G.C.E. (Advanced Level) Examination – August 2010
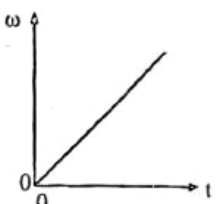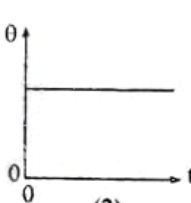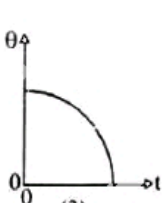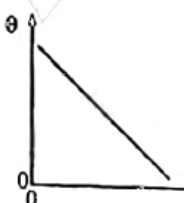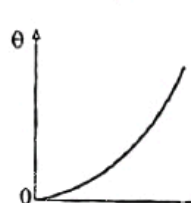## PHYSICS - I
Two hours

Important :
- ○ This question paper includes 60 questions in 07 pages.
- ○ Enter your **Index Number** in the space provided on the answer sheet.
- ○ **Answer all the questions.**
- ○ Instructions are given on the back of the answer sheet. Follow them carefully.
- ○ In each of the questions 1 to **60**, pick one of the alternatives (1). (2). (3). (4). (5) which is **correct or most appropriate** and mark your response on the answer sheet **in accordance with the instructions given therein.**

Use of calculators is not allowed.

$$(g = 10N\ kg^{-1})$$

01. The dimensions of moment of inertia is
    (1) ML^2 (2) ML   (3) M   (4) L   (5) MLT^{-1}

02. SI unit of the quantity of heat is
    (1) Cal   (2) W   (3) K   (4) J   (5) cd

03. When white light passes through a glass prism, which of the following colours deviates the least?
    (1) green   (2) orange   (3) blue
    (4) yellow   (5) indigo

04. The distance from the eye lens to the retina of a person is 1.7 cm. The focal length of the eye lens when the eye is in completely relaxed position is
    (1) 0.85cm   (2) 1.0 cm   (3) 1.2 cm
    (4) 1.4 cm   (5) 1.7 cm

05. Consider the following statements made about a voltmeter and an ammeter.
    (A) A voltmeter has a large internal resistance and an ammeter has a small internal resistance.
    (B) A voltmeter is connected in series with a circuit component to measure the voltage across the component.
    (C) An ammeter measures the charge per unit time that flows through it.
    Of the above statements
    (1) only (A) is true.   (2) only (C) is true.
    (3) only (A) and (B) are true.   (4) only (A) and (C) true.
    (5) only (B) and (C) are true.

06. Two guitar wires A and B identical in all respects except that the diameter of A is twice the diameter of B, and are subjected to same tension.
    The ratio, $\dfrac{\text{fundamental frequency produced by A}}{\text{fundamental frequency produced by B}}$ is
    (1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{1}{\sqrt{2}}$
    (4) $\sqrt{2}$ (5) 2

07. In order to double the root mean square speed of an ideal gas, the factor by which the absolute temperature of the gas to be increased is
    (1) $\sqrt{2}$ (2) 2   (3) 4
    (4) 8   (5) 16

08. If the angular velocity (ω) an object varies with time (t) as shown in figure, the corresponding variation of angular displacement (θ) with time (t) is best represented by

09. A major artery with a 1.0 cm² cross-sectional area carrying blood branches into 18 smaller arteries. each having a cross-sectional area of 0.4 cm² and carrying equal volumes of blood per unit time.
    The ratio, $\dfrac{\text{speed of blood in the major artery}}{\text{speed of blood in a smaller artery}}$ is
    (1) 3.6   (2) 4.0   (3) 7.2
    (4) 8.4   (5) 45

10. The figure shows a wave pulse travelling along a string towards its end which is connected to a small light ring that can move along a vertical wire. Which of the following figures best repre

sents the shape of the wave pulse at the instant when the peak of the pulse reaches the ring?
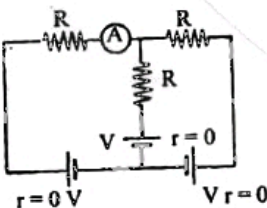

(1)   (2)   (3)

(4)   (5)
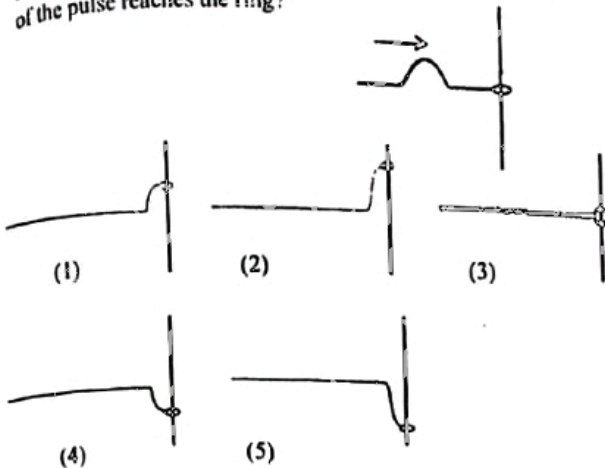
11. A point object O is placed in front of a thin convex lens as shown in the figure. The refracted path of the incident ray shown is best represented by

