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முழுப் பதிப்புரிமையுடையது]
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ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
Department of Examinations, Sri Lanka

01 E I

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2010 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர)ப் பரீட்சை, 2010 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2010

| | |
|---|---|
| භෞතික විද්‍යාව I<br>பௌதிகவியல் I<br>**Physics I** | පැය දෙකයි<br>இரண்டு மணித்தியாலங்கள்<br>***Two hours*** |

***Important :***

- *This question paper consists of* **60** *questions in* **12** *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* **60**, *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 dimensions of moment of inertia is
   (1) $ML^2$ (2) ML (3) M (4) L (5) $MLT^{-1}$

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

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

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

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

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

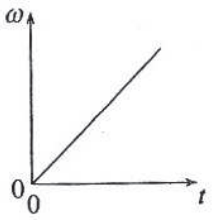
6. Two guitar wires *A* and *B* identical in all respects except that the diameter of *A* is twice the diameter of *B*, and are subjected to same tension.

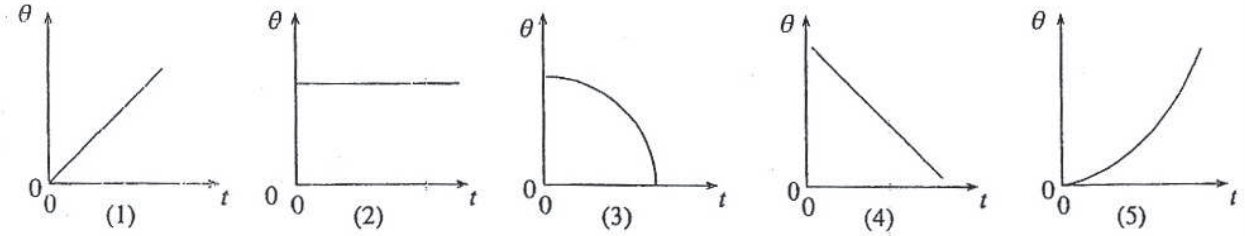
   The ratio, $\frac{\text{fundamental frequency produced by } A}{\text{fundamental frequency produced by } B}$ is

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

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

8. If the angular velocity ($\omega$) of an object varies with time ($t$) as shown in the figure, the corresponding variation of angular displacement ($\theta$) with time ($t$) is best represented by



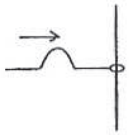




9. A major artery with a 1.0 $cm^2$ cross-sectional area carrying blood branches into 18 smaller arteries, each having a cross-sectional area of 0.4 $cm^2$ and carrying equal volumes of blood per unit time.

The ratio, $\frac{\text{speed of blood in the major artery}}{\text{speed of blood in a smaller artery}}$ is

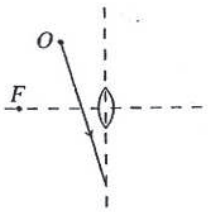
(1) 3.6 (2) 4.0 (3) 7.2 (4) 8.4 (5) 45

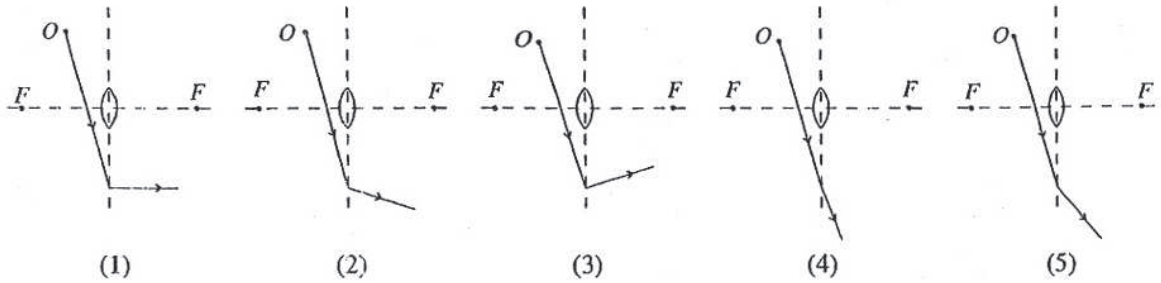
10. The figure shows a wave pulse travelling along a string towards its end which is connected to a small light ring that can move along a vertical wire. Which of the following figures best represents the shape of the wave pulse at the instant when the peak of the pulse reaches the ring?






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

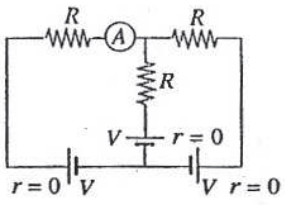



12. Current through ammeter $A$ of the circuit shown is

(1) 0 (2) $\frac{V}{3R}$ (3) $\frac{3V}{2R}$

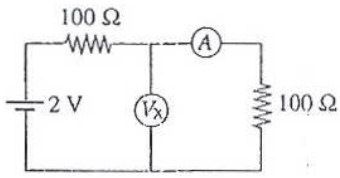
(4) $\frac{V}{R}$ (5) $\frac{3V}{R}$



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

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

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




(1) 1 V, 1 V (2) 1 V, 0 (3) 2 V, 0
(4) 0, 1 V (5) 2 V, 2 V

15. In the nuclear reaction,

$$^{7}_{3}\text{Li} + ^{A}_{Z}\text{X} \rightarrow ^{A+6}_{Z+2}\text{Y} + a$$

particle denoted by $a$ is

(1) a proton. (2) an electron. (3) a neutron.
(4) an $\alpha$ particle. (5) a positron.

