සියලු ම හිමිකම් ඇවිරිණි/முழுப் பதிப்புரிமையுடையது/All Rights Reserved]

නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

NEW

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
General Certificate of Education (Adv. Level) Examination, 2020

භෞතික විද්‍යාව I
பௌதிகவியல் I
Physics I

01 E I

පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Instructions:

- *This question paper consists of* **50** *questions in* **11** *pages.*
- *Answer* ***all*** *the questions.*
- *Write your* ***Index Number*** *in the space provided in the answer sheet.*
- *Read the instructions given on the back of the answer sheet carefully.*
- *In each of the questions* **1** *to* **50**, *pick one of the alternatives from* (1), (2), (3), (4), (5) *which is* ***correct*** *or* ***most appropriate*** *and* ***mark your response on the answer sheet with a cross*** (×) ***in accordance with the instructions given on the back of the answer sheet.***

Use of calculators is not allowed.

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

1. Dimensions of Planck's constant are,
(1) M^2LT (2) M^2LT^{-1} (3) MLT^2 (4) MLT^{-1} (5) ML^2T^{-1}

2. Figure (a) shows the scale of a micrometer screw gauge when the spindle and the anvil touch each other. Figure (b) shows the scale when a metal sphere is properly placed between the spindle and the anvil. The pitch of the screw is 0·5 mm and the circular scale is divided into 50 equal divisions.

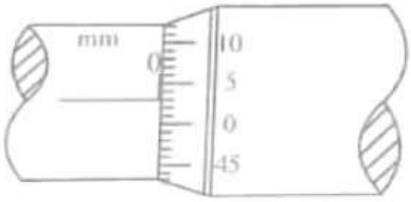


Figure (a)

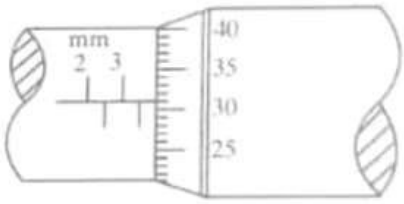
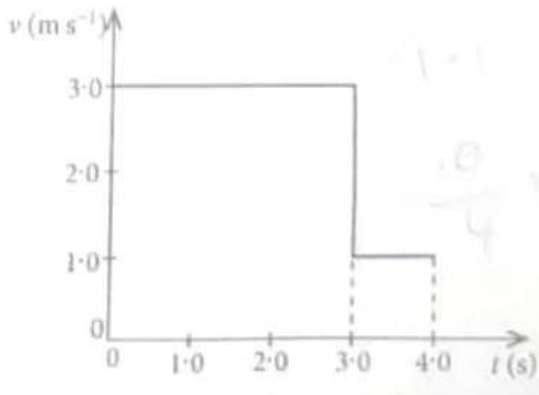


Figure (b)

What is the correct diameter of the metal sphere?
(1) 3·28 mm (2) 3·31 mm (3) 3·78 mm (4) 3·81 mm (5) 3·84 mm

3. The threshold of hearing of a normal human ear is $10^{-12}\ W\ m^{-2}$. This corresponds to a sound intensity level of
(1) 0 dB (2) 1 dB (3) 10 dB (4) 12 dB (5) 120 dB

4. The figure shows the velocity (v) - time (t) graph for an object moving along a straight line. What is the average velocity of the object from $t = 0$ to $t = 4$ s?



(1) $1{\cdot}5\ m\ s^{-1}$ (2) $2{\cdot}0\ m\ s^{-1}$
(3) $2{\cdot}5\ m\ s^{-1}$ (4) $2{\cdot}7\ m\ s^{-1}$
(5) $3{\cdot}3\ m\ s^{-1}$

[See page two

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5. The figure shows a thin uniform rod AB of length L and mass M. Moment of inertia of the rod about axis PQ parallel to the rod, situated at a distance y is,

(1) My^2 (2) $M(L^2 + y^2)$

(3) $\frac{1}{3}ML^2$ (4) $\frac{1}{2}M(L^2 + y^2)$

(5) zero

6. The quark content of a proton (p) and a neutron (n) are respectively given by,

(1) ssd, sdd (2) udd, uus (3) ssd, und

(4) uud, udd (5) udd, uud

7. Which of the following statements made regarding seismic waves is **incorrect**?

(1) All seismic waves are mechanical waves and require a medium to propagate.

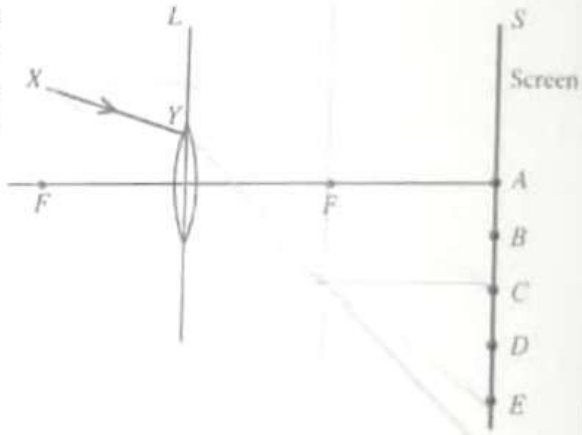
(2) Primary (P) waves are longitudinal and secondary (S) waves are transverse.

(3) Speed of S - waves is less than that of P - waves.

(4) S - waves can travel through both liquid and solid media.

(5) P - waves can travel through both liquid and solid media.

