ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka

අධ්‍යාපන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2011 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர)ப் பரீட்சை, 2011 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2011

භෞතික විද්‍යාව I பௌதிகவியல் I Physics I	01 E I	පැය දෙකයි இரண்டு மணித்தியாலங்கள் *Two hours*

Instructions:

- *This question paper consists of* **50** *questions in* **10** *pages.*
- *Answer all the questions.*
- *Write your* ***Index Number*** *in the space provided in the answer sheet.*
- *Instructions are given on the back of the answer sheet. Follow those carefully.*
- *In each of the questions* **1** *to* **50**, *pick one of the alternatives from* (1), (2), (3), (4), (5) *which is correct or most appropriate and mark your response on the answer sheet with a cross* (×) *in accordance with the instructions given in the back of the answer sheet.*

Use of calculators is not allowed.

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

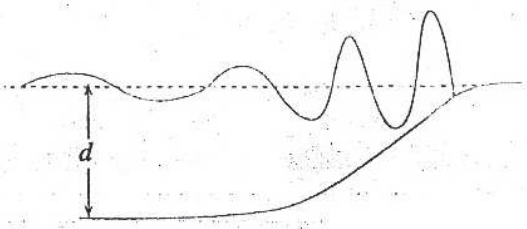
1. The unit of thermal conductivity is
   (1) J m^{-1} K^{-1} (2) W m^{-1} K^{-1} (3) W m^{-2} K^{-1} (4) J m^{-2} K^{-1} (5) W m^{-2} K^{-2}

2. The most suitable measuring instrument to measure the external diameter of a soft rubber tube having its value of the order of 1 cm is
   (1) meter ruler. (2) vernier callipers. (3) spherometer.
   (4) micrometer screw gauge. (5) travelling microscope.

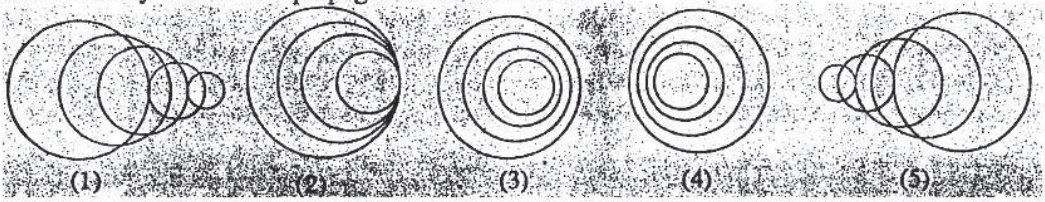
3. A simple pendulum of period T on the earth is brought to the moon. If the ratio of the acceleration due to gravities of the earth and the moon is 6, the period of oscillation of the pendulum on the moon is
   (1) T (2) $6T$ (3) $\sqrt{6}\,T$ (4) $\frac{T}{\sqrt{6}}$ (5) $\frac{T}{6}$

4. Final image of a compound microscope at normal adjustment is
   (1) virtual, inverted and larger than the object.
   (2) virtual, erect and larger than the object.
   (3) real, inverted and larger than the object.
   (4) real, erect and larger than the object.
   (5) real, inverted and smaller than the object.

5. The figure shows the shape of a tsunami wave of wavelength λ and amplitude A reaching the beach. The speed of the wave can be approximately given by $v = \sqrt{gd}$, where d is the depth of the sea. When the wave reaches the beach
   (1) λ decreases and v and A increase.
   (2) λ and v decrease and A increases.
   (3) λ remains the same but A and v increase.
   (4) λ, A and v increase.
   (5) λ, A and v decrease.



6. A source of sound is moving to the right with a speed faster than the speed of sound. Which of the following figures correctly shows the propagation of wave fronts?



7. Which of the following gates **cannot** have more than one input?
(1) AND gate (2) OR gate (3) NAND gate (4) NOT gate (5) EX-OR gate

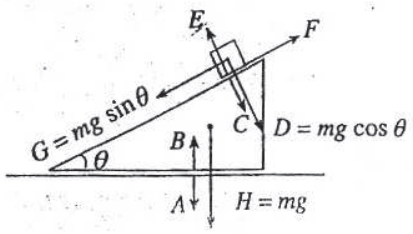
8. In an automobile engine, the gas (a mixture of air and petrol) in the cylinders is compressed to $\frac{1}{9}$ of its original volume. The initial pressure is 1.0 atm and the initial temperature is 27°C. If the pressure after compression is 21 atm, the temperature of the compressed gas is (Assume that the gas behaves as ideal.)
(1) 700 °C (2) 523 °C (3) 427 °C (4) 327 °C (5) 227 °C

9. A planet of uniform density has a mass of 2.0×10^{27} kg. Its radius is 6.7×10^{7} m. The gravitational potential at the surface of the planet is ($G = 6.7 \times 10^{-11}$ N m^2 kg^{-2})
(1) -2.0×10^{9} J kg^{-1} (2) -2.0×10^{2} J kg^{-1} (3) 0
(4) 2.0×10^{9} J kg^{-1} (5) 6.0×10^{2} J kg^{-1}

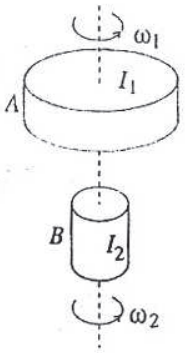
10. When a beam of 100 keV electrons is stopped in a metal target, it produces
(1) β^- particles. (2) β^+ particles. (3) α particles.
(4) neutrons. (5) X rays.

