AL/2022(2023)/01/E-I

Thushara Perera

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, 2022(2023)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2022 (2023)
General Certificate of Education (Adv. Level) Examination, 2022(2023)

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* **11** *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.

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

1. Which one of the following pairs of quantities consists of a vector and a scalar, respectively?
   (1) Mass, Velocity (2) Power, Speed
   (3) Work, Distance (4) Force, Potential Energy
   (5) Momentum, Torque

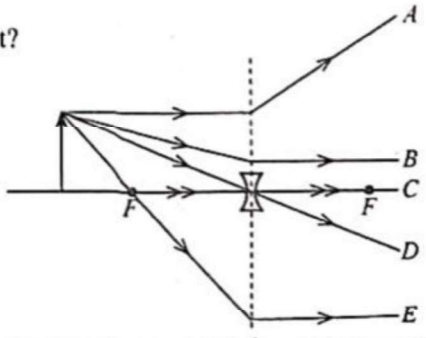
2. The magnitudes of two coplanar forces acting on a body are 11 N and 5 N. Which one of the following values could **not** be equal to the magnitude of the resultant force?
   (1) 16N (2) 9N (3) 7N (4) 6N (5) 5N

3. The quality of sound produced by a musical instrument depends on the
   (1) frequency of sound. (2) amplitude of sound.
   (3) intensity of sound. (4) wavelength of sound.
   (5) existence of overtones in the sound.

4. A stationary magnetic field **does not** interact with any
   (1) stationary electric charges. (2) moving electric charges.
   (3) current carrying wires. (4) stationary permanent magnets.
   (5) moving permanent magnets.

5. The back e.m.f. in an electric motor is maximum when the motor
   (1) is not operating. (2) begins its operation.
   (3) is increasing its speed. (4) is at its maximum speed.
   (5) is decreasing its speed.

6. Which one of the rays drawn in the figure is **not** correct?
   (1) *A* (2) *B* (3) *C*
   (4) *D* (5) *E*



[See page two

0303000022011290 4

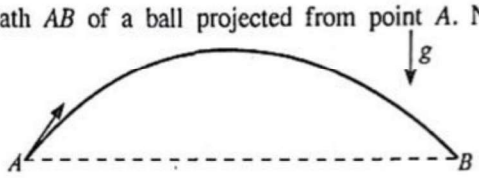
CamScanner

Scanned with CamScanner

7. What is the charge of an $\bar{u}$ quark? (The elementary charge is e)
(1) 0 (2) $+\frac{1}{3}e$ (3) $+\frac{2}{3}e$ (4) $-\frac{2}{3}e$ (5) $-\frac{1}{3}e$

8. The surface temperature of the sun is 6000 K and it emits blackbody radiation at peak wavelength 500 nm. For a blackbody with a surface temperature of 10 000 K, what will be the value of peak wavelength of emitted radiation?
(1) 30 nm (2) 300 nm (3) 500 nm (4) 600 nm (5) 800 nm

9. The figure shows the path AB of a ball projected from point A. Neglect air resistance.



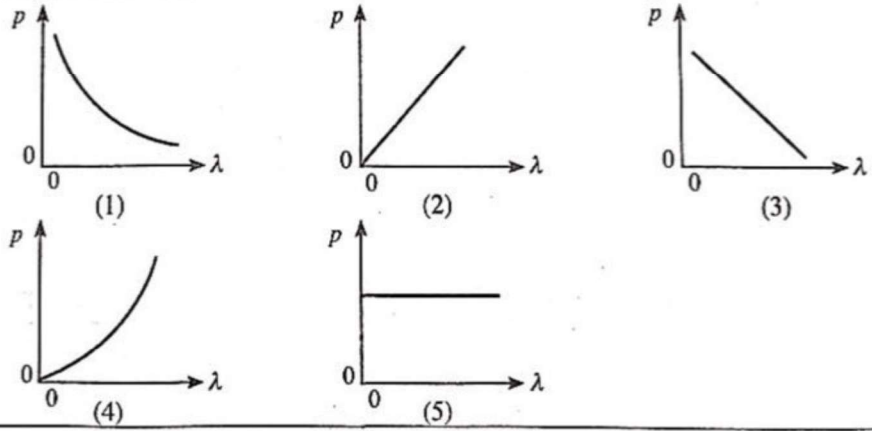
Consider the following statements.
(A) The velocity of the ball at the maximum height of the path is zero.
(B) The velocity of the ball at point B is equal to the velocity at point A.
(C) The kinetic energy of the ball at point B is equal to the kinetic energy at point A.
Of the above statements,
(1) Only (A) is true. (2) Only (C) is true.
(3) Only (B) and (C) are true. (4) Only (A) and (C) are true.
(5) All (A), (B) and (C) are true.

