G.C.E. (Advanced Level) Examination - August 2009

PHYSICS - I

Two hours

Important :

- ✱ This question paper includes **60** questions in **07** 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.**

<u>Use of calculators is not allowed.</u>

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

01. SI unit of 'activity' of a radioactive element is
(1) Bq (2) Ci (3) Gy (4) Sv (5) rad

02. Energy E of a photon of frequency f is given by E = hf. The dimensions of h are
(1) ML^2T^{-1} (2) $ML^{-1}T^{-2}$ (3) $ML^{-2}T^{-1}$
(4) ML^2T^{-2} (5) $ML^{-3}T^{-1}$

03. Astronomical telescope has an objective lens of focal length f_0 and an eyepiece of focal length f_e. If the telescope is in normal adjustment, the total length and the magnifying power of the telescope are given respectively by

(1) $2(f_o+f_e)$, and $\left(\frac{f_o}{f_e}\right)$ (2) $2(f_o+f_e)$, and $\left(\frac{f_e}{f_o}\right)$

(3) (f_o+f_e), and $\left(\frac{f_e}{f_o}\right)$ (4) (f_o+f_e), and $\left(\frac{2f_o}{f_e}\right)$

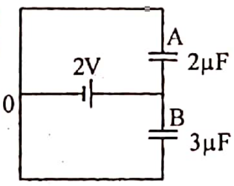
(5) (f_o+f_e), and $\left(\frac{f_o}{f_e}\right)$

04. A metal plate is illuminated with light of a certain frequency. Which of the following determines whether electrons are emitted or not from the plate?
(1) The intensity of the light
(2) Time of exposure of the plate to the light
(3) The thermal condustivity of the material of the plate
(4) The area of the plate
(5) The material of which the plate is made

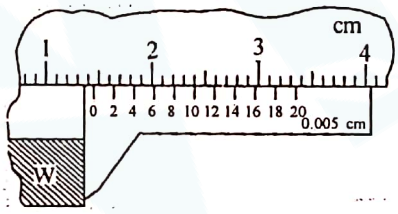
05. A transformet having which of the following characteristics is suitable to reduce a 220V ac voltage to 20V ac?

	Transformer type	Number of turns in secondary coil / Number of turns in primary coil
(1)	step-down	$\frac{1}{22}$
(2)	step-down	$\frac{1}{11}$
(3)	step-down	11
(4)	step-up	$\frac{1}{11}$
(5)	step-up	11

06. Magnitudes of charge stored in the two capacitors A and B shown in figure respectively are
(1) 0, 0 (2) 0,6μC (3) 4 μC, 0
(4) 4 μC, 4 μC (5) 4μC, 6μC



07. The length of rectangular wooden block (W) is measured using vernier callipers. The figure shows the relevant sections of the vernier callipers and the block. (Only relevant divitions in the vernier scale are shown.)

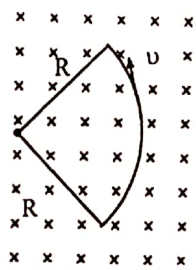


If there in no zero error in the vernier callipers, then the length of the wooden block is
(1) 1.30cm (2) 1.35 cm (3) 1.45 cm
(4) 1.50 cm (5) 1.55cm

08. A person cannot see clearly the objects beyond a distance of 50 cm from his eyes. In order to see distant objects he must wear
(1) concave lenses of focal length 10cm.
(2) convex lenses of focal length 50 cm.
(3) concave lenses of focal length 50 cm.
(4) convex lenses of focal length 100 cm.
(5) concave lenese of focal length 100 cm.

09. Minimum amount of heat that is necessary to melt completely an ice cube of mass 30 g at 0°C is (specific latent heat of fusion of ice is $3.3 \times 10^5\ Jkg^{-1}$)
(1) 11J (2) 990J (3) 1 100J
(4) 9 900J (5) 11 000J

10. Figure shows the path of an electron travelling along an arc of a circle of radius R with a speed υ in a uniform magnetic field. The magnitude (B) of the magnetic flux density is given by (m = mass of an electron; e = charge of an electron)



(1) $B=\sqrt{\frac{m\upsilon}{eR}}$ (2) $B=\left(\frac{m\upsilon}{eR}\right)^2$

(3) $B=\frac{m\upsilon}{2eR}$ (4) $B=\frac{m\upsilon}{eR}$

(5) $B=\frac{2m\upsilon}{eR}$

11. The moment of inertia of a ceratin spinning star has dropped to $\frac{1}{3}$ of its initial value due to contraction.