(1)   (2)   (3)

(4)   (5)
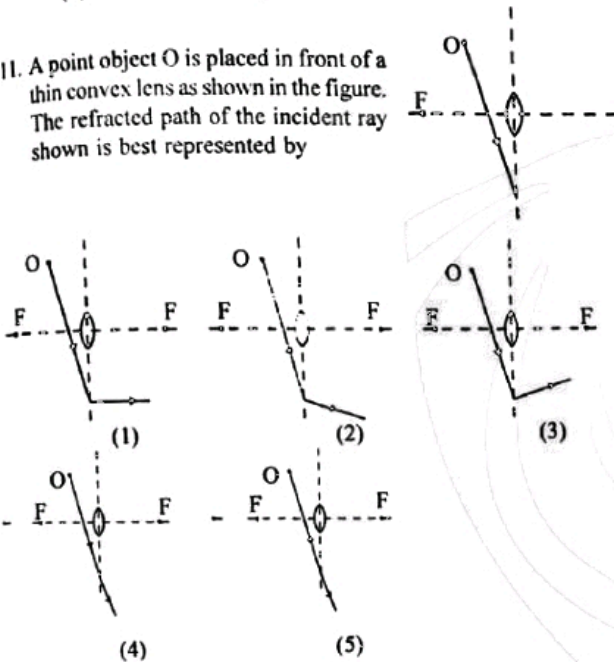
12. Current through ammeter A of the circuit shown is

(1) 0

(2) $\dfrac{V}{3R}$

(3) $\dfrac{3V}{2R}$

(4) $\dfrac{V}{R}$

(5) $\dfrac{3V}{R}$

13. A coil made of a platinum wire has a resistance of 50 Ω at 0 °C. When immersed in melting lead, the resistance of the coil increases to 115 Ω. If the temperature coefficient of resistivity of platinum is 4.0×10^{-3} °C^{-1}, the melting point of lead is

(1) 225 °C (2) 325 °C (3) 475 °C (4) 575 °C (5) 598 °C

14. The circuit shown in figure is constructed using ideal components. A is an ammeter and V_x is a voltmeter. If a Student by mistake replaces the ammeter A with an ideal voltmeter V_y, then V_x and V_y respectively read

(1) 1 V, 1 V

(2) 1V, 0

(3) 2V, 0

(4) 0, 1V

(5) 2V, 2V
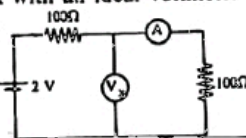
15. In the nuclear reaction,

$$^{7}_{3}Li + ^{A}_{Z}X \longrightarrow ^{A+6}_{Z+2}Y + a$$
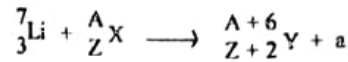
Particle denoted by a is

(1) a proton.   (2) an electron.   (3) a neutron.

(4) an α particle.   (5) a positron.

16. A small conducting sphere of mass m has a + Q charge. This sphere is hung form an insulating thread of length l in a region where there is an electric field of intensity E in vertically downward direction, (in addition to the gravitational field), and is allowed to oscillate as a simple pendulum. If the period of small oscillations of this simple pendulum is T, then

(1) $T = 2\pi\sqrt{\dfrac{l}{g}}$

(2) $T = 2\pi\sqrt{\dfrac{l}{g+E}}$

(3) $T = 2\pi\sqrt{\dfrac{l}{g+QE}}$

(4) $T = 2\pi\sqrt{\dfrac{l}{g-\dfrac{QE}{m}}}$

(5) $T = 2\pi\sqrt{\dfrac{l}{g+\dfrac{QE}{m}}}$

17. Two stars, A and B of uniform density have equal radii. Star A having twice the mass of star B is spinning three times faster than star B.

The ratio, $\dfrac{\text{angular momentum of star A}}{\text{angular momentum of star B}}$ is

(1) $\dfrac{1}{6}$ (2) 2 (3) 3 (4) 6 (5) 18

18. A circular disk of radius 0.5 m rolls with a uniform angular speed 12 rad s^{-1} on a horizontal surface without slipping. Two points P and Q are located on the perimeter of the disk. The speeds of the two points relative to the earth when they are at the positions shown in the figure, are

|	P	Q
(1)	6 ms^{-1}	6 ms^{-1}
(2)	6 ms^{-1}	3 ms^{-1}
(3)	6 ms^{-1}	0
(4)	12 ms^{-1}	6 ms^{-1}
(5)	12 ms^{-1}	0 ms^{-1}
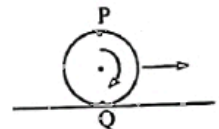
19. The graph shows the variation of a force F exerted on an object P when it is moving along the x-axis from x = -5 to x = 5.
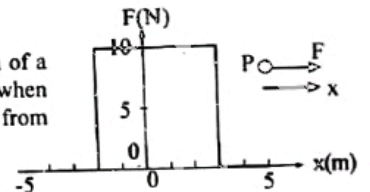
The work done on the object by the force is