11. An electron of mass m_e, when accelerated through a potential difference, has a de Broglie wavelength λ. The de Broglie wavelength associated with a proton of mass m_p accelerated through the same potential difference would be
(1) $\lambda\sqrt{\frac{m_p}{m_e}}$ (2) $\lambda\sqrt{\frac{m_e}{m_p}}$ (3) $\lambda\frac{m_e}{m_p}$ (4) $\lambda\frac{m_p}{m_e}$ (5) $\frac{\lambda m_e^2}{m_p^2}$

12. A block of mass m is placed on a wedge of mass M which is placed on a horizontal plane. The free body diagram of the system is shown in figure. Out of the forces marked on the diagram what could be considered as action - reaction pairs?
(1) E and C, F and G (2) E and D, B and A
(3) E and D, B and H (4) E and C, B and A
(5) E and C, B and H

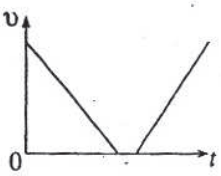


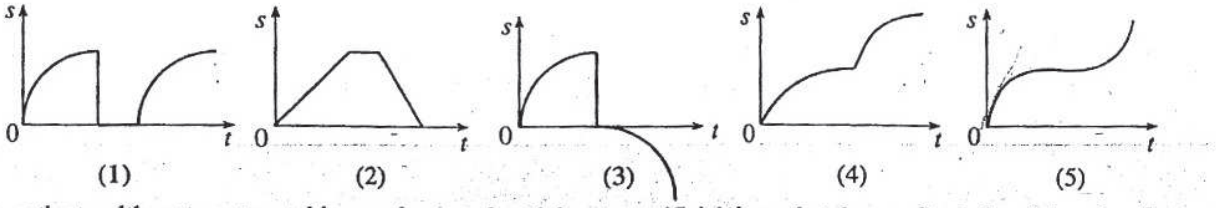
13. A space shuttle B of moment of inertia I_2 and angular speed ω_2 joins smoothly with a space station A of moment of inertia I_1, and angular speed ω_1 along the common axis as shown in the figure. Neglect the linear motions of both objects. The angular speed of the system about the common axis after joining the two objects would be
(1) $\omega_1 + \omega_2$ (2) $I_1\omega_1 + I_2\omega_2$ (3) $\frac{I_1\omega_1 - I_2\omega_2}{I_1 + I_2}$
(4) $\frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$ (5) $\frac{I_1\omega_1 + I_2\omega_2}{I_1 - I_2}$



14. An empty, thin walled container of volume V and mass M_0 is filled with n number of glass and steel balls out of which x are glass balls. If M_s and M_g are the masses of a steel and a glass ball respectively, then the effective density of the container with balls would be
(1) $\frac{nM_g + xM_s + M_0}{nV}$ (2) $\frac{M_g + (n-x)M_s}{V}$
(3) $\frac{xM_g + (n-x)M_s + M_0}{nV}$ (4) $\frac{xM_g + (n-x)(M_s + M_0)}{V}$
(5) $\frac{xM_g + (n-x)M_s + M_0}{V}$

15. Velocity (v) - time (t) curve for the motion of a particle is shown in the figure. The corresponding displacement(s)-time (t) curve would be

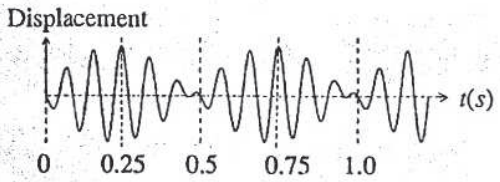




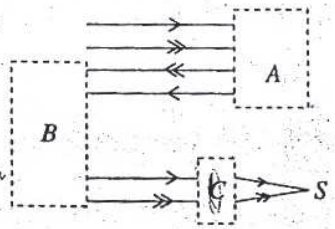
(1) (2) (3) (4) (5)

16. A patient with cataract got his eye lens replaced by an artificial lens that has a fixed focal length, after a surgery. His vision was then found to be best for viewing objects at a distance of 10 m. The lens that he should use for reading is (near point is 25 cm)
    (1) a convex lens of approximate focal length 4 cm.
    (2) a concave lens of approximate focal length 4 cm.
    (3) a convex lens of approximate focal length 25 cm.
    (4) a concave lens of approximate focal length 25 cm.
    (5) a convex lens of approximate focal length 8 cm.

17. The figure shows the resultant wave produced by two sound waves of slightly different frequencies. The beat frequency is equal to
    (1) 1 Hz (2) 2 Hz (3) 4 Hz
    (4) 6 Hz (5) 8 Hz



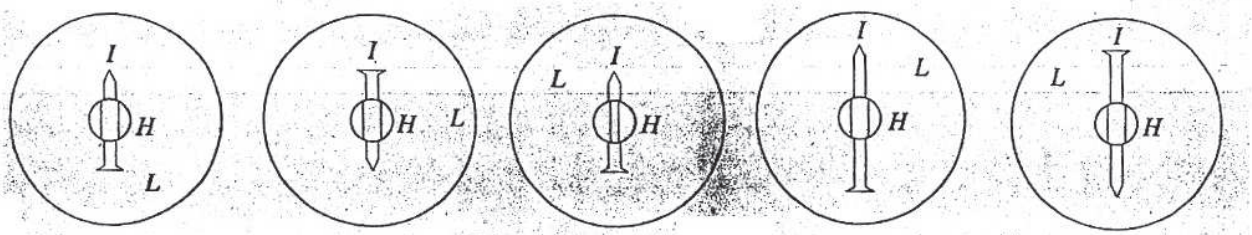
18. The set up shown in the diagram is used to focus a parallel beam of light to the point S.
    The respective optical elements A, B and C should be
    (1) a plane mirror, a plane mirror and a 60°-60°-60° prism.
    (2) a 60°-60°-60° prism, a 60°-60°-60° prism and a convex lens.
    (3) a 45°-90°-45° prism, a 45°-90°-45° prism and a 60°-60°-60° prism
    (4) a 45°-90°-45° prism, a 45°-90°-45° prism and a concave lens.
    (5) a 45°-90°-45° prism, a 45°-90°-45° prism and a convex lens.



