අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

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. Which of the following pairs of physical quantities have same dimensions?
(1) Stress and strain (2) Work and energy
(3) Velocity and displacement (4) Weight and mass
(5) Torque and angular momentum

2. In a vernier calliper a length of 19 main scale divisions is equally divided into 20 vernier scale divisions. What should be the length of a main scale division in order to have a least count of 0·025 mm?
(1) 0·5 mm (2) 1·0 mm (3) 1·5 mm (4) 2·0 mm (5) 2·5 mm

3. Bending of light when passing a sharp edge is due to
(1) reflection. (2) refraction. (3) interference.
(4) diffraction. (5) total internal reflection.

4. If no external forces act on a system, which of the following is conserved in any type of collision?
(1) total kinetic energy (2) total potential energy
(3) total mechanical energy (4) total angular velocity
(5) total linear momentum

5. The mean kinetic energy of an ideal gas depends on its
(1) pressure. (2) volume. (3) density.
(4) absolute temperature. (5) specific heat capacity.

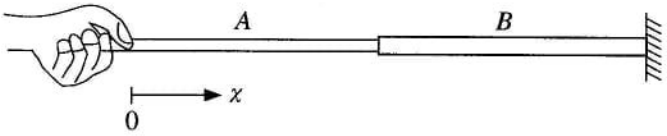
6. A block of mass M moving at velocity $2v$ on a flat frictionless surface makes a **perfect inelastic** collision with another block of mass M moving at velocity v along the same direction. What is the velocity of the first block after the collision?
(1) 0 (2) $\frac{1}{2}v$ (3) v (4) $\frac{3}{2}v$ (5) $2v$

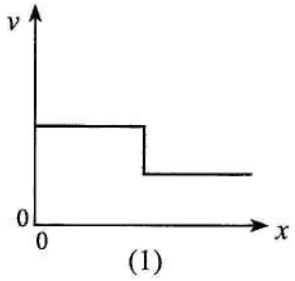
7. The breaking strain of an aluminium rod is 0·2%. What is the minimum cross-sectional area of the rod to withstand a force of $3{\cdot}5 \times 10^3$ N? (Young's modulus of aluminium is $7{\cdot}0 \times 10^{10}\ N\ m^{-2}$)
(1) $1{\cdot}0 \times 10^{-3}\ m^2$ (2) $4{\cdot}0 \times 10^{-4}\ m^2$ (3) $4{\cdot}0 \times 10^{-5}\ m^2$
(4) $2{\cdot}5 \times 10^{-5}\ m^2$ (5) $1{\cdot}0 \times 10^{-5}\ m^2$

8. What is the charge of a down quark (d)? (The elementary charge is e.)

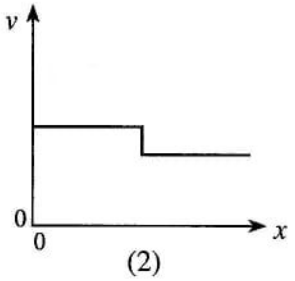
(1) $+e$ (2) $+\frac{2}{3}e$ (3) $-\frac{1}{3}e$ (4) $-\frac{2}{3}e$ (5) $-e$

9. The figure shows a composite string made of same material. The cross-sectional area of string B is twice that of string A. The other end of the string B is attached to a fixed wall. If both strings are under same tension which of the following graphs best represents the variation of speed v of transverse waves generated in strings with distance x?

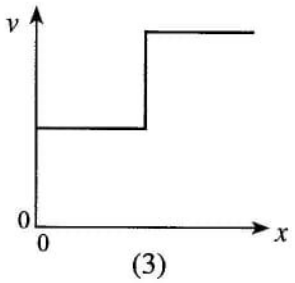




(1)



(2)



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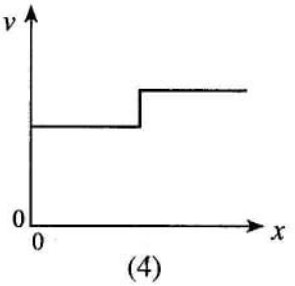

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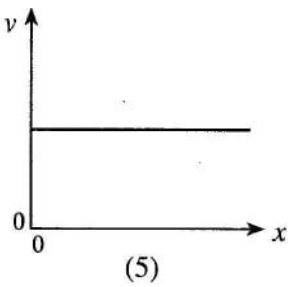
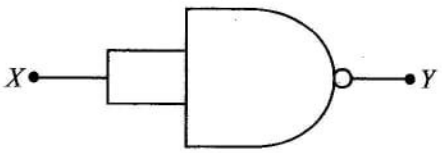


(5)

10. The given circuit is equivalent to a

(1) NOT gate.
(2) OR gate.
(3) AND gate.
(4) NOR gate.
(5) EXOR gate.