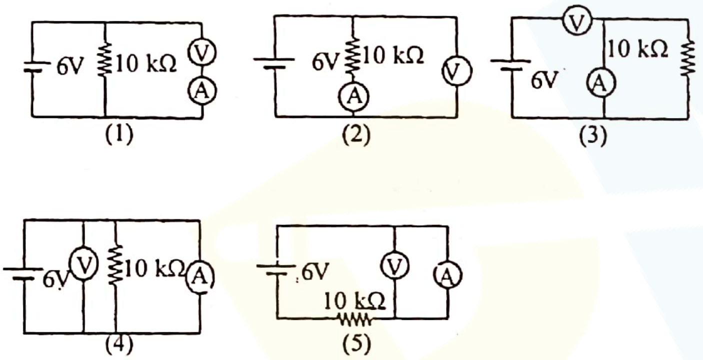
The ratio, $\frac{\text{new rotational kinetic energy of the star}}{\text{initial rotational kinetic energy of the star}}$ is equal to

(1) $\frac{1}{9}$ (2) $\frac{1}{3}$ (3) 3 (4) 9 (5) 27

12. A uniform copper wire of cross-sectional area $10^{-7}\,m^2$ carries a current of 1.6A. If there are 10^{29} free electrons in 1 m^3 of copper, the drift velocity of electrons in the wire is (magnitude of the charge of an electron is 1.6×10^{-19}C)

(1) 1.0 mm s^{-1} (2) 1.6 mm s^{-1} (3) 2.0 mm s^{-1}
(4) 10.0 mm s^{-1} (5) 20.0 mm s^{-1}

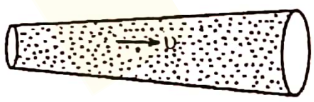
13. In the circuits shown below Ⓐ and Ⓥ represent an ammeter and a voltmeter respectively. In which circuit arrangement the am meter will have the highest risk of getting damaged?



14. If the absolute value of the surface temperature of the sun were three times the existing value, the radiation of the sun would have been mostly in

(1) microwave range (2) infrared range (3) visible range
(4) X-ray range (5) ultraviolet range

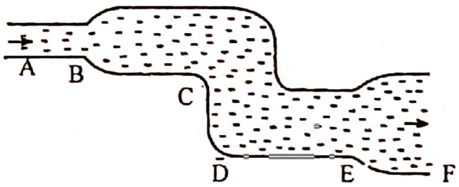
15. A non viscous fluid of density d has a streamlined flow through horizontal pipe of variable cross-section as shown in the figure.

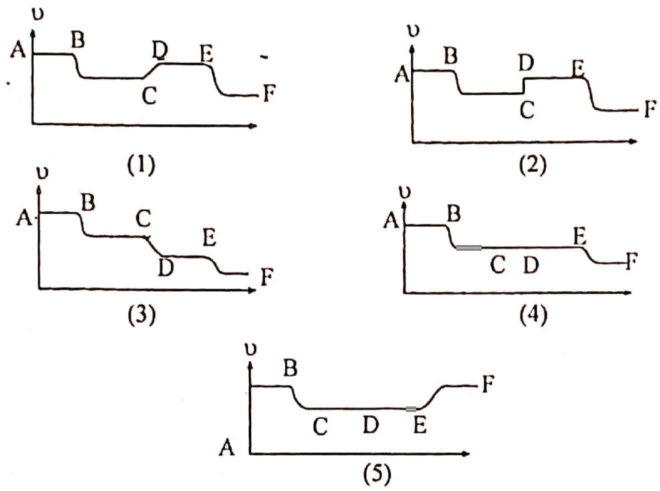


If the pressure of the fluid is P at a point where the velocity of flow is υ, what is the pressure at another Point where the velo city of flow is 3υ?

