Department of Examinations, Sri Lanka

01 E I

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கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 2002 ஏப்பிரல்
General Certificate of Education (Advanced Level) Examination, April 2002

භෞතික විද්‍යාව I
பௌதிகவியல் I
Physics I

පැ දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Important : ✻ *This question paper consists of* **60** *questions in* **twelve** *pages.*
✻ *Enter your* ***Index Number*** *in the space provided on the answer sheet.*
✻ ***Answer all the questions.***
✻ *Instructions are given on the back of the answer sheet. Follow them carefully.*
✻ *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 in accordance with the instructions given therein.*

Use of calculators is not allowed.

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

1. Dimensions of frequency is
   (1) LT^{-1} (2) Hz (3) L^{-1} (4) T^{-1} (5) ML^{-1}

2. Which of the following phenomenon could **not** be explained by the wave theory of light?
   (1) Interference (2) Diffraction (3) Refraction (4) Reflection (5) Photo emission

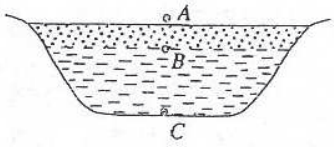
3. Which of the following could influence the speed of sound in air?
   (A) Frequency of the sound wave
   (B) Temperature of air
   (C) Humidity of air
   (1) (A) only (2) (B) only (3) (C) only
   (4) (B) and (C) only (5) All (A), (B) and (C)

4. Of the thermometers given below, the most suitable thermometer to measure the temperature of a drop of liquid is
   (1) thermocouple. (2) mercury thermometer.
   (3) alcohol thermometer. (4) pyrometer.
   (5) gas thermometer.

5. The volume expansivity of a metal is equal to
   (1) its linear expansivity. (2) twice its linear expansivity.
   (3) three times its linear expansivity. (4) half of its linear expansivity.
   (5) one third of its linear expansivity.

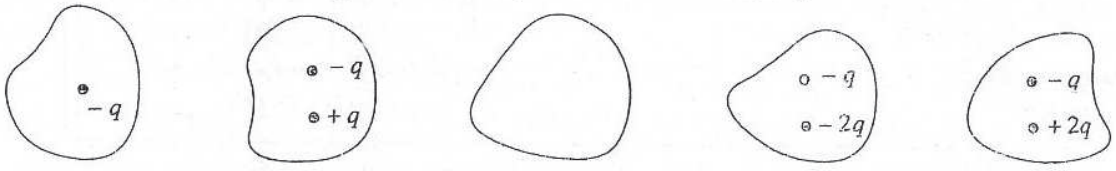
6. When one touches a piece of metal in the environment one feels it to be colder than a piece of wood, because
   (1) the temperature of metal pieces in the environment is generally lower than that of wood.
   (2) metal pieces have a higher heat capacity.
   (3) the temperature of wood is generally closer to the body temperature.
   (4) metal has higher thermal conductivity than wood.
   (5) surface emissivity of metal is higher than that of wood.

7. During the formation of ice in a pond (see figure) due to cold weather, the possible temperatures at points A, B and C shown in the figure are



(1) –5°C, 0°C and 0°C respectively.
(2) –5°C, 0°C and 4°C respectively.
(3) 5°C, 0°C and 4°C respectively.
(4) –5°C, 4°C and 4°C respectively.
(5) –5°C, 4°C and 0°C respectively.

8. Across which of the following closed surfaces, is the net electric flux positive?

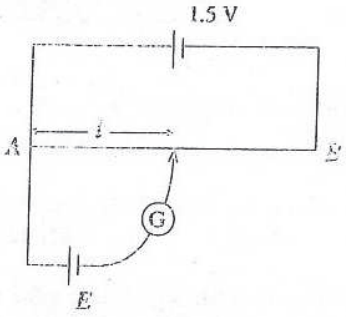


(1) (2) (3) (4) (5)

9. An ideal transformer has 100 windings in the primary and 200 windings in the secondary. The primary is connected to an A.C. supply of 120 V at 10 A. Then the 'voltage/current' in the secondary is

(1) 240 V/5 A (2) 240 V/10 A
(3) 240 V/2·5 A (4) 120 V/5 A
(5) 120 V/2·5 A

10. In the potentiometer circuit shown, the balanced length for a cell E of e.m.f. 1·3 V was found to be 65 cm. When another cell of unknown e.m.f. was substituted for E the balanced length was found to be 45 cm. The e.m.f. of the second cell is



(1) 1·5 V. (2) 1·1 V.
(3) 1·0 V. (4) 0·9 V.
(5) 0·8 V.

11. A radioactive nucleus ${}^{A}_{Z}X$ decays by emission of an α-particle followed by a γ ray. The daughter nucleus thus formed has a mass number and atomic number

(1) $A - 5$ and $Z - 2$ respectively. (2) $A - 4$ and $Z - 2$ respectively.
(3) $A - 5$ and $Z - 3$ respectively. (4) $A - 4$ and $Z - 3$ respectively.
(5) $A - 4$ and Z respectively.

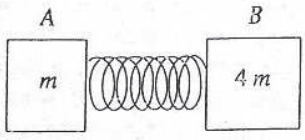
12. Consider the following statements made regarding an object of mass m at a height h from the surface of the earth.