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

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

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

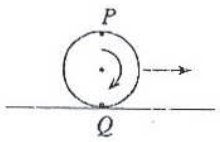
17. Two stars, $A$ and $B$ of uniform density have equal radii. Star $A$ having twice the mass of star $B$ is spinning three times faster than star $B$.

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

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

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

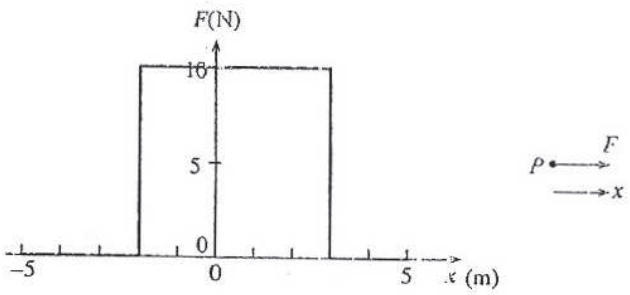
| | $P$ | $Q$ |
|---|---|---|
| (1) | 6 m s$^{-1}$ | 6 m s$^{-1}$ |
| (2) | 6 m s$^{-1}$ | 3 m s$^{-1}$ |
| (3) | 6 m s$^{-1}$ | 0 |
| (4) | 12 m s$^{-1}$ | 6 m s$^{-1}$ |
| (5) | 12 m s$^{-1}$ | 0 |



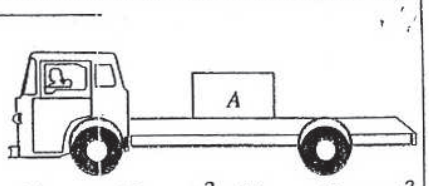

19. The graph shows the variation of a force $F$ exerted on an object $P$ when it is moving along the $x$-axis from $x = -5$ to $x = 5$.

The work done on the object by the force is

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



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



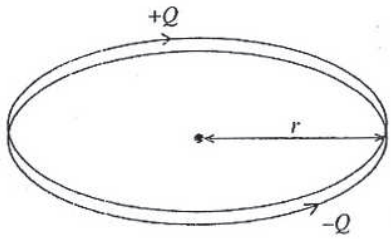

(1) 2 m s$^{-2}$ (2) 4 m s$^{-2}$ (3) 8 m s$^{-2}$ (4) 10 m s$^{-2}$ (5) 12 m s$^{-2}$

21. When a standing wave is setup on a string fixed at both ends,
(1) the number of nodes is equal to the number of antinodes.
(2) the wavelength of the wave is always equal to the value obtained when the length of the string is divided by an integer.
(3) the frequency of the wave is equal to the value of the number of nodes times the fundamental frequency.
(4) the frequency of the wave is equal to the value of the number of antinodes times the fundamental frequency.
(5) the shape of the string at the fundamental frequency is **not** symmetric about the mid point of the string.

22. If the ratio of sound intensities and the corresponding difference in sound intensity levels (in dB) of two sound sources are numerically equal, then the ratio of sound intensities is
(1) 10 (2) 20 (3) 100 (4) 200 (5) 1000

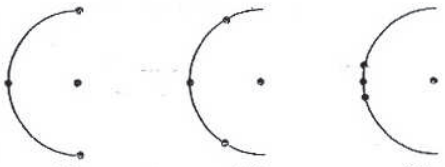
23. A telescope having a magnifying power of 15 has an eyepiece of power 50 diopters. The length of the telescope, when it is in the normal adjustment is
(1) 15 cm (2) 28 cm (3) 30 cm (4) 32 cm (5) 64 cm

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



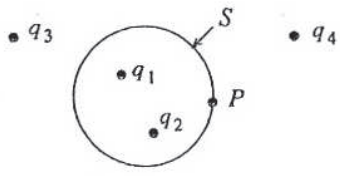

(1) zero (2) $\frac{\mu_0 Q\omega}{4\pi r}$ (3) $\frac{\mu_0 Q\omega}{2\pi r}$
(4) $\frac{\mu_0 Q\omega}{2\pi^2 r}$ (5) $\frac{\mu_0 Q\omega}{4r}$

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




(1) $F_C > F_B > F_A$ (2) $F_B < F_C < F_A$
(3) $F_C < F_B < F_A$ (4) $F_C = F_B = F_A$
(5) $F_C = F_B > F_A$

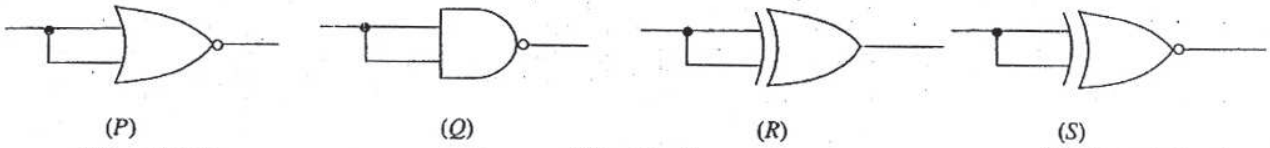
26. Figure shows four point charges and a Gaussian surface $S$.




