) decrease by 600 J. (3) increase by 400 J.
(4) decrease by 400 J. (5) remain unchanged.

40. 

A sound S moves towards and away from a stationary observer O as shown in the figure, If the ratio of the velocity of sound in air (v_0) and the velocity of the source (v_s) $\left(\text{i.e. } \frac{v_0}{v_s}\right)$ is 11, the ratio of the maximum and minimum apparent frequencies heard by the observer will be

(1) 1. (2) $\frac{11}{10}$. (3) $\frac{12}{11}$. (4) $\frac{6}{5}$. (5) 11.

41. The fundamental frequency (f_0) produced by a certain closed and an open are same. The open pipe is inserted fully into the closed pipe until it hits the bottom of the closed pipe. If the end corrections are neglected the corresponding fundamental frequency of the new setup will be

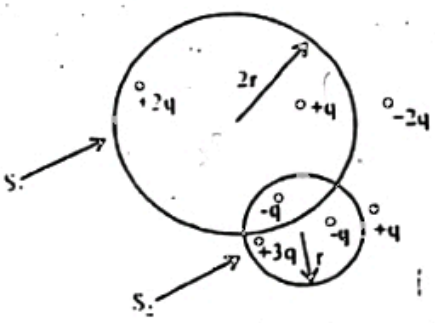
(1) $\frac{f_0}{3}$. (2) $\frac{f_0}{2}$. (3) f_0 (4) $2f_0$. (5) $3f_0$.

42. Two thin lenses in contact focus a parallel beam of light to a point 10 cm away from the combination. The lens combination will consist of
(1) a convex lens of focal length 10 cm and a concave lens of focal length 10 cm.
(2) a convex lens of focal length 10 cm and a concave lens of focal length 20 cm.
(3) a convex lens of focal length 20 cm and a concave lens of focal length 10 cm.
(4) two concave lenses of focal length 20 cm each.
(5) two convex lenses of focal length 20 cm each.

43. A closed cylinder contains a gas mixture of H_2, N_2 and O_2 at constant temperature. The pressure inside the cylinder increases most if M grams of
(1) H_2 is added to the cylinder. (2) N_2 is added to the cylinder.
(3) O_2 is added to the cylinder. (4) a mixture of H_2 and N_2 is added to the cylinder
(5) a mixture of N_2 and O_2 is added to the cylinder.

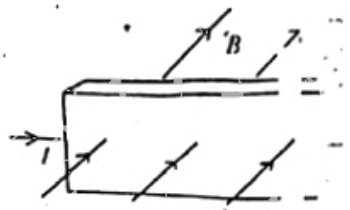
44. A closed room which is maintained at a constant temperature has a relative humidity of 50% , When the room is occupied by a few persons. the relative humidity is found to be increased up to 70%. As a result, the water vapour content inside the room is increased by
(1) 10% (2) 20% (3) 30% (4) 40% (5) 50%

45. S_1 and S_2 are two hypothetical spherical surfaces of radii 2r and r. drawn in a charge distribution of point charges having magnitudes -q, +q, +2q and +3q . The ratio $\frac{\text{net electric flux passing through } S_1}{\text{net electric flux passing through } S_2}$ is
(1) 1. (2) 2. (3) 4. (4) 8. (5) 16



46 Three identical metal spheres are supported on three insulating stands. A charge q is given on the first sphere. The first sphere is then momentarily touched with the second sphere and then the second sphere is momentarily touched with the third. Finally the third sphere is momentarily touched with the first sphere. The final amounts of charge residing on first, second, and the third spheres respectively are
(1) $\frac{q}{4}, \frac{q}{4}, \frac{q}{8}$ (2) $\frac{3q}{8}, \frac{q}{4}, \frac{3q}{8}$ (3) $\frac{q}{4}, \frac{q}{2}, \frac{q}{4}$ (4) $\frac{q}{2}, 0, \frac{q}{2}$ (5) $\frac{q}{8}, \frac{3q}{4}, \frac{q}{8}$

47. A flat rectangular metal plate is placed perpendicular to a uniform horizontal magnetic field of flux density B as shown in the figure. When a current I is passed through the plate horizontally, a vertical electric field E is established in the plate. The drift velocity of electrons inside the metal plate is



(1) $\frac{E}{B}$. (2) $\frac{B}{E}$. (3) $\frac{IE}{B}$. (4) $\frac{IB}{E}$. (5) IBI

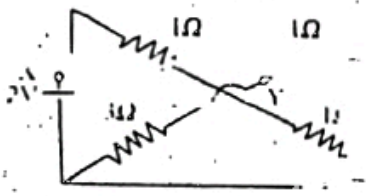
48. Assume that the moon is a sphere of radius R with g' as the acceleration due to gravity at the ir universal constant of gravitation is G, the mean density of the moon is given by