(1) 10 J (2) 30 J (3) 40 J (4) 50 J (5) 100 J

20. A box (A) of mass 50 kg is placed on the horizontal floor-bed of a lorry as shown in the figure. The coefficient of static friction between the box and the floor-bed is 0.8 and the lorry accelerates along a straight horizontal road.
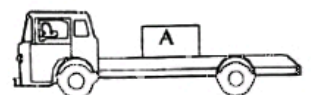
The maximum acceleration the lorry can have so that the box will not slide over the floor-bed is

(1) 2 ms^{-2} (2) 4 ms^{-2} (3) 8 ms^{-2} (4) 10 ms^{-2} (5) 12 ms^{-2}

21. When a standing wave is setup on a string fixed at both ends,

(1) the number of nodes is equal to the number of antinodes.

(2) the wavelength of the wave is always equal to the value obtained when the length of the string is divided by an integer.

(3) the frequency of the wave is equal to the value of the number of nodes times the fundamental frequency.

(4) the frequency of the wave is equal to the value of the number of antinodes times the fundamental frequency.

(5) the shape of the string at the fundamental frequency is not symmetric about the mid point of the string.

22. If the ratio of sound intensities and the corresponding difference in sound intensity levels (in dB) of two sound sources are numerically equal, then the ratio of sound intensities is

(1) 10   (2) 20   (3) 100   (4) 200   (5) 1000

23. A telescope having a magnifying power of 15 has an eyepiece of power 50 diopters. The length of the telescope, when it is in the normal adjustment is

(1) 15cm   (2) 28cm   (3) 30cm   (4) 32cm   (5) 64cm

24. Two particles having charges $+Q$ and $-Q$ revolve in opposite directions with the same angular frequency ω along two circular paths of radius r, which are very close to each other as shown in the figure. Magnetic flux density at the centre of the circular paths is
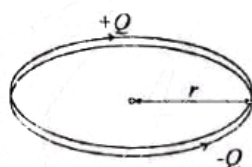
(1) zero

(2) $\dfrac{\mu_0 Q\omega}{4\pi r}$

(3) $\dfrac{\mu_0 Q\omega}{2\pi r}$

(4) $\dfrac{\mu_0 Q\omega}{2\pi r}$

(5) $\dfrac{\mu_0 Q\omega}{4 r}$

25. Figure shows three arrangements (A, B and C) of four identical particles with three of them placed on a semi circle and fourth placed at the centre of the semi circle. If the respective magnitudes of the net gravitational force on the particle at the centre due to the other three particles are represented by F_A, F_B and F_C then


(A)   (B)   (C)
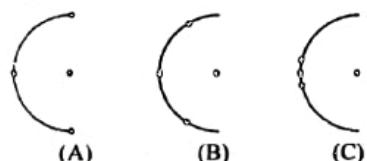
(1) $F_C > F_B > F_A$ (2) $F_B < F_C < F_A$ (3) $F_C < F_B < F_A$

(4) $F_C = F_B = F_A$ (5) $F_C = F_B > F_A$

26. Figure shows four point charges and a Gaussian surface S.

Consider the following statements.

(A) Net electric flux through the surface depends only on the fields produced by q_1 and q_2.

(B) The electric field intensity at point P depends only on the fields produced by q_1 and q_2.

(C) The electric field intensity at point P depends on the locations of the charges q_1, q_2, q_3 and q_4.
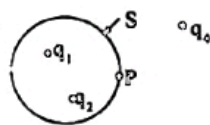

Of the above statements

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

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

(5) all (A), (B) and (C) are true

27. Which of the arrangements shown is/are equivalent to a NOT gate?

(P)   (Q)

(R)   (S)
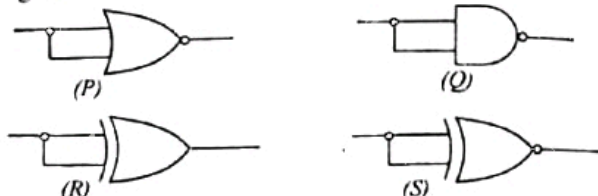
(1) P only   (2) Q only   (3) P and Q only

(4) P, Q and S only   (5) all P, Q, R and S

28. Figure shows two silicon transistors T_1 and T_2 located in a circuit, which operate properly. If V_{CE} values of the transistors T_1 and T_2 are 0.1V and 3V respectively, which of the following is true?


$V_{CE} = 0.1$ V $V_{CE} = 3$ V

T_1 T_2
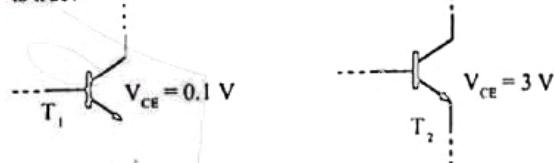
(1) V_{BC} of T_1 is approximately 0.6 V, and the BC junction is forward biased.

