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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2000 අගෝස්තු
கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 2000 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2000

භෞතික විද්‍යාව I
பௌதிகவியல் I
Physics I

01
E | I

පැය දෙකයි / இரண்டு மணித்தியாலம் / Two hours

Important : This question paper consists of **three** sheets. Put the sheets together in the correct **order of pages before answering.**

Use of calculators is not allowed.

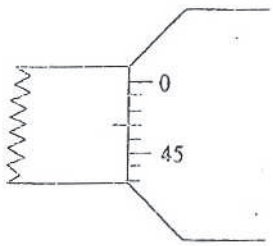
Note : (i) *Enter your Index Number in the space provided on the answer sheet.*
(ii) *Answer all the questions.*
(iii) *Instructions are given on the back of the answer sheet. Follow them carefully.*
(iv) *In each of the questions* **1** *to* **60**, *pick one of the alternatives* (1), (2), (3), (4), (5) *which is* ***correct or most appropriate*** *and mark your response on the answer sheet* ***accordance with the instructions given therein.***

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

1. One of the following units measures a physical quantity that is different from the physical quantity measured by the others. This unit is
(1) eV. (2) J s^{-1}. (3) W s. (4) kW hours. (5) MeV.

2. The dimensions of power are
(1) ML^{2}T^3. (2) ML^{2}T^{-2}. (3) MLT^{-3}. (4) ML^{2}T^{-3}. (5) ML^{-2}T^{-3}.

3. The figure shows a part of a micrometer screw gauge, when the two jaws touch each other. The zero error of the gauge is,
(1) 0·43 mm and it should be added to the scale reading.
(2) 0·43 mm and it should be subtracted from the scale reading.
(3) 0·03 mm and it should be added to the scale reading.
(4) 0·03 mm and it should be subtracted from the scale reading.
(5) 0·47 mm and it should be subtracted from the scale reading.



4. Which of the following objects of mass M has the greatest acceleration?

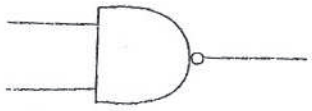


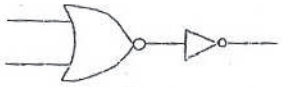
5. Two particles A and B have equal kinetic energies, but the velocity of the particle B is four times that of A.
The ratio $\frac{\text{momentum of } A}{\text{momentum of } B}$ is
(1) 1 (2) 2 (3) 4 (4) 8 (5) 16

6. A Geiger counter can be used to detect
   (A) α particles.
   (B) γ rays.
   (C) neutrons.
   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.

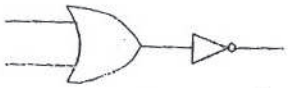
7. An organ pipe closed at one end resonates with one of the strings of a guitar. The length of the string is 0·8 times that of the pipe. If both the pipe and the string vibrate at their fundamental frequencies, and the end correction of the pipe is neglected, the ratio $\frac{\text{speed of wave on the string}}{\text{speed of sound in air}}$ is equal to
   (1) 0·1. (2) 0·2. (3) 0·4. (4) 0·8. (5) 1·6.

8. The gate shown in figure is equivalent to

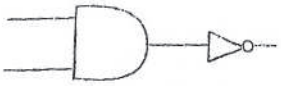




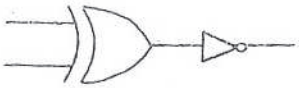
(1)



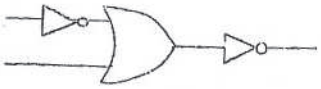
(2)



(3)

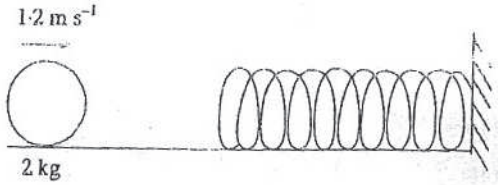


(4)

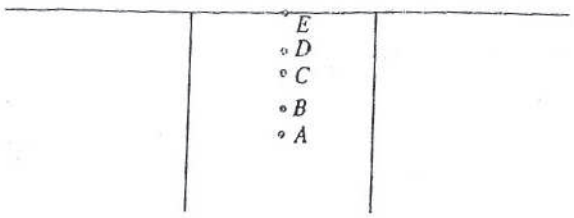


(5)

9. A mass of 2 kg moving with a velocity of $1{\cdot}2\,\text{m s}^{-1}$ collides with a light spring of spring constant $50\,\text{N m}^{-1}$, kept horizontally on a frictionless table as shown in the figure. The maximum compression of the spring after the collision will be
   (1) 0·024 m. (2) 0·048 m.
   (3) 0·12 m. (4) 0·24 m.
   (5) 0·36 m

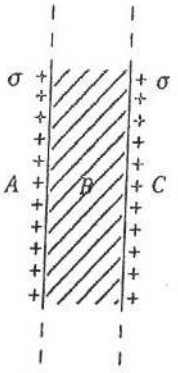


10.



The frame shown in the figure is made from a uniform wire. The centre of gravity of the frame is most likely to be found at
   (1) *A*. (2) *B*.
   (3) *C*. (4) *D*.
   (5) *E*.

11. An infinitely long thick conducting sheet shown in the figure carries a uniform surface charge density σ.



The electric field intensities in the regions *A*, *B*, and *C* respectively are
   (1) $\frac{\sigma}{2\epsilon_0}, \frac{\sigma}{\epsilon_0}, \frac{\sigma}{2\epsilon_0}$. (2) $\frac{\sigma}{\epsilon_0}, 0, \frac{\sigma}{\epsilon_0}$.
   (3) $\frac{2\sigma}{\epsilon_0}, 0, \frac{2\sigma}{\epsilon_0}$. (4) $0, \frac{\sigma}{2\epsilon_0}, 0$.
   (5) $\frac{\sigma}{2\epsilon_0}, 0, \frac{\sigma}{2\epsilon_0}$.