11. An object is placed in front of a concave lens as shown in the figure. The paths of the refracted rays emitting from point A of the object are

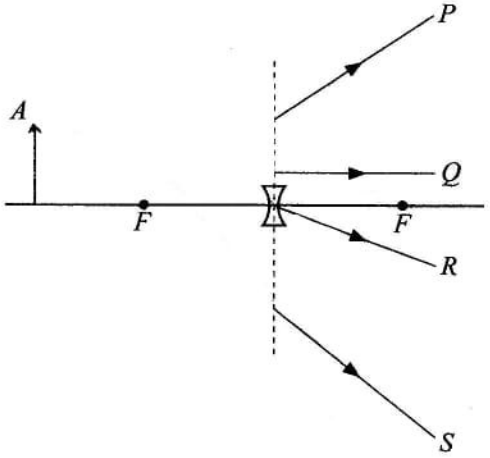
(1) P and R only.

(2) Q and R only.

(3) P, R, and S only.

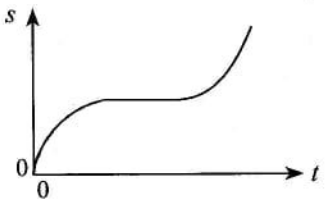
(4) P, Q, and R only.

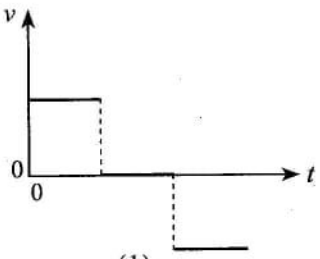
(5) all P, Q, R and S.



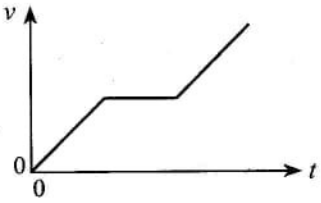
[See page three

12. The displacement-time (s-t) graph for the motion of an object is shown in the figure. The corresponding velocity-time (v-t) graph would be best represented by,

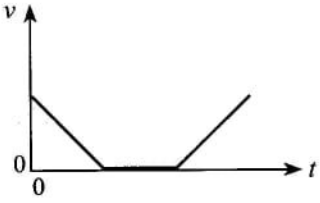




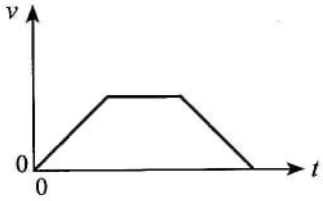
(1)



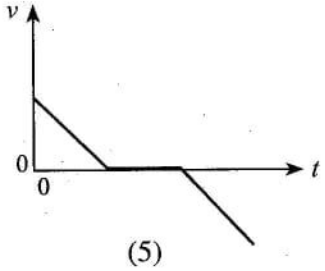
(2)



(3)

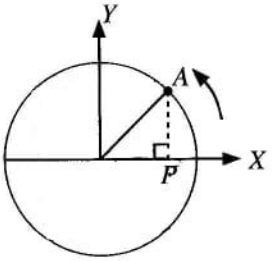


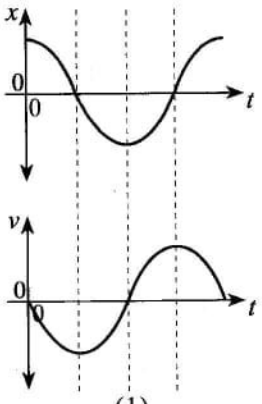
(4)



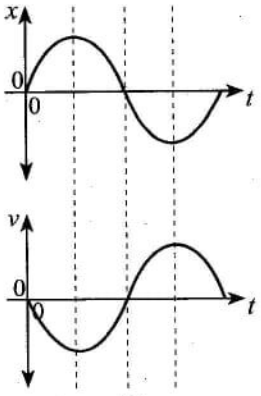
(5)

13. An object A moving in a circular path at a uniform angular velocity is shown in the figure. The variation of displacement (x) and velocity (v) of the point (P) of projection of the object on the X-axis with time (t) is best represented by,

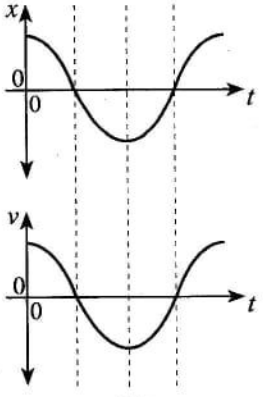




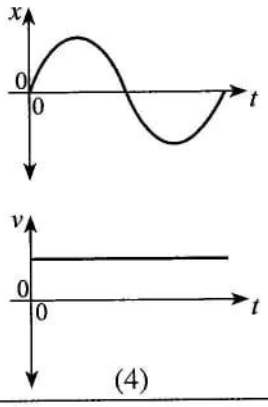
(1)



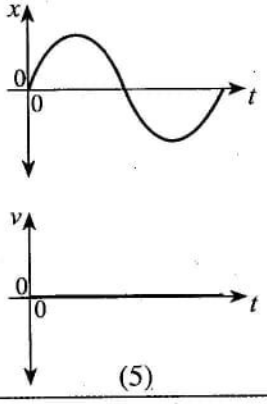
(2)



(3)



(4)



(5)

[See page four

14. Water rises in a long vertical capillary tube up to a height of 2·0 cm. When the tube is inclined at an angle 60° with the vertical, what is the length of the water column in the tube?