8. A narrow beam of monochromatic light XY falls on a converging lens L as shown in the figure. After refraction through the lens, the beam hits the screen S and makes a light spot. What would be the position of the light spot?

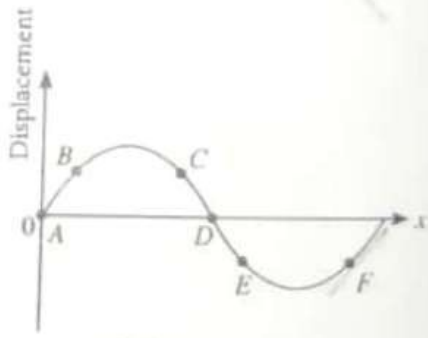


(1) A (2) B

(3) C (4) D

(5) E

9. Positions of particles of a transverse wave travelling along $+x$ direction at a certain instance is shown in the figure. A pair of particles with same **instantaneous velocities** is,



(1) B and F (2) A and D

(3) B and C (4) C and F

(5) B and E

10. A small instrument of mass 1·0 kg is placed on a planet. The mass of the planet is three times and radius is two times that of the earth. What would be the weight of the instrument on the surface of the planet? Neglect all the other effects except gravitation.

(1) $\frac{15}{4}$ N (2) $\frac{20}{3}$ N (3) $\frac{15}{2}$ N (4) 10 N (5) $\frac{45}{4}$ N

11. Two identical transverse waves of frequency 300 Hz and speed 30 m s^{-1} travelling in opposite directions along x-axis, superimpose with each other and produce a standing wave. The distance between a node and its adjacent anti-node is equal to,

(1) 2·5 cm (2) 5·0 cm (3) 10·0 cm (4) 15·0 cm (5) 20·0 cm

[See page three

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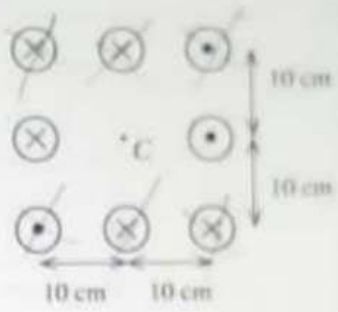
12. Very long eight parallel wires each carries a current of 10 A. The directions of the current in each wire are shown in the figure. The magnitude and the direction of the magnetic flux density produced at the centre (C) are,

($\frac{\mu_0}{4\pi} = 10^{-7}$ T m A^{-1} ; Neglect the effect of earth's magnetic field)



(1) 20 μT ↓ (2) 20 μT ↑

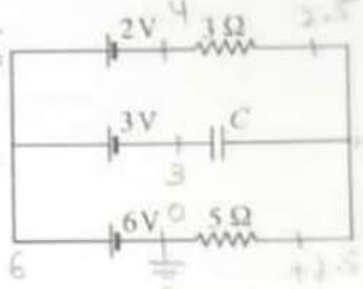
(3) 40 μT ↑ (4) 40 μT ↓

(5) 40 μT →

13. Two adjacent rooms A and B at same temperature, connected by a closed door are initially at relative humidity (RH) 60% and 90% respectively. The volume of room A is twice that of room B. If the door is kept open for a long time at the same temperature, what would be the final relative humidity of the rooms?

(1) 65% (2) 70% (3) 75% (4) 80% (5) 85%

14. All batteries shown in the circuit diagram have negligible internal resistances. If the capacitor C is ideal, what is the potential difference across C?



(1) 0·5 V (2) 1·0 V

(3) 2·0 V (4) 2·5 V

(5) 3·5 V

15. Which of the following statement is **incorrect**?

(1) The electrical conductivity of an intrinsic semiconductor increases with increasing temperature.

(2) A full-wave rectifier cannot produce a constant d.c. output voltage for a sinosoidal input.

(3) In a bipolar transistor, the emitter is heavily doped than that of the collector.

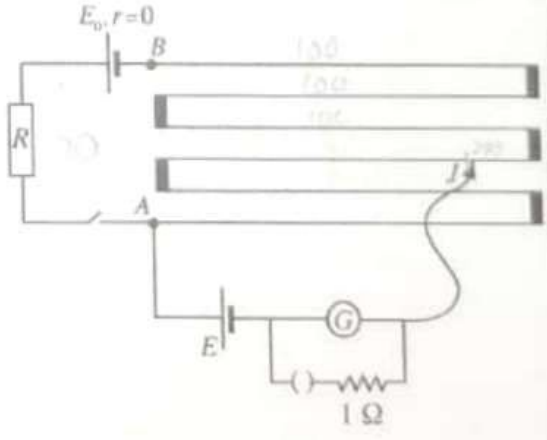
(4) Drain current (I_D) of a Junction Field Effect Transistor (JFET) is maximum when Gate to Source voltage is zero ($V_{GS} = 0$).

(5) When an op-amp is used as a voltage comparator, closed loop state is used.

16. A particle of mass m performs a simple harmonic motion. If the maximum velocity and the maximum acceleration of the particle are V and a respectively, the angular frequency (ω) of the particle is given by,

(1) $\frac{V}{ma}$ (2) $\frac{2\pi V}{a}$ (3) $\frac{2\pi a}{V}$ (4) $\frac{a}{V}$ (5) $\frac{V}{a}$

17. The length of the potentiometer wire AB is 600 cm and its resistance is 10 Ω. R is a resistance box. When R is set to 70 Ω the balance length is 280 cm. What will be the distance that sliding key J must be moved from the previous position to balance again if R is changed to 80 Ω?



