සියලු හිමිකම් ඇවිරිණි/முழுப் பதிப்புரிமையுடையது/All Rights Reserved]

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2023(2024)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2023 (2024)
General Certificate of Education (Adv. Level) Examination, 2023 (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. Electron volt (eV) is a unit of
   (1) energy. (2) power. (3) charge. (4) voltage. (5) force.

2. The distance between the centers of two uniform spherical masses $M$ and $m$ is $r$. What is the gravitational potential energy of the two masses?
   (1) $\frac{GMm}{r}$ (2) $-\frac{GMm}{r}$ (3) $\frac{GMm}{r^2}$ (4) $-\frac{GMm}{r^2}$ (5) $-\frac{GM}{r}$

3. When a bull pulls a cart, what is the force that causes the bull to move forward?
   (1) The force exerted on the cart by the bull
   (2) The force exerted on the bull by the cart
   (3) The force exerted on the ground by the bull
   (4) The force exerted on the bull by the ground
   (5) The force exerted on the ground by the cart

4. Two displacements of magnitude 9 m and 6 m can be added to give a resultant displacement of
   (1) 1 m. (2) 2 m. (3) 4 m. (4) 16 m. (5) 20 m.

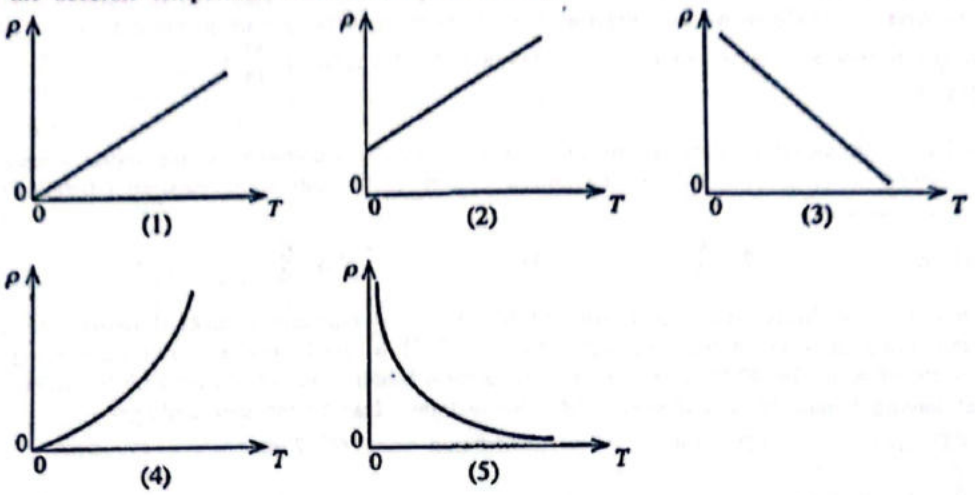
5. Longitudinal waves do **not** exhibit
   (1) reflection. (2) refraction. (3) interference.
   (4) diffraction. (5) polarization.

6. If the absolute temperature of a blackbody is increased by 2 times, the energy radiated by the blackbody per unit time per unit area will increase by
   (1) two times. (2) four times. (3) eight times.
   (4) sixteen times. (5) thirty two times.

7. When transistors are used in digital circuits they operate in the
   (1) active region. (2) breakdown region. (3) linear region.
   (4) saturation region. (5) saturation and cutoff regions.

8. What is the quark composition of a neutron ($n$)?
   (1) uud (2) udd (3) uuu (4) $\bar{u}\bar{u}\bar{u}$ (5) $\bar{d}\bar{d}\bar{d}$

9. If the pressure of a given mass of an ideal gas is kept constant, the variation of its density $\rho$ with the absolute temperature $T$ is best represented by




10. Three thermodynamic processes are given below.
(A) an isothermal process
(B) a constant volume process
(C) a constant pressure process

All the heat energy supplied to an ideal gas is converted to work done by the gas
(1) only by (A). (2) only by (B). (3) only by (C).
(4) only by (A) and (C). (5) by all (A), (B) and (C).

11. Electric potential of two conducting parallel plates are –10 V and 30 V respectively. If the separation between the plates is 2 cm what is the electric field intensity between the plates?
(1) 1000 V m$^{-1}$ (2) 1500 V m$^{-1}$ (3) 2000 V m$^{-1}$ (4) 3000 V m$^{-1}$ (5) 4000 V m$^{-1}$

12. Which of following is **not** true about the electric field lines?
(1) Field lines start from positive charges and end at negative charges.
(2) If a single positive charge exists field lines end at infinity.
(3) Two field lines can never cross each other.
(4) Electrostatic field lines form closed loops.
(5) Field lines are imaginary lines which are used to represent the pattern of an electric field.

