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සියලුම හිමිකම් ඇවිරිණි/முழுப் பதிப்புரிமையுடையது/All Rights Reserved]

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

භෞතික විද්‍යාව I பௌதிகவியல் I **Physics I**	**01 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***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.*
- *Read the instructions given on the back of the answer sheet 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 on the back of the answer sheet.***

Use of calculators is not allowed.

($g = 10\ m\ s^{-2}$)

1. Which of the following physical quantity has a unit but no dimensions?
(1) Planck constant (2) Surface tension
(3) Energy (4) Relative velocity
(5) Sound intensity level

2. In a vernier calliper, the main scale 1·0 cm has 20 subdivisions. The length of 19 main scale subdivisions has equally been divided into 20 vernier scale divisions. What is the least count of the calliper?
(1) 0·025 mm (2) 0·050 mm (3) 0·20 mm (4) 0·25 mm (5) 0·50 mm

3. The kinetic energy of a projectile at its maximum height is one-fourth ($\frac{1}{4}$) of its initial kinetic energy. What is the angle of projection of the projectile with the horizontal? (Neglect air resistance.)
(1) 10° (2) 20° (3) 30° (4) 45° (5) 60°

4. Consider the following statements about a pair of action-reaction forces.
(A) They are equal in magnitude but opposite in direction.
(B) They act only on objects touching each other.
(C) They act on the same object.
Of the above statements
(1) only (A) is true. (2) only (A) and (B) are true.
(3) only (A) and (C) are true. (4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

5. As shown in the figure, a bullet hits a wooden block placed on a smooth horizontal surface and embeds within the block.



Consider the following statements.
(A) The law of conservation of linear momentum is valid for the collision.
(B) The law of conservation of energy is valid for the collision.
(C) A part of kinetic energy of the system is lost due to the collision.
Of the above statements
(1) only (A) is true. (2) only (A) and (B) are true.
(3) only (A) and (C) are true. (4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

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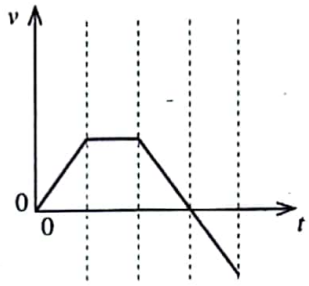
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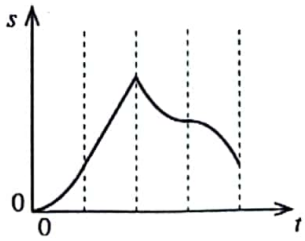
6. Consider following statements about a muon (μ^-).

(A) It is a lepton.
(B) It is made out of three quarks.
(C) Its mass is larger than that of an electron.

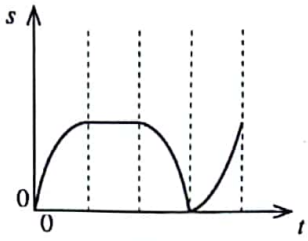
Of the above statements
(1) only (A) is true. (2) only (A) and (B) are true.
(3) only (A) and (C) are true. (4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

7. The graph of the variation of velocity (v) with time (t) of an object is shown in the figure. The corresponding displacement (s)-time (t) curve is best represented by

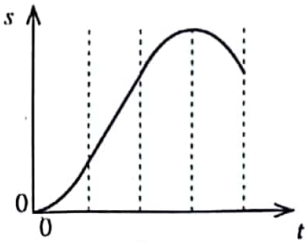




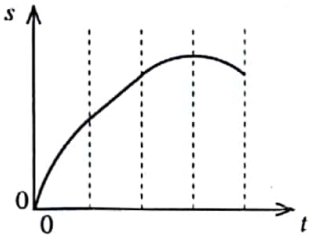
(1)



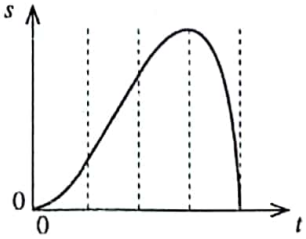
(2)



(3)



(4)



(5)

8. A circular disc of moment of inertia about a perpendicular axis through the centre is 8 kg m^2. It is smoothly pivoted from the centre and initially rotates at constant angular speed of 40 rad s^{-1}. When a constant torque is applied for 10 s, the angular speed of the disc reduces to 20 rad s^{-1}. What is the magnitude of the applied torque?
(1) 8 N m (2) 16 N m (3) 32 N m (4) 40 N m (5) 80 N m