12. A long straight wire carrying a current is placed in a uniform magnetic field at right angles to the direction of the field. In a plane perpendicular to the current, the number of points having a zero resultant magnetic flux density is

(1) zero. (2) 1. (3) 2. (4) 3. (5) 4.

13. One end of a stretched string is attached to a wall. When the other end of the string vibrates with frequency f_1 a standing wave is set up along the string. The tension in the string is now tripled while maintaining the same number of loops in the string. If the new frequency of vibration of the string is f_2, the ratio $\frac{f_2}{f_1}$ is

(1) $\frac{1}{\sqrt{3}}$. (2) $\frac{1}{3}$. (3) $\sqrt{3}$. (4) 3. (5) 9.

14. Power of a lens combination is 44 diopters and the power of one of the lenses is 40 diopters. The magnitude of the focal length of the other lens is

(1) 0·25 cm. (2) 2·5 cm. (3) 4·0 cm. (4) 25·0 cm. (5) 84·0 cm.

15. Consider the following statements made regarding the Hall effect.

(A) The sign (positive or negative) of the Hall voltage is independent of the sign (positive or negative) of the current carriers inside the metal.

(B) A Hall voltage is not generated when the direction of the magnetic field is parallel to the direction of the current.

(C) The Hall effect is a consequence of the force acting on a moving charge in a magnetic field.

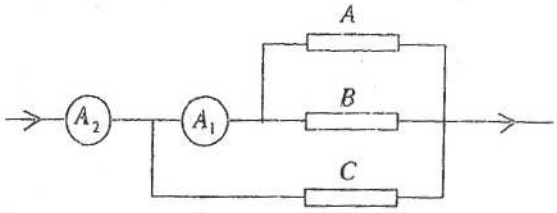
Of the above statements

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

16. A uniform wire of length L fixed at one end attains the proportional limit when a mass m is hung from the other end. If a $\frac{L}{2}$ length of the same wire is used the proportional limit will attain when the mass hung is

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

17. A uniform wire is cut into three equal pieces A, B and C, and are connected as shown in the figure.



If the ammeter A_2 reads 1·2 A, then the reading of the ammeter A_1 will be

(1) 0·3 A. (2) 0·4 A.
(3) 0·6 A. (4) 0·8 A.
(5) 1·0 A.

18. Consider the following statements made about a p-n junction.

(A) Its current (I) - Voltage (V) characteristic is linear.

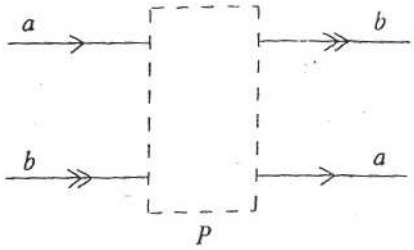
(B) Built in electric field across the junction is directed from n-region to p-region.

(C) Currents carried by holes and electrons are in opposite directions.

Of the above statements

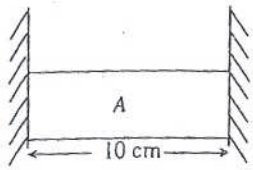
(1) only (B) is true. (2) only (A) and (B) are true.
(3) only (B) and (C) are true. (4) only (A) and (C) are true.
(5) All (A), (B) and (C) are true.

19. Two monochromatic light rays *a* and *b* after passing through an optical element *P*, emerge as shown in the figure. The optical element is a



(1) convex lens. (2) convex mirror.
(3) concave lens. (4) plane mirror.
(5) prism.

20. An aluminium (Young's modulus = $7{\cdot}0 \times 10^{10}$ N m^{-2} ; Linear expansivity = $2{\cdot}5 \times 10^{-5}$ K^{-1}) cylinder *A* of length 10 cm, and cross-sectional area 20 cm^2, is to be used as a spacer between two rigid walls as shown in the figure. At 30 °C it just slips in between the walls. When it warms to 34 °C, the force exerted by the cylinder on each wall is,

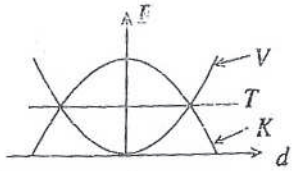


(1) $1{\cdot}4 \times 10^3$ N. (2) $3{\cdot}5 \times 10^3$ N. (3) $1{\cdot}4 \times 10^4$ N. (4) $1{\cdot}4 \times 10^5$ N. (5) $7{\cdot}0 \times 10^6$ N.

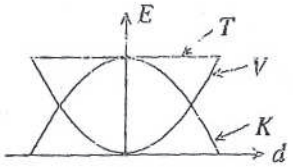
21. Consider the following statements regarding the flow of a viscous liquid through a narrow tube.
(A) Speed of flow is maximum along the axis of the tube.
(B) Rate of flow of the liquid is proportional to the internal cross-sectional area of the tube.
(C) Rate of flow does not depend on the temperature of the liquid.

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.

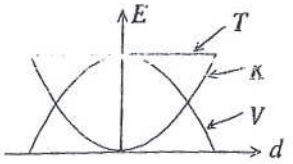
22. Which one of the following energy *(E)* – displacement *(d)* graphs best represents the variation of the kinetic energy *K*, the potential energy *V* and the total energy *T* with displacement *d* of a particle performing simple harmonic motion?