Consider the following statements.
(A) Net electric flux through the surface depends only on the fields produced by $q_1$ and $q_2$
(B) The electric field intensity at point $P$ depends only on the fields produced by $q_1$ and $q_2$
(C) The electric field intensity at point $P$ depends on the locations of the charges $q_1$, $q_2$, $q_3$ and $q_4$.

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

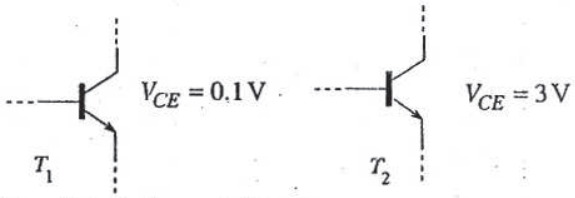
27. Which of the arrangements shown is/are equivalent to a NOT gate?



(P) (Q) (R) (S)

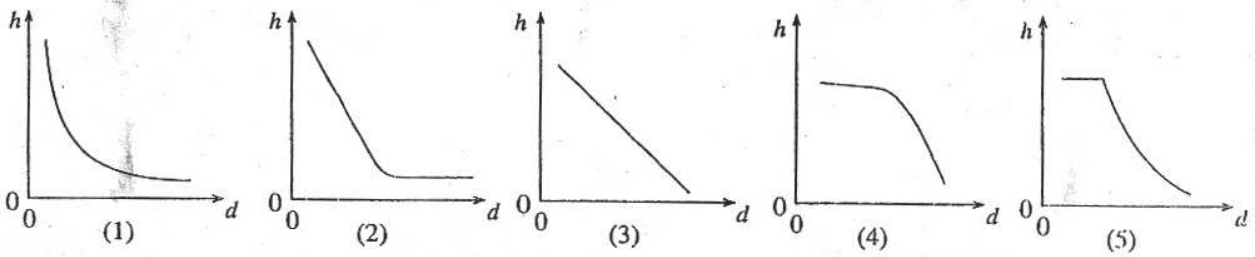
(1) $P$ only (2) $Q$ only (3) $P$ and $Q$ only
(4) $P$, $Q$ and $S$ only (5) all $P$, $Q$, $R$ and $S$

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



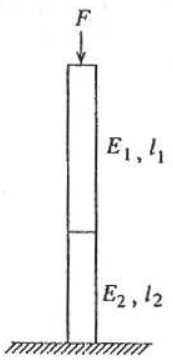

(1) $V_{BC}$ of $T_1$ is approximately 0.6 V, and the $BC$ junction is forward biased.
(2) $V_{BC}$ of $T_2$ is approximately 0.6 V, and the $BC$ junction is forward biased.
(3) $V_{BC}$ of $T_1$ is approximately 0.6 V, and the $BC$ junction is reverse biased.
(4) $V_{BC}$ of $T_2$ is approximately 2.3 V, and the $BC$ junction is forward biased.
(5) $V_{BC}$ of $T_1$ is approximately 3 V, and the $BC$ junction is reverse biased.

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



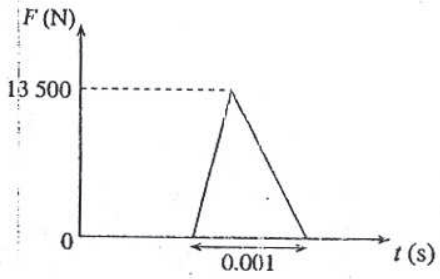

30. Two light rods of initial lengths $l_1$ and $l_2$, having equal areas of cross-section are joined end to end, and a force $F$ is applied as shown in the figure.

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

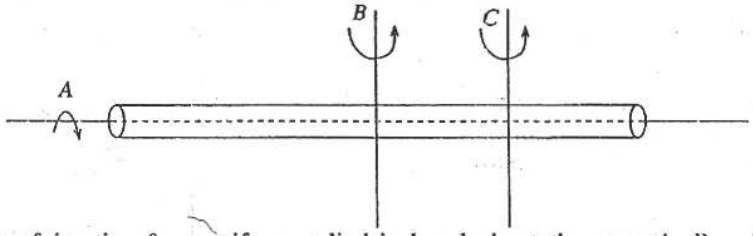



(1) $E_2 l_1 = E_1 l_2$ (2) $E_2 l_2 = E_1 l_1$
(3) $E_1^2 l_2 = E_2^2 l_1$ (4) $E_1 l_2^2 = E_2 l_1^2$
(5) $E_1^2 l_1 = E_2^2 l_2$

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



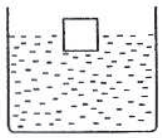

(1) 20 $m\,s^{-1}$ (2) 25 $m\,s^{-1}$ (3) 65 $m\,s^{-1}$
(4) 70 $m\,s^{-1}$ (5) 110 $m\,s^{-1}$

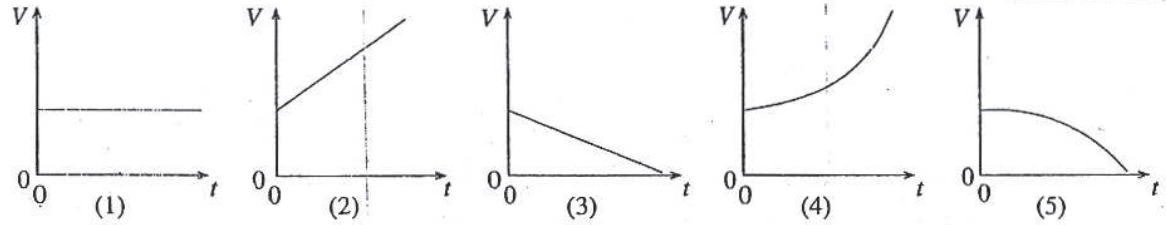
32. 