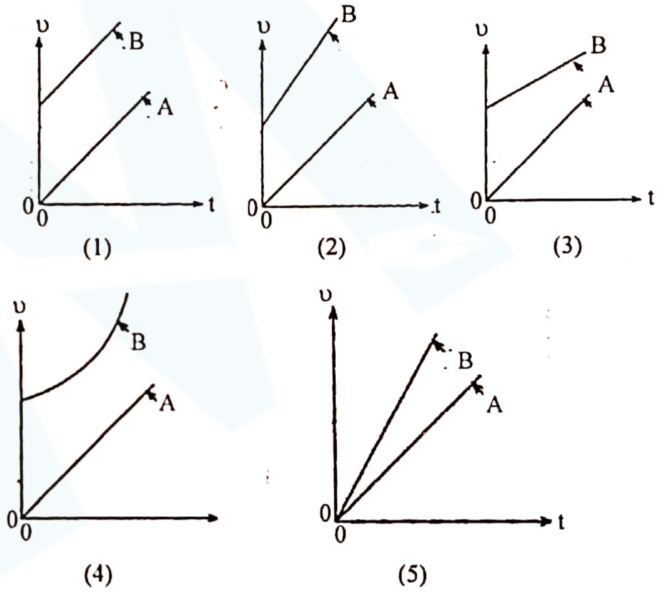
(1) $p - 3d\upsilon^2$ (2) $p - 4d\upsilon^2$ (3) $p + 4d\upsilon^2$
(4) $p + 8d\upsilon^2$ (5) $p - 8d\upsilon^2$

16. Non viscous, incompressible fluid flows steadily through the pipe shown in the figure. The variation of the flow speed υ of the fluid along the tube from A to F is best represented by





17. A person simultaneously drops an object, and throws another object vertically downwards from a certain height. Which of the following graphs best represents the velocity (υ) - time (t) curves for the two objects? (Curve A represents the dropped object and curve B represents the thrown object.)



18. A light ray deviates from a prism with the minimum deviation of 30°. If the angle of the prism is 60°, the refractive index of the material of the prism is

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

19. A light wave of frequency 4.5×10^{14} Hz has a wavelength of 4×10^{-7} m in a certain medum. If the velocity of light in vacuum is 3×10^8 ms^{-1}, the refractive index of the medium for that light is

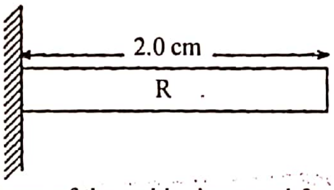
(1) $\frac{6}{5}$ (2) $\frac{4}{3}$ (3) $\frac{7}{5}$ (4) $\frac{3}{2}$ (5) $\frac{5}{3}$

20. The best vacuum that can be achieved in a laboratory has a pressure of 10^{-13} Pa. The number of gas molecules present in 1 cm^3 of such a vacuum at 300 K is (take Boltzmann constant $= \frac{4}{3} \times 10^{-23} JK^{-1}$)

(1) 0 (2) 5 (3) 10 (4) 25 (5) 100

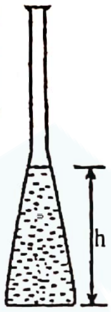
21. The motion of an insect living on sand generates transverse waves travelling at $50 ms^{-1}$ and longitudinal waves travelling at $150\ ms^{-1}$ along the sand surface. A scorpion can estimate the location of the insect from the difference Δt in the arrival times of these waves. If $\Delta t = 4.0 \times 10^{-3}$ s, the distance from the scorpion to the insect is
(1) 0.05m (2) 0.10m (3) 0.20m
(4) 0.30m (5) 0.40m

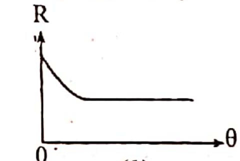
22. In a certain experiment the unclamped end of an aluminium rod R of length 2.0 cm has to be moved at a constant speed of $100 nms^{-1}$.