13. A sound source of intensity $I_1$ produces a sound intensity level of 90 dB at a certain point. Another sound source of intensity $I_2$ produces a sound intensity level of 40 dB at the same point. The distance from both the sources to the point is same. What is the ratio of $\frac{I_1}{I_2}$ ?
(1) 5 (2) 50 (3) 500 (4) $10^2$ (5) $10^5$

14. The photoelectric threshold frequency of a metal is $f_0$. When light of frequency $4f_0$ is incident on the metal, what is the maximum kinetic energy of the ejected photoelectrons?
(1) $hf_0$ (2) $2hf_0$ (3) $3hf_0$ (4) $4hf_0$ (5) $5hf_0$

15. A convex lens of focal length 20 cm and a concave lens of focal length 5 cm are kept along the same axis with a distance $d$ between them. If a parallel monochromatic beam of light incident on the convex lens leaves the concave lens as a parallel beam what is the distance $d$?
(1) 25 cm (2) 20 cm (3) 15 cm (4) 10 cm (5) 5 cm



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16. Trolley $X$ of mass $m$ and trolley $Y$ of mass $M$ are moving in the same direction along a straight line on a smooth horizontal surface. The speed of trolley $X$ is twice that of trolley $Y$. When the two trolleys collide both move together with a common velocity. Due to the collision if the speed of the trolley $Y$ is increased by 20%, what will be the ratio of $\frac{M}{m}$?

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

17. A ball is projected upwards at an angle of 60° with the horizontal. If the initial kinetic energy of projection is $K$ what will be the kinetic energy of the ball at its maximum height? (Neglect air resistance)

(1) $K$ (2) $\frac{K}{2}$ (3) $\frac{K}{3}$ (4) $\frac{K}{4}$ (5) 0

18. An immersion heater made of a wire of length $L$ and diameter $d$ takes 4 minutes to raise the temperature of a given mass of water by 40 °C. How much time is taken for heating a same amount of water by 40 °C using another immersion heater made of a wire with the same material, but having length $2L$ and diameter $2d$? (Neglect heat loss to the surroundings)

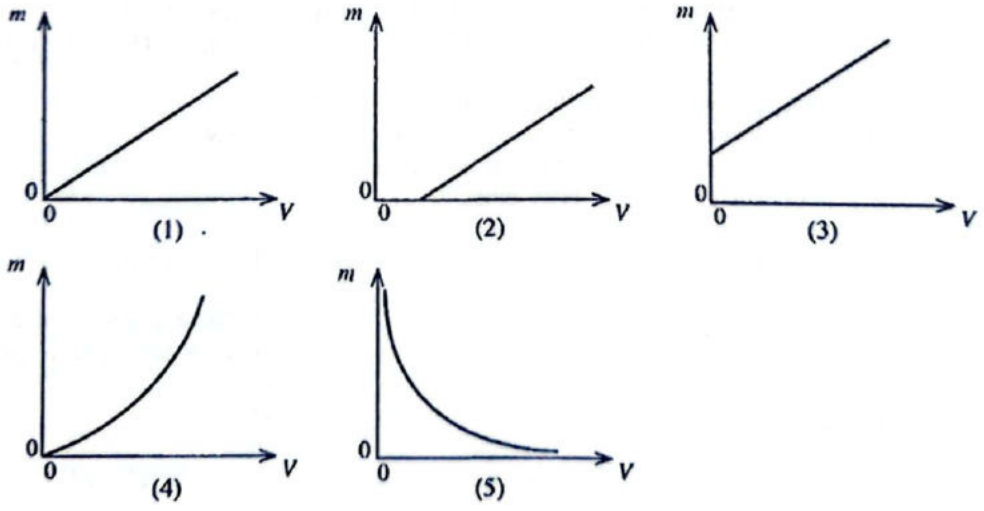
(1) 0·5 min (2) 1 min (3) 1·5 min (4) 2 min (5) 8 min

19. Assume that the earth revolves around Sun in a circular path of radius $r_1$ with a speed of $v_1$, and Mars revolves around Sun in a circular path of radius $r_2$ with a speed of $v_2$.

What is the ratio of $\frac{v_1}{v_2}$?