(A) Gravitational force acting on the object does not depend on h.
(B) Gravitational potential energy of the object does not depend on m.
(C) Gravitational potential energy of the object depends on h.

Of the statements

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

13. Two masses m and $4m$ lying on a smooth table are compressed against a spring as shown in the figure. As the masses are released the speeds of masses, V_A and V_B, are related by



(1) $V_A = V_B$ (2) $V_A = 2V_B$
(3) $V_A = 4V_B$ (4) $2V_A = V_B$
(5) $4V_A = V_B$

14. Consider the following statements made about the magnification m of an image produced by a convex lens. As the object distance u increases

(A) from $u = 0$ to $u = f$, m increases.
(B) from $u = f$ to $u = 2f$, m decreases.
(C) from $u = 2f$ to $u = \infty$, m increases.

Of the above statements

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

15. A simple microscope has a convex lens of focal length 5 cm. If the least distance of distinct vision is 25 cm, the magnification of the microscope in normal adjustment is

(1) 2. (2) 4. (3) 5. (4) 6. (5) 8.

16. A person hears a sound intensity level of 10 dB, when a speaker produces a sound output of 5 W. When the sound output of the speaker is increased to 50 W, the sound intensity level that the person hears, is

(1) 15 dB. (2) 20 dB. (3) 40 dB. (4) 80 dB. (5) 100 dB.

17. A sound wave of intensity 2·0 $\mu W m^{-2}$ passes normal to a surface area of 10 cm^2. The amount of energy passes through the area in 1 hour is

(1) 7·2 μJ. (2) 72 μJ. (3) 0·072 J. (4) 7·2 J. (5) 72 kJ.

18. The frequencies of the fundamental and the first overtone of a stretched string fixed at both ends are f_1 and f_2 respectively. The ratio of $\frac{f_1}{f_2}$ is

(1) 0·5 (2) 1 (3) 2 (4) 4 (5) 6

19. An observer is moving at a speed of 40 $m s^{-1}$ towards a stationary siren sounding at a frequency of 600 Hz. If the speed of sound in air is 320 $m s^{-1}$ what is the frequency of the sound heard by the observer?

(1) 686 Hz. (2) 675 Hz. (3) 600 Hz. (4) 533 Hz. (5) 525 Hz.

20. Two bodies having thermal capacities in the ratio 1 : 4 are heated to a few degrees above the room temperature and allowed to cool. If their rates of fall of temperatures are the same at a particular instant, then their rates of loss of heat would be in the ratio

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

21. 10 g of steam at 100°C is mixed with 10 g of ice at 0°C. The final temperature of the mixture will most likely to be

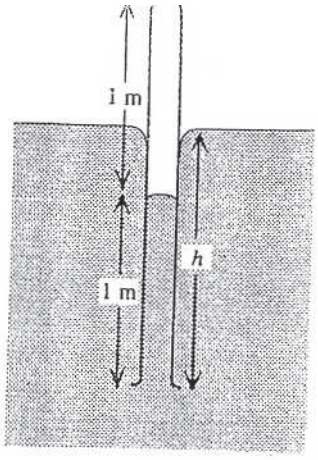
(1) 40°C.
(2) less than 40°C.
(3) 45°C.
(4) 50°C.
(5) greater than 50°C.

22. An ideal gas of volume 300 cm^3 at a pressure of 1 atmosphere and temperature of 27°C is compressed to 5 atmospheres, and then heated to 127°C at constant pressure. The new volume of the gas would be

(1) 1500 cm^3 (2) 300 cm^3 (3) 80 cm^3 (4) 60 cm^3 (5) 45 cm^3

23. A uniform glass tube of length 2 m with one end sealed contains air at atmospheric pressure. It is pressed vertically down into a mercury bath until the mercury rises halfway up in the glass tube as shown in the figure. If the atmospheric pressure is 76 Hg cm, then the depth h would be

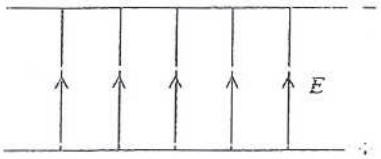
(1) 124 cm.
(2) 150 cm.
(3) 174 cm.
(4) 176 cm.
(5) 200 cm.



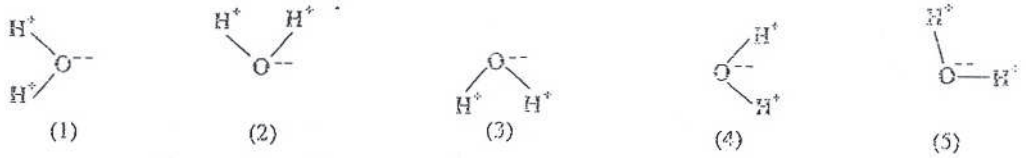
24. At what temperature is the r.m.s. speed of nitrogen molecules equal to that of hydrogen molecules at 27 °C? (A nitrogen molecule is 14 times as massive as a hydrogen molecule.)

(1) 6000 °C (2) 5200 °C (3) 4927 °C (4) 4900 °C (5) 3000 °C

25.