10. The Young's modulus of the material of a wire depends on
(A) the initial length of the wire.
(B) the cross-sectional area of the wire.
(C) the nature of the material of the wire.
Of the above statements,
(1) Only (A) is true. (2) Only (B) is true.
(3) Only (C) is true. (4) Only (A) and (C) are true.
(5) All (A), (B) and (C) are true.

11. A uniform electric field of intensity 200 V m^{-1} is applied in between a pair of parallel metallic plates. What should be the separation between the plates in order to produce a potential difference of 10 V?
(1) 20 mm (2) 30 mm (3) 50 mm (4) 20 m (5) 30 m

12. An alarm in a car at rest is emitting sound waves of frequency 510 Hz. A person on a motorcycle is travelling directly away from the car. What is his velocity if he hears the frequency of the alarm as 480 Hz? (Speed of sound in air is 340 m s^{-1})
(1) 10 m s^{-1} (2) 15 m s^{-1} (3) 20 m s^{-1} (4) 25 m s^{-1} (5) 30 m s^{-1}

13. Which of the following graphs best represents the variation of momentum (p) of a particle with its de Broglie wavelength (λ)



[See page three

CamScanner
Scanned with CamScanner

14. A car has a grease nipple of length of 3×10^{-3} m and diameter 5×10^{-4} m. If the coefficient of viscosity of grease is 80 Pa s, what is the pressure difference needed to force a volume of 10^{-6} m^3 grease through the nipple in 10 s? [Take $(2{\cdot}5)^4 = 40$ and $\pi = 3$]

(1) $1{\cdot}6 \times 10^3$ Pa (2) $1{\cdot}6 \times 10^4$ Pa (3) $1{\cdot}6 \times 10^5$ Pa (4) $1{\cdot}6 \times 10^6$ Pa (5) $1{\cdot}6 \times 10^7$ Pa

15. Consider the following statements made about absolute zero temperature.

(A) It is the temperature at which water freezes at atmospheric pressure.

(B) It is the temperature at which all gases become liquids.

(C) It is the temperature at which mean kinetic energy of an ideal gas becomes zero.

Of the above statements,

(1) Only (A) is true. (2) Only (C) is true.

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

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

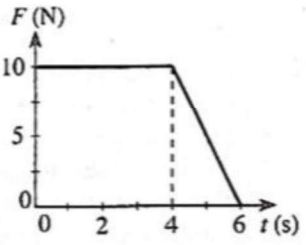
16. Which of the following can store one bit of data?

(1) AND gate (2) NOR gate (3) XOR gate (4) OR gate (5) Flip-flop

17. The period of oscillation of a simple pendulum of length l is T. Suppose a simple pendulum of length $2l$ is hung from the ceiling of an elevator. What will be the period of oscillations of this pendulum if the elevator accelerates vertically upward at $\frac{g}{2}$?

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

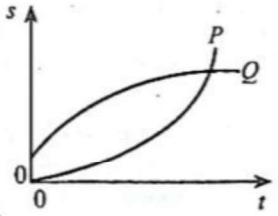
18. A body of mass 2 kg is initially at rest on a frictionless horizontal surface. Then a horizontal force F varying with time t as shown in the figure acts on the body during 6 s. What is the final velocity of the body?



(1) 20 m s^{-1} (2) 25 m s^{-1} (3) 30 m s^{-1}

(4) 40 m s^{-1} (5) 50 m s^{-1}

19. The figure shows the displacement (s) - time (t) graphs of two objects P and Q moving along a straight line. Consider the following statements.



(A) Both objects have velocities in the same direction.

(B) Velocities of both objects increase with time.

(C) Both objects have the same velocity at the crossing point of the two graphs.

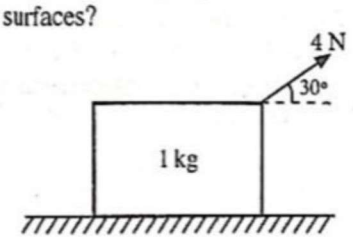
Of the above statements,

(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.

20. A block of mass 1 kg is kept on a rough horizontal surface. The block is pulled by a force of 4 N inclined at 30° to the horizontal as shown in the figure. If the block is at limiting equilibrium what is the value of the coefficient of limiting friction between the two surfaces?



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

(4) $\frac{\sqrt{3}}{8}$ (5) $\frac{\sqrt{3}}{10}$

[See page four

007904

02030000220112904

CamScanner

Scanned with CamScanner

21. Consider the following statements made regarding Tsunami waves.

(A) Wavelengths of waves in deep water are lower than that in shallow water.

(B) Speeds of waves are higher in deep water than that in shallow water.

(C) Amplitudes of the waves in deep water are higher than that in shallow water.

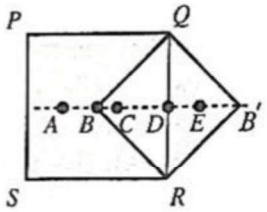
Of the above statements,

(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.