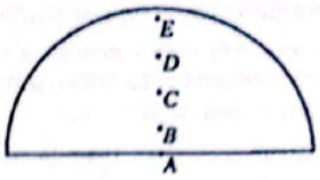
(1) $\frac{r_1}{r_2}$ (2) $\frac{r_2}{r_1}$ (3) $\sqrt{\frac{r_2}{r_1}}$ (4) $\sqrt{\frac{r_1}{r_2}}$ (5) $\frac{r_1^2}{r_2^2}$

20. The variation of linear magnification ($m$) of real images formed by a convex lens with the image distance ($V$) is best represented by



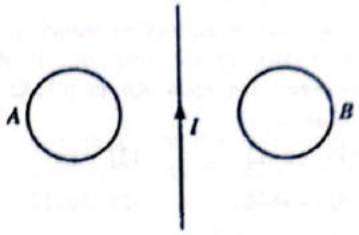

21. If a proton is projected with a velocity $v$ along the axis of a current carrying long solenoid,
(1) the proton will be accelerated along the axis.
(2) the proton will be decelerated along the axis.
(3) the path of the proton will be circular about the axis.
(4) the path of the proton will be helical about the axis.
(5) the proton will continue to move with velocity $v$ along the axis.

22. The figure shows a semi-circular uniform thin sheet. The center of gravity of the sheet is most likely to be found at



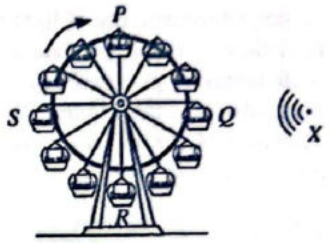

(1) $A$ (2) $B$ (3) $C$
(4) $D$ (5) $E$

23. Two conducting circular loops $A$ and $B$ are kept on the same plane with a straight current carrying wire at either side of it as shown in the figure. If the current ($I$) in the wire decreases in magnitude, the induced current in the loops




(1) will be clockwise in $A$ and clockwise in $B$.
(2) will be anti-clockwise in $A$ and clockwise in $B$.
(3) will be clockwise in $A$ and anti-clockwise in $B$.
(4) will be anti-clockwise in $A$ and anti-clockwise in $B$.
(5) will be zero in both loops.

24. The figure shows a Ferris-wheel rotating in the clockwise direction. A loud speaker fixed at $X$ emits continuous sound waves at a constant frequency $f_0$. Consider the following statements regarding the pitch of the sound heard by a man in the Ferris-wheel when he passes the positions at $P$, $Q$, $R$ and $S$?




(A) The original pitch is heard when the man is at positions $Q$ and $S$.
(B) The highest pitch is heard when the man is at position $P$.
(C) The lowest pitch is heard when the man is at position $R$.

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.

25. Consider the following statements regarding the magnitude of the magnetic force acting on a current carrying wire placed in a magnetic field.

(A) It depends on the length of the wire.
(B) It depends on the way that the wire is bended.
(C) It depends on the cross-sectional area of the wire.

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

26. The speed $v$ of a liquid having coefficient of viscosity $\eta$ passing through a horizontal tube of inner radius $a$ and length $l$ under a pressure difference $\Delta p$ can be written as $v = \frac{Ca^n \Delta p}{\eta l}$. Here $C$ is a dimensionless constant. What is the value of $n$?

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

27. A steel measuring tape has been calibrated at 20 °C temperature. A student uses this tape to measure a length at 40 °C. The value that he reads off the tape is 50·00 m. What is the actual length? The linear expansivity of steel is $2 \times 10^{-5}\,°C^{-1}$.

(1) 49·96 m (2) 49·98 m (3) 50·02 m (4) 50·04 m (5) 50·06 m

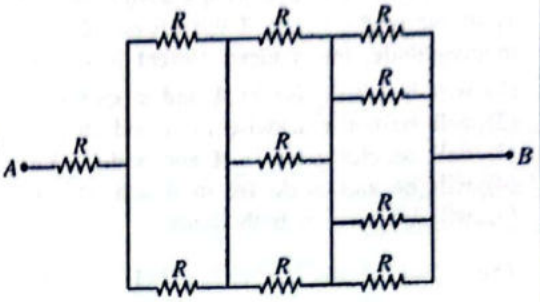


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28. An incompressible, non-viscous fluid of density $\rho$ flows through a horizontal pipe of inner radius $r$ and then passes through a narrow part of the pipe of inner radius $\frac{r}{2}$. If the fluid pressure and the velocity in the wider part are $P_0$ and $v_0$ respectively, what is the pressure of the fluid in the narrow part of the tube?