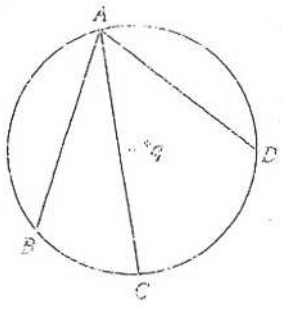
If a water molecule is placed in the electric field shown in figure, which orientation would it take in order to minimize its energy?



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

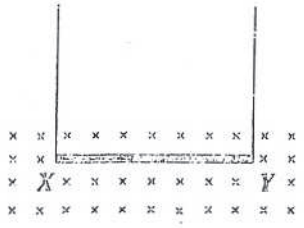
26. A point charge $+q$ is placed at the centre of a circle as shown in the figure. Another point charge $+q$ is carried separately from A to B, A to C, and A to D. The work done in carrying the charge

(1) is least along the path AB.
(2) is least along the path AD.
(3) is least along the path AC.
(4) is same for all the paths, but has a non-zero value.
(5) is zero along all the paths.

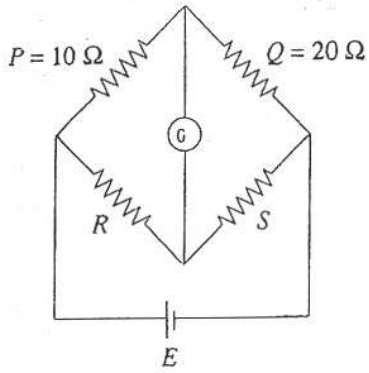


27. A horizontal conducting wire XY of length 20 cm and mass 4·5 g is suspended by a pair of light wires in a magnetic field of 0·15 T which is directed into the paper and perpendicular to the wire, as shown in the figure. What magnitude and direction of current in the wire XY are required to nullify the tension in the light wires?

(1) 0·15 A, $X \rightarrow Y$
(2) 0·15 A, $Y \rightarrow X$
(3) 1·5 A, $X \rightarrow Y$
(4) 1·5 A, $Y \rightarrow X$
(5) 0



28. Wheatstone bridge shown in the diagram is balanced. Consider the following statements.



The balance condition does not change when
(A) the galvanometer G is replaced by another one with different resistance.
(B) the cell E is replaced by another one with different e.m.f.
(C) the resistances R and S are interchanged.

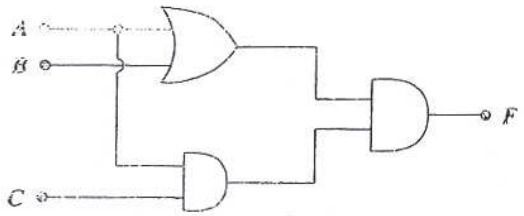
Of the above statements
(1) only (A) is true.
(2) only (B) is true.
(3) only (C) is true.
(4) only (A) and (B) are true.
(5) all (A), (B) and (C) are true.

29. An immersion heater which is connected to home electricity supply (230 V) and having a resistance of 115 Ω at its operating temperature, is immersed in boiling (100°C) water. The specific latent heat of vaporisation of water is $2{\cdot}3 \times 10^6$ J kg^{-1}.

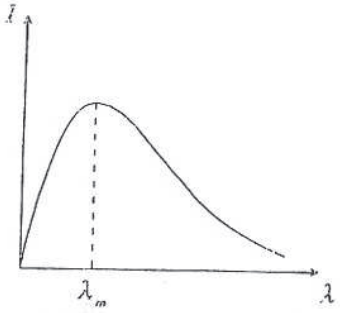
The rate of production of steam in kg s^{-1} is
(1) 1×10^{-4} (2) 2×10^{-4} (3) 3×10^{-4} (4) 2×10^{-3} (5) 1×10^{-1}

30. 100 W filament electric bulb is replaced with an energy saving bulb of 10 W. If the bulb is used 4 hours daily the electrical units (kWh) saved in 100 days would be
(1) 3·6 (2) 9 (3) 36 (4) 9000 (5) 36000

31. In the circuit shown F becomes 1 when
(1) $A = 0,\ B = 1,\ C = 1$
(2) $A = 0,\ B = 0,\ C = 1$
(3) $A = 1,\ B = 0,\ C = 1$
(4) $A = 1,\ B = 0,\ C = 0$
(5) $A = 1,\ B = 1,\ C = 0$



32. Figure shows the black body radiation curve for a body at a given temperature. Consider the following statements.
At a higher temperature
(A) λ_m would be lower.
(B) intensity would be higher.
(C) velocity of the emitted radiation would be higher.



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.

33. A monochromatic beam of light is falling on a photosensitive surface. An increase in the intensity of the beam
(1) will increase the rate of emission of electrons.
(2) will decrease the rate of emission of electrons.
(3) will increase the energy of emitted electrons.
(4) will decrease the energy of emitted electrons.
(5) will not change the energy and the rate of emission of electrons.

34. Two soap bubbles coalesce. Once they joined together, the radii of the two bubbles become a and b ($a > b$). The radius of curvature of the interface between the two bubbles would be

(1) $b - a$ (2) $b + a$ (3) $\frac{b^2}{a} - \frac{a^2}{b}$ (4) $\frac{ab}{a-b}$ (5) $\frac{a^2 b}{(a-b)^2}$

35. The material of a wire X has a higher value of Young's modulus than the material of a wire Y. When the two wires are subjected to the same tension, the extension of wire X is found to be more than that of wire Y. Consider the following statements.