19. How much more thumb pressure should a nurse apply in administering an injection with a needle of inside diameter 0.2 mm compared to a needle of inside diameter 0.4 mm? Assume that the two needles have the same length and that the volume flow rate is the same in both cases.
    (1) 2 times (2) 4 times (3) 8 times (4) 10 times (5) 16 times

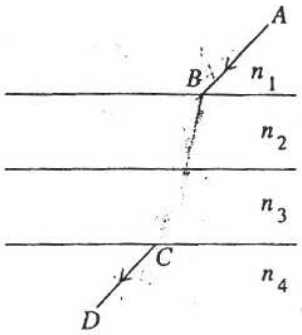
20. The image I formed by a concave lens L of an object pin O mounted on a stand is set to align with the object pin, and viewed through a small circular hole H cut at the centre of the lens. Which of the following figures correctly indicates the view of the object pin O and the image I ?





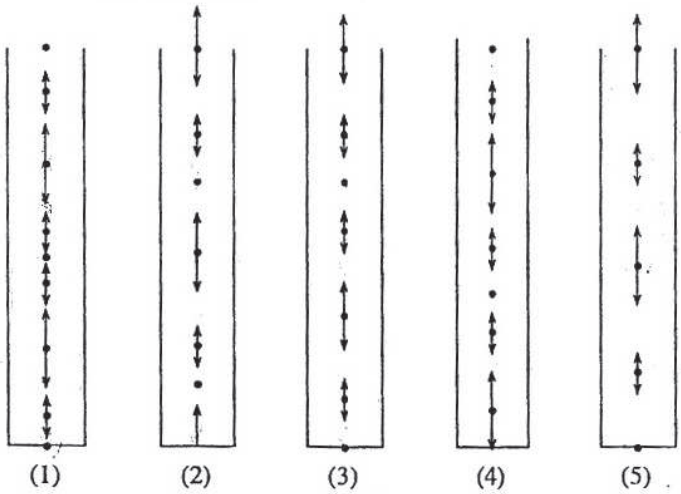
(1) (2) (3) (4) (5)

21. A monochromatic ray of light passes through four layers of transparent plastic with refractive indices n_1, n_2, n_3 and n_4 as shown. If the emergent ray CD is parallel to the incident ray AB, then

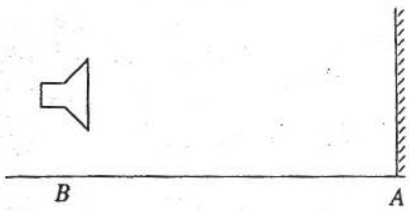


(1) $n_1 > n_2 > n_3 > n_4$ (2) $n_1 < n_2 < n_3 < n_4$
(3) $n_1 > n_2 > n_3 = n_4$ (4) $n_1 = n_4$
(5) $n_1 = n_2 > n_3 = n_4$

22. If the length and arrow head of arrows in the figures represent the magnitudes and directions of motion of air molecules, which of the following figures correctly shows the displacement of air molecules in a closed tube when it resonates at its first overtone?

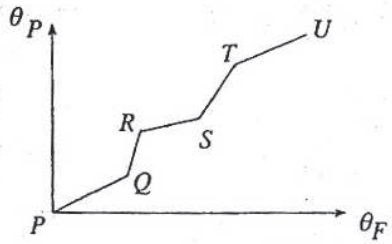


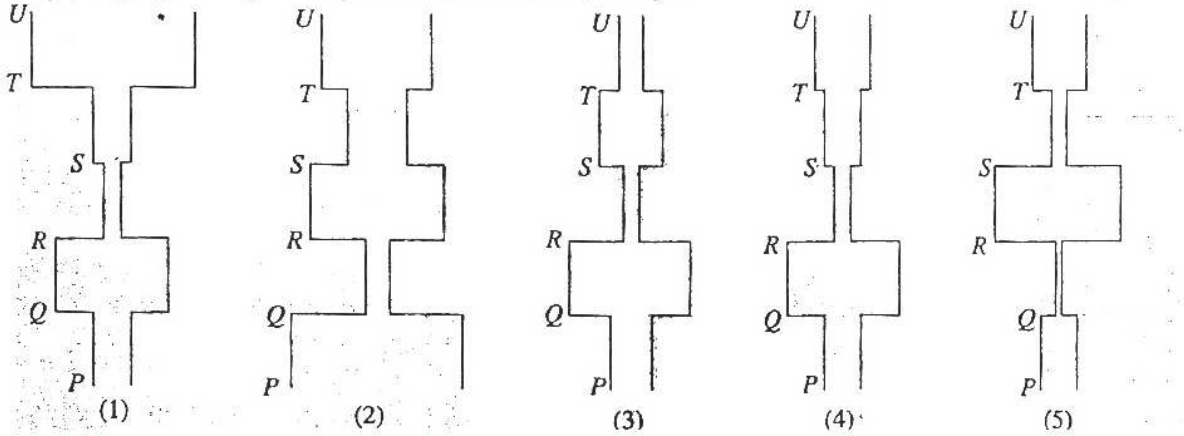
23. The figure shows a speaker mounted at B, at a certain distance from a smooth wall A, and emitting a sound of single frequency. When a sound detector which is sensitive to pressure variations is taken from A to B, a minimum of sound level is detected at 2 m from the wall. Speed of sound in air is 320 m s^{-1}. The frequency of the sound emitted by the speaker could be



(1) 40 Hz (2) 60 Hz (3) 80 Hz
(4) 100 Hz (5) 160 Hz

24. A mercury in glass thermometer made of a glass capillary of uneven bore radius when calibrated against a correct thermometer produces the curve shown in the figure. Here θ_P is the reading of the correct thermometer and θ_F is the corresponding reading of the uneven thermometer. Several students have deduced the shape of the bore of the capillary tube by considering the above curve as follows. Which of the following figures represents the best model for the shape?