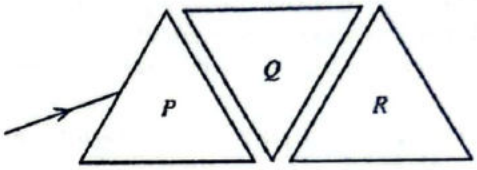
(1) $\frac{P_0}{4}$ (2) $\frac{P_0}{2}$ (3) $P_0 - \frac{1}{2}\rho v_0^2$ (4) $P_0 - \frac{3}{2}\rho v_0^2$ (5) $P_0 - \frac{15}{2}\rho v_0^2$

29. Ten resistors, each of resistance $R$, are connected as shown in the diagram. If the resistance between the ends $AB$ is 50 kΩ, what is the value of $R$?




(1) 12kΩ (2) 15kΩ (3) 18kΩ
(4) 24kΩ (5) 36kΩ

30. A monochromatic ray of light suffers minimum deviation $D$ in an equilateral prism $P$. Three such identical prisms $P$, $Q$ and $R$ are placed as shown in the figure. What is the total deviation of the ray after passing through the prism combination?

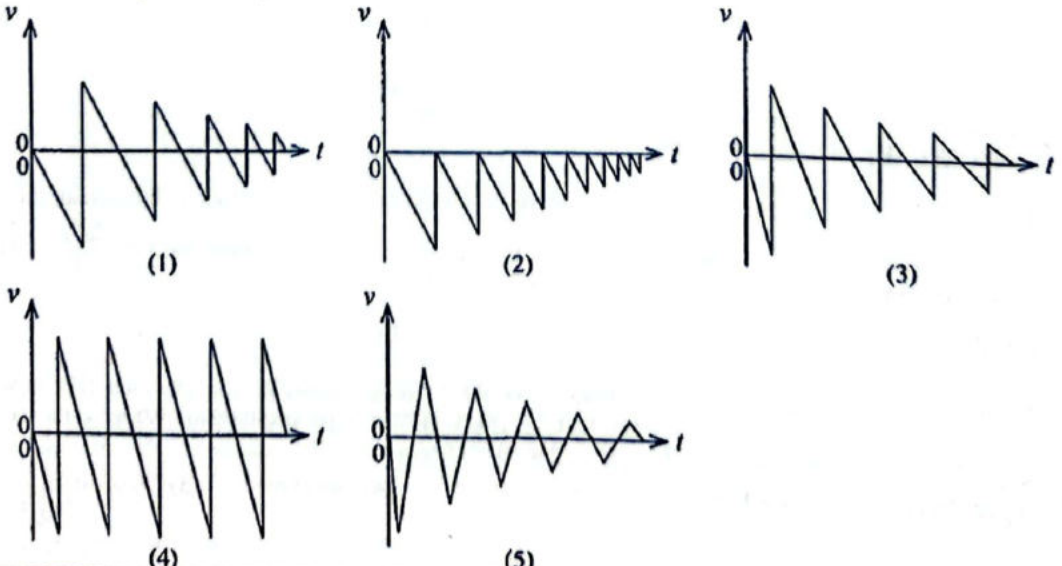



(1) $\frac{D}{3}$ (2) $\frac{D}{2}$ (3) $D$
(4) $2D$ (5) $3D$

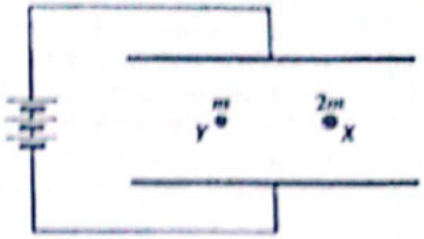
31. A sinusoidal a.c. voltage with r.m.s. value of 200 V is supplied to a full-wave rectifier circuit. Each diode in the rectifier has a forward bias voltage of 0·7 V. What is the peak value of the rectified voltage? (Take $\sqrt{2} = 1{\cdot}4$)

(1) 141·5 V (2) 142·2 V (3) 277·2 V (4) 278·6 V (5) 280·0 V

32. A ping pong ball is dropped from a height of 1 m above a table. In every successive bounce, the ball loses its kinetic energy by the same amount. The velocity ($v$) – time ($t$) graph of the ping pong ball is best represented by



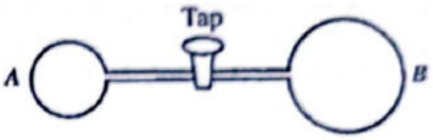
33. A voltage is applied across two parallel conducting plates. As shown in the figure two charged droplets $X$ and $Y$ of masses $2m$ and $m$ respectively are at rest between the plates. Neglect the interaction between $X$ and $Y$. When two plates are brought closer,




(1) $X$ and $Y$ remain at equilibrium.
(2) $X$ and $Y$ fall down with equal accelerations.
(3) $X$ and $Y$ rise up with equal accelerations.
(4) $X$ rises with greater acceleration than $Y$.
(5) $X$ falls down with greater acceleration than $Y$.