9. An astronomical telescope is in normal adjustment. If the focal length of objective lens is 80 cm and the angular magnification is 20, what is the distance between the objective lens and the eyepiece?
(1) 40 cm (2) 76 cm (3) 84 cm (4) 96 cm (5) 100 cm

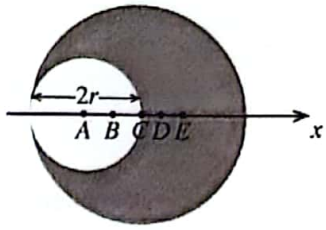
10. A source emitting sound waves of frequency 1000 Hz is moving directly towards a stationary observer at a velocity of 0·9v, where v is the speed of sound in air. What is the frequency of the sound heard by the observer?
(1) 1040 Hz (2) 1100 Hz (3) 1111 Hz (4) 1900 Hz (5) 10 000 Hz

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11. Faraday's law of electromagnetic induction is related to
(1) law of conservation of charge.
(2) law of conservation of energy.
(3) Newton's third law of motion.
(4) law of conservation of angular momentum.
(5) law of conservation of linear momentum.

12. From a homogeneous uniform circular plate of radius $2r$ a circular part of radius r is removed as shown in the figure. The centre of gravity of the remaining part of the plate is most likely to be found at



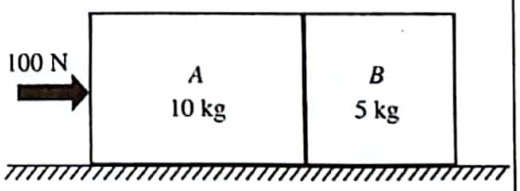
(1) A (2) B (3) C
(4) D (5) E

13. Two sound sources A and B are placed at a distance r away from a point. The sound intensity levels measured at that point are 72 dB and 92 dB, respectively. If the sound intensity of source A at that point is I (W m^{-2}), what is the sound intensity of source B at that point?
(1) $1{\cdot}3I$ (2) $10I$ (3) $20I$ (4) $25I$ (5) $100I$

14. An ideal transformer has 200 turns in the primary coil and 400 turns in the secondary coil. When the primary is connected to an a.c. supply of $V_{r.m.s.} = 110$ V, a current of $I_{r.m.s.} = 10$ A flows through it. The r.m.s. voltage and r.m.s current in the secondary are respectively given by
(1) 55 V, 20 A (2) 440 V, 5 A (3) 220 V, 10 A (4) 220 V, 5 A (5) 55 V, 10 A

15. The coefficient of static friction between a small coin and the surface of a horizontal turntable is 0·36. The rotational speed of the turntable is 30 rpm (revolutions per minute). What is the maximum distance from the centre of the turntable at which the coin will not slide? (Take $\pi = 3$)
(1) 4 cm (2) 12 cm (3) 36 cm (4) 40 cm (5) 72 cm

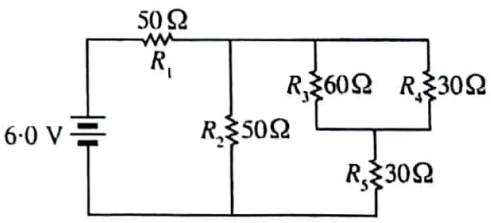
16. Two boxes A and B of mass 10 kg and 5 kg respectively and made of different materials are placed on a rough horizontal surface as shown in the figure. The coefficient of kinetic friction between box A and the surface is 0·5. When a horizontal force of 100 N is applied to box A, the reaction force between boxes A and B is 40 N. What would be the coefficient of kinetic friction between box B and the horizontal surface?



(1) 0·7 (2) 0·6 (3) 0·5 (4) 0·4 (5) 0·3

17. A steel metre ruler is to be used in a measurement so that millimetre readings are accurate up to 5×10^{-5} mm at a certain temperature. What is the maximum temperature variation allowable during the measurement? (linear expansivity of steel is 1×10^{-5} °C^{-1})
(1) 0·1 °C (2) 0·2 °C (3) 1 °C (4) 2 °C (5) 5 °C

18. Five resistors and a battery are connected as shown in the figure. The e.m.f. of the battery is 6·0 V and it has negligible internal resistance. What is the voltage across the resistor R_4?



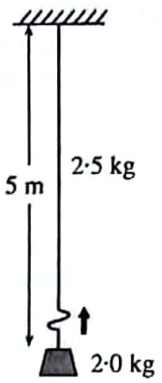
(1) 0·7 V (2) 0·8 V (3) 1·2 V
(4) 2·0 V (5) 2·4 V

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19. A uniform rope of length 5·0 m and mass 2·5 kg hangs vertically from a rigid support. A block of mass 2·0 kg is attached to the free end of the rope as shown in the figure. A transverse pulse of wavelength 2·0 cm is produced at the lower end of the rope. What is the wavelength of the pulse when it reaches the top of the rope?