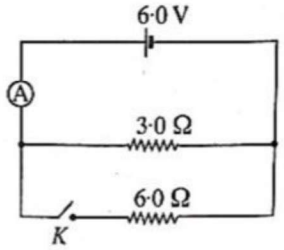
22. A triangular shaped portion QBR is removed from a uniform square sheet $PQRS$ and connected to form the composite sheet $PQB'RS$ as shown in the figure. The center of the gravity of the composite sheet is most likely to be at



(1) A (2) B (3) C

(4) D (5) E

23. The diagram shows a circuit having a battery of e.m.f. 6·0 V, a 3·0 Ω resistor and a 6·0 Ω resistor connected in parallel. When the switch K is opened reading of the ideal ammeter is 1·5 A. What is the ammeter reading when the switch is closed?

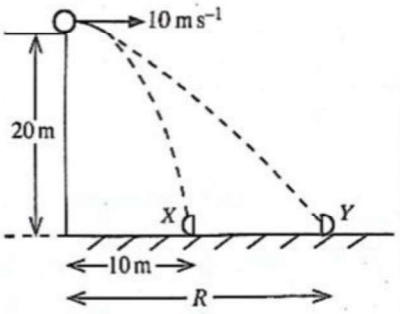


(1) 1·0 A (2) 1·2 A (3) 1·5 A

(4) 2·0 A (5) 3·0 A

24. A ball is projected at a velocity of $10\,m\,s^{-1}$ horizontally from the top edge of a building of height 20 m. While falling, the ball splits into two identical pieces, X and Y. Then pieces X and Y hit the ground simultaneously at horizontal distances 10 m and R respectively from the building as shown in the figure. Neglect air resistance.

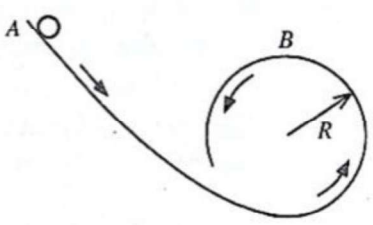
What is the distance R?



(1) 20 m (2) 30 m (3) 40 m

(4) 50 m (5) 60 m

25. A ball released at point A travels on a frictionless track as shown in the figure. Then the ball **just touches** point B on the inner surface of the circular part of the track of radius R. What is the velocity of the ball at point B?



(1) 0 (2) $\sqrt{gR}$ (3) $2\sqrt{gR}$

(4) $\sqrt{5gR}$ (5) $4\sqrt{gR}$

26. Ten identical musical instruments placed along the circumference of a circle produce a sound intensity level of 50 dB at the center of the circle. How many identical musical instruments placed along the circumference are needed to produce a sound intensity level of 60 dB at the center?

(1) 10 (2) 20 (3) 50 (4) 100 (5) 200

[See page five

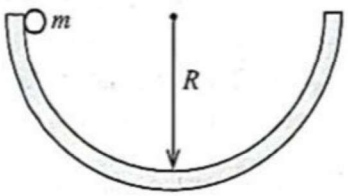
CamScanner

Scanned with CamScanner

27. As shown in the figure, a sphere of mass m is released from the rim of a hemispherical bowl of radius R. The sphere finally stops due to friction at the bottom of the bowl after oscillating several times.

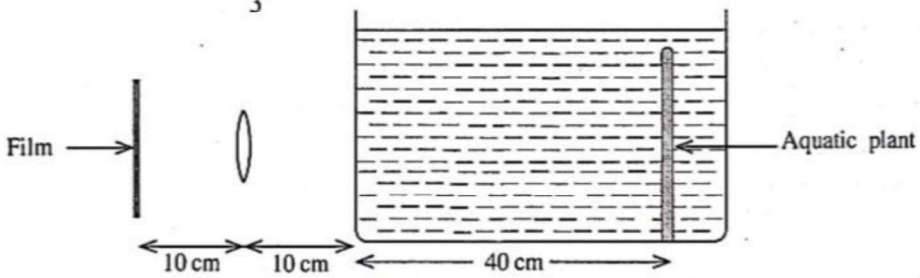
Which of the following is true regarding the work done by gravitational force and the normal reaction force acting on the sphere during the process?

	Work done by gravitational force	Work done by normal reaction force
(1)	0	0
(2)	$\frac{1}{2}mgR$	0
(3)	mgR	0
(4)	0	mgR
(5)	mgR	mgR



28. A person takes a picture of a aquatic plant in a container with thin glass walls using a convex lens. The container is filled with water. When the film, lens, and aquatic plant are positioned as shown in the figure, a clear image of the aquatic plant is recorded on the film.

(Refractive index of water $=\frac{4}{3}$)



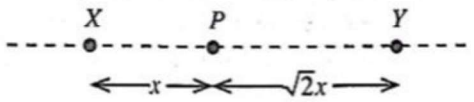
What is the focal length of the convex lens?