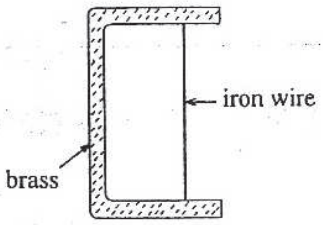




25. Heat is supplied at a steady rate to a block of ice in a container at 0 °C. After a time t, the block of ice has converted completely to steam at 100 °C. (Specific latent heat of fusion of ice = 3×10^5 J kg^{-1}; specific heat capacity of water = 4×10^3 J kg^{-1} K^{-1}; specific latent heat of vaporisation of water = 2×10^6 J kg^{-1}; Neglect the heat capacity of the container and heat loss to the surroundings.) At time $\frac{t}{2}$, the container has

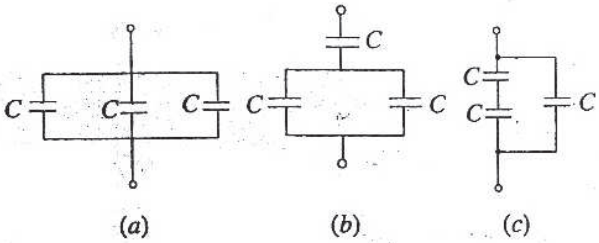
(1) ice and water at 0 °C. (2) water at 30 °C. (3) water at 50 °C.
(4) water at 70 °C. (5) water and steam at 100 °C.

26. The figure shows an iron wire fastened to a brass frame. At room temperature, the wire is neither slack nor under stress. The linear expansivities of brass and iron are 18×10^{-6} K^{-1} and 10×10^{-6} K^{-1} respectively. Young's modulus of iron is 30×10^9 N m^{-2}. When the temperature of the whole system is increased by 1 °C, the stress on the wire will become



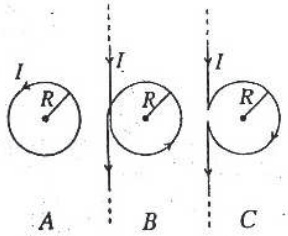
(1) 2.4×10^5 N m^{-2} (2) 3×10^5 N m^{-2}
(3) 5.4×10^5 N m^{-2} (4) 8.4×10^5 N m^{-2}
(5) 3×10^6 N m^{-2}

27. Three arrangements (*a*), (*b*) and (*c*) made of identical capacitors of capacitance C are shown in the figures. Equivalent capacitances of the arrangements when arranged in ascending order would be



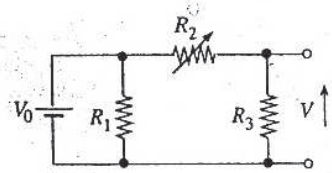
(1) (*a*), (*b*), (*c*) (2) (*b*), (*c*), (*a*)
(3) (*c*), (*a*), (*b*) (4) (*a*), (*c*), (*b*)
(5) (*c*), (*b*), (*a*)

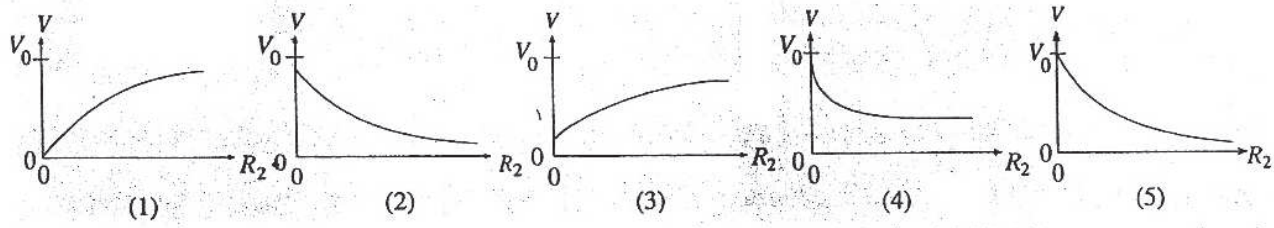
28. Equal currents I flow through three isolated wires A, B and C. Wire A is a circular loop of radius R. B and C are infinitely long straight wires, parts of which are bent to form circular loops of radius R as shown in the figure. If B_A, B_B and B_C represent the magnitudes of the magnetic flux densities produced at the centre of respective loops, then



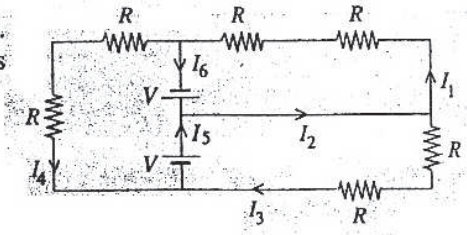
(1) $B_A > B_B > B_C$ (2) $B_B > B_A > B_C$
(3) $B_A < B_B < B_C$ (4) $B_B = B_C > B_A$
(5) $B_A = B_B = B_C$

29. In the circuit shown, V_0 represents the voltage of a battery with negligible internal resistance. Variation of V with R_2 is best represented by



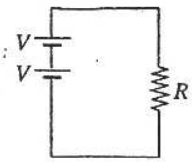


30. In the circuit shown, batteries have negligible internal resistances. Which of the following is **not** true with regard to the magnitudes of the currents in the circuit?