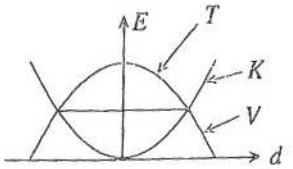
(1)



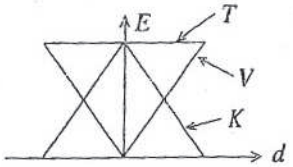
(2)



(3)

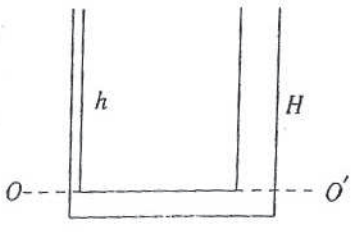


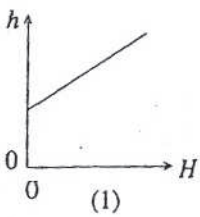
(4)



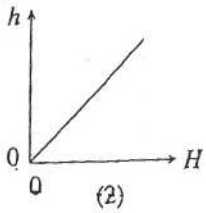
(5)

23. One limb of a glass U tube is made of a capillary and the other limb is made of a wider tube as shown in figure. When water is poured into the U tube, the equilibrium heights of the water columns inside the capillary and the wider tubes as measured from the *OO'* level are *h* and *H* respectively. The variation of *h* with *H* is best represented by

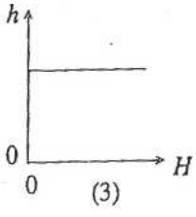




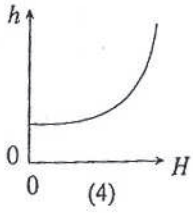
(1)



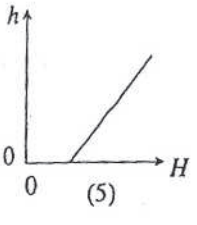
(2)



(3)



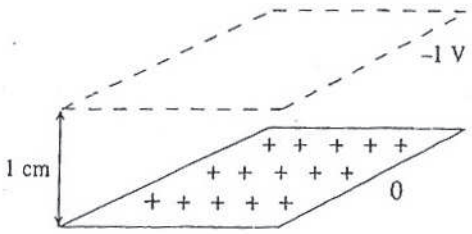
(4)



(5)

24. A uniformly charged large metal plate is kept at zero potential. An equipotential surface of -1 V is observed at a distance of 1 cm, as shown in the figure. The potential of the equipotential surface at a distance of 2 cm above the metal plate is

(1) -2 V. (2) -1 V. (3) 0·5 V.
(4) 1 V. (5) 2 V.



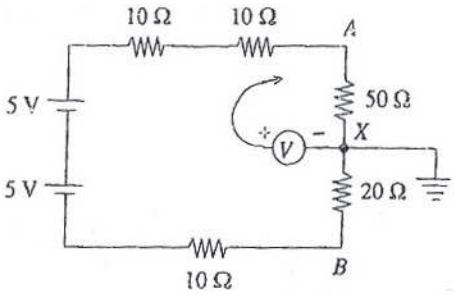
25. Cross-sectional view of a variable capacitor with parallel plates is shown in the figure. The separation between adjacent plates is 0·5 cm, and the effective area of overlap of adjacent plates is 5 cm^2. If $\epsilon_0 = 9\times10^{-12}\,F\,m^{-1}$, the capacitance of the variable capacitor at this position is

(1) 0·15 pF. (2) 0·3 pF.
(3) 0·9 pF. (4) 2·7 pF.
(5) 5·4 pF.



26. All the components shown in the circuit are ideal, and the point X is grounded. If a centre-zero voltmeter V is used to measure the voltages at A and B by connecting its free end to A and B respectively, then the corresponding readings will be

(1) 5 V, 2 V. (2) 5 V, -2 V.
(3) 7 V, 1 V. (4) 7 V, -1 V.
(5) 8 V, 1 V.

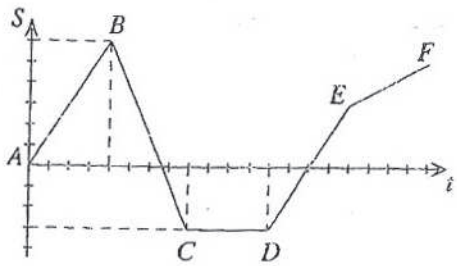


27. A flywheel of moment of inertia 9 $kg\,m^2$ about its perpendicular axis through the centre, is connected to a motor. The motor accelerates the flywheel from rest to 600 revolutions per minute. Neglecting friction the work done on the flywheel is

(1) $900\pi^2$ J. (2) $1800\pi^2$ J (3) $3600\pi^2$ J. (4) $4000\pi^2$ J. (5) $6000\pi^2$ J.

28. Displacement (S) of a particle measured along the x-axis with time (t) is shown in the figure. The magnitude of the velocity of the particle is largest when it travels from

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

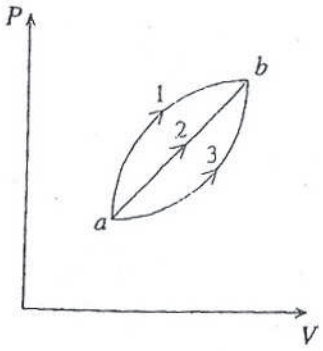


29. An ideal gas is taken from state 'a' to state 'b' separately along the three paths shown in the P–V diagram. If $U_b > U_a$, consider the following statements.

(A) The work done by the gas is same for all three processes.
(B) Heat is absorbed when the gas is taken along path 1 whereas heat is liberated when taken along path 3.
(C) The temperature of the gas at state b is higher than that at state a.