(1) 8·0 cm (2) $\frac{25}{3}$ cm (3) $\frac{110}{13}$ cm (4) 9·0 cm (5) $\frac{40}{3}$ cm

29. As shown in the figure, two point charges X and Y are fixed along a straight line. The charge of X is $+q$. When a negative point charge is placed at point P, it remains stationary. What is the charge of Y? Neglect all other forces acting on charges.

(1) $-\frac{1}{\sqrt{2}}q$ (2) $-\frac{1}{2}q$ (3) $+\frac{1}{2}q$

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

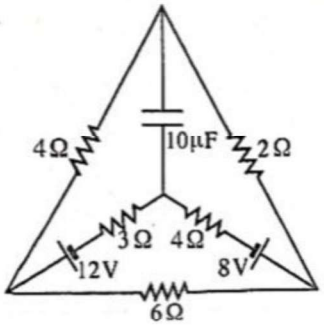


30. The figure shows a circuit containing two batteries with negligible internal resistance, five resistors, and one capacitor.

What is the current flowing through the 3 Ω resistor after steady state of the circuit has achieved?

(1) 0·1 A (2) 0·2 A (3) 0·4 A

(4) 0·8 A (5) 1·0 A



[See page six

007904
0103000022011290 4
CamScanner
Scanned with CamScanner

31. A current carrying metallic wire with different cross-sections is shown in the figure. Consider the following statements.



(A) The current in the wire is same everywhere.

(B) The power dissipation of the wire is higher in the thin section than that in thick section.

(C) The drift velocity of electrons is higher in the thin section than that in thick section.

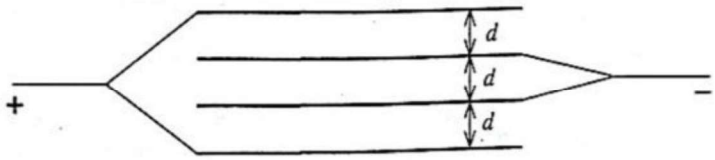
Of the above statements,

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

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

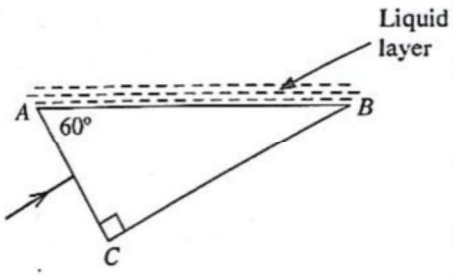
(5) All (A), (B) and (C) are true.

32. Four metallic plates are placed at a separation d from each other as shown in the figure. The overlapping area of each plate with the other is A. What is the equivalent capacitance of the system?



(1) $\frac{1}{3}\frac{\varepsilon_0 A}{d}$ (2) $\frac{1}{2}\frac{\varepsilon_0 A}{d}$ (3) $\frac{\varepsilon_0 A}{d}$ (4) $2\frac{\varepsilon_0 A}{d}$ (5) $3\frac{\varepsilon_0 A}{d}$

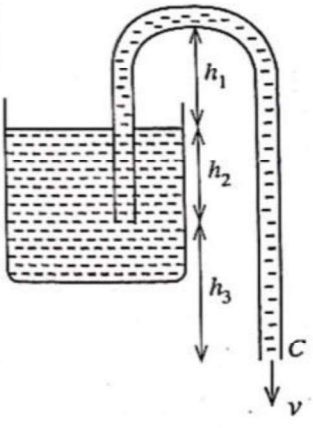
33. As shown in the figure, a monochromatic ray of light is incident normally on the face AC of a glass prism. The refractive index of glass is $\frac{3}{2}$. A layer of transparent liquid of refractive index n is placed on face AB of the prism. Which of the following is correct with regard to n for the ray to be totally internal reflected from face AB?



(1) $n < \frac{3\sqrt{3}}{8}$ (2) $n < \frac{3}{4}$ (3) $n < \frac{3\sqrt{3}}{4}$

(4) $n > \frac{3\sqrt{3}}{8}$ (5) $n > \frac{3\sqrt{3}}{4}$

34. Figure shows a siphon which is filled with a liquid. The respective heights are marked in the figure. What is the speed (v) of the emerging liquid from the siphon at C? Assume that the cross-sectional area of the liquid container is large compared to the cross-sectional area of the tube and the flow is steady and non-viscous.



(1) $v = \sqrt{2g(h_1 + h_2 + h_3)}$

(2) $v = \sqrt{2g(h_1 + h_2)}$

(3) $v = \sqrt{2g(h_1 + h_3)}$

(4) $v = \sqrt{2g(h_2 + h_3)}$

(5) $v = \sqrt{2gh_3}$

[See page seven

CamScanner

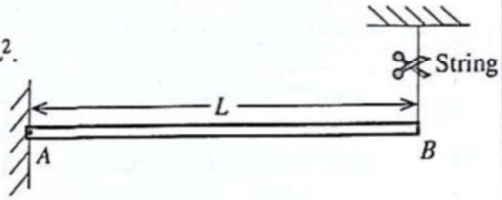
Scanned with CamScanner

35. A uniform rod AB of mass M and length L is freely hinged at end A and kept horizontally by a string attached to end B as shown in the figure. What will be initial vertical linear acceleration of end B once the string is cut?