(2) V_{BC} of T_2 is approximately 0.6V, and the BC junction is forward biased.

(3) V_{BC} of T_1 is approximately 0.6V, and the BC junction is reverse biased.

(4) V_{BC} of T_2 is approximately 2.3V, and the BC junction is forward biased.

(5) V_{BC} of T_1 is approximately 3V, and the BC junction is reverse biased.

29. When a glass capillary tube of internal diameter d is immersed vertically in water, the water level inside the tube rises to a height of h. The variation of h with d is best represented by


(1)   (2)   (3)

(4)   (5)
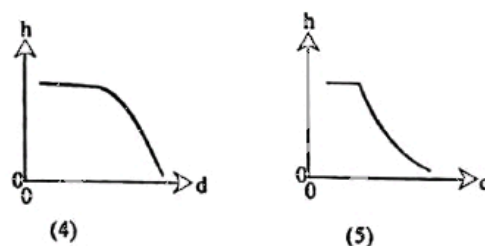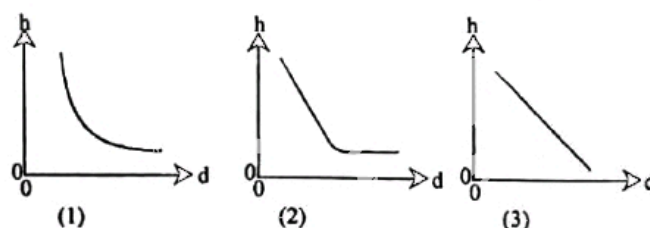
30. Two light rods of initial lengths l_1 and l_2, having equal areas of cross-section are joined end to end, and a force F is applied as shown in the figure.

If the respective Young's moduli of the materials of rods are E_1 and E_2, (see figure) then they will contract by the same amount when
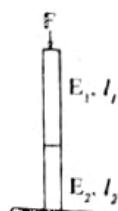

(1) $E_2 l_1 = E_1 l_2$ (2) $E_2 l_2 = E_1 l_1$ (3) $E_1^2 l_2 = E_2^2 l_1$

(4) $E_1 l_2^2 = E_2 l_1^2$ (5) $E_1^2 l_1 = E_2^2 l_2$

31. A cricket ball of mass 0.15kg travels with a speed of 20 ms^{-1} just before batted by a batsman When he batted. the variation of the force (F) exerted by the bat on the ball with time (t) is shown in the graph. If the ball bounces back in the opposite direction the speed of the cricket ball just after batting is
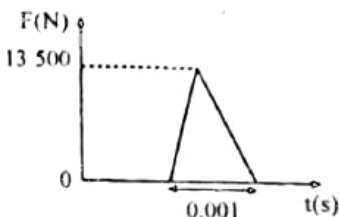

(1) 20ms-1   (2) 25 ms-1   (3) 65ms-1

(4) 70 ms-1   (5) 110ms-1

32. If the moments of inertia of an uniform cylindrical rod about the axes A. B and C shown are I_A, I_B and I_C respectively, then
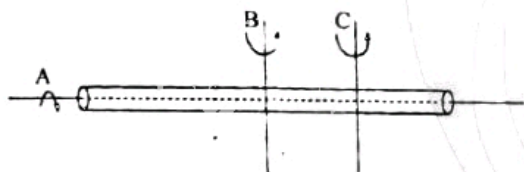

(1) $I_A > I_B > I_C$ (2) $I_A < I_B < I_C$ (3) $I_B = I_C > I_A$

(4) $I_A = I_B = I_C$ (5) $I_B > I_C > I_A$

33. A cube of wood is floating in a beaker of water as shown in the figure. At time $t = 0$, the beaker begins to move in the downward direction from rest with a constant acceleration. The variation of the volume V of the portion of the cube that is immersed in water, with time t is best represented by
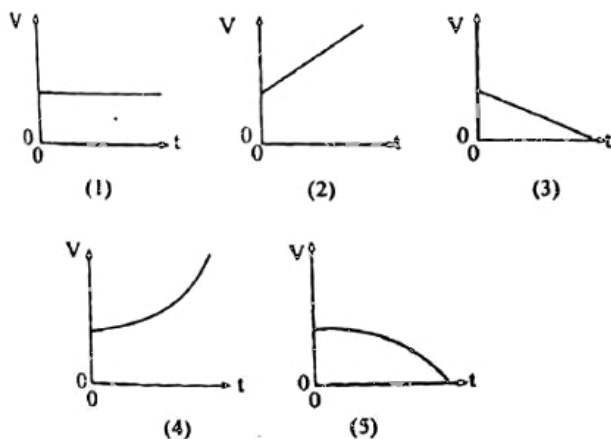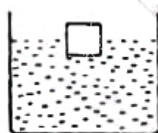
34. Two long parallel wires placed normal to the plane of the paper carry equal currents in opposite directions as shown in the figure.
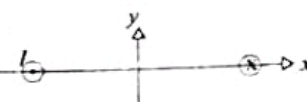