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.

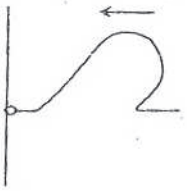


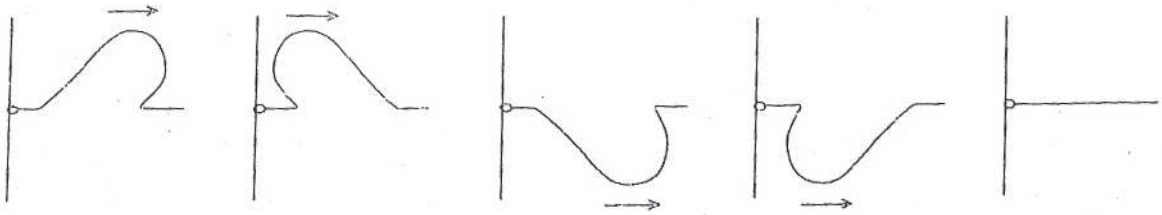
30. At the atmospheric pressure the specific latent heat of fusion of ice and vaporization of water are $3\times10^5\,\mathrm{J\,kg^{-1}}$ and $20\times10^5\,\mathrm{J\,kg^{-1}}$ respectively. If the specific heat capacity of water is $4\times10^3\,\mathrm{J\,kg^{-1}\,°C^{-1}}$, the minimum amount of energy required to convert 1 kg of ice at 0 °C to steam at 100 °C under the atmospheric pressure is

(1) 27×10^5 J. (2) 24×10^5 J. (3) 23×10^5 J. (4) 20×10^5 J. (5) 7×10^3 J.

31. Dew **cannot** appear if
(1) temperature is high, and relative humidity is 100%.
(2) temperature is low, and absolute humidity is equal to its corresponding value at dew point.
(3) temperature is high, and the absolute humidity is equal to its corresponding value at dew point.
(4) temperature is below the dew point, and relative humidity is 100%.
(5) temperature is low, and the absolute humidity is less than the maximum possible value at that temperature.

32. A transverse pulse is travelling on a stretched string as shown in the figure. The left end of the string is tied to a light ring that could slides on a frictionless rod perpendicular to the string. The reflected pulse is best represented by



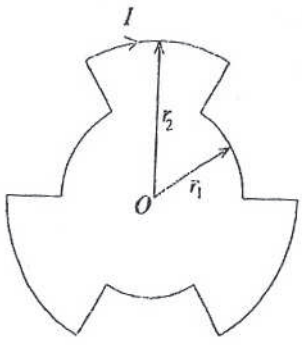


(1) (2) (3) (4) (5)

33. A geostationary satellite A moves in an orbit of radius R_A. Another geostationary satellite B has twice the mass of A. The orbital radius of the satellite B is

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

34. A current I flows around a closed loop as shown in the figure. The magnetic flux density produced at the centre O is given by



(1) $\frac{\mu_0 I}{6}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$.
(2) $\frac{\mu_0 I}{3}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$.
(3) $\frac{\mu_0 I}{2}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$.
(4) $\frac{\mu_0 I}{2}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$.
(5) $\frac{\mu_0 I}{6}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$.

35. Consider the following statements regarding an astronomical telescope and a compound microscope.
(A) To obtain a high magnification the telescope must have an objective lens of long focal length and an eyepiece of short focal length.
(B) To obtain a high magnification the microscope must have an objective lens of short focal length and an eyepiece of long focal length.
(C) At the normal adjustment of the telescope the separation between the lenses is equal to the sum of the focal lengths of the lenses.

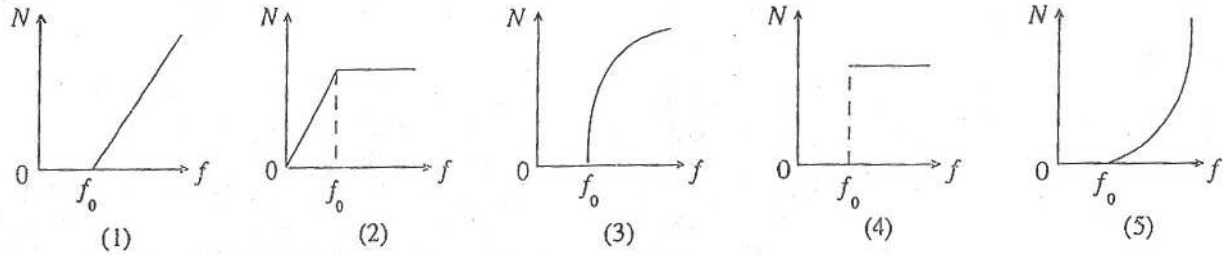
Of the above statements
(1) only (A) is true.
(2) only (B) is true.
(3) only (C) is true.
(4) only (A) and (C) are true.
(5) all (A), (B) and (C) are true.

36. A radioactive element $^{A}_{86}X$ decays to a stable element $^{206}_{82}Y$ after several α - emissions.

The value of A is

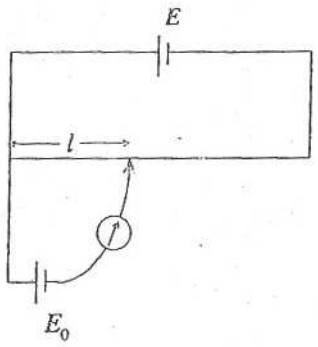
(1) 206. (2) 208. (3) 210. (4) 212. (5) 214.

37. A light beam is incident on a photosensitive surface. If the intensity of the incident beam is not changed which of the following graphs best represents the variation of number (N) of electrons emitted per second with the frequency (f) of the incident light. (f_0 represents the threshold frequency of the photosensitive material).