(1) 1·5 cm (2) 2·0 cm (3) 2·5 cm
(4) 3·0 cm (5) 4·0 cm



20. Four wires of equal lengths are subjected to the same tension. The properties of these wires are as follows.

Wire	Young's Modulus of the material ($\times 10^{11}$ N m^{-2})	Diameter (mm)
A	2·0	1·0
B	2·0	2·0
C	1·0	1·0
D	1·0	2·0

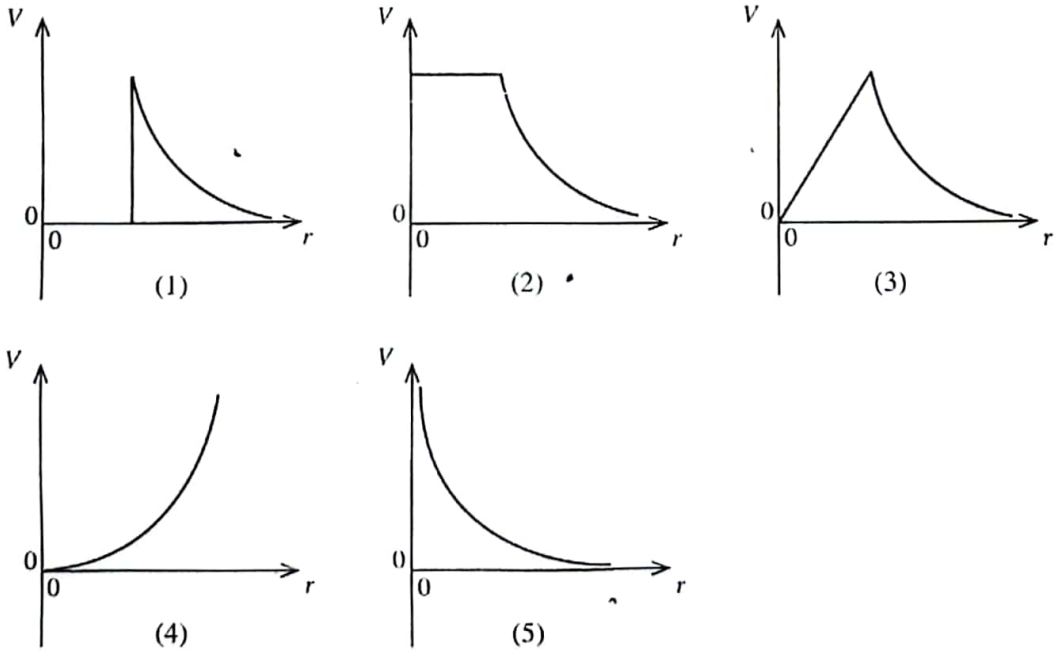
Which of the following statements is true?

(1) Wire *A* has the largest extension. (2) Wire *B* has the largest extension.
(3) Wire *C* has the largest extension. (4) Wire *D* has the largest extension.
(5) All wires have the same extension.

21. A thin light circular loop of radius 2 cm is kept just below the surface of a liquid. If a force of 0·04 N is required to pull this loop out from the surface of the liquid (just before the liquid film breaks), what is the surface tension of the liquid?

(1) 4 N m^{-1} (2) 2 N m^{-1} (3) $\frac{1}{\pi}$ N m^{-1} (4) $\frac{1}{2\pi}$ N m^{-1} (5) $\frac{1}{4\pi}$ N m^{-1}

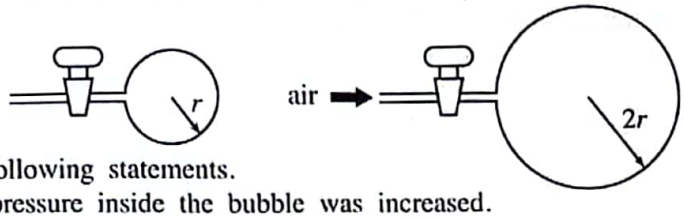
22. In a uniformly charged hollow metallic spherical shell, the variation of the electric potential (V) with distance (r) from center is best represented by,



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23. A soap bubble of radius r was made at the end of a very narrow tube as shown in the figure. Then more air was blown into the bubble isothermally to increase the radius of the bubble to $2r$.