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

15. Consider the following statements regarding the moment of inertia of a body.

(A) It depends on mass of the body.

(B) It depends on mass distribution of the body.

(C) It depends on angular velocity of the body.

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.

16. A liquid of density ρ flowing at speed $3v$ through a horizontal tube of cross-sectional area A strikes a vertical wall perpendicularly and flows down along the wall without recoil. The force exerted on the wall by the liquid is

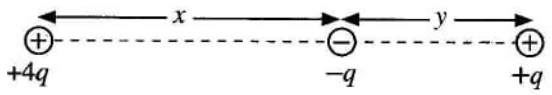
(1) $3\rho Av^2$ (2) $9\rho Av^2$ (3) $18\rho Av^2$ (4) $9\rho A^2v^2$ (5) $18\rho A^2v^2$

17. Two point charges $+4q$ and $-q$ are fixed at distance x apart as shown in the figure. Another point charge $+q$ does not experience a net electric force when it is kept along the same line at distance y from $-q$. The relation between x and y is given by

(1) $x=y$ (2) $\sqrt{2}x=y$

(3) $x=\sqrt{2}y$ (4) $x=2y$

(5) $2x=y$

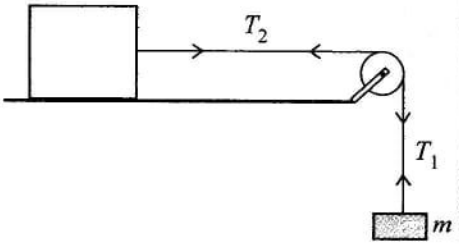


18. A block placed on a horizontal frictionless table is attached to mass m by a light inextensible string that passes over a pulley as shown in the figure. When released from rest, mass m and the pulley accelerate. If the tensions in the sections in the string are T_1 and T_2 as marked, which of the following is true?

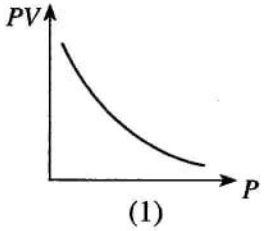
(1) $mg=T_1=T_2$ (2) $mg>T_1=T_2$

(3) $mg>T_1<T_2$ (4) $mg=T_1>T_2$

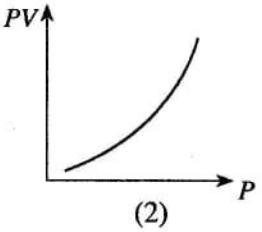
(5) $mg>T_1>T_2$



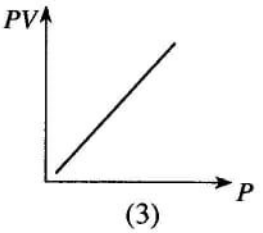
19. The variation of product (PV) of pressure and volume with pressure (P) for a fixed mass of an ideal gas at constant temperature is best represented by



(1)



(2)



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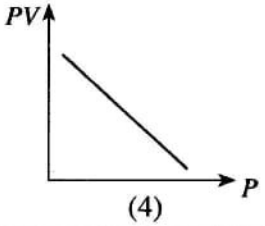
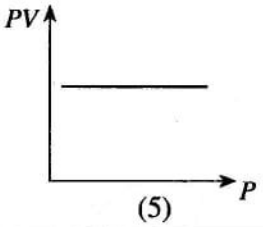


(4)



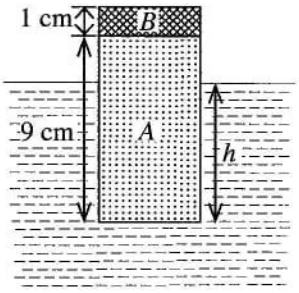
(5)

[See page five

20. The diameter and mean density of Jupiter are 11 times and $\frac{1}{4}$ times respectively to that of Earth. If the gravitational intensity at the surface of Earth is $10\,N\,kg^{-1}$ what is the gravitational intensity at the surface of Jupiter?