(A) The above will happen only if the diameter of the wire X is smaller than that of wire Y.

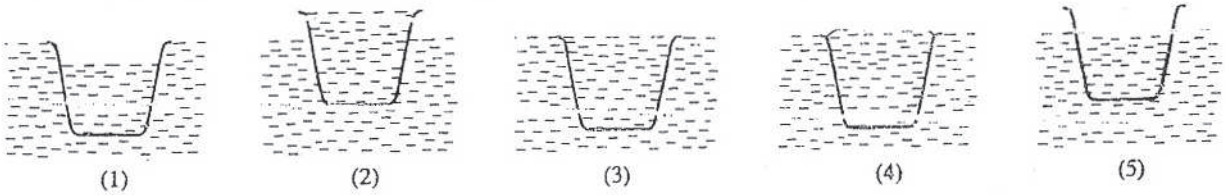
(B) The above will happen only if the ratio $\frac{\text{original length}}{\text{diameter}}$ for X is higher than that of Y.

(C) The above will never happen if the length of the wire X is shorter than that of Y.

Of the above statements

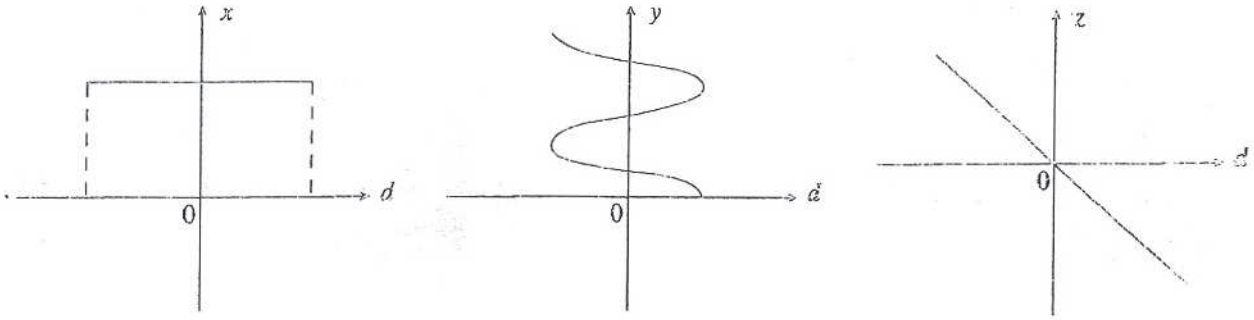
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (A) and (B) are true. (5) only (B) and (C) are true.

36. A steel bowl floats in water with its brim facing up. If water is poured slowly, which of the following figures shows its position at the verge of sinking?



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

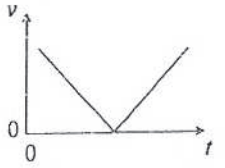
37. The following graphs show how certain quantities x, y, and z vary with the displacement d of a particle undergoing a simple harmonic motion.

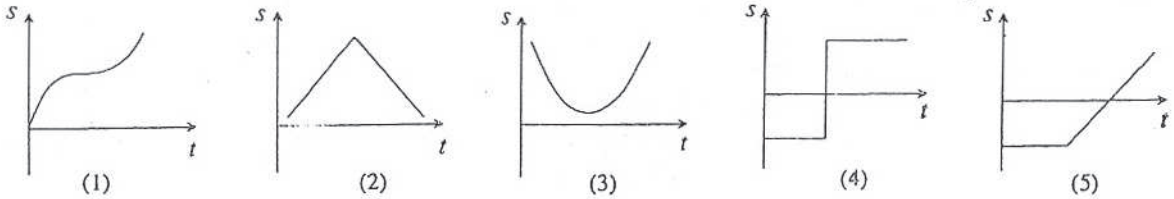


Quantities x, y, and z represent

(1) kinetic energy, momentum, and acceleration respectively.
(2) total energy, time, and force respectively.
(3) potential energy, time, and acceleration respectively.
(4) total energy, acceleration, and force respectively.
(5) total energy, time, and momentum respectively.

38. The graph shown represents the velocity (v) - time (t) curve for an object. The corresponding displacement (s) - time (t) curve is best represented by



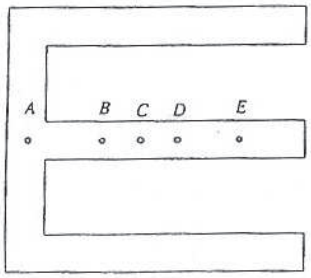


39. A bird of mass m sits on a tightly stretched telegraph wire as shown in the figure. The additional tension produced by the bird in the wire is



(1) zero. (2) less than mg.
(3) more than mg. (4) equal to mg.
(5) equal to $\frac{1}{2}mg$.