The variation of the component of the magnetic flux density in y direction (B) along the x axis is best represented by
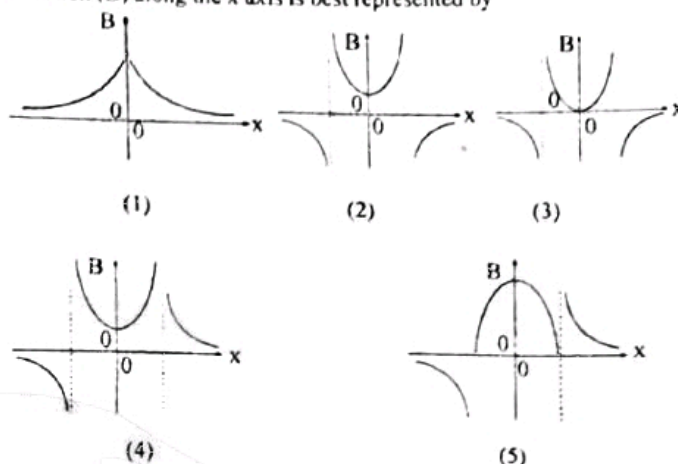
35. Sensitivity of a potentiometer can be increased by

(1) increasing the e.m.f. of the call connected across the wire.

(2) reducing the resistivity of the wire.

(3) connecting a resistance in series with the wire.

(4) reducing the diameter of the wire.

(5) maintaining the temperature of the wire at room temperature.

36. The figure shows two transformers A and B connected to power lines. The primary coil of A is connected to a voltage of 33000V ac and the secondary coil of B provides a voltage of 230V ac for domestic use. Transformer A has N_1 and N_2 turns in its primary and secondary respectively. Transformer B has N_3 and N_4 turns in its primary and secondary respectively.
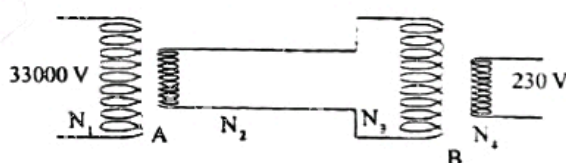
If the power losses in the system are neglected. which of the following is true?

(1) $\dfrac{N_1}{N_4} = \dfrac{33000}{230}$ (2) $\dfrac{N_4}{N_1} = \dfrac{33000}{230}$ (3) $\dfrac{N_1 N_3}{N_2 N_4} = \dfrac{33000}{230}$

(4) $\dfrac{N_2 N_4}{N_1 N_3} = \dfrac{33000}{230}$ (5) $\dfrac{N_1 N_4}{N_2 N_3} = \dfrac{33000}{230}$

37. A fish in a lake releases an air bubble of volume $2.5 \times 10^{-7} m^3$. This bubble subsequently releases a volume of $10^{-6} m^3$ air into the atmosphere. If the atmospheric pressure is 10^5 Pa and the density of water is 10^3 kg m^{-3}, depth of the position of the fish is, (neglect the effects of surface tension)

(1) 30m   (2) 40m   (3) 50m

(4) 60m   (5) 80m

38. Air is rapidly pumped into a tyre by a bicycle pump. Which of the following is true for air inside the pump during the pumping process? (Here all the symbols have their usual meaning)

	ΔQ	ΔW	ΔU
(1)	0	negative	positive
(2)	positive	positive	positive
(3)	0	positive	negative
(4)	0	positive	positive
(5)	negative	negative	positive

39. An electric kettle requires 0.2k Wh to raise temperature of 2kg of water from 28 °C to the boiling point of 100°C. If the specific heat capacity of water is 4200J kg^{-1} K^{-1}, the efficiency with which the kettle works is

(1) 42%   (2) 54%   (3) 60%

(4) 72%   (5) 84%

40. The variation of temperature (θ) with time (t) for two liquids P and Q of equal masses heated in identical manner are shown in the figure.

Consider the following statements.

(A) Liquid Q is a better thermometric liquid than P to measure temperature variations in small quantities of liquids.

(B) Liquid Q is more suitable than P to construct a constant temperature liquid bath.

(C) Liquid Q is better than liquid P for heating air in an enclosed room by sending through a spiralled pipe as shown.
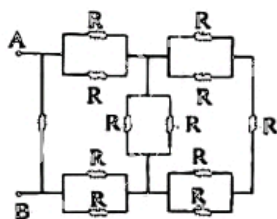
Of the above statements
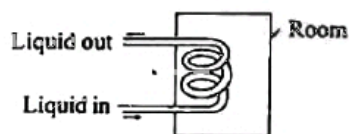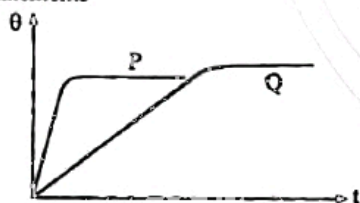
(1) only (A) is true.