Consider the following statements.

(A) The pressure inside the bubble was increased.

(B) The surface potential energy of the bubble was increased by four times.

(C) The volume of the bubble was increased by four times.

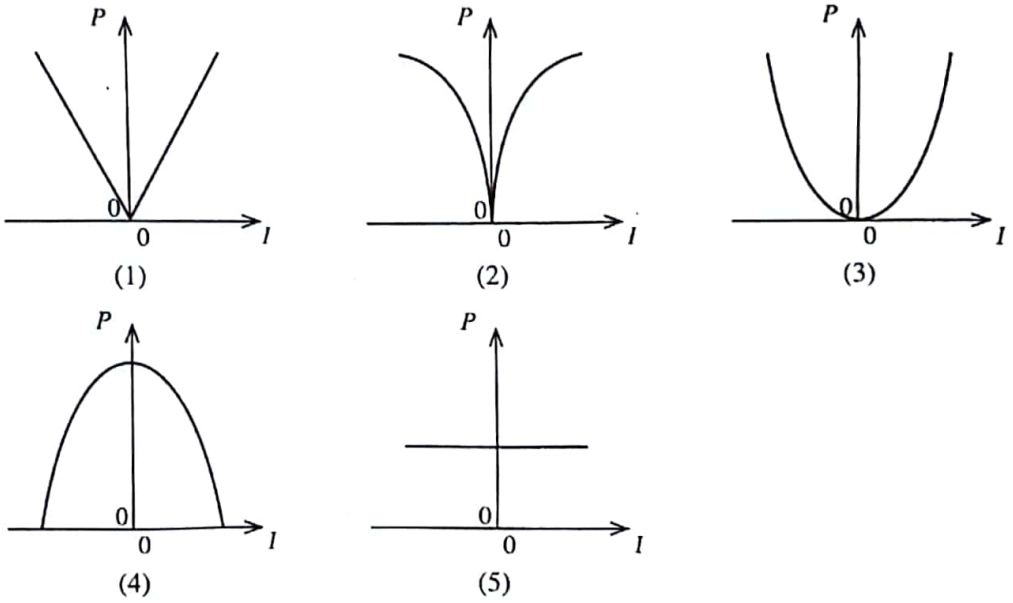
Of the above statements

(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.

24. A current I flows through a uniform metal wire which is maintained at a constant temperature. Which of the following graphs best represents the variation of power dissipation P in the wire with current I in the wire?



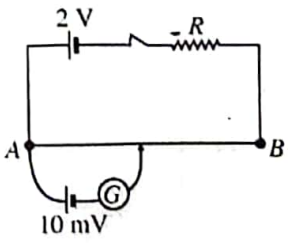
25. Two thin glass lenses in contact has a combined power of +3D (diopters). If one lens is convex and has a focal length of 20 cm, what is the type and focal length of the other lens?

(1) convex, 50 cm (2) concave, 50 cm

(3) convex, 12·5 cm (4) concave, 12·5 cm

(5) concave, 10 cm

26. The potentiometer wire AB shown in figure has a length 100 cm and a resistance 10 Ω. It is connected in series with a resistance R and a cell of e.m.f. 2 V and negligible internal resistance. The balance length for a source of small e.m.f. 10 mV is found to be 40 cm. What is the value of R?



(1) 790 Ω (2) 800 Ω (3) 900 Ω

(4) 1000 Ω (5) 1500 Ω

27. During the decay of radioactive $^{235}_{92}U$ into $^{231}_{91}Pa$ which of the following particles are emitted?

(1) one alpha particle and one electron. (2) one proton and four neutrons.

(3) one alpha particle and one positron. (4) one alpha particle and one neutron.

(5) one alpha particle and two positrons.

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28. The absolute humidity of air inside a closed room of volume 75 m^3 is 0·04 kg m^{-3} and the relative humidity is 75%. For the room to be saturated with water vapour at the same temperature, how much additional mass of water vapour should be added to the room?

(1) 0·5 kg (2) 0·75 kg (3) 1·0 kg (4) 1·25 kg (5) 1·5 kg

29. Three point charges, initially at infinity are brought to the vertices of an equilateral triangle. Out of them two charges each has a charge $+q$. If the total work done due to electric field to bring the three charges to the vertices of the triangle is zero, what should be the value of the third charge?