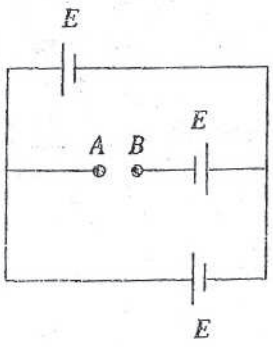
(1) (2) (3) (4) (5)

38. In the potentiometer circuit shown the internal resistance of the cell E is negligible. The balanced length l obtained for the cell E_0 is doubled when a resistance R is connected in series with E. The resistance of the potentiometer wire is



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

(4) $3R$. (5) $4R$.

39. 

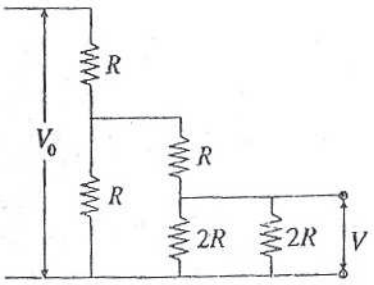
Three identical cells having e.m.f. E and negligible internal resistance are connected in a circuit as shown in the figure. The potential drop across AB is

(1) 0. (2) $\frac{E}{2}$.

(3) E. (4) $2E$.

(5) $3E$.

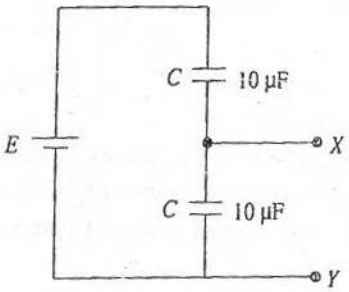
40. $\frac{V}{V_0}$ of the voltage divider shown is



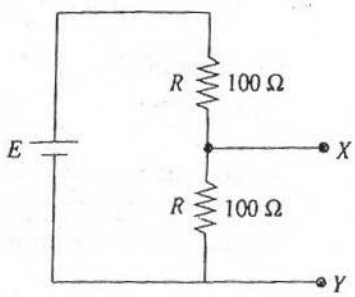
(1) $\frac{2}{3}$. (2) $\frac{3}{4}$. (3) $\frac{4}{5}$.

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

41.



(P)



(Q)

Consider the following statements made about the potential difference across XY of the circuits (P) and (Q) shown in figures. Both cells have e.m.f. E and negligible internal resistance.

(A) Potential differences across XY in both circuits are equal.

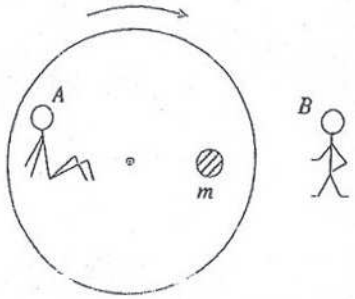
(B) If a voltmeter with finite internal resistance is connected across XY it will read a steady non-zero voltage only in Q.

(C) If the voltmeter is ideal both circuits will provide a same voltage reading across XY.

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.

42. A horizontal table is rotating with a uniform angular velocity about the vertical axis passing through its centre. A mass m is at rest on the table without slipping. Observer A is sitting on the table while the observer B is standing on the floor, as shown in the figure. The total horizontal force on m



(1) according to A is zero and according B is towards the centre.
(2) according to A is zero and according B is away from the centre.
(3) according to both A and B is zero.
(4) according to both A and B is towards the centre.
(5) according to both A and B is away from the centre.

43. In an experiment to measure the thermal conductivity of a good conductor a long bar of the material is normaly used. This is to

(1) obtain the steady-state condition.
(2) achieve a higher heat flow rate.
(3) obtain a practically measurable temperature difference along the bar.
(4) make lagging easy.
(5) ensure a parallel flow of heat along the bar.

44. A liquid and its vapour are enclosed in a closed vessel. The volume of the vessel is expanded slowly at a constant temperature ensuring that some liquid is retained inside the vessel during the expansion. During the expansion

(1) the vapour pressure increases linearly with the volume.
(2) the vapour pressure decreases linearly with the volume.
(3) the vapour pressure remains constant.
(4) the number of vapour molecules per unit volume increases.
(5) the kinetic energy of vapour molecules decreases.

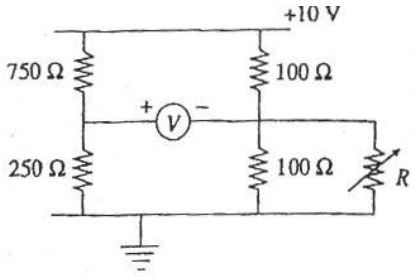
45. Ten identical machines produce a certain sound intensity level at a given point. In order to decrease the sound intensity level by 10 dB, the number of machines that has to be **turned off** is

(1) 1. (2) 2. (3) 5. (4) 8. (5) 9.

46. The maximum focal length of the lens of a normal eye is 2·5 cm. If the near point is 25 cm, the minimum focal length of the eye lens is about

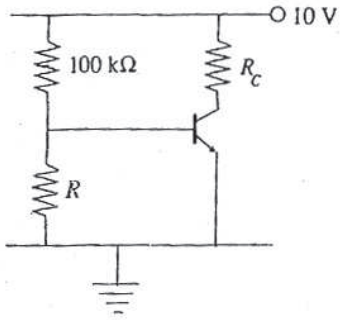
(1) 1·5 cm. (2) 1·8 cm. (3) 2·0 cm. (4) 2·3 cm (5) 2·5 cm.