(1) $I_1 = I_3$ (2) $I_3 = I_5$ (3) $I_2 = 0$
(4) $I_4 = 0$ (5) $I_6 = I_1$

31. Two identical batteries having negligible internal resistances and connected in series as shown in the figure are capable of delivering power to a load resistor of resistance R at a constant rate of P for a time t_0. If only **one** of the two batteries is connected across R it will deliver power at a constant rate of



(1) P for a time t_0

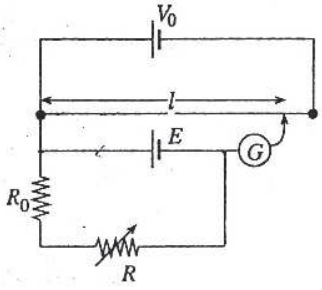
(2) $\frac{P}{2}$ for a time t_0

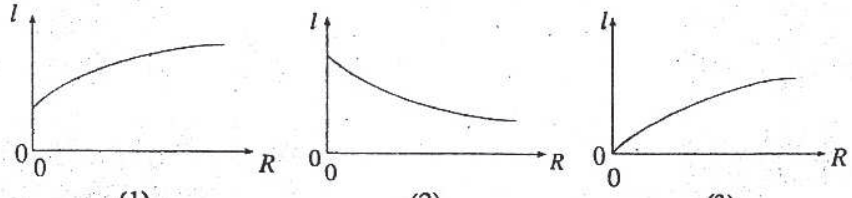
(3) $\frac{P}{2}$ for a time $\frac{t_0}{2}$

(4) $\frac{P}{4}$ for a time $\frac{t_0}{2}$

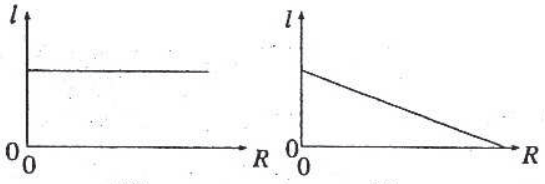
(5) $\frac{P}{4}$ for a time $2t_0$

32. In the potentiometer circuit shown, V_0 represents the voltage of a battery with negligible internal resistance, and E represents a cell with finite internal resistance. Variation of balanced length l with R is best represented by



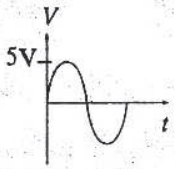


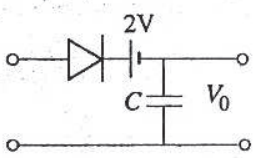
(1) (2) (3)

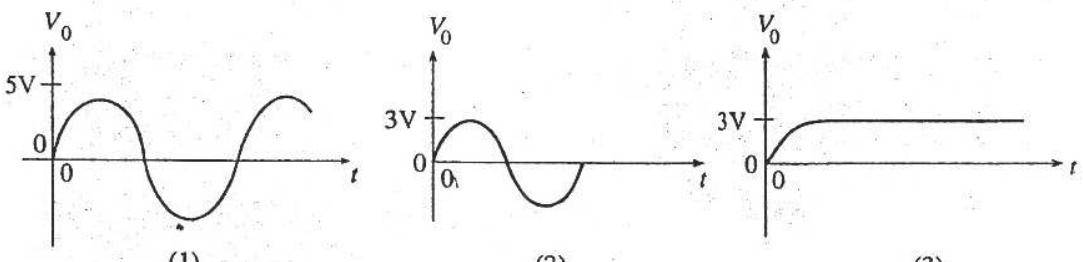


(4) (5)

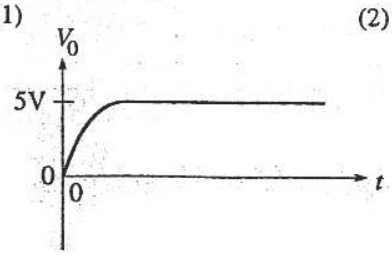
33. The circuit shown in the figure is made of ideal elements. When a sinusoidal voltage of peak amplitude 5 V is applied to the input, the waveform of the output voltage V_0 would be

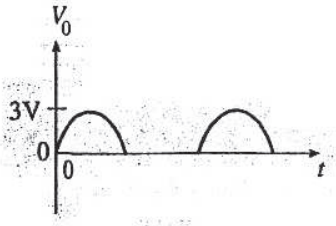






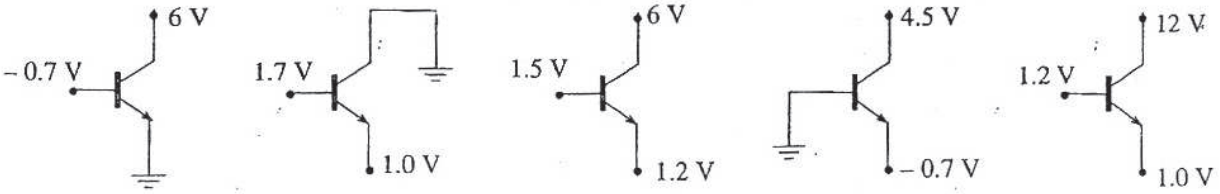
(1) (2) (3)





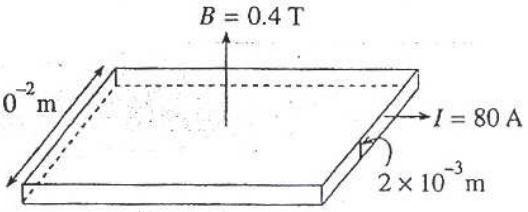
(4) (5)

34. Which of the Si transistors shown operates in the active mode?



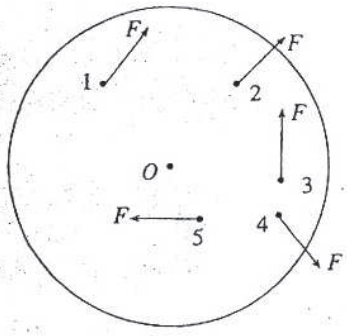
(1) (2) (3) (4) (5)