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

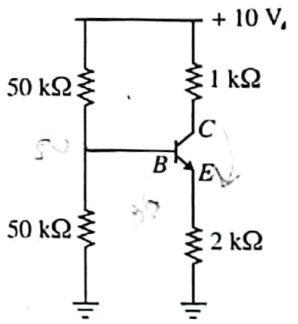
30. A small solid sphere made of material having density β is released from rest at a depth H below the surface of water in a tank. The density of water is ρ ($\rho > \beta$). What is the maximum height that the sphere will rise from the surface of water? Neglect all viscous forces and surface tension of water.

(1) $\frac{\rho}{\beta}H$ (2) $\frac{\beta}{\rho}H$ (3) $\left(1+\frac{\rho}{\beta}\right)H$ (4) $\left(1-\frac{\beta}{\rho}\right)H$ (5) $\left(\frac{\rho}{\beta}-1\right)H$

31. Two solid spheres A and B are made of the same material with identical surface properties. The diameter of sphere A is half that of sphere B. They are heated to the same temperature and then allowed to cool in the same environmental conditions. The initial rate of cooling of A and B are R_A and R_B respectively. Which of the following is true?

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

32. The transistor shown in the circuit diagram is operating in the active region. What is the approximate value of V_{CE}? Assume that V_{BE} = 0·6 V.

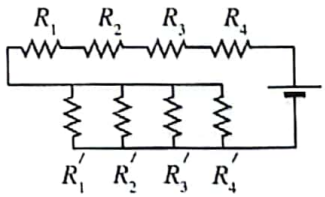


(1) 1·6 V (2) 3·4 V (3) 4·6 V
(4) 5·2 V (5) 7·4 V

33. Water of mass 100 g at 30 °C and ice of mass 100 g at −10 °C are mixed in an insulated container without any heat exchange with the surroundings. Assume that the specific heat capacity of ice and water are 2×10^3 J $kg^{-1}K^{-1}$, 4×10^3 J $kg^{-1}K^{-1}$ respectively and specific latent heat of fusion of ice is 3×10^5 J kg^{-1}. What is the equilibrium temperature of the mixture?

(1) 5 °C (2) 0 °C (3) −5 °C (4) −10 °C (5) −25 °C

34. A set of parallel resistors and a set of series resistors are connected as shown in the figure. The resistance values of resistors may or may not be the same. Which of the following statements is **always** true?



(1) The current through each resistor in the set of parallel resistors is the same.
(2) The voltage drop across each resistor in the set of series resistors is the same.
(3) The total resistance of the entire network is greater than the resistance of any individual resistor in the set of series resistors.
(4) The total resistance of the entire network is less than the largest resistance in the set of parallel resistors.
(5) The total resistance of the entire network is less than the resistance of any individual resistor in the network.

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35. One electron is moving opposite to a uniform electric field (E) and another electron is moving perpendicular to a uniform magnetic field (B) as shown in figures (1) and (2). For each situation the de Broglie wavelength of the electrons respectively

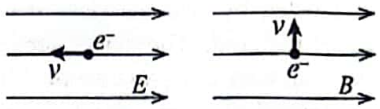


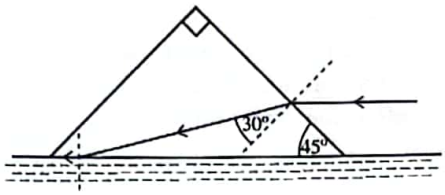
Figure (1) Figure (2)

(1) increases, increases. (2) increases, decreases.
(3) decreases, does not change. (4) decreases, decreases.
(5) increases, does not change.

36. A spherical water droplet of radius 2 mm falls down through air at a terminal velocity of 8 cm s^{-1}. What is the terminal velocity of a spherical water drop falling through air and having a volume of eight (8) such identical droplets?

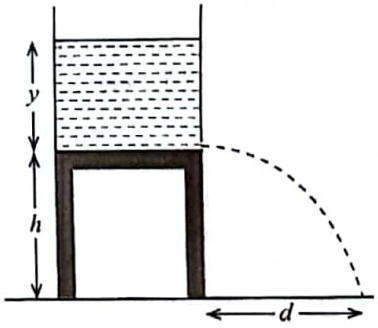
(1) 8 cm s^{-1} (2) 16 cm s^{-1} (3) 24 cm s^{-1} (4) 32 cm s^{-1} (5) 64 cm s^{-1}

37. The bottom of a rectangular isosceles glass prism is just touching a liquid surface as shown in the figure. A monochromatic ray of light parallel to the liquid surface enters the prism and passes along the glass and liquid interface. What is the refractive index of the liquid?