40. Figure shows a piece of metal in the shape of the letter 'E', cut from a uniform sheet. The centre of gravity is most likely to be found at



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

41. Which of the following optical element/s could turn a ray of light as shown below?



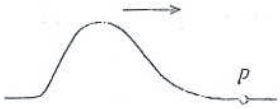
(A) A prism
(B) A convex lens
(C) A concave lens

(1) (A) only (2) (B) only (3) (A) and (B) only
(4) (A) and (C) only (5) All (A), (B) and (C)

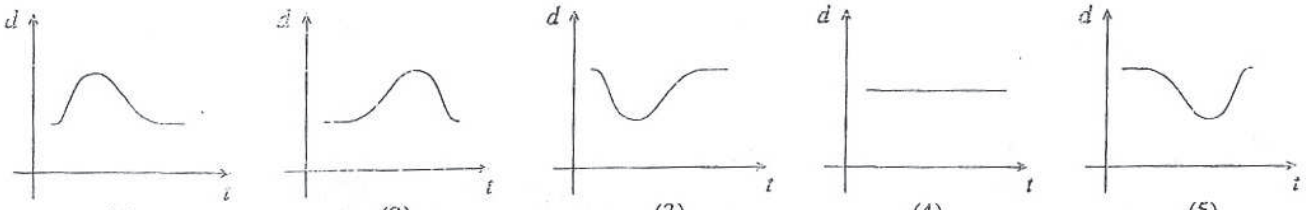
42. A certain person has a defective eye. The distance between the eye-lens and the retina of the eye is 0·025 m, but the power of the lens of the resting eye is 45 diopters. What should be the type, and power of the corrective lens he should wear in order to see distant objects?

(1) Convex, and 4 D (2) Convex, and 5 D (3) Concave, and 4 D
(4) Concave, and 5 D (5) Concave, and 10 D

43. A pulse propagates with a uniform speed along a stretched string as shown in the figure.

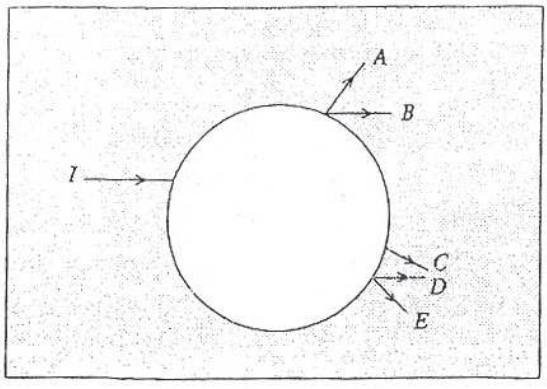


Which of the following best represents the displacement (d) of the point p of the string with time (t)?



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

44. A ray of monochromatic light (I) approaches a spherical air bubble in a block of glass as shown in the figure. Which of the paths shown best represents the emergent ray?



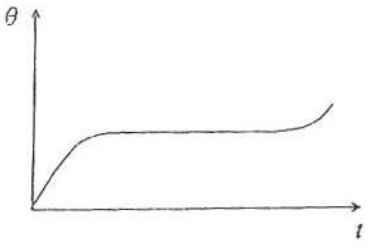
(1) A
(2) B
(3) C
(4) D
(5) E

45. A travelling microscope is focused upon a mark at the bottom of an empty beaker. Now if the microscope is raised by 1 cm, to what depth should water be poured into the beaker so that the mark be again in focus?

$\left(\text{Refractive index of water} = \frac{4}{3}.\right)$

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

46. When a certain amount of matter is heated at a constant rate, the variation of its temperature (θ) with time (t) is given by the curve shown in the figure. Consider the following statements made about the information that can be gathered from this curve about the matter.

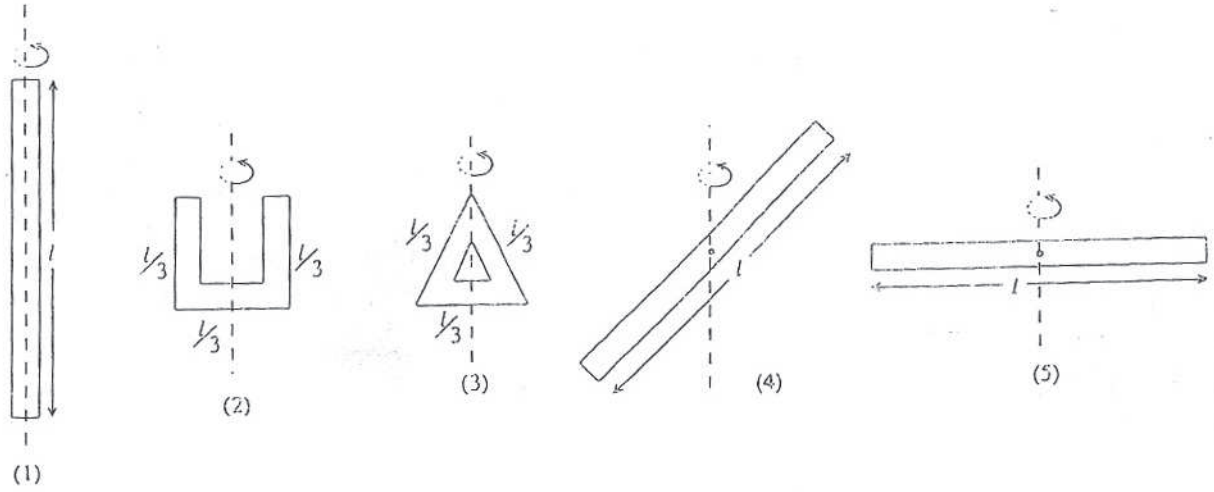


(A) Matter shows a change of state with temperature.
(B) Matter should have a large value for its specific latent heat of fusion / vaporisation.
(C) Matter definitely has attained its boiling point.