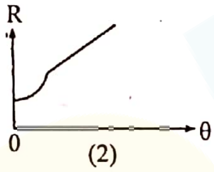
The rate at which the temperature of the rod be increased for this to happen is (linear expansivity of aluminium = $2.0\ 10^{-5}\ {}^{\circ}C^{-1}$)
(1) 0.25 $°C\ s^{-1}$ (2) 0.30 $°C\ s^{-1}$ (3) 0.55 $°C\ s^{-1}$
(4) 0.65 $°C\ s^{-1}$ (5) 0.75 $°C\ s^{-1}$

23. A glass container with a narrow area of cross-section as shown in figure is filled with a liquid to a height h. If the expansion of the container is negligible, the **rate of change** (R) of h with temperature (θ) is best represented by

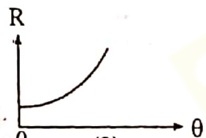




(1)



(2)

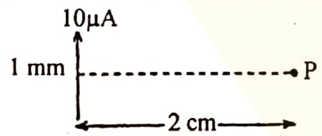


(3)

(4)

(5)

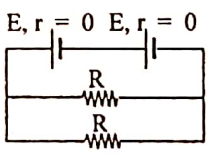
24. When a person performs a certain task a weak current of 10μA is produced along a conducting path between brain cells. The figure shown such a small path of length 1mm. The magnitude of the magnetic flux density produced by this current element at a point P at a distance of 2 cm from it is ($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})



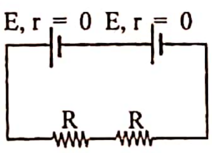
(1) 2.5×10^{-10} T (2) 1.0×10^{-10} T (3) 2.5×10^{-11} T
(4) 1.0×10^{-11} T (5) 2.5×10^{-12} T

25. The radius of a spherical asteroid is 60 km. The acceleration due to gravity on its surface is $3 ms^{-2}$. The escape velocity at the surface of the asteroid is
(1) 400 ms^{-1} (2) 600 ms^{-1} (3) 800 ms^{-1}
(4) 1200 ms^{-1} (5) 3600 ms^{-1}

26. Power dissipation in circuit (B) can be made equal to that of (A) if the resistances in (B) are changed from R to



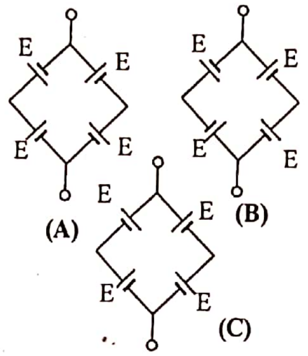
(A)



(B)

(1) 8R (2) 4R (3) 2R (4) $\frac{R}{2}$ (5) $\frac{R}{4}$

27. Four identical batteries with negligible internal resistances are connected as shown in figures (A), (B) and (C).



Currents through the batteries are zero in the arrangement/s
(1) (A) only (2) (C) only (3) (A) and (C) only
(4) (B) and (C) only (5) (A) and (B) only

28. Two masses M and m, placed on a frictionless horizontal surface, are connected together as shown in figure using a spring whose mass in negligible. Two masses are first pressed together so that the spring is compressed, and then relesed. If the initial acceleration of mass m is a, what would be the magnitude of acceleration of mass M at that moment?

(1) $\frac{ma}{M+m}$ (2) $\frac{Ma}{M+m}$ (3) $\frac{ma}{M}$ (4) $\frac{Ma}{m}$ (5) $\frac{(M+m)a}{m}$

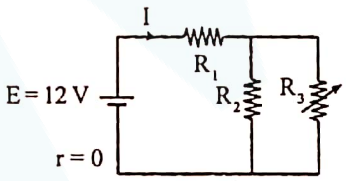


Fig. 1

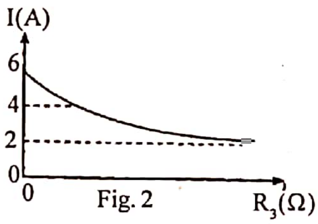


Fig. 2

29. Fig. 2 shows the variation of the current (I) through the battery with R_3 of the circuit shown in Fig. 1. The values of R_1 and R_2 are respectively.
(1) 1Ω,2Ω (2) 1Ω,3Ω (3) 2Ω,4Ω
(4) 2Ω,6Ω (5) 4Ω,8Ω

30. A 6 km long underground cable AB consists of two parallel conducting wires of same dimensions and are separated from each other. A short circuit has occurred between the two wires at a single point inside the cable. In a test conducted in order to find the faulty position, the measured resistance between two wires at the end A of the cable was found to be 3 kΩ while the same measurement done at the end B of the cable gave 5 kΩ. The distance to the faulty position from the end A of the cable is
(1) 1.80 km (2) 2.25 km (3) 3.60 km
(4) 3.75 km (5) 4.50 km

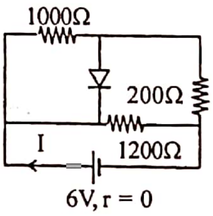
31. A cylindrical metal vessel of height 5cm has a small circular hole of radius 0.2mm at its bottom. This vessel is lowered vertically in a certain liquid of density 800 kg m^{-3}, keeping the bottom down. What should be the minimum value of the surface tension the liquid must have so that the vessel can be lowered up to the brim without liquid entering into the vessel through the hole?