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

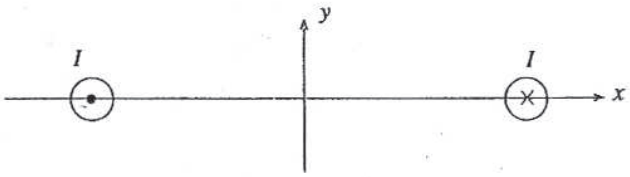
(1) $I_A > I_B > I_C$ (2) $I_A < I_B < I_C$ (3) $I_B = I_C > I_A$ (4) $I_A = I_B = I_C$ (5) $I_B > I_C > I_A$

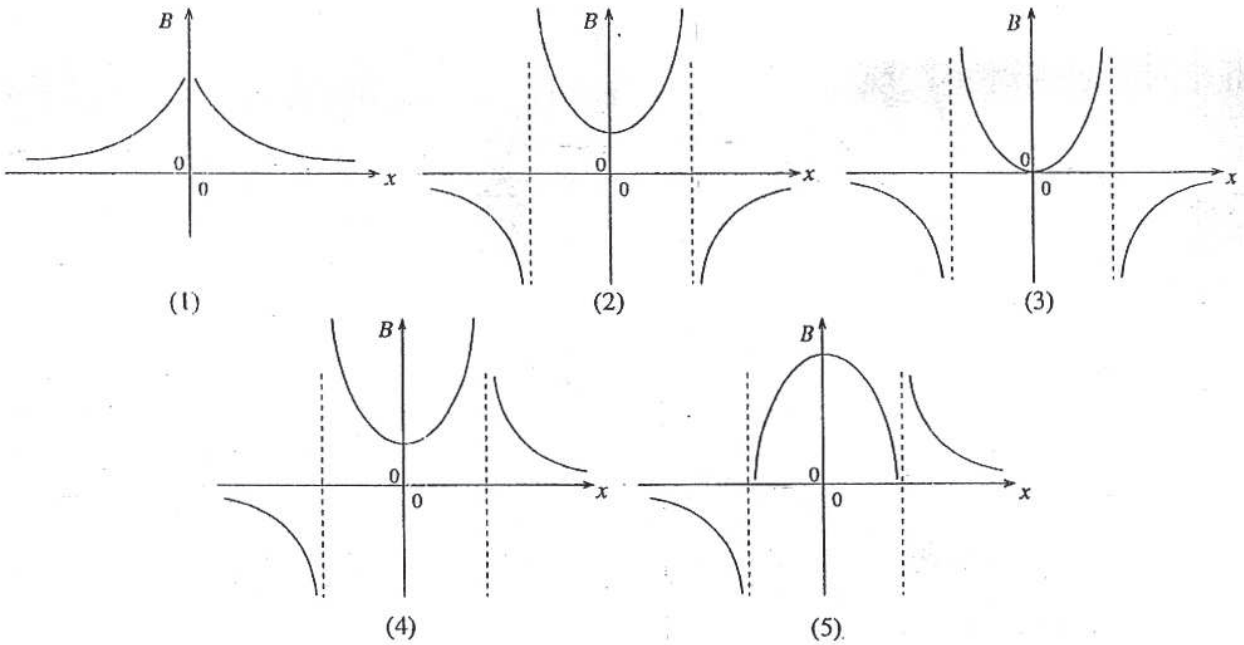
33. A cube of wood is floating in a beaker of water as shown in the figure. At time $t = 0$, the beaker begins to move in the downward direction from rest with a constant acceleration. The variation of the volume $V$ of the portion of the cube that is immersed in water, with time $t$ is best represented by





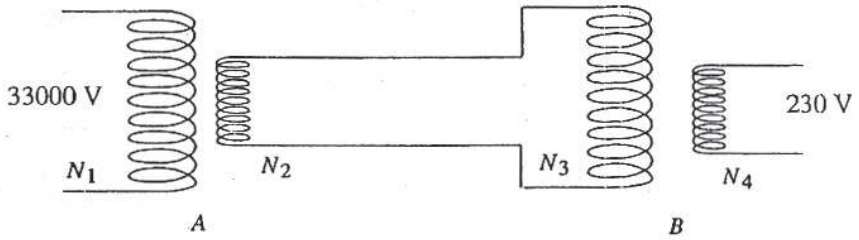

34. Two long parallel wires placed normal to the plane of the paper carry equal currents in opposite directions as shown in the figure. The variation of the component of the magnetic flux density in $y$ direction ($B$) along the $x$ axis is best represented by




35. Sensitivity of a potentiometer can be increased by
(1) increasing the e.m.f. of the cell connected across the wire.
(2) reducing the resistivity of the wire.
(3) connecting a resistance in series with the wire.
(4) reducing the diameter of the wire.
(5) maintaining the temperature of the wire at room temperature.

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




If the power losses in the system are neglected, which of the following is true?