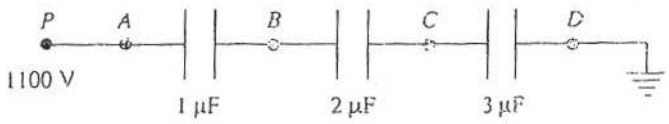
Of the statements

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

47. Five identical uniform rods of length l and mass m, some of which are bent as shown below, are rotated from rest about a vertical axis. Rods are accelerated until they reach a final angular speed of ω_0. Which of the following arrangements requires the highest energy to attain its final angular speed (ω_0)?



48.

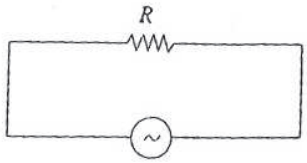


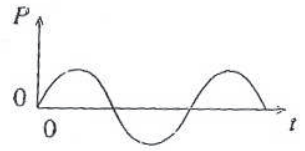
If the point P is maintained at a constant potential of 1100 V, the potential difference across AB is given by

(1) $\frac{1100}{6}$ V. (2) 200 V. (3) 300 V. (4) $\frac{1100}{3}$ V. (5) 600 V.

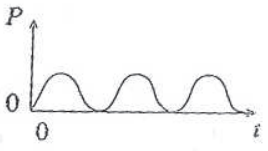
49. Which of the following **does not** show that a 1·5 V dry cell has an internal resistance?
(1) Its terminal voltage varies with the value of the resistance to which it is connected.
(2) Terminal voltage increases slightly when several such cells are connected in parallel.
(3) Terminal voltage depends on the internal resistance of the voltmeter used to measure its voltage.
(4) The cell becomes warm when its terminals are short circuited.
(5) Terminal voltage measured with an ideal voltmeter shows 1·5 V.

50. A sinusoidal A.C. voltage is applied across a resistor R. The power (P) dissipated by the resistor with time (t) is best represented by

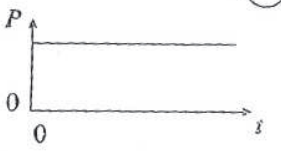




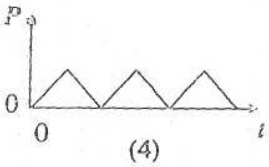
(1)



(2)



(3)

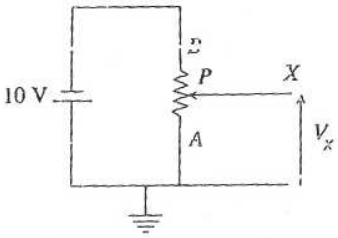


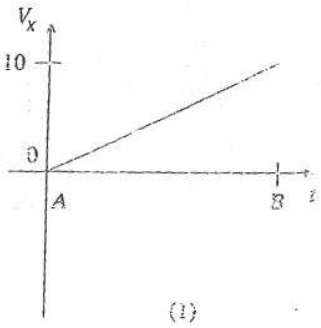
(4)



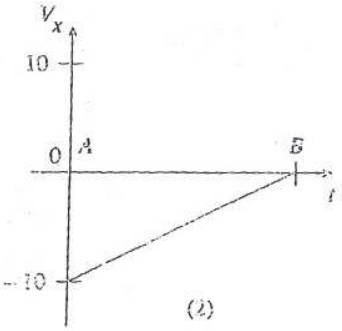
(5)

51. The cell in the circuit shown has negligible internal resistance. As the pointer P moves from A to B which of the following best represents the variation of the potential (V_X) at X.

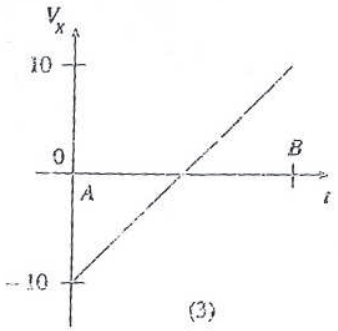




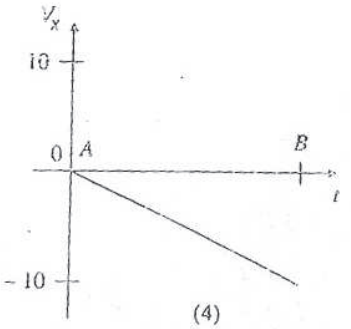
(1)



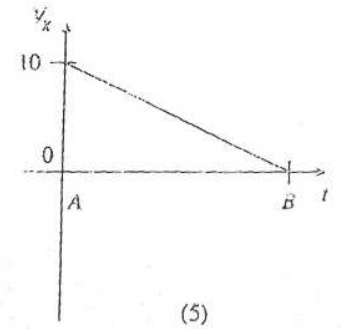
(2)



(3)