(1) 45 cm (2) 40 cm

(3) 35 cm (4) 30 cm

(5) 25 cm

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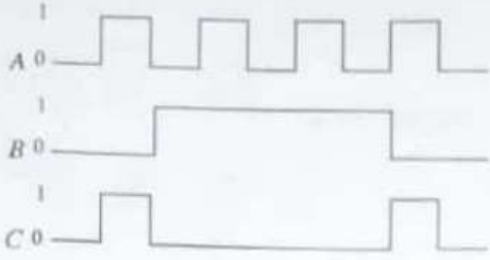
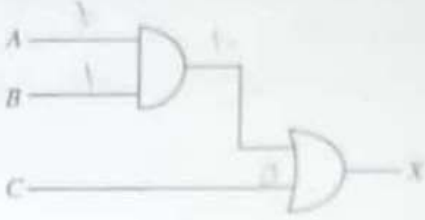
18. Logical inputs A, B and C of the given circuit is shown below.





The shape of the correct output (X) is,

(1) 

(2) 

(3) 

(4) 

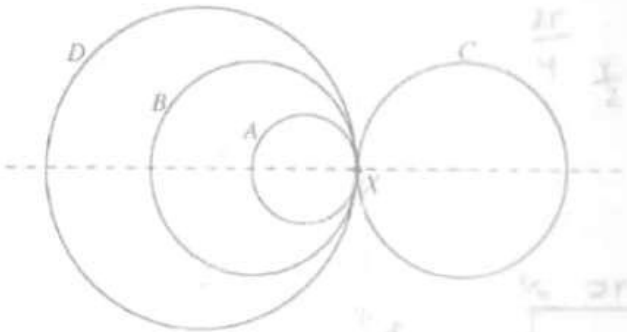
(5) 

19. The combined object, illustrated in the figure is formed by joining four metallic rings A, B, C and D of radii r, $2r$, $2r$ and $3r$ respectively made out of same uniform wire. The distance to the centre of gravity of the combined object from point X is,

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

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

(5) zero



20. Water and coconut oil are poured into the two limbs of a U-tube as shown in the figure. Assume that the water - oil interface is at the middle of the tube and it is vertical. (ρ_w = density of water, ρ_o = density of coconut oil) Consider the following expressions about this situation.

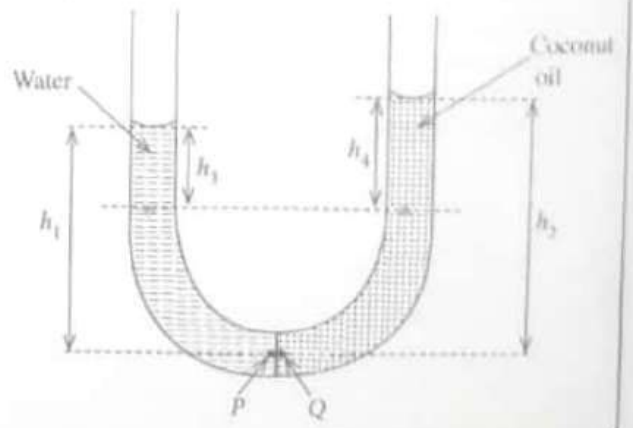
(A) Pressure at point P = Pressure at point Q

(B) $h_1\rho_w = h_2\rho_o$

(C) $h_3\rho_w = h_4\rho_o$

Of the above expressions,

(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.



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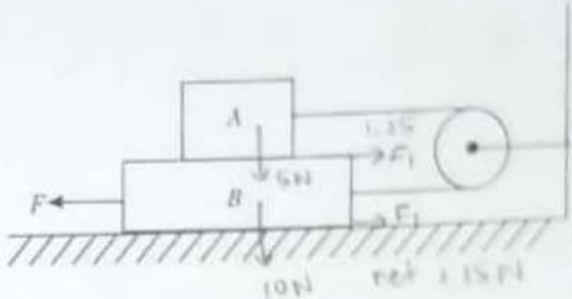
21. Two identical opened pipes each of length 50 cm are sounded with their fundamental notes at 15 °C. The variation of velocity of sound v (m s^{-1}) in air with temperature is given by $v = 331 + 0.6\theta$, where θ is in °C. If the temperature of one pipe is raised to 30 °C, what would be the number of beats produced per second?

(1) 4 (2) 6 (3) 9 (4) 12 (5) 14

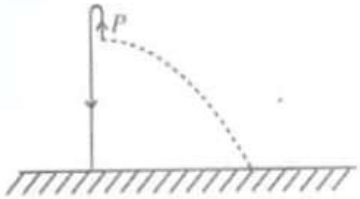
22. Two blocks A and B of mass 0·5 kg and 1·0 kg respectively are connected by a massless inextensible string which goes over a massless, smooth pulley as shown in the figure. The coefficient of dynamic friction between all contact surfaces is 0·25. What is the force F needed to drag the block B to the left with a constant speed?



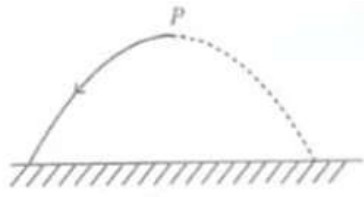
(1) 2·50 N (2) 3·75 N (3) 5·00 N (4) 6·25 N (5) 7·50 N

23. A projectile suddenly explodes into two fragments with equal masses at the highest point (P) of its trajectory. If one fragment falls vertically downwards with an initial velocity as shown, which of the following diagrams best represents the path of the other fragment?