(1) $27{\cdot}5\,N\,kg^{-1}$ (2) $44{\cdot}0\,N\,kg^{-1}$ (3) $48{\cdot}4\,N\,kg^{-1}$ (4) $110\,N\,kg^{-1}$ (5) $440\,N\,kg^{-1}$

21. A composite solid cylinder consisting parts A and B is made from materials whose densities are $600\,kg\,m^{-3}$ and $2000\,kg\,m^{-3}$ respectively. The height of part A is 9 cm and that of B is 1 cm. The cylinder floats in water of density $1000\,kg\,m^{-3}$ as shown in the figure. What is the height (h) of the cylinder under water?



(1) 2·6 cm (2) 5·4 cm

(3) 7·4 cm (4) 8·0 cm

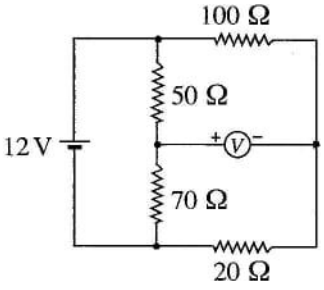
(5) 9·0 cm

22. If the doping concentrations of emitter, base and collector of a bipolar junction transistor are n_E, n_B and n_C respectively which of the following is true?

(1) $n_C > n_B > n_E$ (2) $n_E > n_C > n_B$ (3) $n_B > n_E = n_C$

(4) $n_C > n_E > n_B$ (5) $n_E = n_C > n_B$

23. Consider the circuit shown in the figure. The internal resistance of the 12 V cell is negligible and the centre zero voltmeter is ideal. What is the value of the voltmeter reading?



(1) +5 V (2) +3 V

(3) 0 V (4) –3 V

(5) –5 V

24. When a plate $PQRST$ is hanging freely from point X it balances as shown figure (1). When hanging freely from point Y it balances as shown in figure (2). The centre of gravity of the plate is most likely to be found at

(1) A (2) B

(3) C (4) D

(5) E

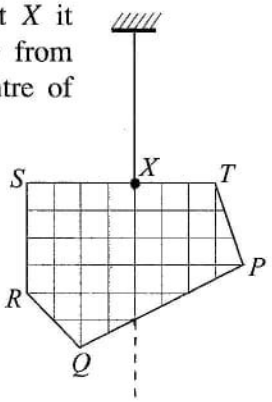


Figure (1)

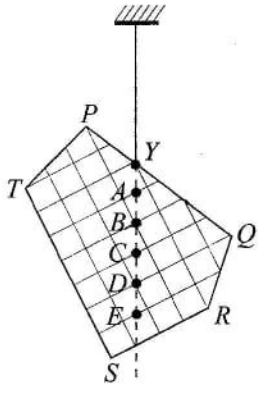


Figure (2)

25. Wind generated by cyclone Burevi passed across a region in Sri Lanka with speed of $30\,m\,s^{-1}$. If the wind had passed over a roof of a house with effective cross-sectional area of $100\,m^2$, what was the lifting force on the roof due to wind? (Assume that air inside the house was still and the density of air is $1{\cdot}3\,kg\,m^{-3}$)

(1) $5{\cdot}85\times10^{2}N$ (2) $5{\cdot}85\times10^{4}N$ (3) $7{\cdot}61\times10^{4}N$ (4) $1{\cdot}17\times10^{5}N$ (5) $1{\cdot}95\times10^{5}N$

[See page six

26. A small spherical liquid drop of radius r. and density ρ falls with terminal velocity v in still air. The coefficient of viscosity of air is η and the density of air can be neglected. Consider the following statements regarding the terminal velocity v of the droplet.

(A) It is directly proportional to r^2.

(B) It is directly proportional to ρ.

(C) It is inversely proportional to η.

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.

27. Consider the following statements made regarding electromagnetic (EM) waves.

(A) They can be transverse or longitudinal.

(B) They require a medium to propagate.

(C) They are not deflected by electric or magnetic field.

Of the above 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.

28. When uranium $^{235}_{92}U$ nucleus is bombarded with a slow neutron (n), the following nuclear reaction may take place.

$$^{235}_{92}U + n \longrightarrow {}^{102}_{44}X + {}^{131}_{a}Y + bn$$

The values of a and b are respectively,

(1) 48 and 1 (2) 48 and 2 (3) 48 and 3 (4) 49 and 2 (5) 49 and 3

29. A metal surface is illuminated with monochromatic blue, red and yellow light separately. Consider the following statements.

(A) If red light ejects photoelectrons, then blue light should also eject photoelectrons.

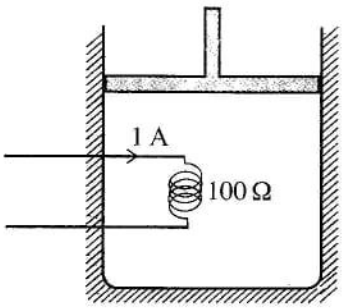
(B) If yellow light ejects photoelectrons, then red light should also eject photoelectrons.

(C) If blue light ejects photoelectrons, then red light should also eject photoelectrons.