The moment of inertia of the rod about end A is $\frac{1}{3}ML^2$.

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

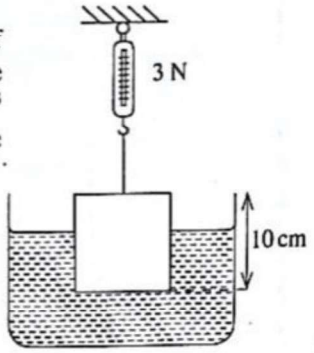
(4) $\frac{3}{2}g$ (5) $2g$



36. A homogeneous wooden cube of side 10 cm is hung in a tank of water by a light string attached to a spring balance as shown in the figure. Densities of wood and water are 800 kg m^{-3} and 1000 kg m^{-3} respectively. If the reading of the balance is 3 N what is the volume of wood under water?

(1) 400 cm^3 (2) 500 cm^3 (3) 600 cm^3

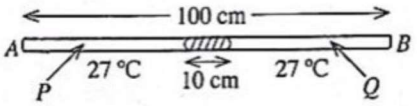
(4) 700 cm^3 (5) 800 cm^3



37. The length of a uniform glass tube AB sealed at both ends is 100 cm. It is kept horizontally and 10 cm long mercury (Hg) column is trapped at the middle when both air columns (P and Q) are at temperature 27 °C and same pressure. If the temperature of the air columns P and Q are increased to 47 °C and 127 °C respectively what will be the **difference** between the lengths of the two air columns? Neglect the expansion of mercury and glass.

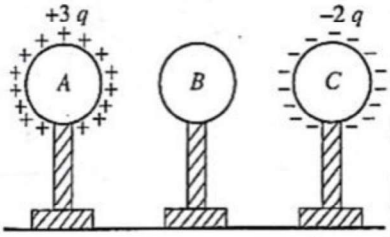
(1) 5 cm (2) 6 cm (3) 8 cm

(4) 10 cm (5) 12 cm



38. Three identical conducting spheres A, B and C are mounted on insulating supports and separated as shown in the figure. The sphere A is given a charge $+3q$ and C is given $-2q$ charge. The sphere B does not have a net charge. Then the sphere B is first touched to sphere C, next sphere B is touched to sphere A and finally spheres brought back to the initial positions. The remaining final charge in each sphere is given by,

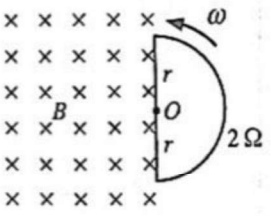
	Sphere A	Sphere B	Sphere C
(1)	$+3q$	$-q$	$-q$
(2)	$+2q$	0	$-q$
(3)	$+2q$	$-q$	0
(4)	$+q$	$-q$	$+q$
(5)	$+q$	$+q$	$-q$



39. A uniform magnetic field of flux density B is directed into the plane of paper as shown in the figure. A semicircular conducting loop of radius r rotates at constant angular velocity of ω about centre O and perpendicular to the plane. The resistance of the loop is 2 Ω. What is the magnitude of current induced in the loop?