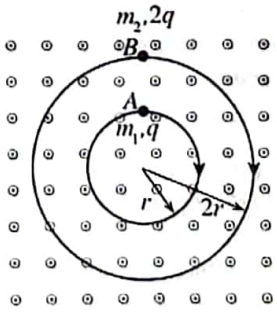
(1) $\sqrt{2}$ (2) $\sqrt{2}\sin 75^\circ$ (3) $\sqrt{2}\sin 60^\circ$
(4) $\frac{2}{\sin 75^\circ}$ (5) $\frac{2}{\sin 60^\circ}$

38. A water tank having a large cross-sectional area is kept on a support of height h. From a small hole close to the bottom of the tank ejects a horizontal stream of water. Water strikes the ground at a horizontal distance d from an edge of the tank as shown in the figure. What is the height (y) of water in the tank?



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

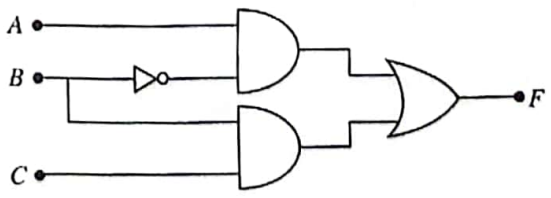
39. Two charged particles A and B of masses m_1, m_2 and charges q, $2q$ respectively are moving in circular paths of radii r, $2r$ perpendicular to a uniform magnetic field as shown in the figure. If the speeds of A and B are v_1, v_2 respectively, what is the value of the ratio $\frac{m_2 v_2}{m_1 v_1}$?



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

40. Consider the logic circuit shown with three inputs A, B and C. What is the Boolean expression that best represents the output F of the circuit?

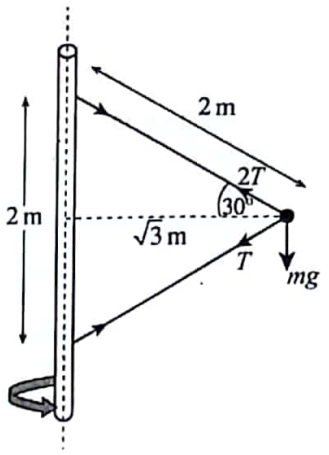
(1) $F = \overline{B}A + BC$ (2) $F = \overline{B}A + \overline{B}C$
(3) $F = BA + \overline{B}C$ (4) $F = BA + BC$
(5) $F = \overline{B}A + B\overline{C}'$



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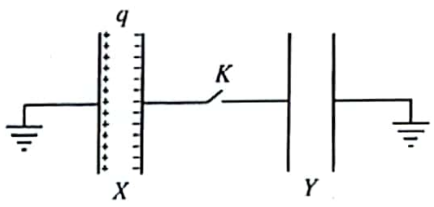
41. As shown in the figure, a metallic ball of mass m is connected by two massless wires, each of length 2·0 m, to a vertical rod. The wires are taut and rigidly fastened to the rod with a separation of 2·0 m. The setup is rotating at a constant angular velocity about the axis of the rod. The tension of the upper wire is twice ($2T$) that of the lower wire (T). What is the angular velocity (rad s^{-1}) of the ball?



(1) $\sqrt{\frac{g}{3}}$ (2) $\sqrt{\frac{3}{2}g}$ (3) $\sqrt{3g}$

(4) $3\sqrt{g}$ (5) $5\sqrt{g}$

42. Two identical capacitors X and Y are connected by a wire with an open switch K as shown in the figure. Initially capacitor X is given charge q while Y is uncharged. Consider the following statements regarding the capacitors after the switch is closed.



(A) The charge in capacitor X decreases to $\frac{q}{2}$.

(B) The voltage across capacitor X does not change from its initial value.

(C) The energy stored in capacitor X decreases to half of its initial value.

Of the above statements

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

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

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

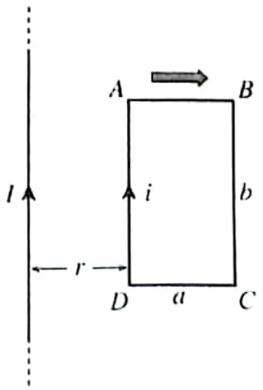
43. The upper half of an inclined plane of inclination θ to the horizontal is smooth while the lower half is rough. A block starting from rest at the top of the plane slides down and comes to rest again at the bottom. The coefficient of kinetic friction μ between the block and the lower half of the plane is given by

(1) $\mu = 2\tan\theta$ (2) $\mu = \cos\theta$ (3) $\mu = \tan\theta$ (4) $\mu = 2\sin\theta$ (5) $\mu = 3\tan\theta$

44. For a satellite moving in a circular path around the earth the kinetic energy, gravitational potential energy and total energy are given by K, V and E respectively. Which of the following relationships is **true**?