(1) $\frac{4\pi RG}{3g'}$. (2) $\frac{3Rg'}{4\pi G}$. (3) $\frac{4\pi Rg'}{3G}$. (4) $\frac{4\pi g'}{3RG}$ (5) $\frac{}{4}$

49. To allow only 20% of the total current to flow through an ammeter of resistance 96Ω required is

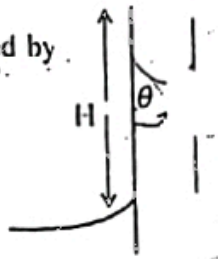
(1) 9.6 Ω (2) 19.2 Ω (3) 24 Ω (4) 48 Ω (5) 60 Ω

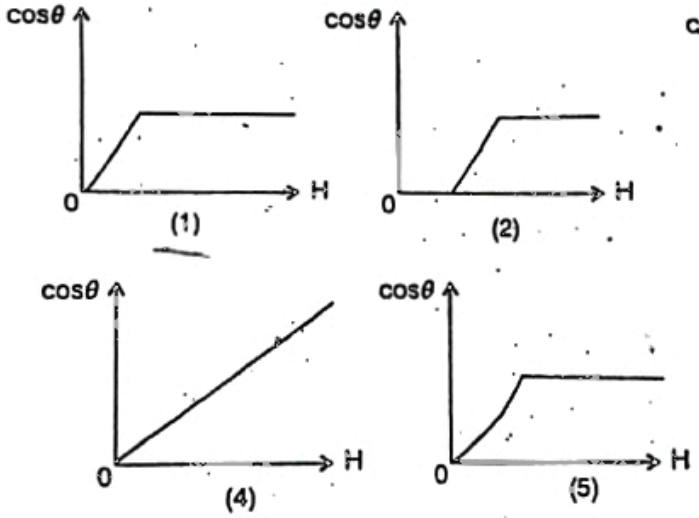
50. In the circuit shown cells have negligible internal resistances Potential at point X with respect to Y is



(1) 0. (2) -1 V. (3) + 1 V.
(4) -3 V. (5) + 3 V.

51. A capillary tube is gently dipped vertically in a liquid as shown in the figure. The variation of the cosine of the contact angle θ, with H is best represented by

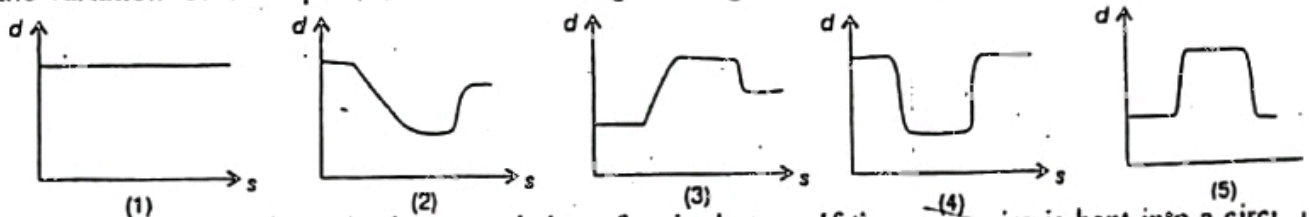




52. A railway wagon of mass 1000 kg and length 11 m is at rest on a frictionless straight horizontal man of mass 100 kg staying in the wagon walks straight from one end of the wagon to the othe wagon is free to move the distance through which it will move is

(1) 0. (2) $\frac{1}{10}$ m. (3) $\frac{1}{11}$ m. (4) 1 m. (5) 11 m.

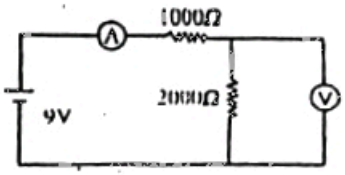
53. A river having a constant breadth is flowing steadily at a certain constant speed except in a cer If the speed of flow in that region is found to be lower, then which of the following curves best r the variation of the depth (d) of the river along the length of the river (s) ?



54. A current flows in a circular loop consisting of a single turn. If the same wire is bent into a circ two turns and the same current is passed through the loop, the magnetic flux density at the ce loop will change by a factor of

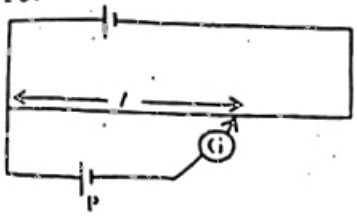
(1) $\frac{1}{4}$. (2) $\frac{1}{2}$. (3) 2. (4) 4. (5) 8.

55. In the circuit shown the ammeter A has negligible internal resistance. When the voltmeter is removed from the circuit ammeter reading will change by 1.5 mA. The internal resistance of the voltmeter is



(1) 500 Ω (2) 1000 Ω (3) 1500 Ω
(4) 2000 Ω (5) 3000 Ω

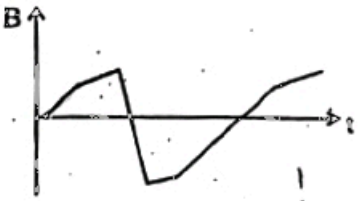
56.