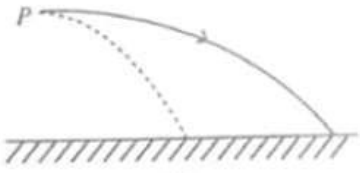
(Neglect air resistance. The broken line represents the path of the projectile if there was no explosion.)



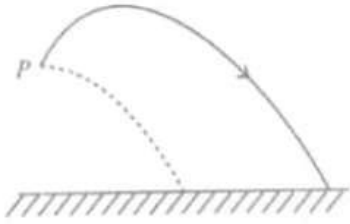
(1)



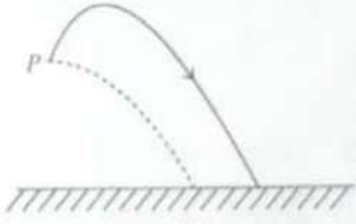
(2)



(3)

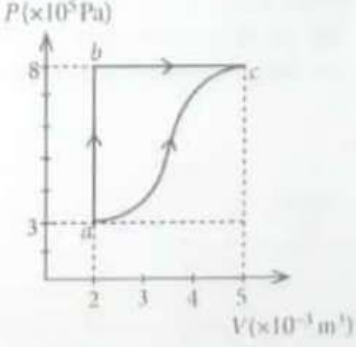


(4)



(5)

24. Two thermodynamic processes ($a \rightarrow b \rightarrow c$ and $a \rightarrow c$) of a closed system of an ideal gas are shown in the figure. In the process abc, 6·0 kJ heat is absorbed by the system to go from a to b and 1·8 kJ heat is absorbed from b to c. What is the change in internal energy in the process ac?



(1) 4·2 kJ (2) 5·4 kJ

(3) 6·3 kJ (4) 6·7 kJ

(5) 10·2 kJ

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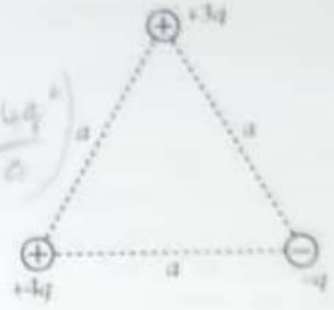
25. Three point charges $+4q$, $+3q$ and $-q$ are placed at vertices of an equilateral triangle of side a as shown in the figure. The electric potential energy of the system is given by,

(1) $\frac{5q^2}{4\pi\varepsilon_0 a}$ (2) $\frac{3q^2}{2\pi\varepsilon_0 a}$

(3) $\frac{7q^2}{4\pi\varepsilon_0 a}$ (4) $\frac{2q^2}{\pi\varepsilon_0 a}$

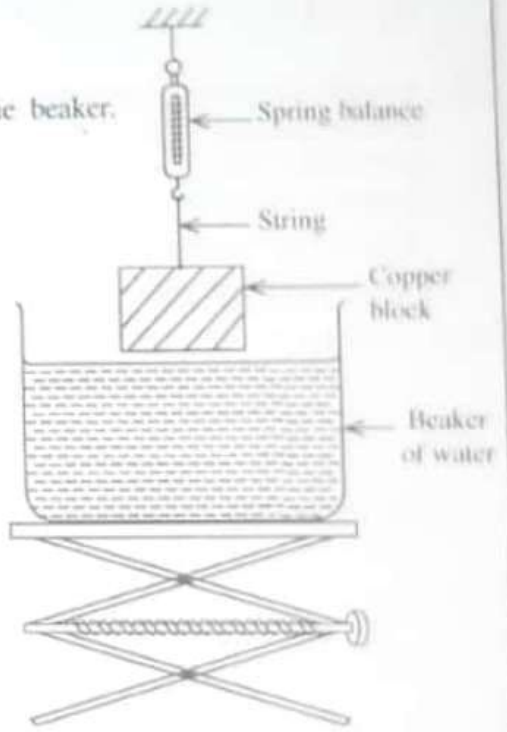
(5) $\frac{19q^2}{4\pi\varepsilon_0 a}$



26. A copper block is hung over a beaker of water by a spring balance as shown in the figure. Consider the following positions while the beaker of water is slowly raising upward.

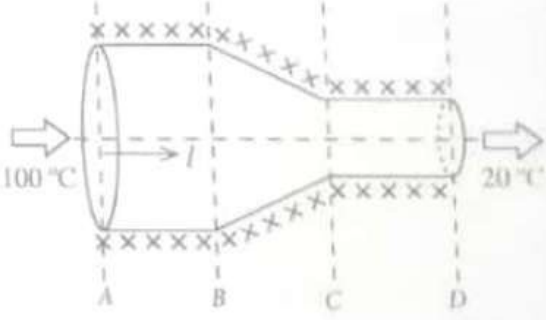
Position 1 : The block is partially submerged.
Position 2 : The block is completely submerged.
Position 3 : The block is on the bottom surface of the beaker.