(1) 0.02 N m^{-1} (2) 0.03 N m^{-1} (3) 0.04 N m^{-1}
(4) 0.05 N m^{-1} (5) 0.06 N m^{-1}

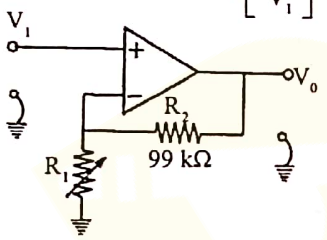
32. A small metal sphere of mass 40 g is released from rest in a viscous medium. When the velocity of the sphere is 0.03 ms^{-1}, the viscous force on the sphere is found to be 0.1 N. If the buoyancy force is negligible, the terminal velocity of the sphere is
(1) 0.06 m s^{-1} (2) 0.09 m s^{-1} (3) 0.12 m s^{-1}
(4) 0.15 m s^{-1} (5) 0.18 m s^{-1}

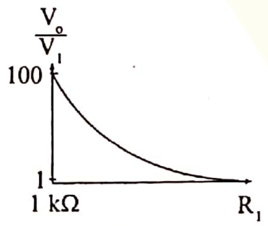
33. Radioactive element $^{232}_{90}Th$ transforms to stable $^{208}_{82}Pb$ after several radioactive decays. The number of α particles and the number of β^- particles emitted in these decays respectively are
(1) 6, 2 (2) 6,4 (3) 6,12 (4) 4,4 (5) 4,8

34. If the voltage necessary to forward bias the diode shown in figure is 0.7 V, the current (I) drawn from the battery would be
(1) 0 (2) 5mA (3) 10mA
(4) 30mA (5) 60mA

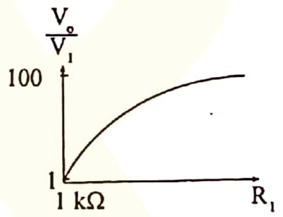


35. Which of the following curves correctly represents the variation of the voltage gain $\left[\frac{V_0}{V_1}\right]$ of the circuit shown when the value of R_1 is changed from 1 kΩ to infinity? $\left[\frac{V_0}{V_1}\right]$ is not drawn to scale.

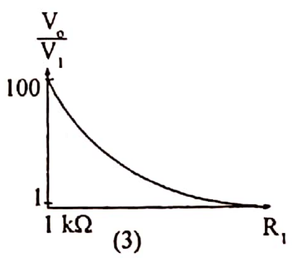




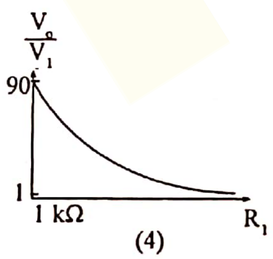
(1)



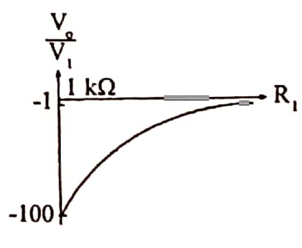
(2)



(3)

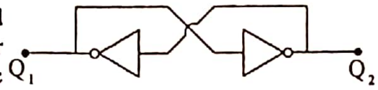


(4)



(5)

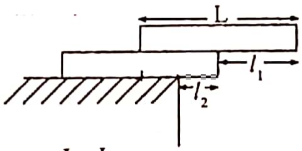
36. Two NOT gates are connected as shown in figure. Consider following combinations of logic levels for the outputs Q_1 and Q_2



	Logic Level for Q_1	Logicc Level for Q_2
(A)	0	0
(B)	0	1
(C)	1	0
(D)	1	1

Which of the above combination/s will provide stable logic levels for Q_1 and Q_2 outputs?
(1) (A) only (2) (D) only (3) (A) and (B) only
(4) (A) and (D) only (5) (B) and (C) only