(1) $E = -K$ (2) $V = -K$ (3) $V = E$ (4) $K = -2E$ (5) $K = V$

45. A rectangular loop of wire $ABCD$ of width a and length b is kept coplanar with a long straight wire carrying a steady current I as shown in the figure. The loop is moved to the right. When the distance between the wire and the side AD of the loop is r, the current induced in the loop is i. What is the magnitude of the net magnetic force on the loop?



(1) $\frac{\mu_0 Ii}{2\pi}\frac{b}{a}$ (2) $\frac{\mu_0 Ii}{2\pi}\frac{(r+a)}{r}$ (3) $\frac{\mu_0 Ii}{2\pi}\frac{r}{(r+a)}$

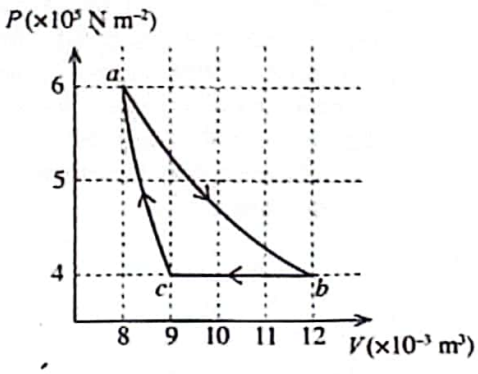
(4) $\frac{\mu_0 Ii}{2\pi}\frac{ab}{r(r+a)}$ (5) $\frac{\mu_0 Ii}{2\pi}\frac{r(r+a)}{ab}$

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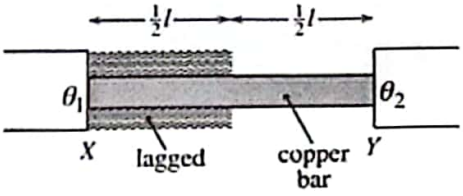
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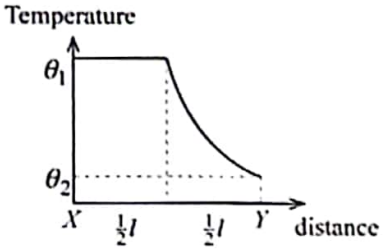
46. The *P-V* diagram shown in the figure illustrates a certain thermodynamic cycle *abca* of an ideal gas. If the temperature of the gas at point *a* is 327 °C, what is the temperature of the gas at point *c*?

(1) 177 °C (2) 227 °C (3) 300 °C
(4) 327 °C (5) 450 °C

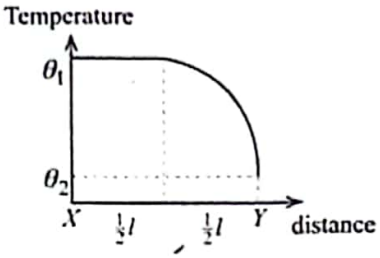


47. The length of *XY* copper bar is *l*. A half of the bar is properly lagged and the remaining half is unlagged. End *X* is maintained at temperature θ_1 and end *Y* is at θ_2 ($\theta_1 > \theta_2$). When the steady state is reached which graph best represents the variation of temperature along the bar?

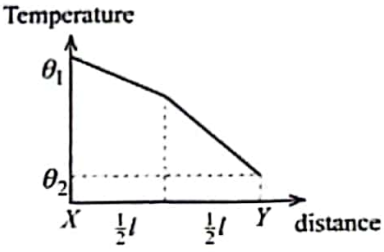




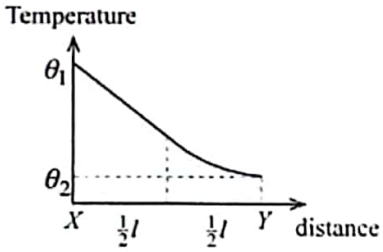
(1)



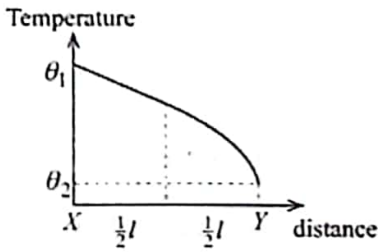
(2)



(3)