47. In the circuit shown V represents an ideal centre-zero voltmeter. R is a variable resistor, value of which can be varied from 0 to 10,000 Ω. As R decreases from 10,000 Ω to zero the voltmeter reading will approximately vary from



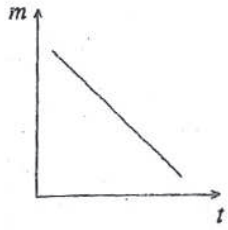
(1) –7·5 V to 2·5 V.
(2) 7·5 V to 10 V.
(3) –2·5 V to 2·5 V.
(4) –2·5 V to 7·5 V.
(5) 2·5 V to 0.

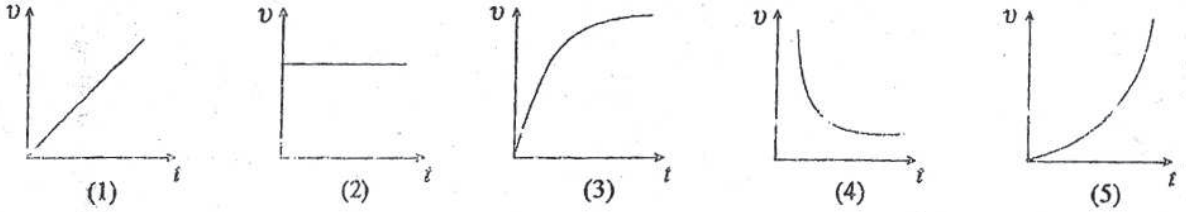
48. A suitable value for R to bias the silicon transistor in the active mode would be



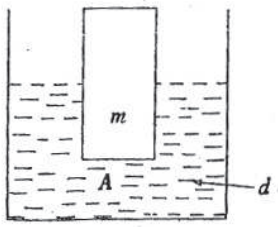
(1) 100 kΩ.
(2) 251 kΩ.
(3) 75 kΩ.
(4) 7·5 kΩ.
(5) 100 Ω.

49. Figure shows how the mass (m) of fuel in a rocket decreases with time (t) when it moves away from the earth perpendicular to the earth surface. If the atmospheric resistance is disregarded and the thrust produced by the fuel is constant throughout, which of the following graphs best represents the variation of the velocity (v) of the rocket with time (t)?



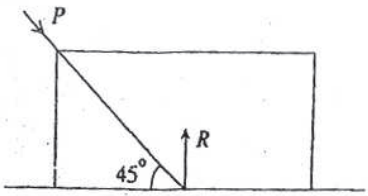


50. A uniform solid cylinder of cross-sectional area A and mass m floats in a vessel of water of density d as shown in the figure. When the vessel is raised upwards with a constant acceleration a, the height of the cylinder submerged in water will



(1) increase by a distance of $\frac{ma}{Adg}$.
(2) decrease by a distance of $\frac{ma}{Adg}$.
(3) increase by a distance of $\frac{m(g-a)}{Adg}$.
(4) decrease by a distance of $\frac{m(g-a)}{Adg}$.
(5) remain unchanged.

51. As shown in figure a force P is applied on an object of mass 2 kg lying on a horizontal surface. The coefficient of kinetic friction between the two surfaces is 0·5. If the object moves with uniform velocity the normal force R acting on the object is



(1) 10 N. (2) $10\sqrt{2}$ N (3) 20 N.
(4) $20\sqrt{2}$ N. (5) 40 N.

52. Two airmen with different weights falling freely after being jumped together from a plane, open their identical parachutes at the same altitude at the same time and start to descend.

Consider the following statements made about the motion of the two airmen.

(A) Initially their speeds are reduced due to the upthrust acting on the parachutes.

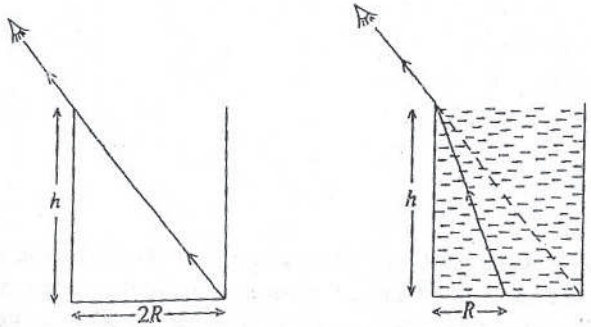
(B) The terminal velocity of the heavier airman is greater than that of the other.

(C) Both airmen reach the ground together.

Of the above statements

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

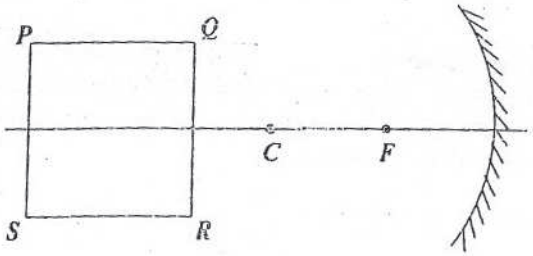
53.