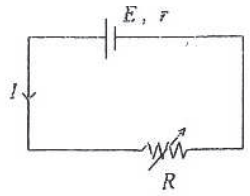


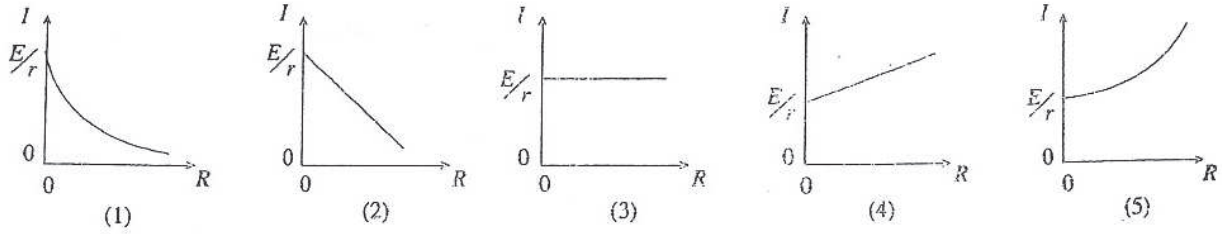
(4)



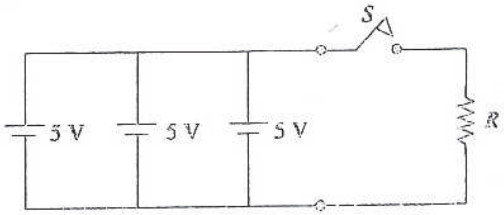
(5)

52. The circuit shows a cell of e.m.f. E and internal resistance r connected in series with a variable resistance R. Which of the following best represents the variation of the current I in the circuit with the resistance R?

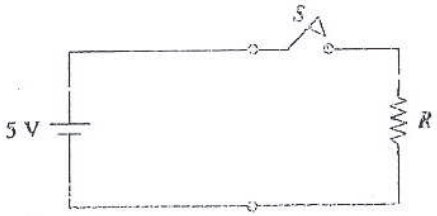




53.

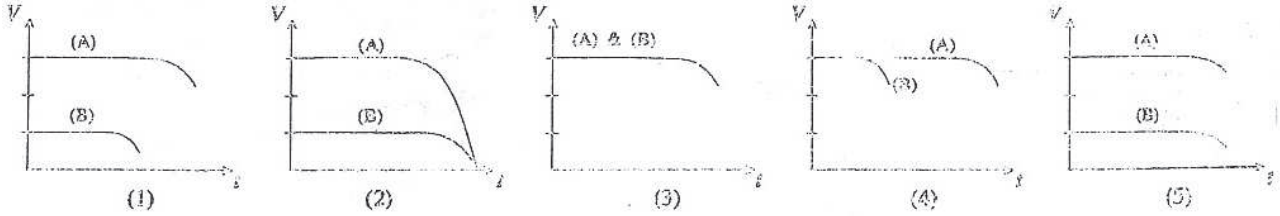


(A)



(B)

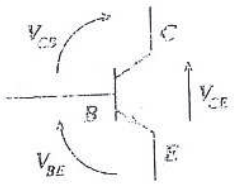
The circuits (*A*) and (*B*) use identical cells with negligible internal resistance. The switches S in both circuits are closed at time $t = 0$ and left for a long time. Which of the following best represents the variation of the potential difference V across R with time t?



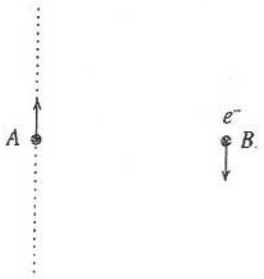
54. Voltages applied across a silicon transistor shown are represented with symbols V_{BE}, V_{CB} and V_{CE}.

The transistor will operate in the active region if

(1) $V_{BE} = 0{\cdot}7\text{ V}$ and $V_{CB} = 0{\cdot}7\text{ V}$
(2) $V_{BE} = 0$ and $V_{CE} = 0{\cdot}7\text{ V}$
(3) $V_{BE} = 5\text{ V}$ and $V_{CE} = 4{\cdot}2\text{ V}$
(4) $V_{BE} = 0{\cdot}7\text{ V}$ and $V_{CE} = 5\text{ V}$
(5) $V_{CB} = 0{\cdot}7\text{ V}$ and $V_{CE} = 0$

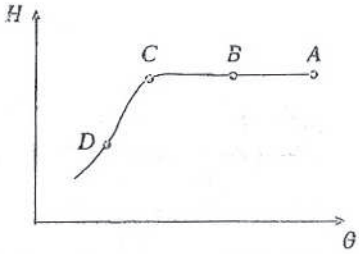


55. A beam of positively charged particles passes through a point A in the upward direction, and an electron passes through B with a velocity in the downward direction as shown in the figure. The directions of electrostatic (F_e) and magnetic (F_m) forces on the electron are such that



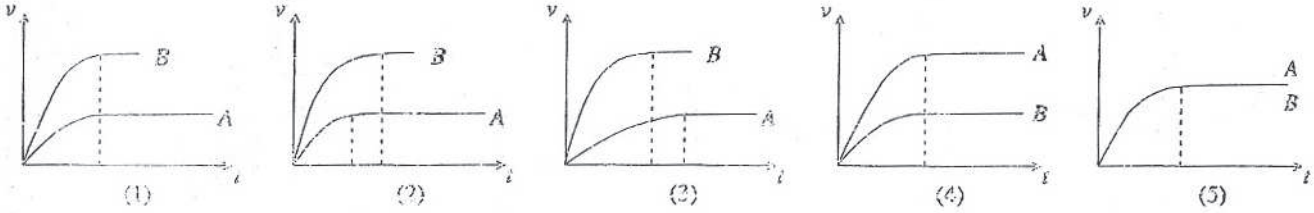
(1) F_e towards A and F_m away from A.
(2) F_e and F_m both away from A.
(3) F_e and F_m both towards A.
(4) F_e towards A and F_m out of the ⊙ paper.
(5) F_e towards A and F_m into the ⊗ paper.