35. A plate of copper, 2×10^{-3} m thick and 4×10^{-2} m wide, is placed in a uniform magnetic field of flux density B of 0.4 T as shown in the figure. When a current of 80 A is being passed through the plate, it generates a Hall voltage of 0.8×10^{-6} V. What is the number of free electrons per unit volume of copper?
($e = 1.6 \times 10^{-19}$ C)



(1) 1.25×10^{29} m^{-3} (2) 1.25×10^{28} m^{-3} (3) 5×10^{27} m^{-3}
(4) 5×10^{28} m^{-3} (5) 2×10^{10} m^{-3}

36. A thin disc has freedom to rotate around an axis passing through its centre O perpendicular to the plane of the disc. The disc is acted upon by five coplanar forces (1 – 5), equal in magnitude, as shown in the figure.



Consider the following statements made about the torques produced by the forces.
(A) Maximum torque is produced by the force 2.
(B) Rotation of the disc due to the resultant torque will be in clockwise direction.
(C) When the magnitudes of the forces are doubled the magnitude of the torque will also be doubled.

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.

37. The figure (a) shows a Hare's apparatus used to compare the densities of two liquids A and B. If the same experiment is done by changing the positions of the limbs of the Hare's apparatus as shown in figures 1 to 5, which of the figures correctly indicates the levels of the liquid columns?

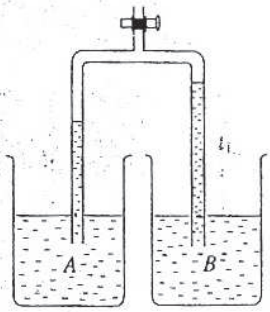
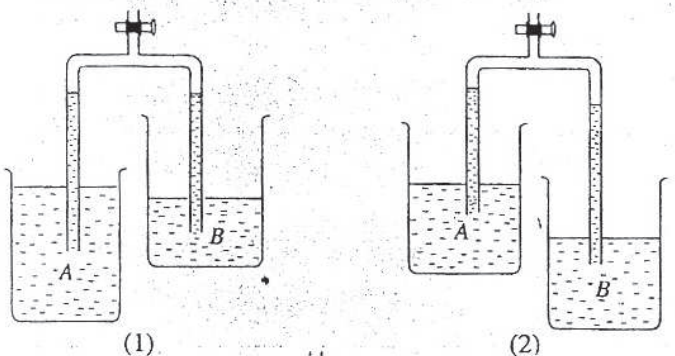
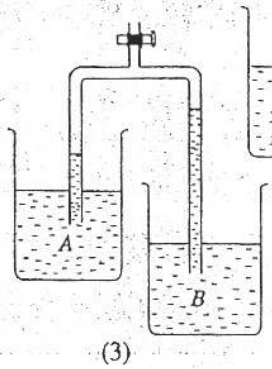


figure (a)

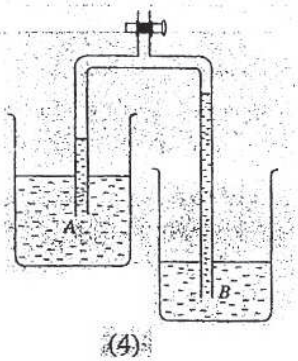


(1)

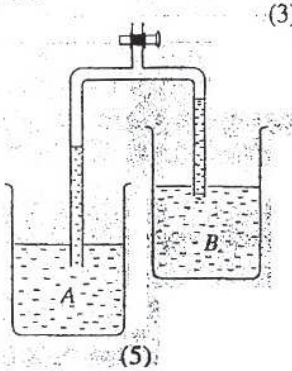
(2)



(3)

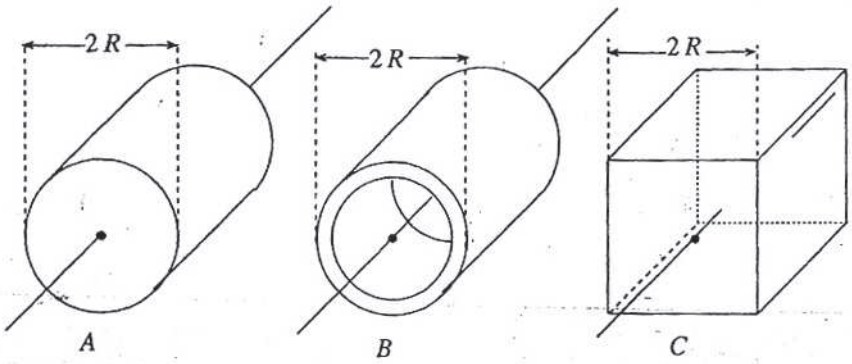


(4)



(5)

38.



The three uniform objects shown in the figure have equal masses. Object A is a solid cylinder of radius R. Object B is a hollow thin cylinder of radius R. Object C is a solid cube whose sides are of length $2R$. If the moments of inertia of the objects about the axes shown are I_A, I_B and I_C respectively then

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

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

39. A particle of mass m_1 moving with speed v along positive(+) x direction collides elastically with another particle of mass m_2 at rest. Which of the following statements made regarding the motion of the particles after the collision is **incorrect**?

(1) If $m_1 < m_2$ then m_1 and m_2 would move in $-x$ and $+x$ directions respectively.

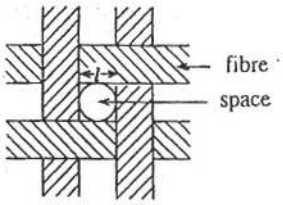
(2) If $m_1 > m_2$ then both m_1 and m_2 would move in $+x$ direction.