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.

30. Air is trapped in a well-insulated container by a frictionless piston as shown in the figure. The air is heated by a coil of resistance 100 Ω passing a current of 1 A for 5 minutes. The air expands from a volume of 0·4 m^3 to 0·5 m^3 at a constant pressure of 150 kPa during the heating process. The change in internal energy of the air is,



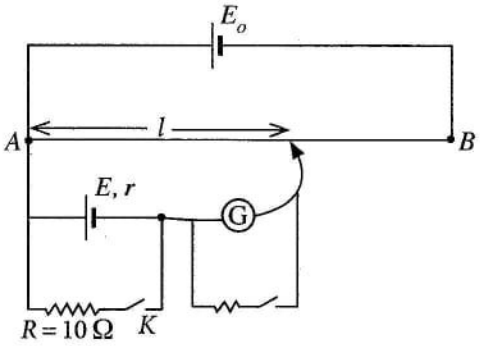
(1) 5 kJ (2) 15 kJ

(3) 30 kJ (4) 45 kJ

(5) 60 kJ

[See page seven

31. A student used the potentiometer circuit shown in the figure to determine the internal resistance (r) of cell E. When key K is opened, the balance length (l) is 60·0 cm and when key K is closed the balance length is 50·0 cm. What is the internal resistance of the cell E?

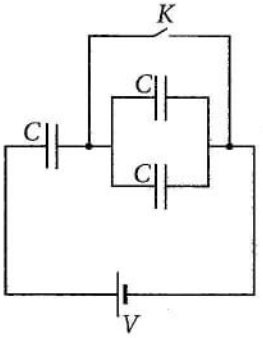


(1) 1·0 Ω (2) 1·2 Ω

(3) 2·0 Ω (4) 5·0 Ω

(5) 6·0 Ω

32. Three capacitors each of capacitance C are connected to a battery and a key K as shown in the figure. Initially the key K is closed. Once the capacitors are fully charged, the key K is opened. If the potential difference across the battery is V, the total charge of the capacitors in the circuit is



(1) not changed.

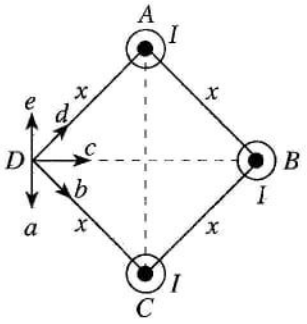
(2) decreased by $\frac{1}{3}CV$.

(3) decreased by CV.

(4) increased by $\frac{1}{3}CV$.

(5) increased by CV.

33. Three long straight conducting wires A, B and C are kept at the three vertices of a square as shown in the figure. They are parallel to each other and carry equal currents of I directed out of the plane of the paper. The direction of the resultant magnetic flux density at point D is given by,

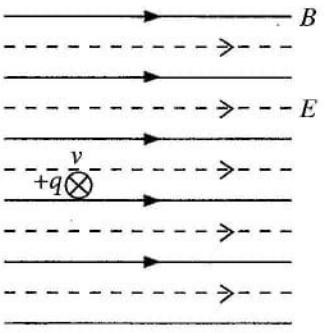


(1) a (2) b

(3) c (4) d

(5) e

34. A uniform magnet field of flux density (B) 1 T and a uniform electric field of field intensity (E) 300 V m^{-1} are parallel to each other in a region as shown in the figure. A particle of charge $+q$ enters at a velocity (v) 400 m s^{-1} perpendicular to the fields and directed into the plane of the paper. The magnitude of the resultant force acting on the particle is

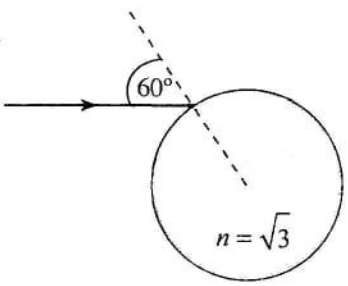


(1) 0 (2) 100q

(3) 300q (4) 500q

(5) 700q

35. A monochromatic ray of light falls on the surface of a glass sphere with incident angle 60° as shown in the figure. Refractive index of glass is $\sqrt{3}$. The total angle of deviation of the emerging ray from the sphere is



(1) 0° (2) 30°

(3) 60° (4) 90°

(5) 180°

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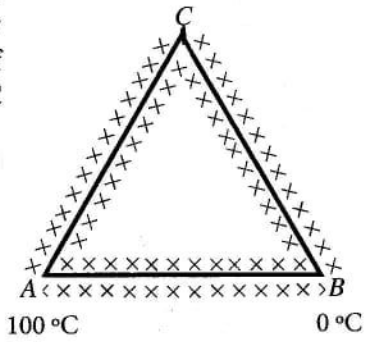
36. An equilateral triangle is constructed using three rods having same cross-sectional area as shown in the figure. All the rods are perfectly lagged. Thermal conductivity of the material of AB is twice that of the materials AC and CB. Ends A and B are maintained at 100 °C and 0 °C, respectively. At the steady state,