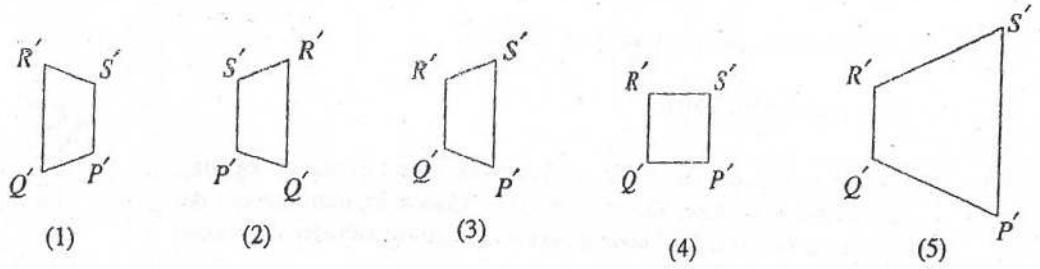
A person can just see the opposite edge of the bottom of an empty vessel over its brim as shown in figure (*A*). While keeping the eye in the same position, the vessel is filled with a clear liquid up to its brim. Then he is able to see a small mark at the centre of the bottom of the vessel as shown in figure (*B*). The refractive index of the liquid is given by

(1) $\frac{\sqrt{h^2+R^2}}{\sqrt{h^2+4R^2}}$. (2) $\frac{2\sqrt{h^2+R^2}}{\sqrt{h^2+4R^2}}$. (3) $\frac{\sqrt{h^2+R^2}}{\sqrt{h^2+2R^2}}$. (4) $\frac{\sqrt{h^2+2R^2}}{\sqrt{h^2+R^2}}$ (5) $\frac{h+2R}{h+R}$.

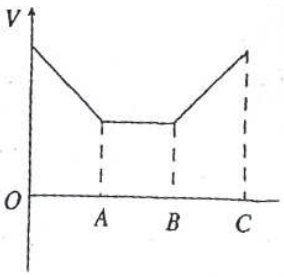
✱ 54.



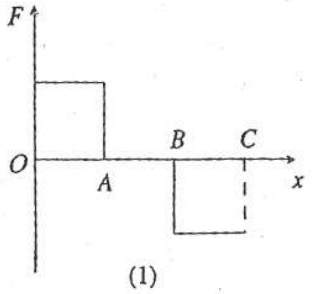
A thin square sheet *PQRS* is placed symmetrically along the principal axis of a concave mirror as shown in the figure. If P', Q', R' and S' represent the images of points *P*, *Q*, *R* and *S* respectively then the image of the sheet formed by the mirror is best represented by



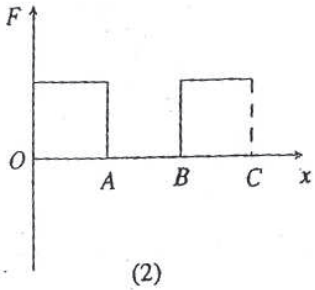
55. The variation of the electric potential V along the x-direction in a certain region of space is shown in the figure.



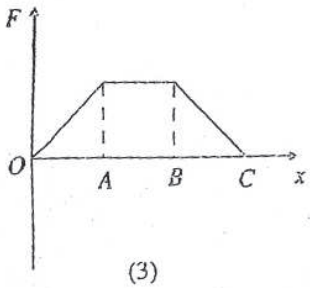
If a charge is taken from O to C along the x-direction, the variation of the electric force F acting on the charge is best represented by



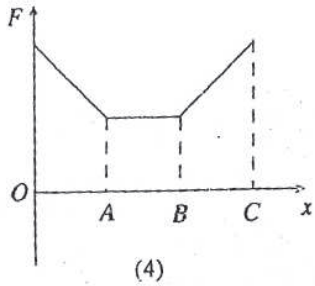
(1)



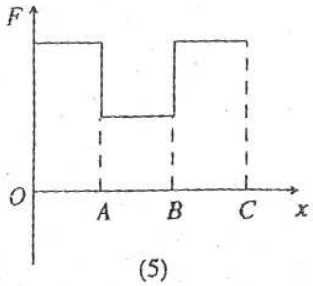
(2)



(3)



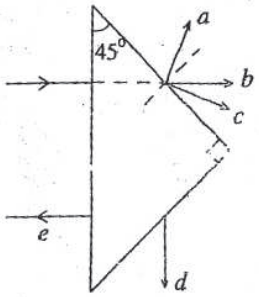
(4)



(5)

56. As shown in the figure a ray of monochromatic light is incident normally on one face of a prism made of plastic of refractive index 1·40. The refracted ray emerging to air is best shown by

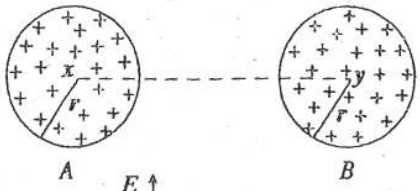
$\left(\sin 45° = \frac{1}{1 \cdot 42}\right)$

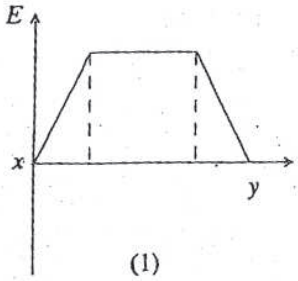


(1) *a.* (2) *b.* (3) *c.*

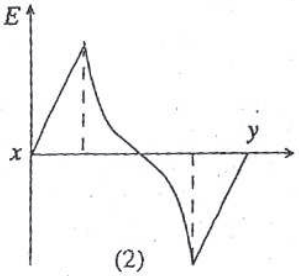
(4) *d.* (5) *e.*

57. A and B are two uniformly charged identical, non conducting solid spheres carrying equal charges. The distance between the spheres is very much greater than their radii r. The variation of the electric field intensity, E, along xy from x to y is best represented by

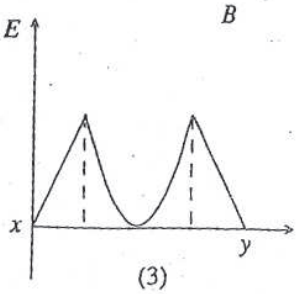




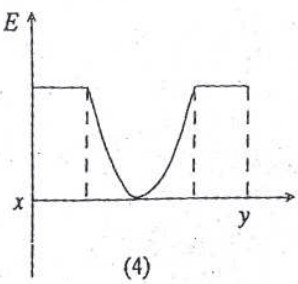
(1)