(3) m_1 and m_2 would move together as a single mass with a speed lower than v in the $+x$ direction.

(4) The speed of m_1 would be lower than v unless m_2 is infinitely large.

(5) If $m_1 = m_2$ then the speed of m_2 would be v.

40. As shown in the figure, spaces between the nylon fibres of an umbrella made of nylon cloth could be considered approximately as circular. If the diameter of these spaces is l and the density of water is d, the minimum surface tension that the water should have in order to prevent water from seeping through the spaces is (Take the contact angle between water and nylon to be zero.)



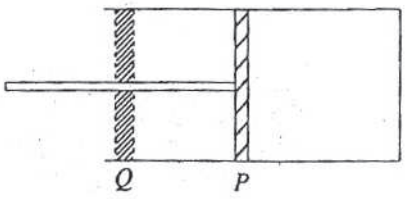
(1) l^2dg (2) $\frac{1}{2}l^2dg$ (3) $\frac{1}{4}l^2dg$

(4) $\frac{1}{12}l^2dg$ (5) $\frac{1}{16}l^2dg$

41. An ideal gas in a cylinder is expanded by moving the piston from P to Q,

(A) very slowly (B) very rapidly

Which of the following answers correctly represents the change in temperature ΔT, (+ or –) and the sign (+ or –) of quantities ΔQ, ΔU and ΔW for the two processes (A) and (B)? (All symbols have their usual meaning.)



	Process	ΔT	ΔQ	ΔU	ΔW
(1)	(A)	0	+	0	+
	(B)	–	0	–	+
(2)	(A)	0	+	0	+
	(B)	–	0	–	–
(3)	(A)	–	+	–	+
	(B)	0	–	0	+
(4)	(A)	0	+	0	+
	(B)	–	0	+	+
(5)	(A)	+	+	+	+
	(B)	–	0	–	–

42. A person wearing a pair of spectacles claims that he experiences a film of moisture being formed suddenly on his glasses when he

(A) gets down from an air-conditioned vehicle.

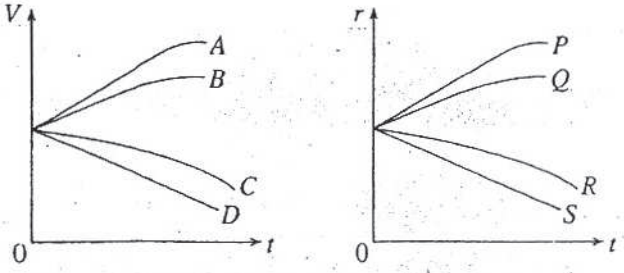
(B) gets into a closed vehicle parked under the sun for a long time.

(C) moves into a heated building in Nuwaraeliya on a cold night when the ambient temperature is around 5 °C.

Of the above claims

(1) only (A) can be true.
(2) (B) can never be true.
(3) only (A) and (B) can be true.
(4) (C) can never be true
(5) all (A), (B) and (C) can be true.

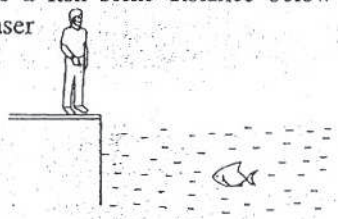
43. The quality of a dry cell can be evaluated by studying the variation of voltage (V) and the internal resistance (r) of the cell with time (t) while drawing a constant current from the cell for a long period of time. The following graphs drawn between V and t, and r and t include possible curves as well as impossible curves. Out of the possible curves, which curve in each graph represents the best cell?



(1) A and P (2) C and Q (3) D and S (4) B and R (5) B and Q

44. As shown in the figure, a person is standing on the shore of a lake. He spots a fish some distance below the water surface. If he uses a laser to locate the fish, he should aim the laser

(1) above the apparent position of the fish.
(2) below the apparent position of the fish.
(3) directly at the apparent position of the fish.
(4) directly at the actual position of the fish.
(5) above the actual position of the fish.



45. A metal wire of radius a and resistance R per unit length has an insulation cover of thickness d and thermal conductivity k. When a current I is sent through the wire, it becomes hot and is cooled by immersing the wire in a liquid which is kept at a constant temperature. Which of the following is true regarding the steady state temperature difference $\Delta\theta$ across the insulation cover?

(1) If $d \ll a$, $\Delta\theta = \dfrac{I^2Rd}{2\pi k\left(a+\dfrac{d}{2}\right)}$

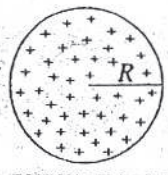
(2) If $d > a$, $\Delta\theta = \dfrac{I^2Rd}{2\pi k\left(a+\dfrac{d}{2}\right)}$

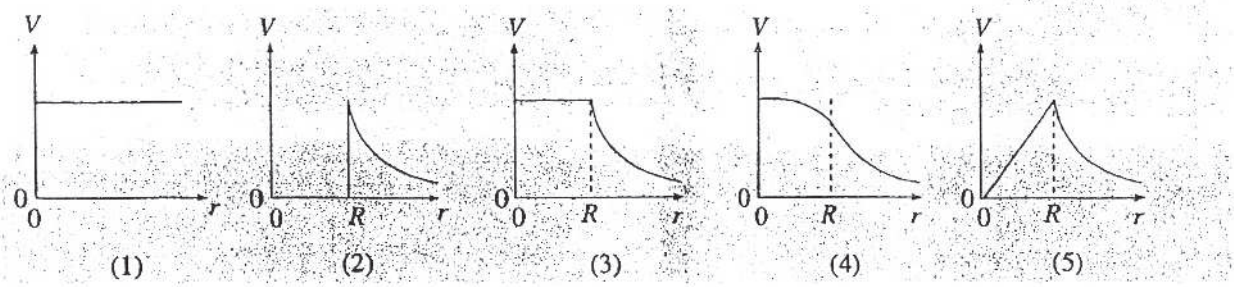
(3) For all d, $\Delta\theta = \dfrac{I^2Ra}{2\pi k\left(a+\dfrac{d}{2}\right)}$