56.

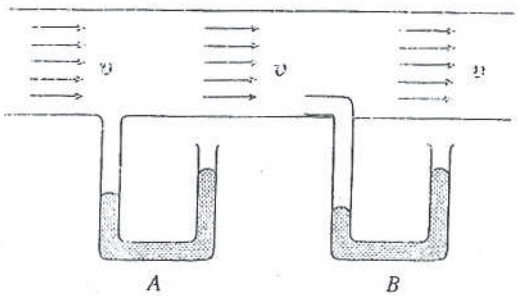


The curve shows the variation of the absolute humidity (H) of an isolated volume of atmosphere with temperature (θ). The relative humidity of the air volume corresponding to the
(1) point A can be 100 %. (2) point B can be 100 %.
(3) points A and C can be the same. (4) point C can be less than 100 %.
(5) point D can never be less than 100 %.

Two masses, A of mass m and B of mass $2m$ but of the same volume, are released from rest at time $t = 0$ at the surface of a deep pond. Which of the following graphs best represents the variation of the speed of two masses from $t = 0$ until they reach the bottom of the pond.



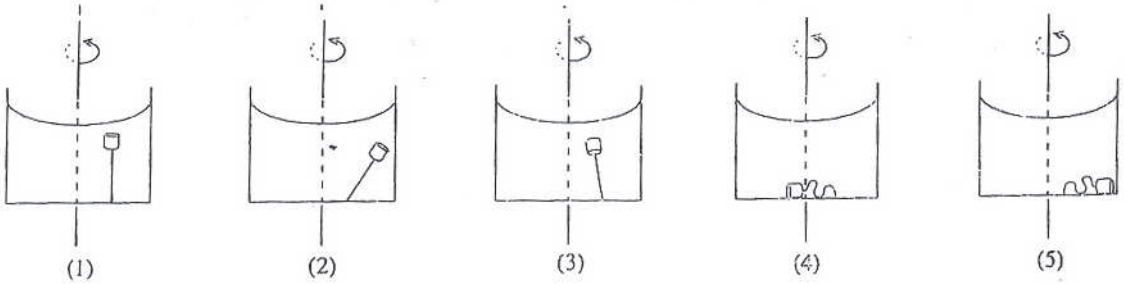
58. A non-viscous, incompressible fluid of density ρ flows through a pipe at a speed of v. Two manometers A and B are connected to the pipe as shown in the figure. If the pressures measured by the manometer A and manometer B are p_1 and p_2 respectively, the speed v of the flow is given by



(1) $\sqrt{\frac{2(p_2 - p_1)}{\rho}}$ (2) $\sqrt{\frac{2(p_1 - p_2)}{\rho}}$ (3) $\sqrt{\frac{2(p_1 + p_2)}{\rho}}$

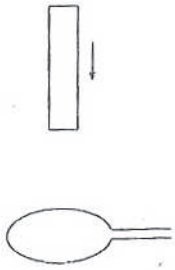
(4) $\sqrt{\frac{(p_2 - p_1)}{\rho}}$ (5) $\sqrt{\frac{(p_1 - p_2)}{\rho}}$

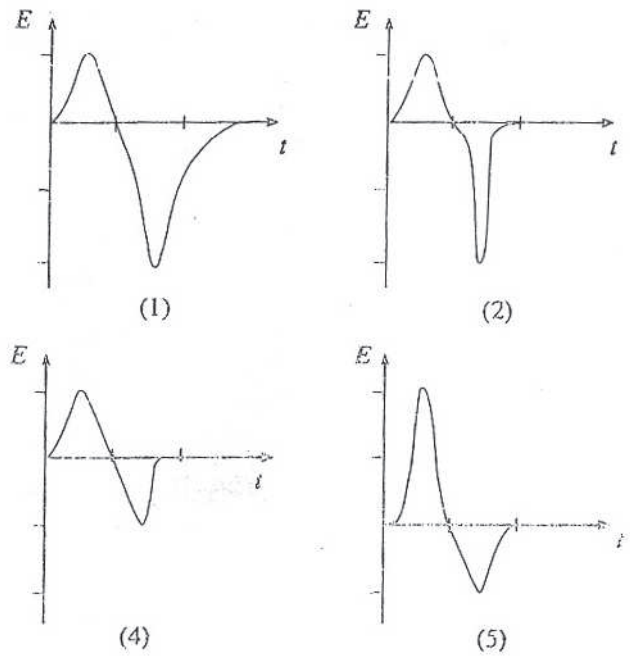
59. A cork is attached to the bottom of a water beaker with a string so that it stays under the surface of water. The beaker is then rotated with a constant angular speed about the vertical axis. Which of the following figures indicates the correct position of the cork?



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

60. A bar magnet is dropped with its axis vertical, and it accelerates through a coil as shown in the figure. Which of the following graphs best represents the variation of the induced e.m.f. (E) of the coil with time (t)?





(1) (2) (3)

(4) (5)