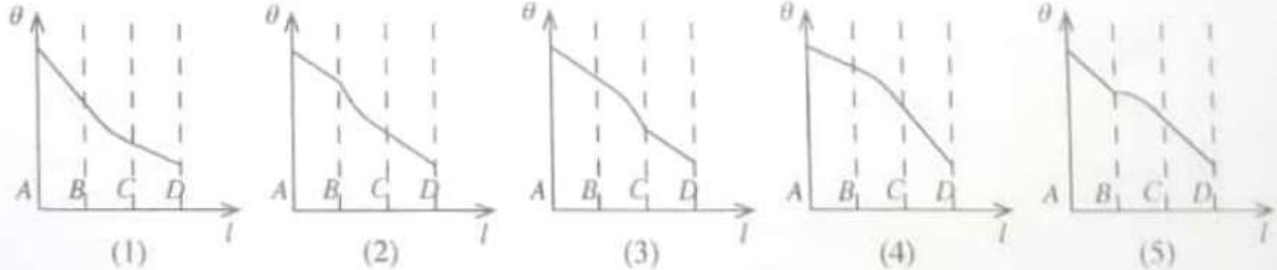
The buoyant forces and the readings of the balance with respect to positions 1, 2 and 3 are given by B_1, B_2, B_3 and W_1, W_2, W_3 respectively. Which of the following is correct?



	Buoyant Force	Reading of the balance
(1)	$B_1 < B_2 < B_3$	$W_1 > W_2 > W_3$
(2)	$B_1 = B_2 < B_3$	$W_1 = W_2 > W_3$
(3)	$B_1 = B_2 < B_3$	$W_1 > W_2 = W_3$
(4)	$B_1 < B_2 = B_3$	$W_1 > W_2 = W_3$
(5)	$B_1 < B_2 = B_3$	$W_1 > W_2 > W_3$

27. The cross-sectional area of a uniform cylindrical metal rod is gradually reduced in part BC to form an object as shown in the figure. The object is perfectly lagged and the two ends of the object are maintained at temperature of 100 °C and 20 °C. At the steady state, the variation of temperature (θ) along the axis (l) of the object is best represented by,





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

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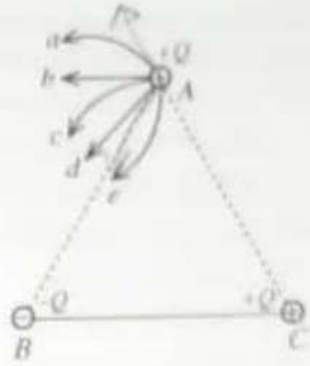
28. Three small conducting spheres carrying charges $+Q$, $-Q$ and $+Q$ are located at the vertices of an equilateral triangle ABC situated on a frictionless horizontal surface as shown in the figure. Spheres at B and C are fixed and the sphere at A is free to move. The possible path of the sphere at A is best represented by

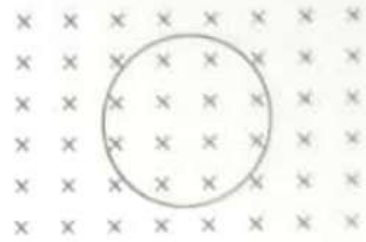


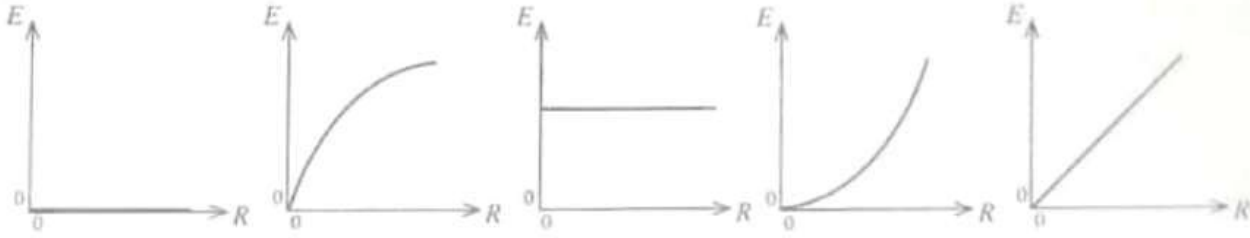
(1) a (2) b

(3) c (4) d

(5) e

29. As shown in the figure a conducting loop is placed perpendicular to a uniformly increasing magnetic field. Which of the following graphs best represents the variation of the magnitude of induced e.m.f. (E) in the loop with the rate of change of the magnetic flux density (R)?





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

30. An object of mass m stationary at time $t = 0$ is subjected to a force F, directed along a straight line, that varies with time t as shown in the graph. Select the correct statement from the followings.

After the motion has started, the velocity of the object becomes zero,

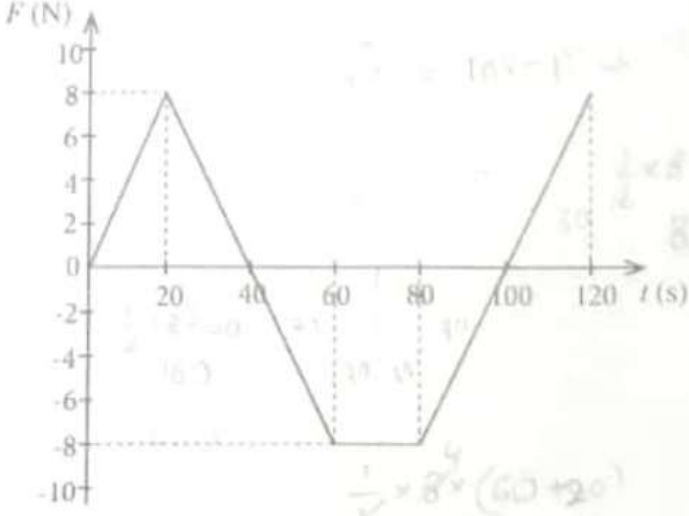
(1) at $t = 40$ s only.

(2) at $t = 70$ s only.