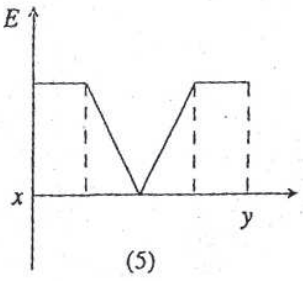
(2)



(3)

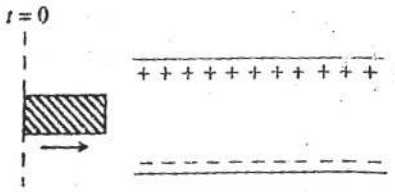


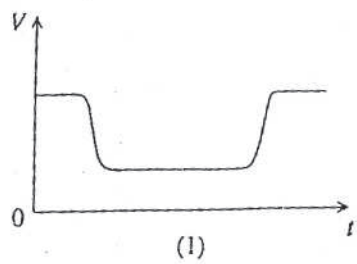
(4)



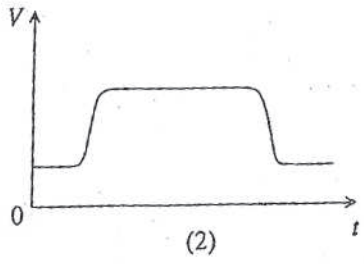
(5)

58. A small dielectric slab is passed through an isolated charged parallel plate capacitor, as shown in the figure. As the slab moves the variation of the potential difference V across the capacitor with time t is best represented by

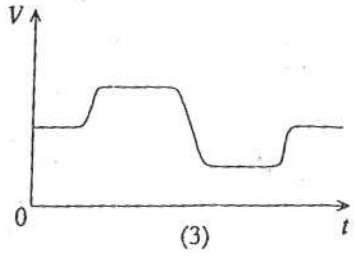




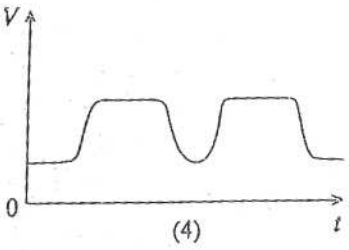
(1)



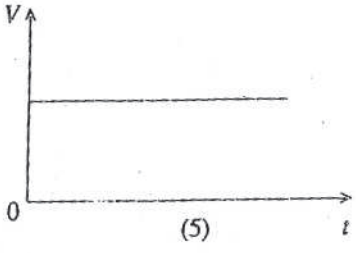
(2)



(3)

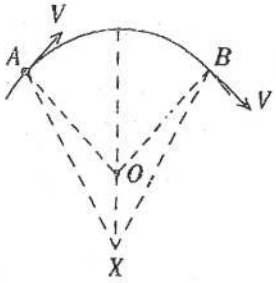


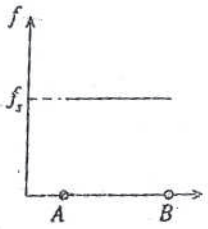
(4)



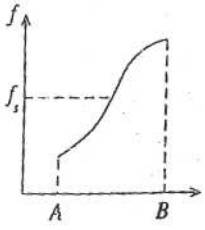
(5)

59. A sound source emitting signals at a constant frequency f_s moves along an arc of a circle with constant speed V as shown in the figure. A stationary observer is located at a point X. O is the centre of the circle. As the source moves from A to B, the variation of the frequency (f) heard by the observer is best represented by

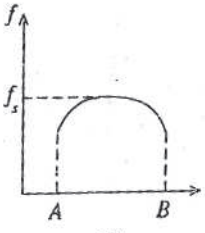




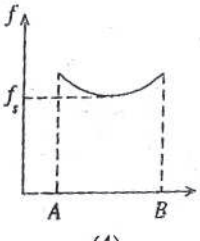
(1)



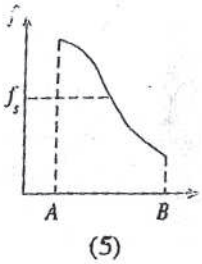
(2)



(3)

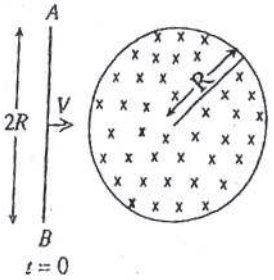


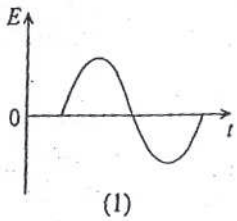
(4)



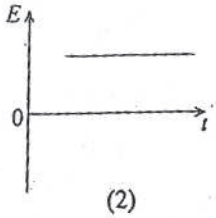
(5)

60. A metal rod AB of length $2R$ moving with a constant velocity V is passing over a uniform magnetic field confined to a circular region of radius R, as shown in figure. The variation of the e.m.f. (E) induced across the rod with time (t) is best represented by

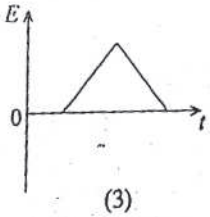




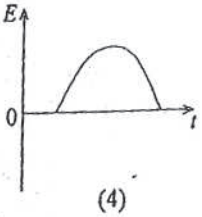
(1)



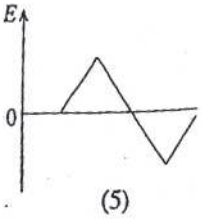
(2)



(3)



(4)



(5)