(2) only (B) is true.

(3) only (A) and (B) are true.

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

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

41. The equivalent resistance across points A and B of the resistor network shown is

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

(3) $\frac{7}{12}R$ (4) $\frac{3}{4}R$

(5) R
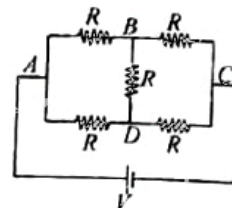

42. The graph shown the variation of a magnetic flux (ϕ) through a coil with time (t).

The variation of the corresponding induced e.m.f. (E) with time (t) is best represented by
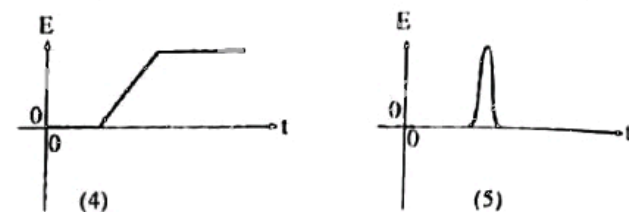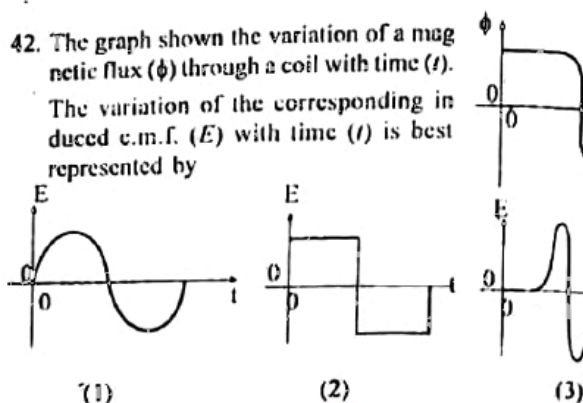
43. The respective effective resistances 'seen by' the voltage source V across AC and BD are

(1) $\frac{5R}{2}$ and R   (2) R and 0

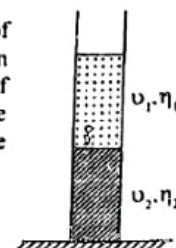(3) $\frac{5R}{2}$ and ∞ (4) R and 3R   (5) R and ∞

44. In the circuit shown, D is a silicon diode. The voltage source provides a variable voltage V. Which of the following curves best represents the variation of I with V?
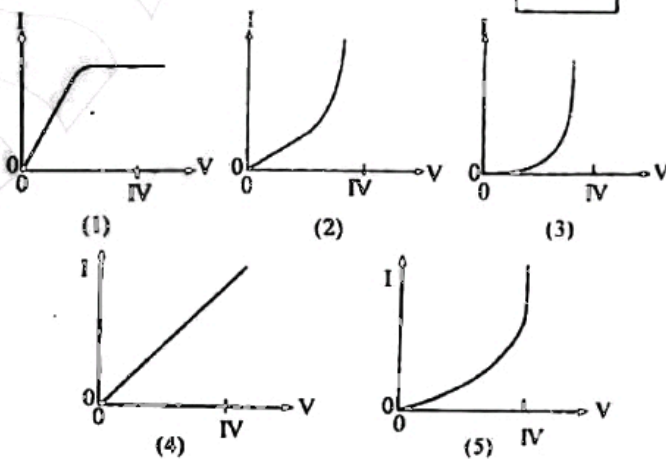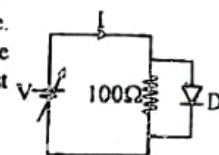

45. A small sphere falls through two columns of immiscible liquids in a deep container as shown in the figure. If η_1 and η_2 are the viscosities of the two liquids, and υ_1 and υ_2 are the corresponding terminal velocities of the sphere respectively, then

(1) $\eta_1\upsilon_1 = \eta_2\upsilon_2$ (2) $\eta_1\upsilon_1 > \eta_2\upsilon_2$ (3) $\eta_1\upsilon_1 < \eta_2\upsilon_2$

(4) $\eta_1\upsilon_2 > \eta_2\upsilon_1$ (5) $\eta_1\upsilon_2 = \eta_2\upsilon_1$

46. A and B are two conducting spheres having radii R and $\frac{R}{2}$, respectively, and each carrying a charge $+Q$. When the two spheres are separated by a distance d ($>> R$), as shown in the figure, the electric potential at point P is V_0. When these two spheres are connected using a very thin metal wire, the electric potential at P will become

(1) zero.
(2) $\frac{V_0}{2}$
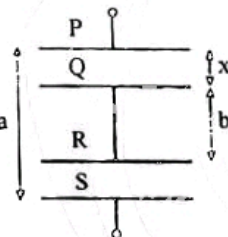(3) $\frac{3V_0}{4}$
(4) V_0
(5) $2V_0$
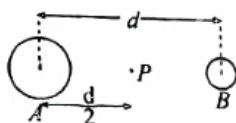
47. A particle having an electric charge is travelling along a circular path under the influence of a uniform magnetic field. Consider the following statements.