37. Two identical uniform bricks of length L are stacked without being toppled on a table as shown in figure. The respective maximum possible values for l_1 and l_2 are

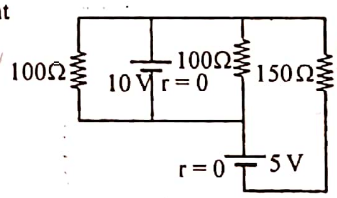


(1) $\frac{L}{2}, \frac{L}{4}$ (2) $\frac{L}{2}, \frac{L}{6}$ (3) $\frac{L}{2}, \frac{L}{8}$

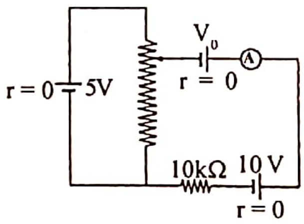
(4) $\frac{L}{4}, \frac{L}{4}$ (5) $\frac{L}{4}, \frac{L}{6}$

38. A simple pendulum hung from the ceiling of an elevator has a period T when the elevator is at rest. Period of this pendulum when the elevator is moving upwards with an acceleration of 5ms^{-2} is
(1) $\sqrt{2}T$ (2) $\sqrt{\frac{3}{2}}T$ (3) $\frac{T}{2}$ (4) $\sqrt{\frac{2}{3}}T$ (5) 2T

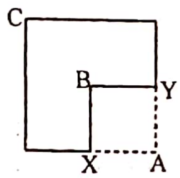
39. In the circuit shown the current through the 150Ω resistor is
(1) 0.01A (2) 0.05A
(3) 0.10A (4) 0.33A
(5) 0.50A



40. In the circuit shown in figure, there is a possibility for a centre-zero ammeter *A* to indicate currents in either direction if V_0 is
(1) 1V (2) 2V (3) 4V
(4) 5V (5) 6V



41. Figure shows a uniform square plate from which the part *XBYA* has been removed. If the moment of inertia of the plate around axes perpendicular to the plate and through the points *A*, *B* and C are I_A, I_B and I_C respctively then

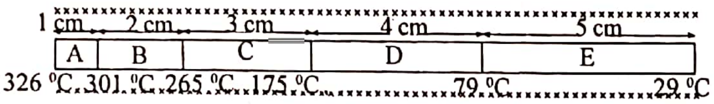


(1) $I_A = I_B = I_C$ (2) $I_A = I_B > I_C$ (3) $I_A > I_B > I_C$
(4) $I_A > I_C > I_B$ (5) $I_A < I_C < I_B$

42. When a guitar string sounds together with a tuning fork of frequency 191Hz, at the room temperature, five beats per second are heard. When the tuning fork is heated up to a certain temperature, the beat frequency heard increased to eight beats per second. Frequency of the note produced by the guitar string at the room temperature is

(1) 181 Hz (2) 186Hz (3) 191 Hz
(4) 196 Hz (5) 201 Hz

43. Five cylindrical metal bars (A, B, C, D, and E) are made five different materials. All bars have the same cross sectional area but different lengths, and they are connected end to end as shown in figure. When the free ends are maintained at temperatures 326 °C and 29°C, steady state temperatures at the interfaces are indicated in the figure. Assume that the system is fully lagged except its free ends. Which metal bar is made out of the material with the smallest thermal conductivity?

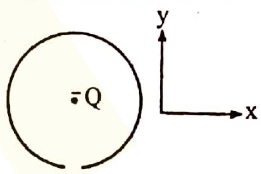


(1) A (2) B (3) C (4) D (5) E

44. Many rock musicians wear special ear-plugs to protect their hearing during performances. If an ear-plug decreases the sound intensity level by 20dB, it reduces the intensity of sound waves by a factor of
(1) 10^4 (2) 10^3 (3) 10^2 (4) 10 (5) $\sqrt{10}$

45. When a person wearing spectacles moves from room P to room Q he observed that a thin film of water is deposited on the lenses. Consider the following that are given as necessary conditions for this to happen.
(A) Temperature of room P > Temperature of room Q
(B) Temperature of room Q > Temperature of room P
(C) Relative humidity of room P > Relative humidity of room Q
(D) Relatve humidity of room Q > Relative humidity of room P
Which of the above condition/s that should be satisfied for the above phenomeon to take place definitely?
(1) (A) only (2) (B) only (3) (B) and (C) only
(4) (A) and (C) only (5) (B) and (D) only