(1) $\frac{1}{4}\omega r^2 B$ (2) $\frac{1}{2}\omega r^2 B$ (3) $\omega r^2 B$

(4) $2\omega r^2 B$ (5) $4\omega r^2 B$

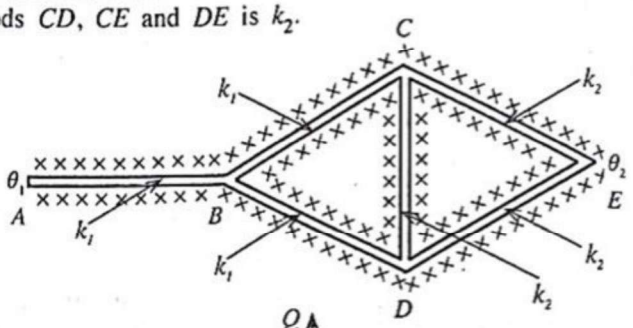


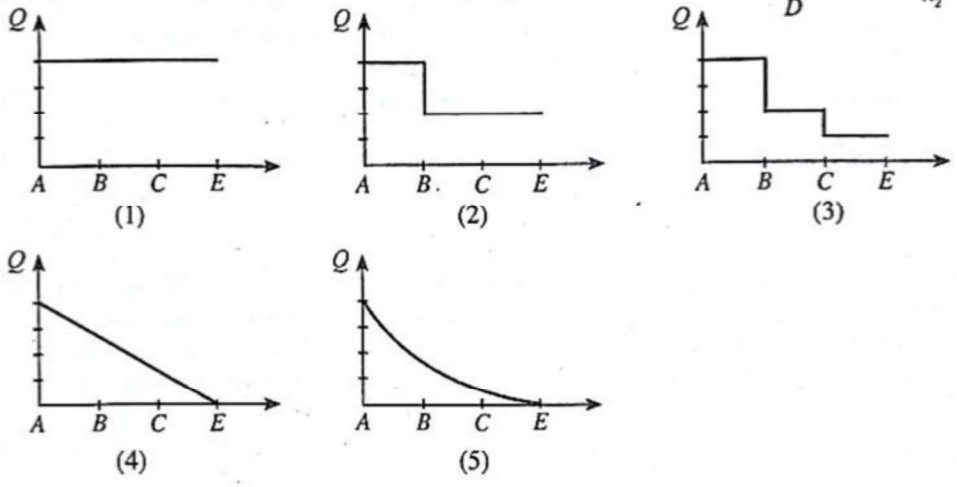
[See page eight

CamScanner
Scanned with CamScanner

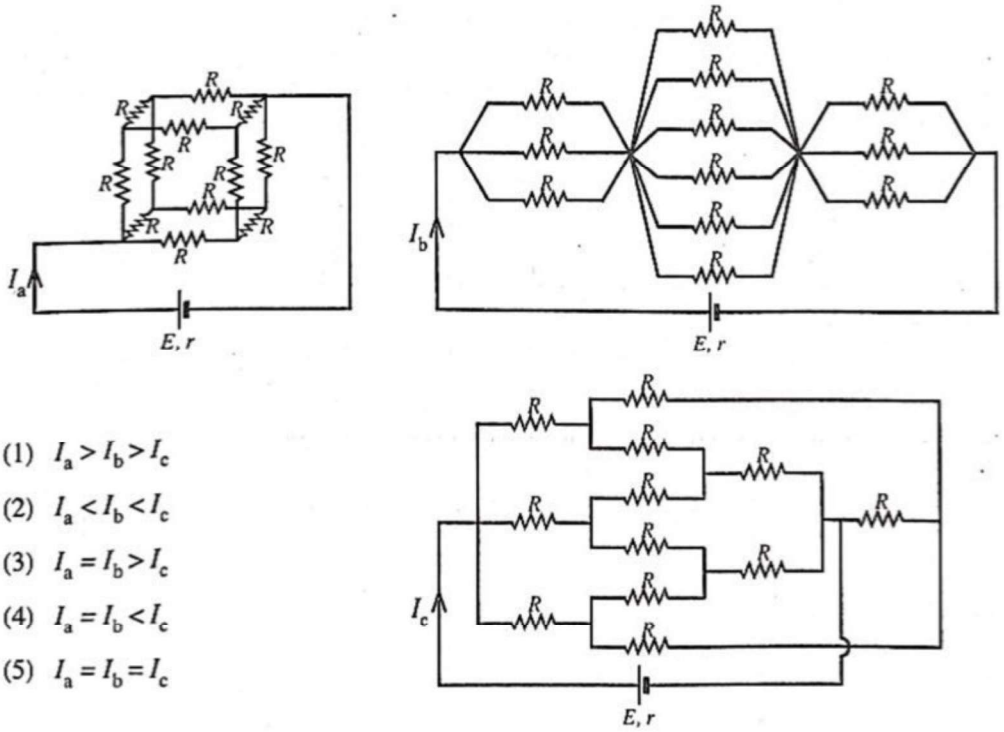
40. Six uniform metal rods AB, BC, BD, CD, CE and DE are connected as shown in the figure. All the rods are identical in length and cross-sectional area. The thermal conductivity of material of rods AB, BC and BD is k_1 and that of rods CD, CE and DE is k_2.

All rods are well lagged and the ends A and E are maintained at temperatures θ_1 and θ_2 $(\theta_1 > \theta_2)$ respectively. Which of the following graphs best represents the variation of rate of heat flow (Q) along the rods AB, BC and CE after steady state has achieved?





41. Three circuit diagrams constructed using 12 resistors are shown in figures. What is the correct relationship of the currents I_a , I_b and I_c flowing in the circuits respectively?



(1) $I_a > I_b > I_c$

(2) $I_a < I_b < I_c$

(3) $I_a = I_b > I_c$

(4) $I_a = I_b < I_c$

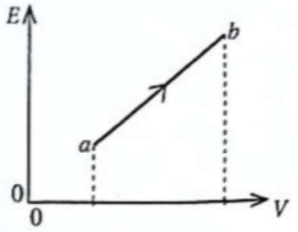
(5) $I_a = I_b = I_c$

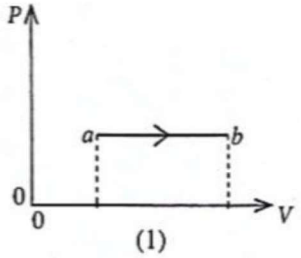
[See page nine

CamScanner

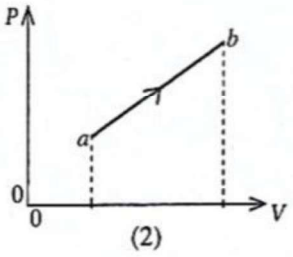
Scanned with CamScanner

42. During a thermodynamic process from a to b, variation of mean kinetic energy E of a given mass of an ideal gas with volume V is shown in the figure. The corresponding variation of pressure P with volume V of the gas is best represented by