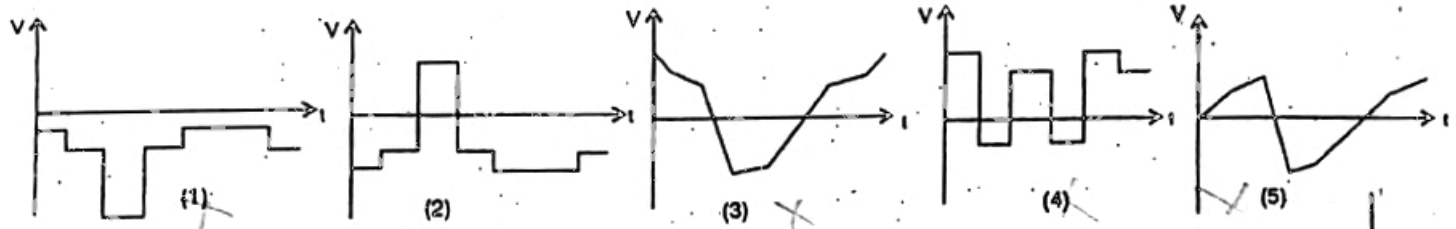


In the potentiometer circuit shown, the balance length l is reduced to $\frac{l}{2}$ when a resistor of resistance R is connected across the terminals of the cell P. The internal resistance of the cell P is

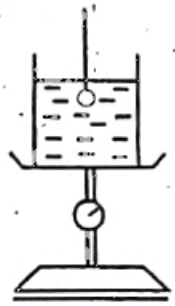
(1) $\frac{R}{2}$ (2) R (3) 2R (4) $\frac{3R}{2}$ (5) 3R

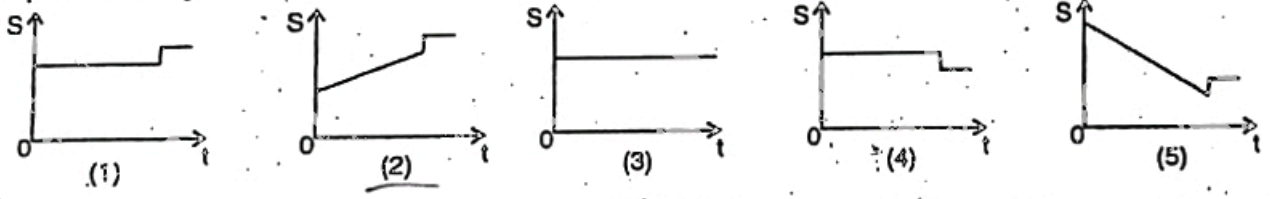
57. A conducting rod is placed normal to a time varying magnetic field, If the magnetic flux density (B) of the field varies with time (t) as shown in the figure. Which of the following curves correctly represents the variation of the potential difference (V) across the rod with time (t) ?



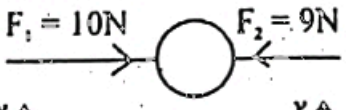


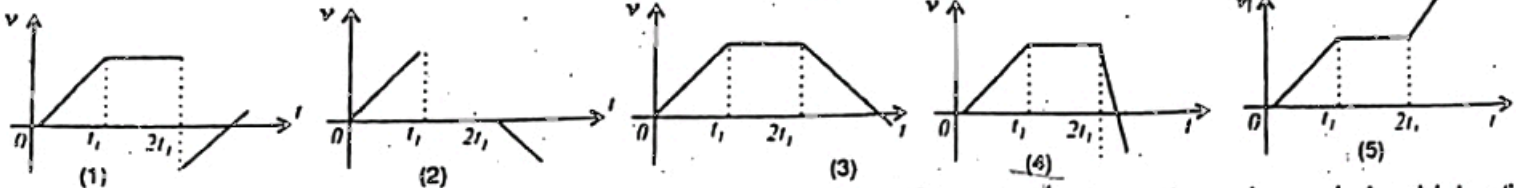
58. A beaker of water is kept on a compression balance. At time t = 0, a solid object immersed just beneath the water level as shown in the figure is lowered slowly into the beaker until it rests at the bottom. The variation of the reading (S) of the balance with time (t) is best represented by





59. Two forces F_1 (=10 N) and F_2 (=9 N) are applied simultaneously to a stationary object at time t = 0 as shown in the figure. The force F_2 is then increased suddenly to 10 N at $t = t_1$ and the force F_1 is completely removed at time $t = 2t_1$ which of the following graphs best represents the variation of the velocity (v) of the object with time (t) ?





60. A block rests on an inclined plane whose angle of inclination (θ) to the horizontal can be varied, which of the following graphs best represents the variation of the frictional force F between the block and the plane with θ ?