34. Two soap bubbles $A$ and $B$ are set at the ends of a narrow tube. Initially the tap at the middle of the tube is closed and the radius of the bubble $A$ is smaller than that of bubble $B$. Then the tap is opened and the system is allowed to reach equilibrium without breaking bubbles. What will be the relation between the final radii ($R_A$, $R_B$) and the final volumes ($V_A$, $V_B$) of the bubbles?

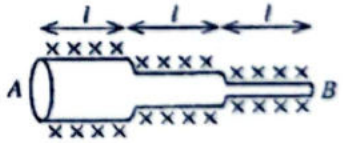
| | Final radii | Final volumes |
|---|---|---|
| (1) | $R_A < R_B$ | $V_A < V_B$ |
| (2) | $R_A < R_B$ | $V_A = V_B$ |
| (3) | $R_A = R_B$ | $V_A = V_B$ |
| (4) | $R_A > R_B$ | $V_A < V_B$ |
| (5) | $R_A = R_B$ | $V_A < V_B$ |

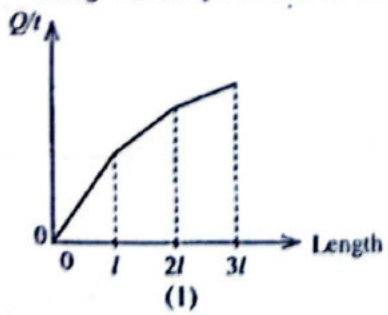



35. At a certain temperature $T$, a pipe open at both ends resonates at a frequency of 400 Hz. At what frequency does the same pipe resonate on a day when the speed of sound is 2% lower than it would be at $T$?

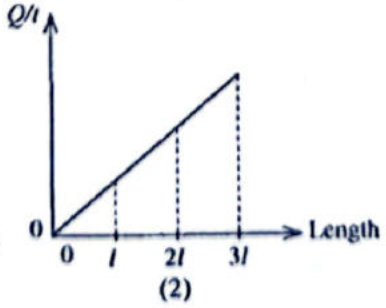
(1) 384 Hz (2) 392 Hz (3) 396 Hz (4) 408 Hz (5) 416 Hz

36. Three perfectly lagged rods made of same conducting material of equal length $l$ are connected to make a composite rod $AB$ as shown in the figure. The radii of their cross-sections have the ratio 4 : 2 : 1 respectively. Heat flows from end $A$ of the rod to end $B$. At steady state, the rate of heat flow $\left(\frac{Q}{t}\right)$ along the composite rod is best represented by

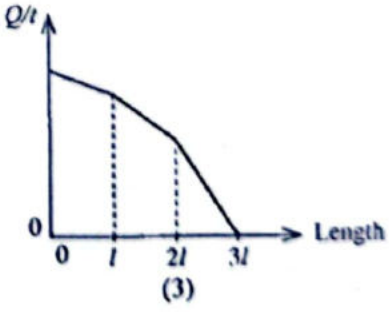


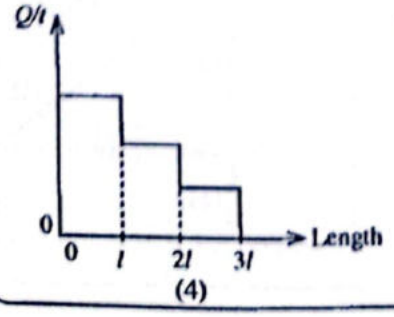
(1)



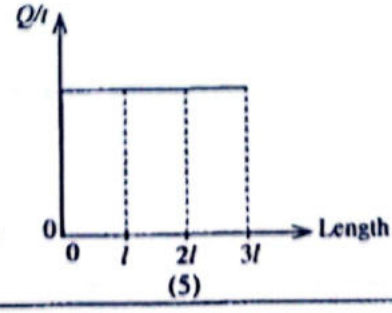
(2)



(3)



(4)

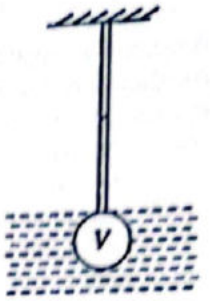


(5)