The ratio $\frac{\text{Rate of heat flow through } AB}{\text{Rate of heat flow through } AC}$ is equal to

(1) 0·25 (2) 0·5

(3) 1 (4) 2

(5) 4

37. Consider the following statements about an astronomical telescope and a compound microscope.

Statement	Astronomical Telescope	Compound Microscope
(A) The focal length of the objective lens is	large	small
(B) The final image at normal adjustment is	at infinity	at infinity
(C) The total angular magnification is	less than 1	greater than 1

What is/are the correct statement/s for both instruments?

(1) Only (A) (2) Only (B)

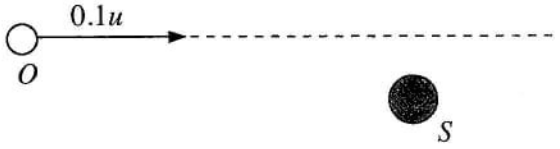
(3) (A) and (B) only (4) (B) and (C) only

(5) (A) and (C) only

38. A flywheel of moment of inertia 0·4 kg m^2 is rotated with uniform angular speed of 10 rad s^{-1} by a motor of power 100 W. When the motor is switched off, the angular deceleration of the flywheel is

(1) 1 rad s^{-2} (2) 20 rad s^{-2} (3) 25 rad s^{-2} (4) 200 rad s^{-2} (5) 400 rad s^{-2}

39. A sound source S emits sound of constant frequency f_0. An observer O travels in the direction shown at a speed of $0{\cdot}1u$ where u is the speed of sound in air. Which of the following gives the correct relationship between f_0 and the frequency f of the sound heard when the observer is travelling towards the source?



(1) $f = 1{\cdot}1f_0$

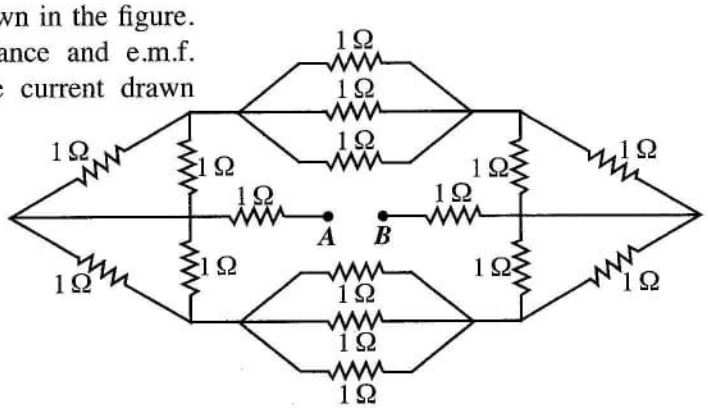
(2) $f_0 < f < 1{\cdot}1f_0$

(3) $f_0 < f \leq 1{\cdot}1f_0$

(4) $f = 0{\cdot}9f_0$

(5) $f_0 > f > 0{\cdot}9f_0$

40. Sixteen 1 Ω resistors are connected as shown in the figure. If a battery of negligible internal resistance and e.m.f. 8 V is connected between A and B, the current drawn from the battery is,



(1) 1 A (2) 2 A

(3) 3 A (4) 4 A

(5) 5 A

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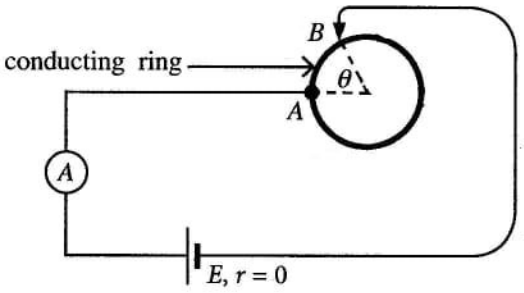
41. Two light rays of red and blue colour are made to pass separately through a glass prism of refracting angle 60°. If both rays suffer **minimum deviation** while passing the prism, which of the following is correct with regard to the angle of refraction of the red ray (r_R) and the angle of refraction of the blue ray (r_B) at the surface of incidence of the prism?