(A) Direction of the velocity of the particle is always perpendicular to the direction of the magnetic field.

(B) Time required for the particle to make one revolution is independent of the radius of the circular path.

(C) Speed of the particle is directly proportional to its $\frac{mass}{charge}$ ratio.

Of the above statements

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

48. P, Q, R and S are four parallel conducting plates each of area A, and P and S are fixed plates. Plates Q and R are connected by a rigid conductor as shown in the figure so that they could be moved up and down together. The equivalent capacitance of the system is given by

(1) $\frac{\varepsilon_0 A}{\alpha}$
(2) $\frac{\varepsilon_0 A}{\alpha - x}$
(3) $\frac{\varepsilon_0 A}{\alpha + b - x}$
(4) $\frac{\varepsilon_0 A}{\alpha + b + x}$
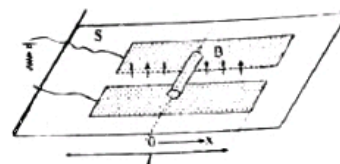(5) $\frac{\varepsilon_0 A}{\alpha - b}$

49. When a free particle with kinetic energy K and de Broglie wavelength λ enters a certain region its potential energy becomes V. The particle's new de Broglie wavelength is given by

(1) $\lambda\sqrt{\frac{V}{V - K}}$
(2) $\lambda\sqrt{\frac{K}{K - V}}$
(3) $\lambda\left[1 + \frac{K}{V}\right]$
(4) $\lambda\left[1 - \frac{K}{V}\right]$
(5) $\lambda\sqrt{\frac{K}{V + K}}$

50. Two empty boxes of volumes 0.1 m³ and 0.3m³ filled with air at room temperature of 30°C are sealed and stored in a refrigerator. A packet of moisture absorbing silica gel has been inserted into the 0.3m³ box just before sealing. Later it was found that the relative humidity of air inside the small box reached 100% at 15°C and relative humidity of air inside the large box reached 100% at 5°C. If the absolute humidities of air at the dew points of 5°C and 15°C are 6.8gm⁻³ and 12.7gm⁻³ respectively, then the amount of water vapour absorbed by the gel is

(1) 1.77g
(2) 2.04g
(3) 3.81g
(4) 6.80g
(5) 12.70g

51. The diagram shows two thin smooth strips of aluminium of length l pasted on a flat smooth horizontal wooden surface S. Strips are connected to a battery at one end. A uniform upward magnetic field is setup, perpendicular to the surface, throughout the region between the aluminium strips. When a steel rod is placed on the two aluminium strips as shown, the rod starts to move. The variation of the velocity (v) of the rod with distance along the x axis is best represented by

(1)
(2)
(3)

(4)
(5)
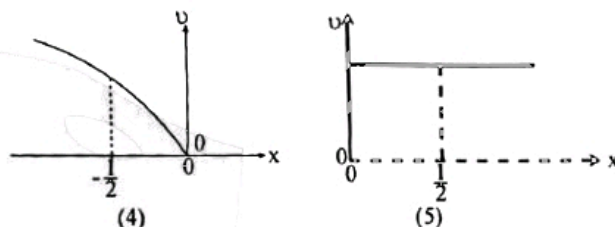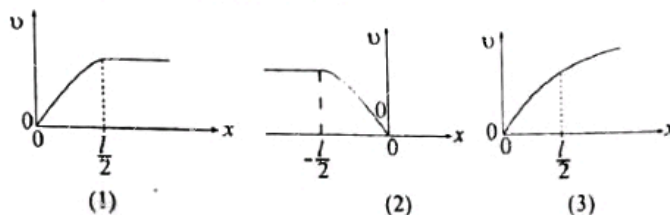
52. A 110 W immersion heater is placed in a metal container of teat capacity 200JK⁻¹, containing 1kg of water. It is found that although the heater is kept switched on for a long time the temperature of water rises only upto 90°C. The temperature of water 10s after turning off the heater, is closest to, (specific heat capacity of water = 4200 J kg⁻¹ K⁻¹)

(1) 89.50 °C
(2) 89.68 °C
(3) 89.70 °C
(4) 89.73 °C
(5) 89.75 °C

53. An artillery gun is positioned on a horizontal ground and an artillery shell is fired from it so that the shell would land at a target, which is located at a distance 2000m from the position of the gun. Accidentally, the shell explodes into two pieces A and B at a certain point of its trajectory. The mass of A is twice that of B, and both pieces land at the same moment, after travelling in the same vertical plane. If A lands at a distance 1800 m in the direction of the target from the gun, the distance to the landing point of B from the gun is

(1) 1600m
(2) 2200m
(3) 2400m
(4) 2600m
(5) 2800m

54. A 10 cm long pencil is placed along the optical axis of a convex lens as shown in the figure. If the length of the image of the pencil is also 10cm, the value of the focal length of the lens is

(1) 4cm
(2) 8cm
(3) 10cm
(4) 12cm
(5) 20cm
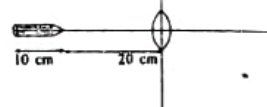
55. The wheel shown in the figure is made of three bi-meteal (P,Q) strips attached to the axis using radial metal parts. This can be setup to oscillate about an axis perpendicular to the plane of the wheel and passing through the centre. The wheel is designed

such that the oscillating period of the wheel remains the same regardless of the changes of the surrounding temperature. Consider the following statements.