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

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

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

(1) 30 m (2) 40 m (3) 50 m (4) 60 m (5) 80 m

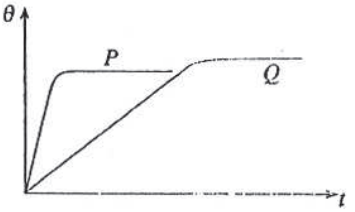
38. Air is rapidly pumped into a tyre by a bicycle pump. Which of the following is true for air **inside the pump** during the pumping process? (Here all the symbols have their usual meaning)

| | $\Delta Q$ | $\Delta W$ | $\Delta U$ |
|---|---|---|---|
| (1) | 0 | negative | positive |
| (2) | positive | positive | positive |
| (3) | 0 | positive | negative |
| (4) | 0 | positive | positive |
| (5) | negative | negative | positive |

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

(1) 42% (2) 54% (3) 60% (4) 72% (5) 84%

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

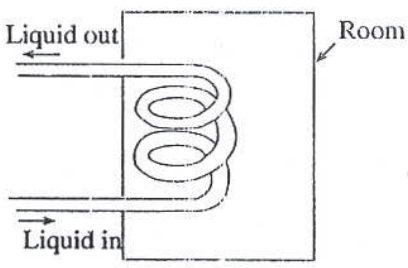



Consider the following statements.

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

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

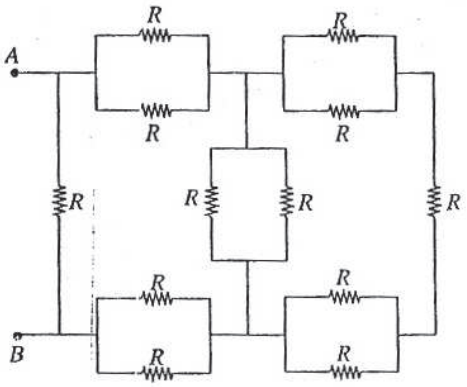
(C) Liquid $Q$ is better than liquid $P$ for heating air in an enclosed room by sending through a spiralled pipe as shown.




Of the above statements

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

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

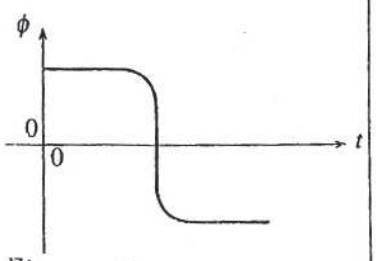



(1) $\frac{1}{3}R$ (2) $\frac{1}{2}R$

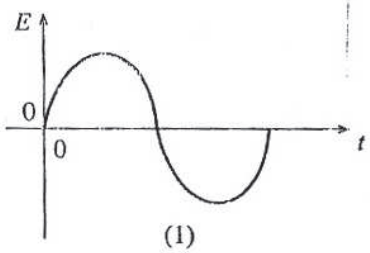
(3) $\frac{7}{12}R$ (4) $\frac{3}{4}R$

(5) $R$

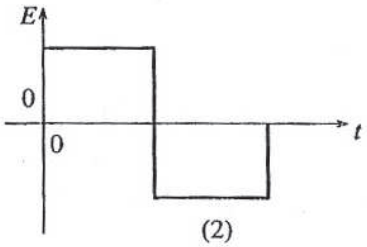
42. The graph shows the variation of a magnetic flux ($\phi$) through a coil with time ($t$).



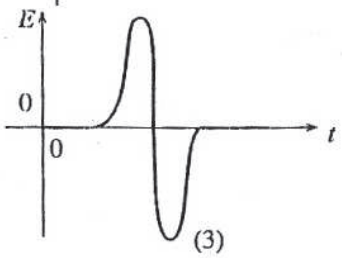

The variation of the corresponding induced e.m.f. ($E$) with time ($t$) is best represented by



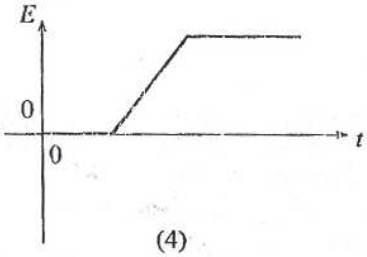

(1)



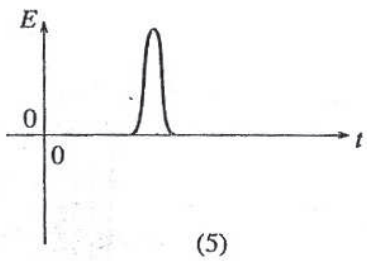

(2)




(3)

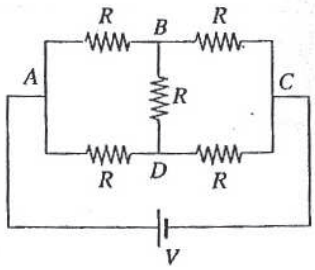



(4)




(5)

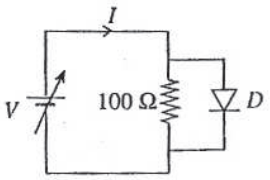
43. The respective effective resistances **'seen by'** the voltage source $V$ across $AC$ and $BD$ are