(4) If $d \ll a$, $\Delta\theta = \dfrac{I^2Rd}{\pi k\left(a+\dfrac{d}{2}\right)^2}$

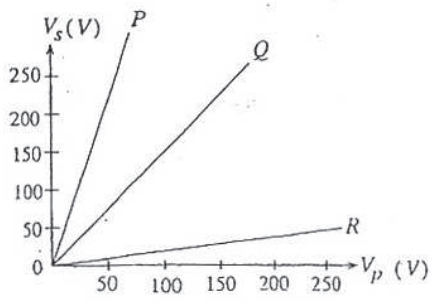
(5) For all d, $\Delta\theta = \dfrac{I^2Rd}{\pi k\left(a+\dfrac{d}{2}\right)^2}$

46. A nonconducting sphere of radius R has a uniform positive charge density distributed within the sphere. The variation of the electric potential (V) with radial distance (r) is best represented by





47. Input (V_p) – Output (V_s) voltage characteristics of three ideal transformers P, Q and R which can be connected to 230 V ac mains are shown in the figure.



Consider following statements

(A) Transformer P can deliver a larger current than Q at a given value of V_p.

(B) Transformer of the type P is suitable to construct a low voltage dc power supply.

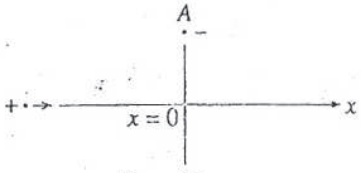
(C) Transformers of the type R has the ratio $\frac{\text{number of turns in the secondary}}{\text{number of turns in the primary}}$ less than 1

Of the above statements

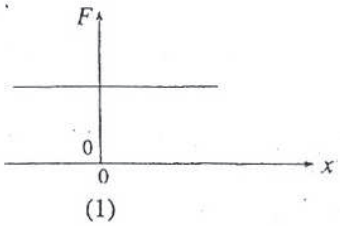
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.

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

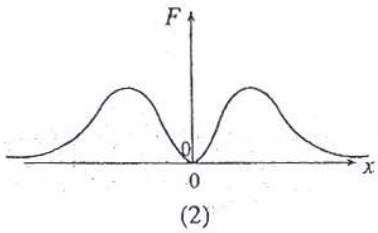
48. The figure shows a positive, point-like charge moving along a straight path between two fixed equal negative point charges.



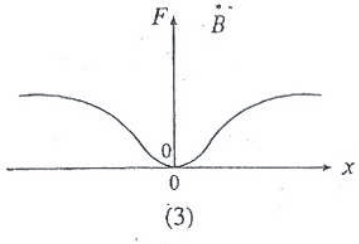
The variation of magnitude F of the net force on the positive charge due to the two negative charges, with the distance x is best represented by



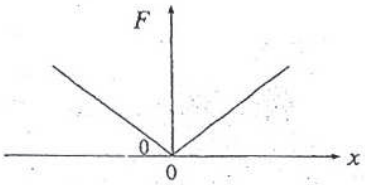
(1)



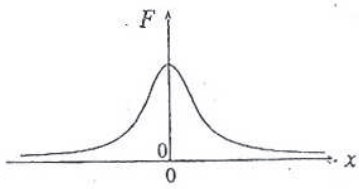
(2)



(3)

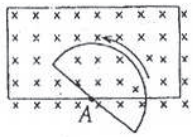


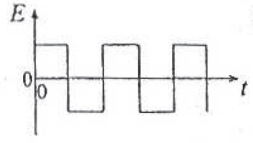
(4)



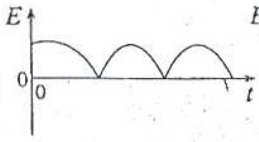
(5)

49. A uniform magnetic field is directed perpendicularly into the plane of the paper everywhere within a rectangular region as shown. A wire loop in the shape of a semicircle is rotated counter clockwise with a constant angular velocity in the plane of the paper about an axis perpendicular to the paper and passing through A. Which of the following graphs best represents the variation of the e.m.f. (E) induced in the loop with time t?

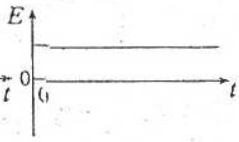




(1)



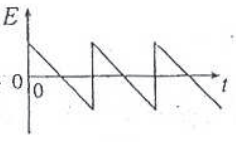
(2)



(3)

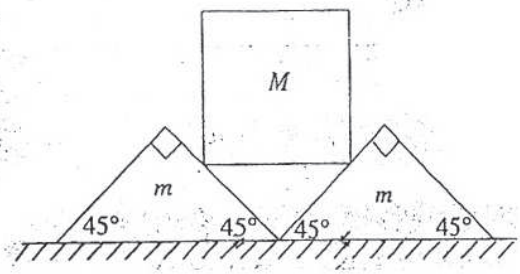


(4)



(5)

50. Two identical wedges each of mass m are placed next to each other on a flat floor. A cube of mass M is placed on the wedges as shown in the figure. Assume that there is no friction between the cube and the wedges. The coefficient of static friction between the wedges and the floor is μ. The largest M that can be balanced without moving the wedges is given by



(1) $\frac{\mu m}{\sqrt{2}}$ (2) $\frac{\mu m}{1-\mu}$ (3) $\frac{2\mu m}{1-\mu}$

(4) $(1-\mu)m$ (5) $\sqrt{2}(1-\mu)m$