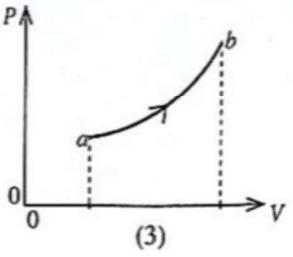




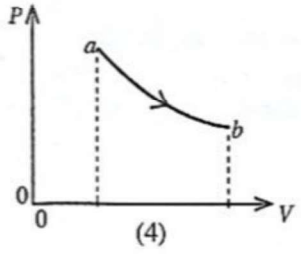
(1)



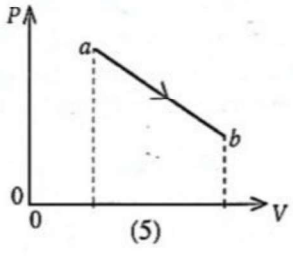
(2)



(3)

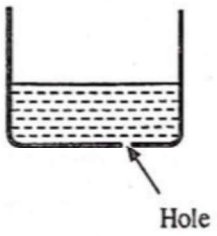


(4)



(5)

43. The bottom surface of a cylindrical container of cross-sectional area A has a small hole of radius r as shown in the figure. When a liquid of surface tension T is filled in the container up to a certain height the liquid starts to seep through the hole. The liquid is filled up to half of that height and an object is floated on the surface of the liquid. What should the minimum mass of the object be in order to seeps the liquid through the hole?



(1) $\frac{AT}{2rg}$ (2) $\frac{AT}{rg}$ (3) $\frac{2AT}{rg}$

(4) $\frac{rg}{AT}$ (5) $\frac{2rg}{AT}$

44. For which values of R would the silicon transistor circuit shown be in cutoff region and active region, respectively?

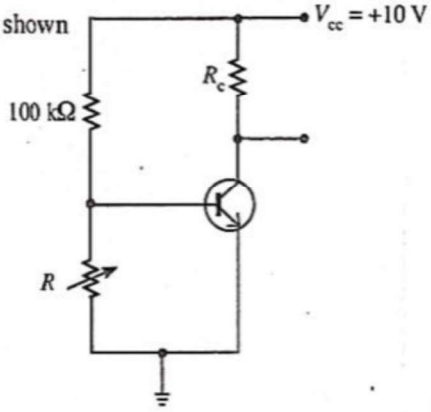
(1) 5 kΩ, 1·0 kΩ

(2) 5 kΩ, 2·5 kΩ

(3) 5 kΩ, 7·5 kΩ

(4) 100 kΩ, 10 kΩ

(5) 100 kΩ, 50 kΩ

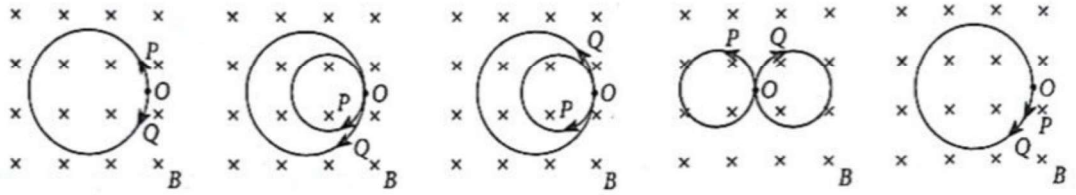


[See page ten

CamScanner
Scanned with CamScanner

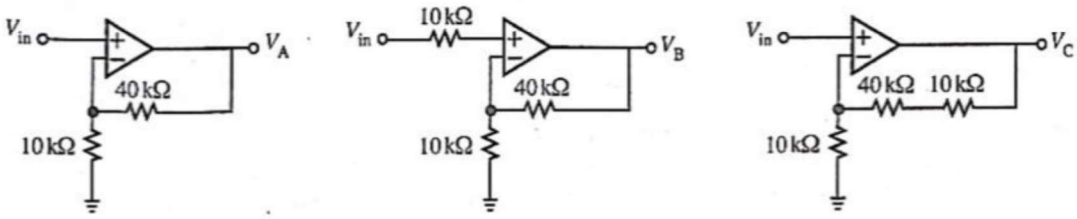
45. A stationary neutral particle at point O decays into two small charged particles P and Q of identical masses as shown in the figure. A constant and uniform magnetic field of flux density B is directed into the plane of the paper. Which of the following correctly shows the paths of the two charged particles P and Q? (Neglect the electrostatic interaction between the two particles)





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

46. The figure shows three circuits A, B and C, made of identical op-amps. All three circuits are fed by identical input voltage V_{in} from an ideal voltage source. Which of the following correctly gives the comparison of the respective magnitudes of the output voltages V_A, V_B and V_C of the three circuits?