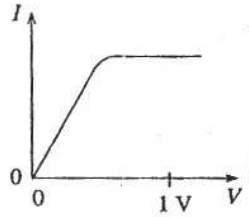



(1) $\frac{5R}{2}$ and $R$ (2) $R$ and 0 (3) $\frac{5R}{2}$ and $\infty$

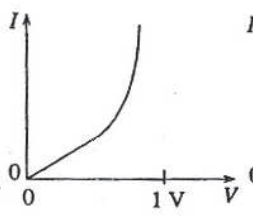
(4) $R$ and $3R$ (5) $R$ and $\infty$

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

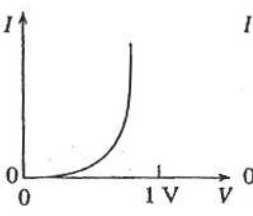


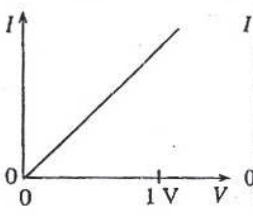

(1)



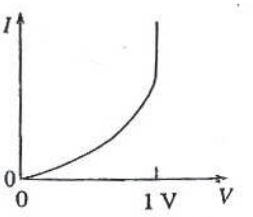

(2)




(3)

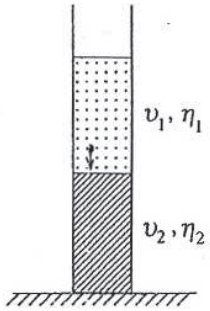



(4)



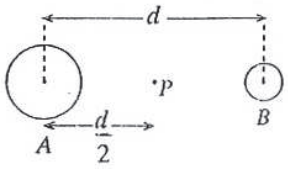

(5)

45. A small sphere falls through two columns of immiscible liquids in a deep container as shown in the figure. If $\eta_1$ and $\eta_2$ are the viscosities of the two liquids, and $v_1$ and $v_2$ are the crresponding terminal velocities of the sphere respectively, then




(1) $\eta_1 v_1 = \eta_2 v_2$ (2) $\eta_1 v_1 > \eta_2 v_2$ (3) $\eta_1 v_1 < \eta_2 v_2$
(4) $\eta_1 v_2 > \eta_2 v_1$ (5) $\eta_1 v_2 = \eta_2 v_1$

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

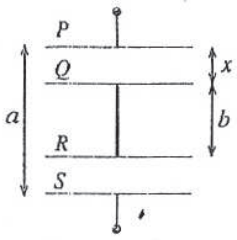



(1) zero. (2) $\frac{V_0}{2}$ (3) $\frac{3V_0}{4}$
(4) $V_0$ (5) $2V_0$

47. A particle having an electric charge is travelling along a circular path under the influence of a uniform magnetic field. Consider the following statements.
(A) Direction of the velocity of the particle is always perpendicular to the direction of the magnetic field.
(B) Time required for the particle to make one revolution is independent of the radius of the circular path.
(C) Speed of the particle is directly proportional to its $\frac{\text{mass}}{\text{charge}}$ ratio.

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

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




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

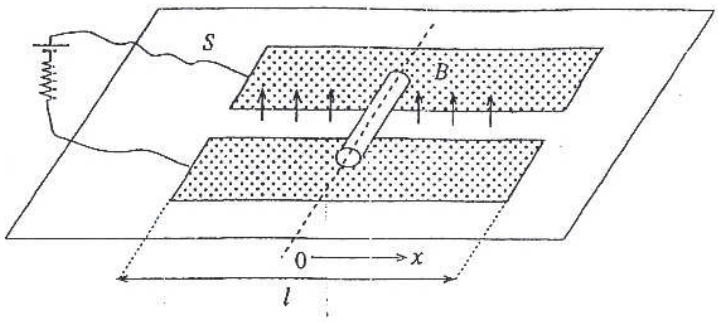
49. When a free particle with kinetic energy $K$ and de Broglie wavelength $\lambda$ enters a certain region its potential energy becomes $V$. The particle's new de Broglie wavelength is given by

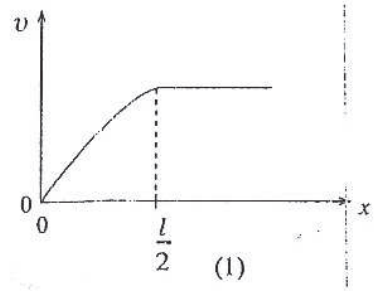
(1) $\lambda\sqrt{\frac{V}{V-K}}$ (2) $\lambda\sqrt{\frac{K}{K-V}}$ (3) $\lambda\left(1+\frac{K}{V}\right)$ (4) $\lambda\left(1-\frac{K}{V}\right)$ (5) $\lambda\sqrt{\frac{K}{V+K}}$

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

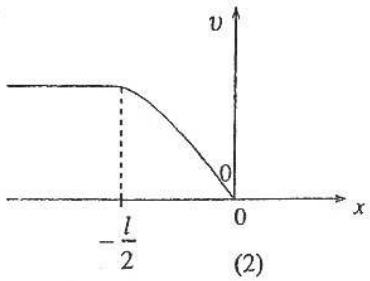
(1) 1.77 g (2) 2.04 g (3) 3.81 g (4) 6.80 g (5) 12.70 g

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

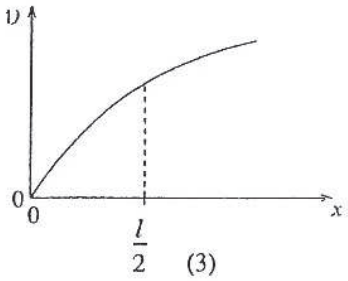


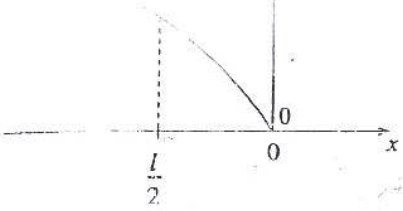

(1)