(3) at $t = 40$ s and $t = 100$ s.

(4) at $t = 70$ s and $t = 120$ s.

(5) during the time interval from $t = 60$ s to $t = 80$ s.



31. Identical small spherical droplets of mercury are charged so that each droplet has the same electric potential of 0·01 V. If one million (10^6) such droplets are combined to form a large spherical drop, what would be the electric potential of the large drop?

(1) 0·01 V (2) 1·0 V (3) 10 V (4) 100 V (5) 1000 V

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32. A narrow beam of monochromatic light is passing through a prism placed in air. Consider the following statements about the angle of **minimum deviation** D.

(A) D increases with the increase of refractive index of the material of prism.

(B) D first decreases and then increases with gradual increasing of the angle of incidence.

(C) D increases with the increase of the angle of prism.

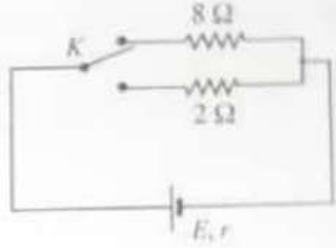
Of the above statements,

(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.

33. Using a two-way key K, a cell of e.m.f. E and internal resistance r can be connected in series either with resistor of resistance 8 Ω or 2 Ω as shown in the figure. If power dissipation of each resistor is the same, what would be the value of the internal resistance r?



(1) 2 Ω (2) 4 Ω

(3) 5 Ω (4) 6 Ω

(5) 8 Ω

34. A hot object hung in a room at 30 °C takes 5 min to cool from 60 °C to 50 °C. What is the time taken by the object to cool further from 44 °C to 36 °C under same conditions?

(1) 10 min (2) 12·5 min (3) 15 min (4) 20 min (5) 25 min

35. What is the **maximum** mass of ice at −5 °C that can be completely dissolved in 1 kg of water at 35 °C in a container with negligible heat capacity?

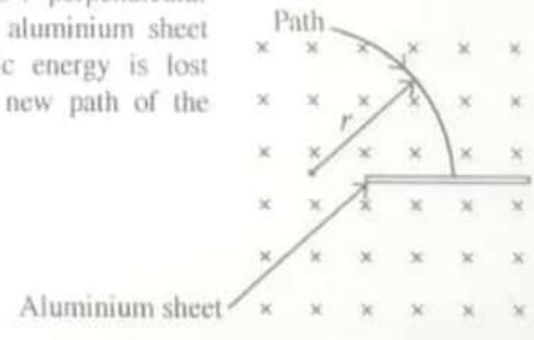
Let the specific heat capacities of ice and water be $2{\cdot}0 \times 10^3$ J kg^{-1} °C^{-1} and $4{\cdot}0 \times 10^3$ J kg^{-1} °C^{-1} respectively, and the specific latent heat of fusion of ice be $3{\cdot}4 \times 10^5$ J kg^{-1}. Assume there is no exchange of heat with the surrounding.

(1) 200 g (2) 240 g (3) 300 g (4) 360 g (5) 400 g

36. Magnifying power of a compound microscope in normal adjustment is 100. The focal length of the objective lens is 2·5 cm and the object distance is 2·6 cm. What is the magnification of the eyepiece?

(1) 4 (2) 5 (3) 10 (4) 20 (5) 25

37. A charged particle moving in a circular path of radius r perpendicular to a uniform magnetic field penetrates through a thin aluminium sheet as shown in the figure. If half of the initial kinetic energy is lost due to penetration, what would be the radius of the new path of the particle?



(1) $\frac{r}{2}$ (2) $\frac{r}{\sqrt{2}}$

(3) r (4) $\sqrt{2}\,r$

(5) $2r$

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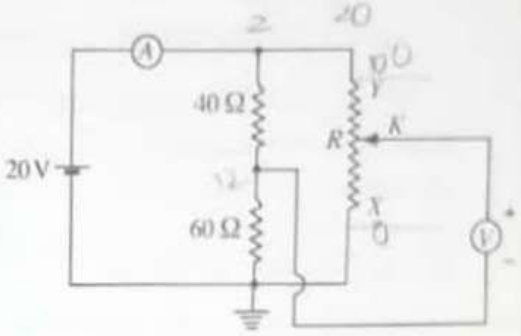
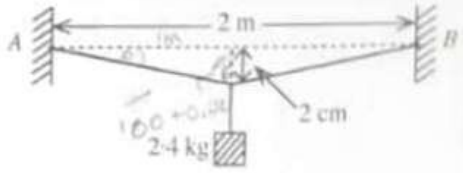
38. The electrical circuit shown in the figure has ideal centre-zero voltmeter and ammeter. The 20 V battery has negligible internal resistance. The value of the variable resistor R can be changed from 0 to 100 Ω. What are the ammeter (A) and voltmeter (V) readings when the sliding key K is at X and at Y?

	K is at X		K is at Y	
	(A)	(V)	(A)	(V)
(1)	200 mA	0	200 mA	+20 V
(2)	400 mA	0	400 mA	+20 V
(3)	200 mA	−12 V	200 mA	+8 V
(4)	400 mA	+12 V	400 mA	−8 V
(5)	400 mA	−12 V	400 mA	+8 V



39. A metal wire of length 2 m and cross-sectional area 5 mm^2 is rigidly clamped at two points A and B which are 2 m apart in the same horizontal plane. Then a block of mass 2·4 kg is hung from the mid point of the wire as shown in the figure. The mid point of the wire sags 2·0 cm from the initial position and the total extension of the wire is 0·04 cm. What will be the approximate value of Young's modulus of the metal?