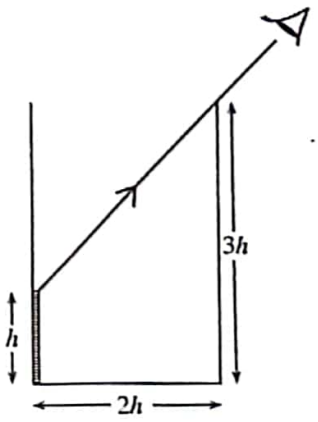
(4)



(5)

48. An observer can see the top of a thin plastic stripe attached to the wall of a beaker when the eye is at a position as shown in the figure. The length of the stripe is *h*, the diameter of the beaker is 2*h* and the height of the beaker is 3*h*. The beaker is then filled with a transparent liquid up to a height of 2*h*. Now the observer can see the bottom of the stripe without changing the position of eye. What is the refractive index of the liquid?

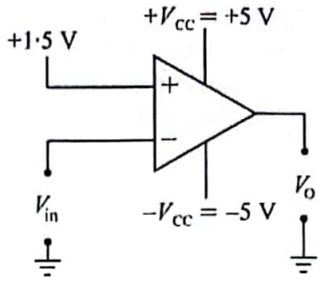
(1) $\frac{5}{2}$ (2) $\sqrt{\frac{5}{2}}$ (3) $\frac{3}{2}$
(4) $\frac{4}{3}$ (5) $\sqrt{\frac{3}{2}}$

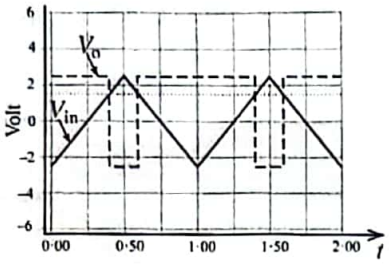


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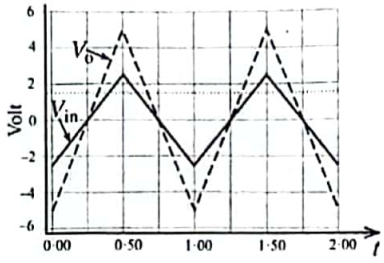
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49. Consider the op-amp circuit shown in the figure with a supply voltage of ±5 V. A triangular alternating voltage (V_{in}) with a peak-to-peak voltage of 5 V (ranging from –2·5 V to +2·5 V) is applied to the inverting input of the op-amp, and a fixed voltage of +1·5 V is applied to the non-inverting input. Which of the following best represents the variation of output voltage (V_o) with time t?

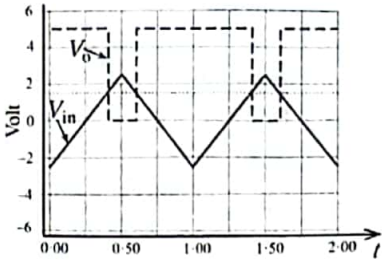




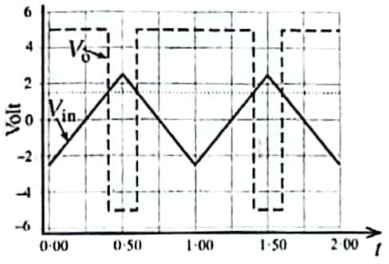
(1)



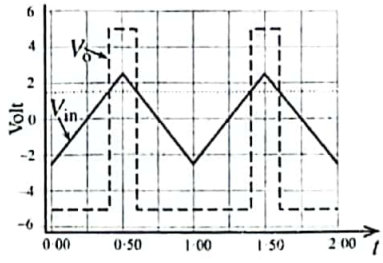
(2)



(3)

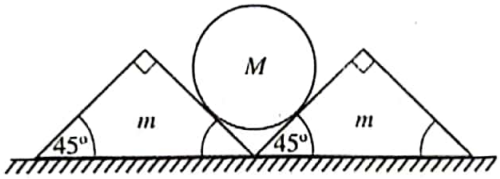


(4)



(5)

50. Two identical rectangular isosceles wedges, each of mass m, are placed next to each other on a rough horizontal surface. A solid cylinder of mass M is balanced on the wedges as shown in the figure. Assume there is no friction between the cylinder and the wedges. The coefficient of static friction between the wedges and the horizontal surface is μ. What is the largest value of M that can be balanced without slipping the wedges?



(1) $\frac{m}{\sqrt{2}}$ (2) $\frac{\mu m}{\sqrt{2}}$ (3) $\frac{\mu m}{1+\mu}$ (4) $\frac{\mu m}{1-\mu}$ (5) $\frac{2\mu m}{1-\mu}$

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