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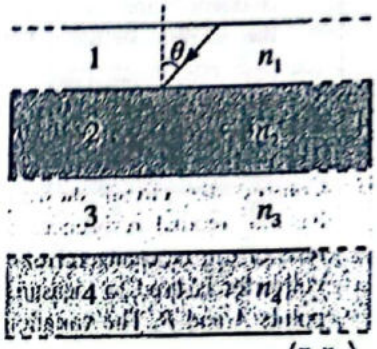
37. Two rods of negligible mass each of initial length $L$ and cross-sectional area $A$ made of materials of Young's moduli $Y_1$ and $Y_2$ are connected in series to make a composite rod. One end of the composite rod is firmly fixed to a rigid ceiling as shown in the figure. A sphere of volume $V$ made of material of density $\beta$ is connected to the free end of the rod, and the sphere is fully immersed in a liquid of density $\rho$ ($\beta > \rho$). What will be the change of the length of the composite rod?




(1) $\frac{V(\beta-\rho)gL}{A}\left(\frac{1}{Y_1}+\frac{1}{Y_2}\right)$ (2) $\frac{V(\beta-\rho)gL}{A}\left(\frac{1}{Y_1}-\frac{1}{Y_2}\right)$ (3) $\frac{A}{V(\beta-\rho)gL}\left(\frac{1}{Y_1}+\frac{1}{Y_2}\right)$

(4) $\frac{A}{V(\beta-\rho)gL}(Y_1-Y_2)$ (5) $\frac{V(\beta-\rho)gL}{A}(Y_1+Y_2)$

38. Four thick transparent parallel sheets are placed on top of each other as shown in the figure. The refractive indices of materials made of the sheets are $n_1$, $n_2$, $n_3$ and $n_4$ respectively. A monochromatic ray of light is incident with angle $\theta$ at the interface of sheet 1 and sheet 2 as shown. What should be the value of $\theta$ for the ray to go along the interface of sheet 3 and 4?

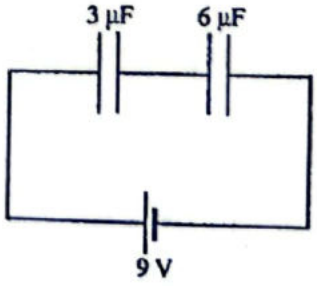



(1) $\theta = \sin^{-1}\left(\frac{n_4}{n_1}\right)$ (2) $\theta = \sin^{-1}\left(\frac{n_3 n_4}{n_1}\right)$ (3) $\theta = \sin^{-1}\left(\frac{n_2 n_4}{n_1}\right)$

(4) $\theta = \sin^{-1}\left(\frac{n_2 n_3 n_4}{n_1}\right)$ (5) $\theta = \sin^{-1}\left(\frac{n_3 n_4}{n_1 n_2}\right)$

39. Two capacitors of capacitance 3 μF and 6 μF respectively are connected in series with a 9 V battery as shown in the figure. What are the voltage across, the charge accumulated and the energy stored in the 3 μF capacitor after steady state has reached?

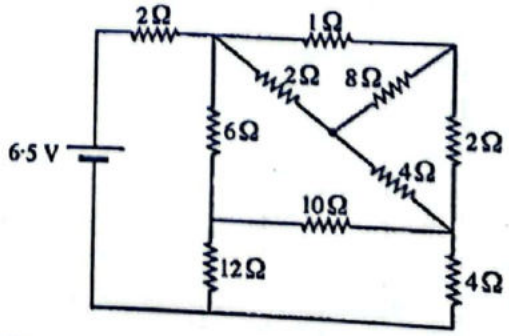
| | Voltage (V) | Charge (μC) | Energy (μJ) |
|---|---|---|---|
| (1) | 3 | 9 | 27 |
| (2) | 3 | 9 | 54 |
| (3) | 3 | 18 | 108 |
| (4) | 6 | 18 | 27 |
| (5) | 6 | 18 | 54 |




40. In the circuit shown the internal resistance of the cell is negligible. What is the current through the cell?

(1) 0·5 A (2) 1·0 A (3) 1·2 A

(4) 1·5 A (5) 2·0 A



41. Two identical blocks $A$ and $B$ connected by a light spring are suspended by a string attached to the ceiling as shown in the figure. Initially the system is at rest and then suddenly the string breaks. Immediately after the string is broken, what will be the downward acceleration of the upper block $A$?