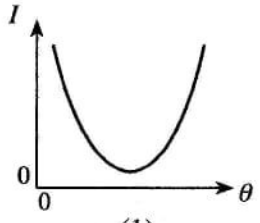
(1) $r_R > r_B$ (2) $r_R < r_B$ (3) $r_R = r_B \neq 30°$
(4) $r_R = r_B = 30°$ (5) $r_R = r_B = 60°$

42. An open copper vessel of mass 2·0 kg is at a temperature of 150 °C. Water of mass 0·1 kg at 25 °C is quickly poured into the vessel. What is the mass of water converted into vapour? Assume that there is no loss of heat to the surroundings. (Take specific heat capacity of copper $4{\cdot}0 \times 10^2$ J kg^{-1} K^{-1}; specific heat capacity of water $4{\cdot}0 \times 10^3$ J kg^{-1} K^{-1}; specific latent heat of vapourization of water $2{\cdot}5 \times 10^6$ J kg^{-1})

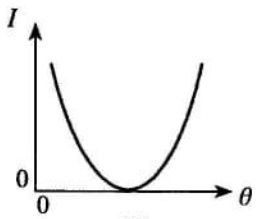
(1) 1 g (2) 2 g (3) 3 g (4) 4 g (5) 5 g

43. A conducting ring is connected to a circuit as shown in the figure. Point A is fixed, but point B can be moved along the ring so that the angle θ changes. The cell and the ammeter are ideal. Which of the following graphs best represents the variation of the ammeter reading I with the angle θ?

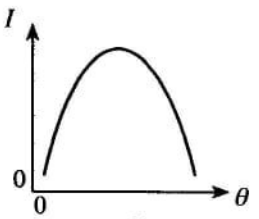




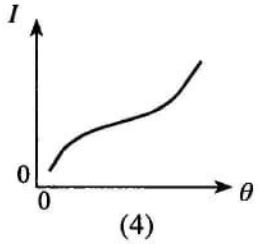
(1)



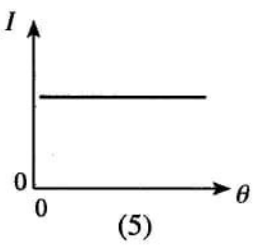
(2)



(3)



(4)



(5)

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44. A straight conducting wire PQ of length l and mass m has to be placed at rest on a frictionless insulating inclined plane, which makes an angle θ to the horizontal. A uniform magnetic field of flux density B acts vertically upwards as shown in the figure. The magnitude and the direction of the current I that should pass through the wire in order to keep the wire at rest is given by

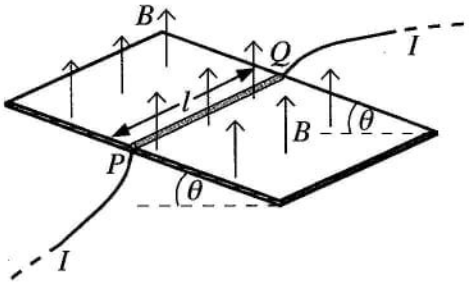
(1) $I = \frac{mg\sin\theta}{lB}$ and Q to P

(2) $I = \frac{mg\sin\theta}{lB}$ and P to Q

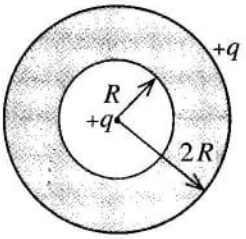
(3) $I = \frac{mg\tan\theta}{lB}$ and Q to P

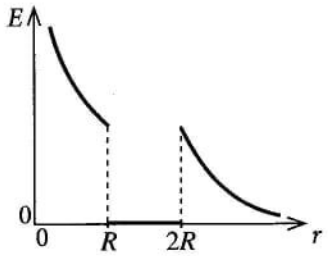
(4) $I = \frac{mg\tan\theta}{lB}$ and P to Q

(5) $I = \frac{mg}{lB}$ and Q to P

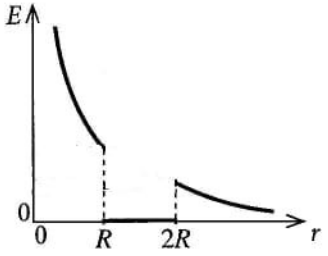


45. A solid conducting sphere of radius $2R$ contains a cavity of radius R inside it as shown in the figure. The sphere carries a net charge of $+q$. Another point charge of $+q$ is placed at the centre of the sphere. Which of the following graphs best represents the variation of the electric field intensity E with the radial distance r from the centre of the sphere?

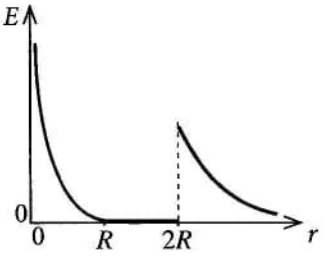




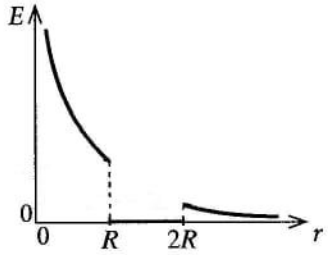
(1)