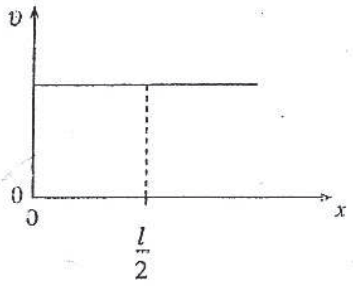



(2)




(3)




(5)

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

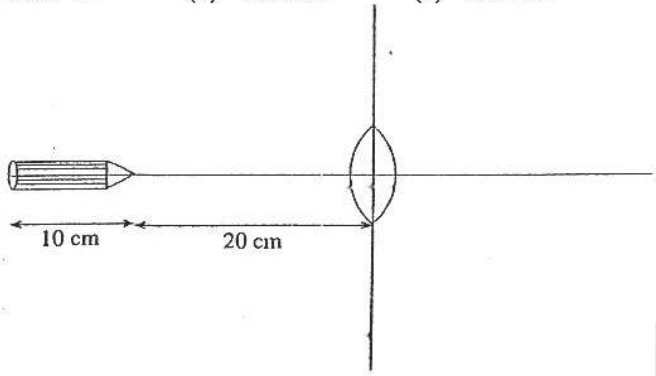
(1) 89.50 °C (2) 89.68 °C (3) 89.70 °C (4) 89.73 °C (5) 89.75 °C

53. An artillery gun is positioned on a horizontal ground and an artillery shell is fired from it so that the shell would land at a target, which is located at a distance 3000 m from the position of the gun. Accidentally, the shell explodes into two pieces $A$ and $B$ at the main point of its trajectory. The mass of $A$ is twice that of $B$, and both pieces land at the same point, after travelling in the same vertical plane. If $A$ lands at a distance 1800 m in the direction of target from the gun, the distance to the landing point of $B$ from the gun is

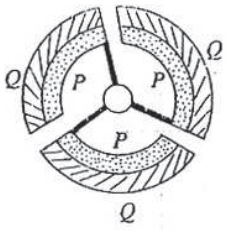
(1) 1600 m (2) [illegible] (3) 2400 m (4) 2600 m (5) 2800 m

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

(1) 4 cm (2) 8 cm
(3) 10 cm (4) 12 cm
(5) 20 cm



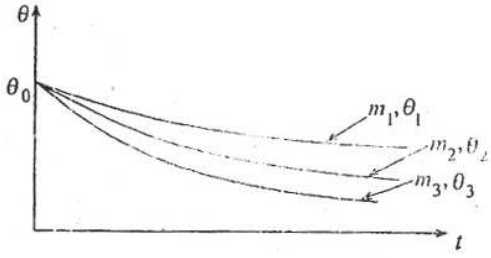
55. The wheel shown in the figure is made of three bi-metal ($P$, $Q$) strips attached to the axis using radial metal parts. This can be setup to oscillate about an axis perpendicular to the plane of the wheel and passing through the centre. The wheel is designed such that the oscillating period of the wheel remains the same regardless of the changes of the surrounding temperature. Consider the following statements,




(A) The moment of inertia of the wheel should not change with the temperature.
(B) The shape of the wheel should not change with temperature.
(C) The linear expansivity of metal $P$ should be greater than that of $Q$.

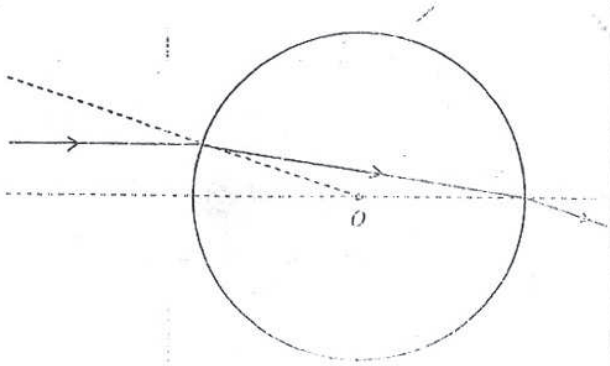
Of the above statements,
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (A) and (B) are true. (5) all (A), (B) and (C) are true.

56. Three masses $m_1$, $m_2$ and $m_3$, of hot water at temperatures $\theta_1$, $\theta_2$ and $\theta_3$ respectively are added to three identical containers each having mass $m$ of water to achieve the same final temperature $\theta_0$. Then the containers are allowed to cool. The cooling curves for the three containers are shown in the figure. If the rate of loss of heat from each container is the same, then