(1) 2×10^{11} N m^{-2} (2) 3×10^{11} N m^{-2} (3) 4×10^{11} N m^{-2}

(4) 6×10^{11} N m^{-2} (5) 12×10^{11} N m^{-2}

40. An infinitely long thin straight wire which is located on the z-axis has a linear charge density of $-\lambda$. A small positive charge $+q$ of mass m is allowed to move in the xy-plane in a circular path of radius r about the wire. The periodic time of the charge is given by,

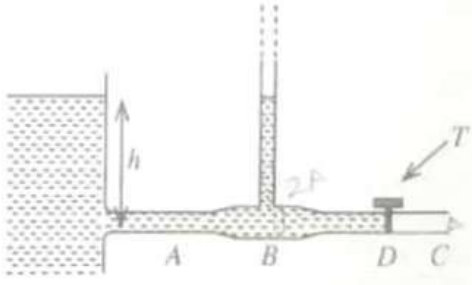
(1) $\sqrt{\frac{8\pi^3 r^2 m\varepsilon_0}{\lambda q}}$ (2) $\sqrt{\frac{4\pi^2 r^3 m\varepsilon_0}{\lambda q}}$ (3) $\sqrt{\frac{\lambda q}{8\pi^3 r^2 m\varepsilon_0}}$ (4) $\sqrt{\frac{\lambda q}{4\pi^2 r^3 m\varepsilon_0}}$ (5) $\sqrt{\frac{8r^2 m\lambda}{\varepsilon_0 q}}$

41. As shown in the figure a horizontal pipe ABC is connected to a water tank with a large cross-sectional area. The internal cross-sectional area of the pipe at B is twice that of at C. Initially a water tap (T) located at D is closed. Once the tap is opened what would be the height of water level in the vertical tube located at B? (Assume that the water flow is steady and streamline; Neglect the viscosity of water.)

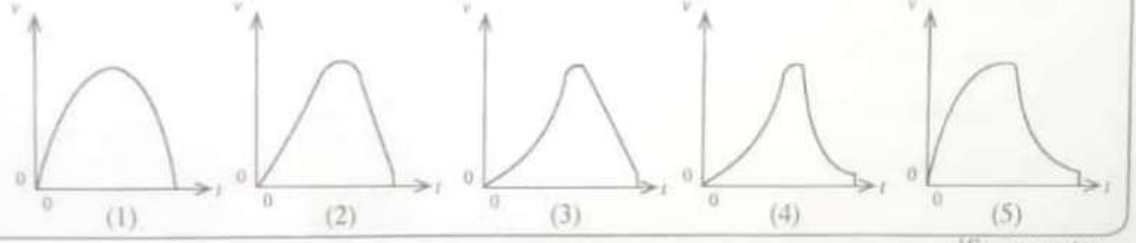
(1) $\frac{1}{4}h$ (2) $\frac{1}{2}h$

(3) $\frac{3}{4}h$ (4) h

(5) $\frac{4}{3}h$



42. A parachutist bails out from a helicopter at time $t = 0$. After a certain time he opens his parachute and then reaches the ground. Which of the following graph best represents the variation of the vertical component of the velocity (v) of the parachutist with time (t)?



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43. Consider the following statements about the half-life ($T_{1/2}$) of radioactive atoms in a sample.

(A) $T_{1/2}$ changes with the number of radioactive atoms present in the sample

(B) $T_{1/2}$ changes with the date and time of the prepared sample.

(C) $T_{1/2}$ does not change even if the radioactive atoms are ionized.

Of the above statements,

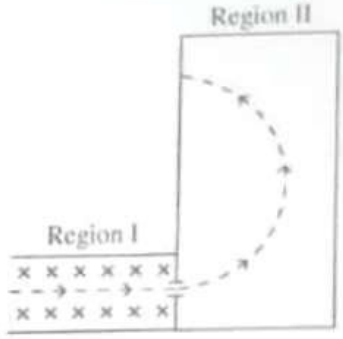
(1) only (A) is true. (2) only (B) is true.

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

(5) only (B) and (C) are true.

44. An electron moves in the plane of the paper through two regions along the path shown in the figure by broken line. Uniform Magnetic fields B_1 and B_2 exist in regions I and II respectively. A uniform electric field exists only in region I directed into the plane of the paper as denoted by crosses (×). Which of the following gives the correct directions of magnetic fields in regions I and II?

	B_1	B_2
(1)	↑	⊗
(2)	↑	⊙
(3)	⊙	⊗
(4)	⊗	⊙
(5)	↓	⊙



45. Figure shows a capillary tube dipped vertically in a container of water with a large cross-sectional area. The system is fixed in an elevator at rest. The open end of the capillary is 40 mm above the water level of the container and the capillary rise is 8 mm.

If the elevator is,

(I) moving downwards with an acceleration of 5 m s^{-2}

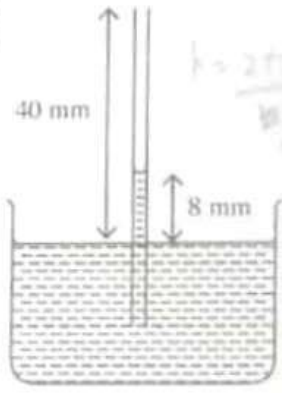
(II) falling freely

what would be the respective capillary rise?