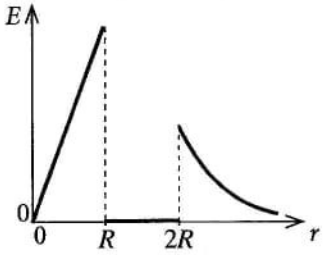
(2)



(3)



(4)



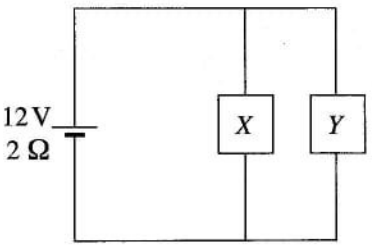
(5)

46. A battery of e.m.f. 12 V and internal resistance 2 Ω is connected to two devices X and Y as shown in the figure. The resistances of X and Y are 6 Ω and 3 Ω respectively. When the devices are in operation what is the power consumed by each device X and Y respectively?

(1) 3 W, 6 W (2) 6 W, 3 W

(3) 6 W, 6 W (4) 6 W, 12 W

(5) 12 W, 6 W



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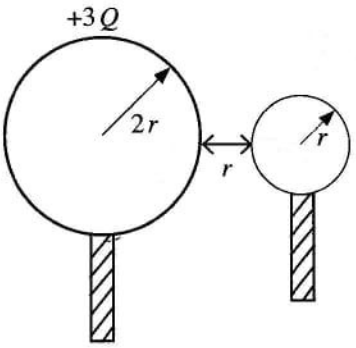
47. A conducting sphere of radius $2r$ is given a charge of $+3Q$. Another uncharged conducting sphere of radius r is touched to the first sphere and then separated by a distance r as shown in the figure. What is the electrical potential energy of the system now? (Assume that the charge distributions of spheres are uniform and the system is in free space.)



(1) $\frac{Q^2}{4\pi\varepsilon_o r}$ (2) $\frac{Q^2}{8\pi\varepsilon_o r}$

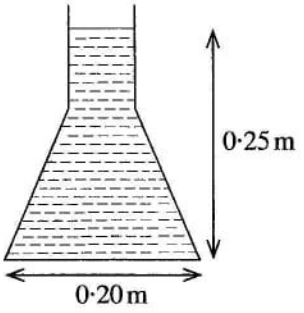
(3) $\frac{Q^2}{16\pi\varepsilon_o r}$ (4) $\frac{3Q^2}{8\pi\varepsilon_o r}$

(5) $\frac{3Q^2}{16\pi\varepsilon_o r}$

48. A ball is thrown vertically upward from the ground. The time duration between the two instances that the ball passes the point at a height of 25 m on its path from the ground is 4 s. What is the initial velocity of the ball? (Neglect air resistance)

(1) 20 m s^{-1} (2) 25 m s^{-1} (3) 30 m s^{-1} (4) 35 m s^{-1} (5) 40 m s^{-1}

49. The figure shows a vertical cross-section of a conical flask filled with water. The height of the water level in the flask is 0·25 m and its circular base has a internal diameter of 0·20 m. The volume of water in the flask is $2{\cdot}5 \times 10^{-3}$ m^3. What is the magnitude of the total force exerted by the water on the inclined surface of the flask? Density of water = 10^3 kg m^{-3}. (Take $\pi = 3$)

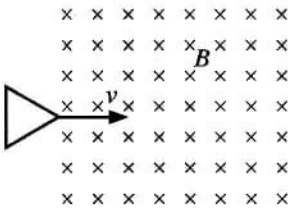


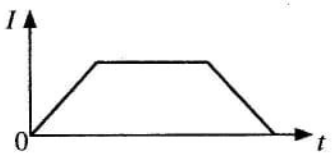
(1) 10 N (2) 20 N

(3) 30 N (4) 40 N

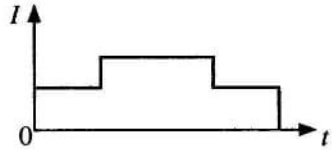
(5) 50 N

50. An equilateral triangular conducting loop passes a region of uniform magnetic field of flux density B at a uniform velocity v as shown in the figure. The variation of the induced current (I) in the loop with time (t) is best represented by

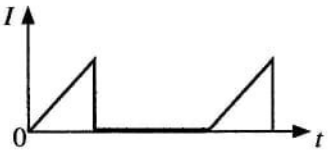




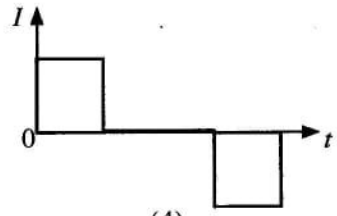
(1)



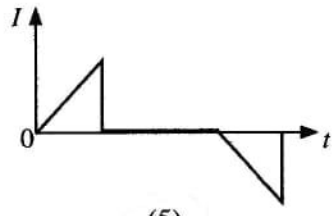
(2)



(3)



(4)



(5)

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