(A) The moment of inertia of the wheel should not change with the temperature.

(B) The shape of the wheel should not change with temperature.

(C) The linear expansivity of metal P should be greater than that of Q.
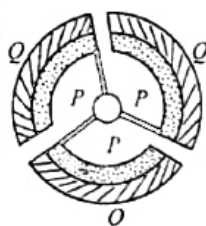
Of the above statements,

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

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

(5) all (A), (B) and (C) are true

56. Three masses m_1, m_2 and m_3 of hot water at temperatures θ_1, θ_2, and θ_3 respectively are added to three identical containers each having mass m of water to achieve the same final temperature θ_0. Then the containers are allowed to cool. The cooling curves for the three containers are shown in the figure. If the rate of loss of heat form each container is the same, then
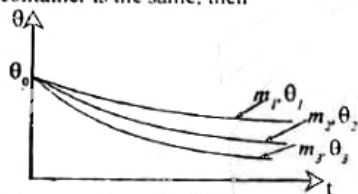
(1) $m_1 < m_2 < m_3$ and $\theta_1 < \theta_2 < \theta_3$

(2) $m_1 < m_2 < m_3$ and $\theta_1 > \theta_2 > \theta_3$

(3) $m_1 > m_2 > m_3$ and $\theta_1 < \theta_2 < \theta_3$

(4) $m_1 > m_2 > m_3$ and $\theta_1 > \theta_2 > \theta_3$

(5) $m_1 = m_2 = m_3$ and $\theta_1 = \theta_2 = \theta_3$

57. A monochromatic ray of light is incident close and parallel to a diameter of a transparent plastic sphere with centre O and refracted as shown in the figure. The refractive index of the plastic is closest to (take $\sin \theta \approx \theta$ for small θ angles)
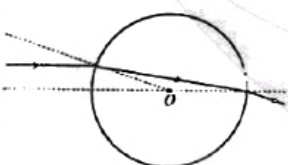
(1) 1.2   (2) 1.3   (3) 1.5   (4) 2.0   (5) 2.5

58. A source of sound is located at a point O above the earth surface. In the daytime, the air temperature decreases gradually when moving upwards from the earth surface. Which of the following figures best represents the way in which the wave fronts of the sound emitted from the source are propagated?
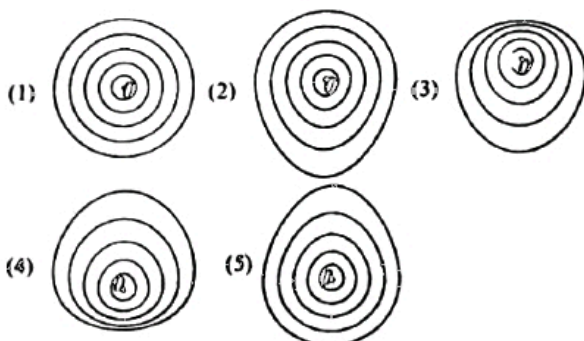
59.

Two cars are moving along a road at constant speeds as shown in the figure. The driver of A is sounding the horn of his car of frequency f_0 continuously. Initially the car B is moving faster than A. Suddenly B slows down and stops. A continues to move at the same speed B which is stopped. The graph that best represents the variation of frequency (f) of sound heard by the driver of B with time (t) is

(1)   (2)   (3)

(4)   (5)
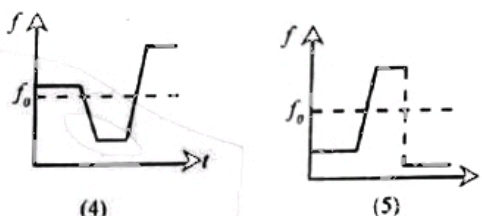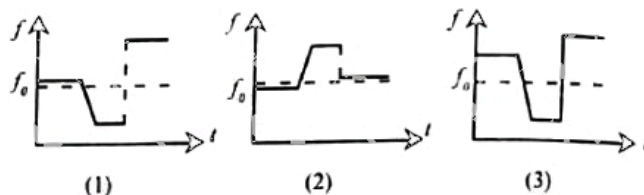
60. A metal rod is initially at 0 °C. New one end of this rod is immersed in boiling water and the other end is held by fingers as shown in the figure. The temperature of the fingers is 37 °C. Which of the following curve correctly represents the variation of the rate of flow of heat (P_Q) along the rod with x at a certain instant?

(1)   (2)   (3)

(4)   (5)