(1) 4 mm, 0 (2) 16 mm, 0

(3) 4 mm, 8 mm (4) 16 mm, 32 mm

(5) 16 mm, 40 mm



46. Two vertical glass tubes (T_1 and T_2) filled with a liquid are connected at their lower ends by a horizontal capillary tube. One tube (T_1) is surrounded by a mixture of ice and water at 0 °C, and the other (T_2) by water kept at constant temperature 40 °C. The difference in the heights of the liquid in the two columns is 1·6 cm and the height of the liquid column at 0 °C is 80 cm as shown in the figure (drawn not to a scale). The real volume expansivity of the liquid is,

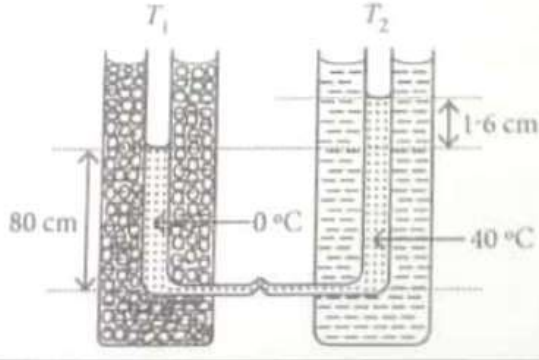
(1) $2{\cdot}5 \times 10^{-4}$ °C^{-1}

(2) $5{\cdot}0 \times 10^{-4}$ °C^{-1}

(3) $6{\cdot}0 \times 10^{-4}$ °C^{-1}

(4) $1{\cdot}0 \times 10^{-3}$ °C^{-1}

(5) $1{\cdot}2 \times 10^{-3}$ °C^{-1}



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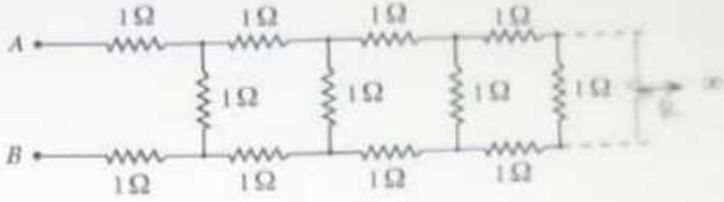
47. Figure shows an infinite ladder network of 1Ω resistors. If the equivalent resistance of this network between points A and B is R, which of the following is true?

(1) $R < 2\,\Omega$
(2) $R = 2\,\Omega$
(3) $R > 3\,\Omega$
(4) $R = 3\,\Omega$
(5) $2\,\Omega < R < 3\,\Omega$

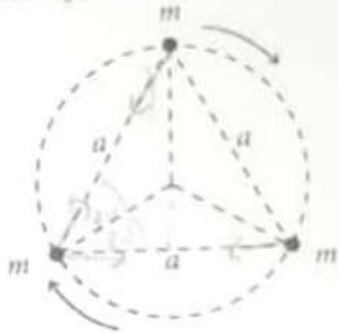


48. Three stars each of mass m are at the vertices of an equilateral triangle of side a as shown in the figure. Suppose, these three stars rotate in a circular path about the centroid of the triangle while retaining the initial distances among the stars. If only the mutual gravitational forces are acting among the stars, the periodic time of the system is given by,

(1) $2\pi\sqrt{\frac{a^3}{2GM}}$ (2) $2\pi\sqrt{\frac{a^3}{3GM}}$

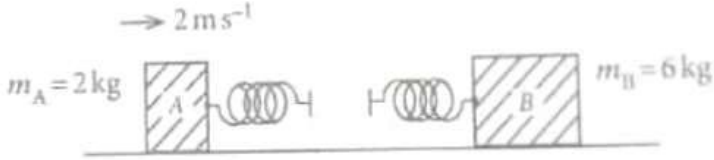
(3) $2\pi\sqrt{\frac{3a^3}{GM}}$ (4) $2\pi\sqrt{\frac{2a^3}{GM}}$

(5) $2\pi\sqrt{\frac{3a^3}{2GM}}$



49. Block A of mass 2 kg and block B of mass 6 kg are placed on a frictionless horizontal surface. Two identical springs of negligible mass are fixed to the blocks as shown in the figure. Block A is projected with speed $2\,m\,s^{-1}$ towards block B which is at rest. What is the **maximum energy** that the two springs could attain?

(1) 0 (2) 1 J
(3) 2 J (4) 3 J
(5) 4 J

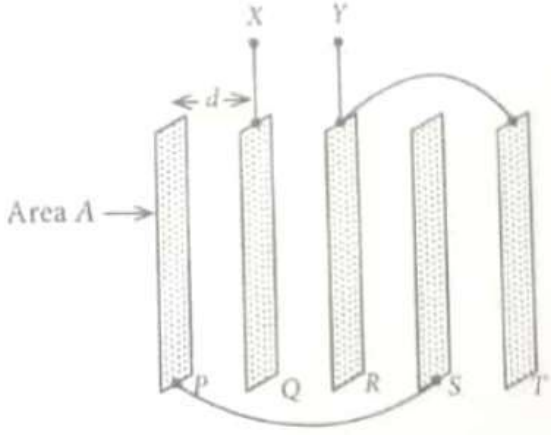


50. Five thin flat metal plates, each of area A are kept parallely in vacuum with an equal gap d. If plate P is connected to S and plate R is connected to T using conducting wires as shown in the figure, the equivalent capacitance between terminals X and Y is given by,

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

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

(5) $\frac{\varepsilon_0 A}{5d}$



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