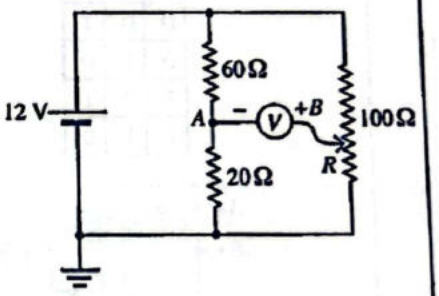

(1) 0 (2) $\frac{g}{2}$ (3) $g$

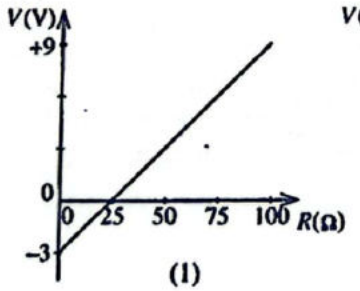
(4) $\sqrt{2}g$ (5) $2g$

42. A vertical container of height $h$ contains water up to a height $y$. When viewed from above it is observed that the container is half filled with water. The refractive index of water is $\frac{4}{3}$. What is the value of $y$?

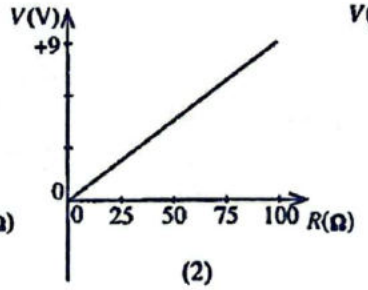
(1) $\frac{1}{4}h$ (2) $\frac{1}{3}h$ (3) $\frac{1}{2}h$ (4) $\frac{4}{7}h$ (5) $\frac{3}{4}h$

43. Consider the circuit shown in the figure. The 12 V battery has no internal resistance. The resistance $R$ of the variable resistor can be changed from 0 to 100 Ω. An ideal center-zero voltmeter is used to measure the potential difference between points $A$ and $B$. The variation of the voltmeter reading $V$ with $R$ is best represented by,

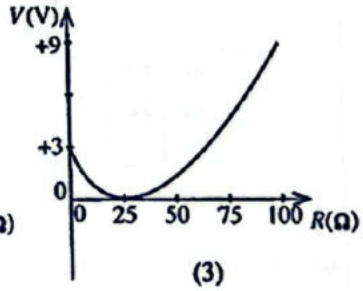


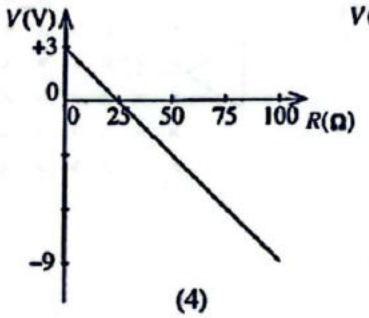

(1)



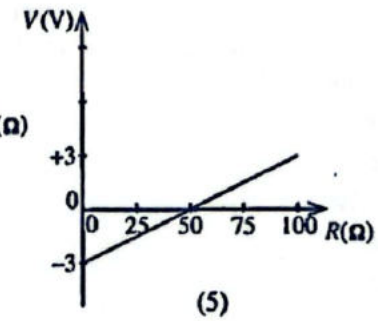

(2)




(3)



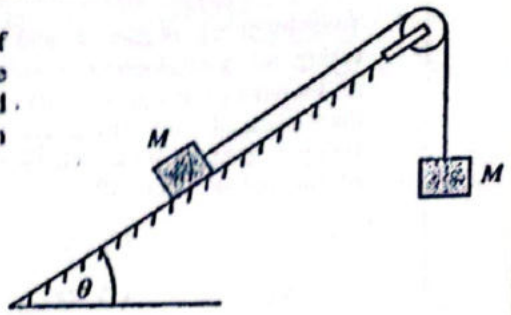

(4)




(5)

0915000018811001 7

44. In the system shown, the two equal masses, each of mass $M$ connected by an inextensible light string are moving with a uniform velocity. The pulley is light and frictionless. The coefficient of dynamic friction between the inclined plane and the mass $M$ is




(1) $\tan\theta$ (2) $1-\sin\theta$ (3) $\frac{1-\sin\theta}{\cos\theta}$

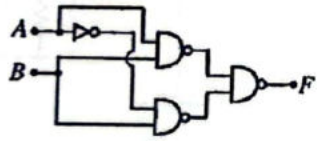
(4) $\frac{\sin\theta-1}{\cos\theta}$ (5) $\frac{1+\sin\theta}{\cos\theta}$

45. A car of mass 1200 kg is traveling at constant speed of 20 m s$^{-1}$ on a horizontal straight road with the engine power of 22 kW. To climb with the same speed on a straight identical road but inclined at 3° to the horizontal, what should be the power of the engine?
(Take $\pi = 3$. For small angles $\theta$ in radians take $\sin\theta = \theta$)