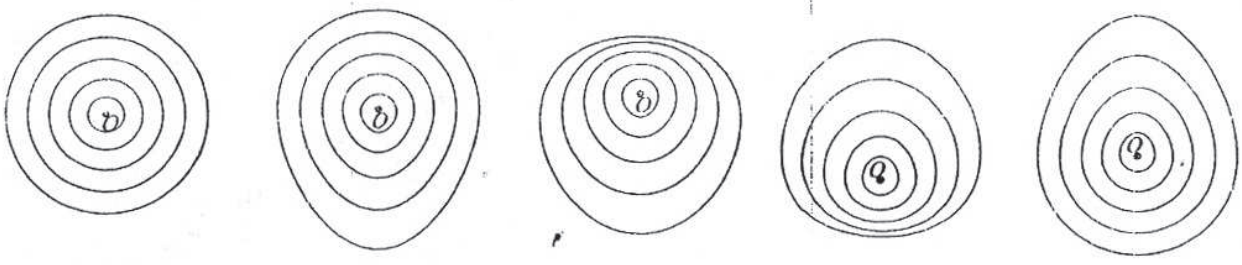

(1) $m_1 < m_2 < m_3$ and $\theta_1 < \theta_2 < \theta_3$
(2) $m_1 < m_2 < m_3$ and $\theta_1 > \theta_2 > \theta_3$
(3) $m_1 > m_2 > m_3$ and $\theta_1 < \theta_2 < \theta_3$
(4) $m_1 > m_2 > m_3$ and $\theta_1 > \theta_2 > \theta_3$
(5) $m_1 = m_2 = m_3$ and $\theta_1 = \theta_2 = \theta_3$

57. A monochromatic ray of light is incident close and parallel to a diameter of a transparent plastic [illegible]h centre $O$ and refracted as shown in the figure. The refractive index of the plastic is closest to (take $\sin\theta \approx \theta$ for small $\theta$ angles)



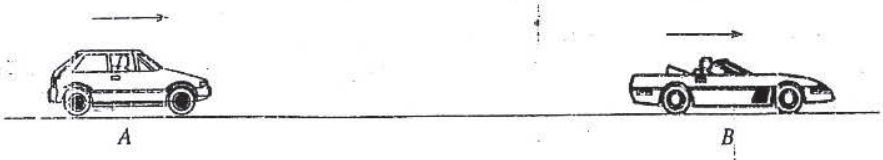

(1) 1.2 (2) 1.3
(3) 1.5 (4) 2.0
(5) 2.5

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

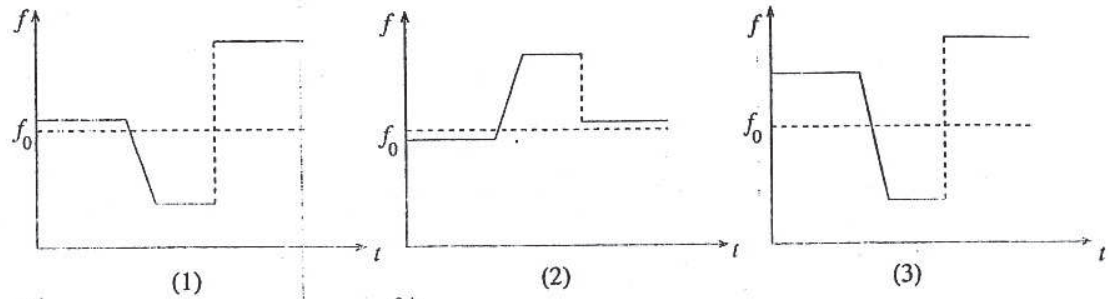



(1) (2) (3) (4) (5)

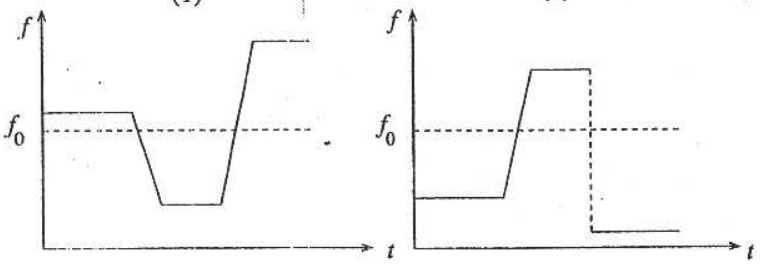
59.




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

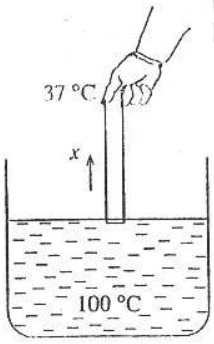


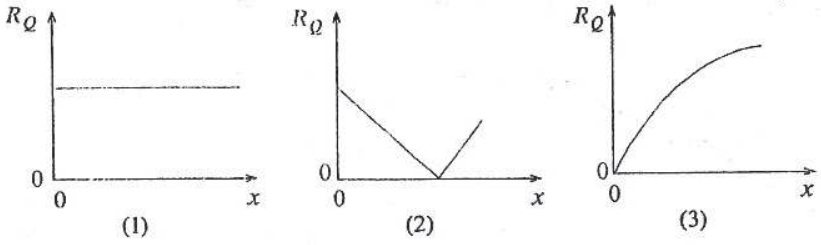

(1) (2) (3)



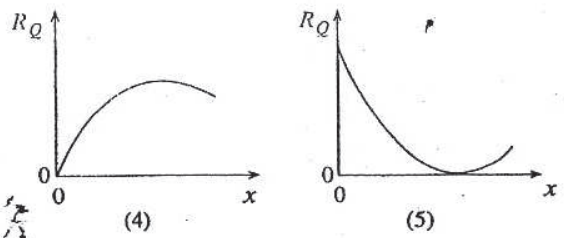

(4) (5)

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




(1) (2) (3)




(4) (5)

* * *