(A) (B) (C)

(1) $V_A = V_B = V_C$ (2) $V_A = V_B < V_C$ (3) $V_A > V_B = V_C$

(4) $V_A = V_B > V_C$ (5) $V_A < V_B < V_C$

47. Ambient air at 30 °C and relative humidity (RH) 90% is cooled to 10 °C and some of the moisture in air is removed by an air-conditioning plant. Then this air is heated to 20 °C and passed to a computer laboratory. If the values of saturated water vapour pressure at temperatures 10 °C, 20 °C and 30 °C are given by a, b and c respectively, what is the ratio of moisture removed from the plant and the final relative humidity (RH) of the air at 20 °C?

(1) $\frac{(0{\cdot}9c-a)}{0{\cdot}9c}, \frac{a\times100}{b}\%$ (2) $\frac{(0{\cdot}9c-a)}{0{\cdot}9c}, \frac{c\times100}{b}\%$

(3) $\frac{(0{\cdot}9c-a)}{c}, \frac{a\times100}{b}\%$ (4) $\frac{(c-a)}{c}, \frac{b\times100}{c}\%$

(5) $\frac{(c-a)}{c}, \frac{a\times100}{c}\%$

48. When a tuning fork is sounded with a tube closed at one end and filled with air at temperature 51 °C, a beat frequency of 4 Hz is heard. Same beat frequency is heard when the tuning fork is sounded with the tube filled with air at temperature 127 °C. In both situations the tube is sounded with the same overtone. What is the frequency of the tuning fork? Neglect the end correction of the tube. ($\sqrt{324} = 18$)

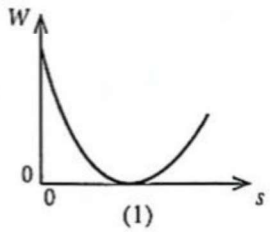
(1) 56 Hz (2) 60 Hz (3) 66 Hz (4) 76 Hz (5) 80 Hz

[See page eleven

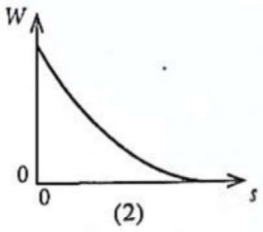
CamScanner

Scanned with CamScanner

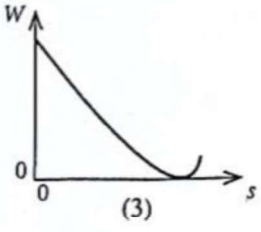
49. Suppose a spacecraft moves from the earth to the moon. Which one of the following graphs best represents the variation of the magnitude of its net weight (W) with distance (s)? (Neglect the effect of other objects)



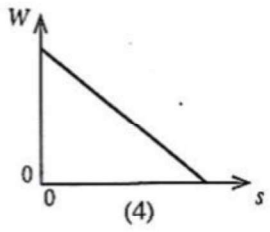
(1)



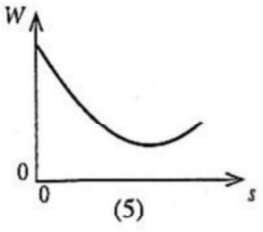
(2)



(3)

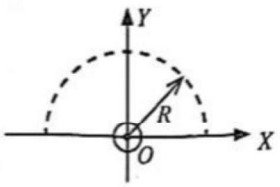


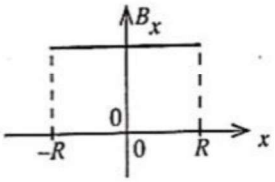
(4)



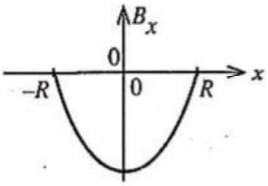
(5)

50. A long straight wire placed at the origin O carries a constant current directed out of the paper along the Z-axis. Figure shows a semicircle of radius R drawn on the X-Y plane centering the wire. Which one of the following graphs best represents the variation of the x–component of the magnetic flux density (B_x) along the semicircular path with x ?

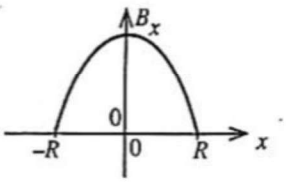




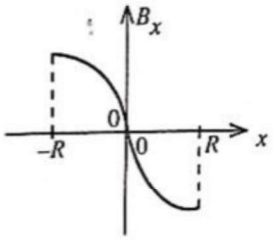
(1)



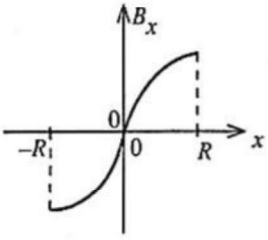
(2)



(3)



(4)



(5)

***

CamScanner

Scanned with CamScanner