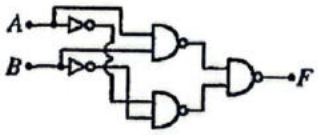
(1) 25 kW (2) 34 kW (3) 35 kW (4) 42 kW (5) 47 kW

46. Which of the circuits represents the truth table given below?

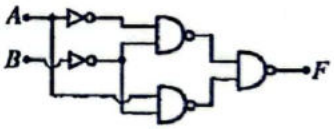
| A | B | F |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |



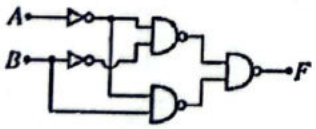
(1)



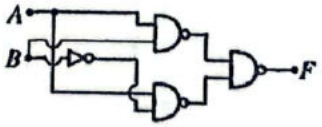
(2)



(3)

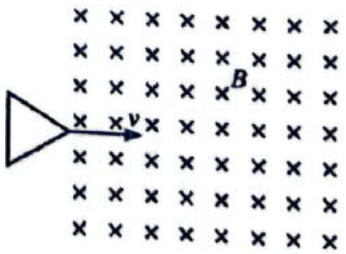


(4)



(5)

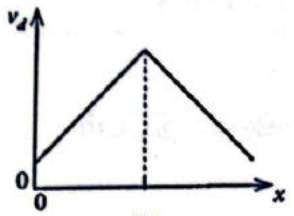
47. An equilateral triangular conducting loop of side 0·05 m passes a region of uniform magnetic field of flux density $B = 0{\cdot}1$ T at a uniform velocity $v = 0{\cdot}5$ m s$^{-1}$ as shown in the figure. What are the magnitude of the maximum induced e.m.f. and the direction of the current in the loop as the loop enters the field?



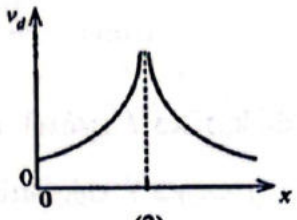

(1) 2·5 mV, anticlockwise
(2) 2·5 mV, clockwise
(3) 0·5 mV, anticlockwise
(4) 0·5 mV, clockwise
(5) 0·25 mV, clockwise

48. Figure shows a conducting wire carrying a current $I$. The wire has a non-uniform circular cross-section of varying radius along the length. The variation of the drift velocity $v_d$ of electrons in the wire with the length $x$ measured from the left end of the wire is best represented by

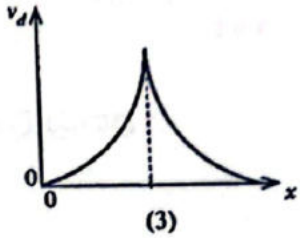


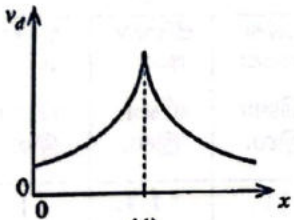

(1)



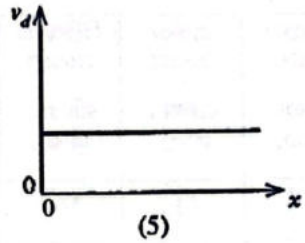

(2)




(3)




(4)

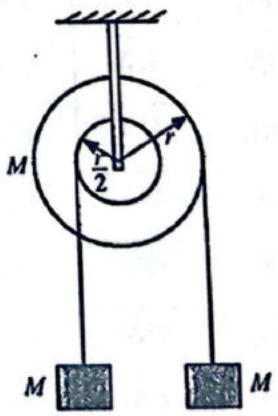



(5)

49. A small conducting sphere of radius $a$ falls from rest in a viscous liquid. When the sphere attains its terminal velocity the rate of work done by the viscous force is proportional to

(1) $a^5$ (2) $a^4$ (3) $a^3$ (4) $a^2$ (5) $a$

50. A specially made single frictionless pulley of mass $M$ consisting of two parts of radii $r$ and $\frac{r}{2}$ is hung from a ceiling. Two light inextensible strings are wound around on each part of the pulley and two blocks each of mass $M$ are hung from the free ends as shown in the figure. The total moment of inertia $I$ of the pulley about the axis is given by $I = \frac{3}{4}Mr^2$. When the blocks are released from rest what is the angular acceleration of the pulley?




(1) 0 (2) $\frac{g}{2r}$ (3) $\frac{g}{3r}$

(4) $\frac{g}{4r}$ (5) $\frac{g}{5r}$

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