46. A charge $+q$ is uniformly distributed along a very thin non-conducting circular ring of radius R and a charge $-Q$ is placed at the centre of the ring. Now, a very small part containing a charge Δq is removed from the ring as shown in figure. The electrostatic force acting on the charge $-Q$ at the centre of the ring is



(1) zero
(2) $\frac{1}{4\pi\varepsilon_0}\frac{Q(q-\Delta q)}{R^2}$ along +y direction.
(3) $\frac{1}{4\pi\varepsilon_0}\frac{Q(q-\Delta q)}{R^2}$ along -y direction.
(4) $\frac{1}{4\pi\varepsilon_0}\frac{Q(\Delta q)}{R^2}$ along +y direction.
(5) $\frac{1}{4\pi\varepsilon_0}\frac{Q(\Delta q)}{R^2}$ along -y direction.

47.

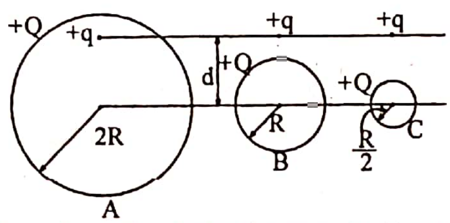
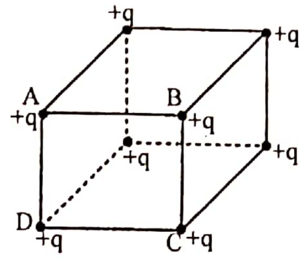


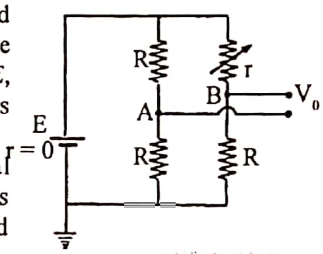
Figure shows three isolated systems (A, B and C) each having a point charge $+q$ and uniformly charged conducting shell of charge $+Q$. If the respective electrostatic forces between the point charge and the shell are given by F_A, F_B and F_C then
(1) $F_A = 0$, $F_B > F_C$ (2) $F_A = 0$, $F_B = F_C$
(3) $F_A = 0$, $F_C > F_B$ (4) $F_A < F_B < F_C$
(5) $F_A = F_B = F_C$

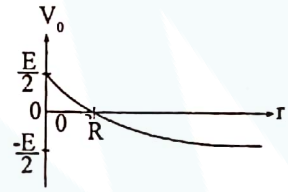
48. Eight $+q$ point charges are placed at the vertices of a cube as shown in the figure. The number of electric field lines passing through the face $ABCD$ due to charges is



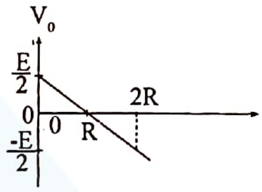
(1) $\frac{q}{3\varepsilon_0}$ (2) $\frac{q}{4\varepsilon_0}$ (3) $\frac{q}{6\varepsilon_0}$
(4) $\frac{q}{24\varepsilon_0}$ (5) $\frac{q}{48\varepsilon_0}$

49. Three fixed resistors of value R and a variable resistor of resistance r are connected to a battery of e.m.f. E, with zero internal resistance as shown in the figure.
The variation of the potential difference (V_0) between points A and B with r is best represented by

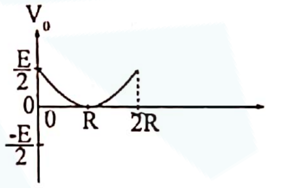




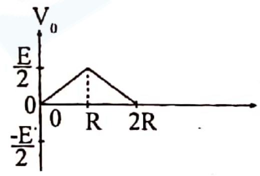
(1)



(2)



(3)



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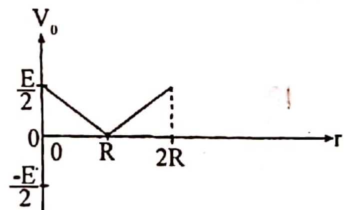
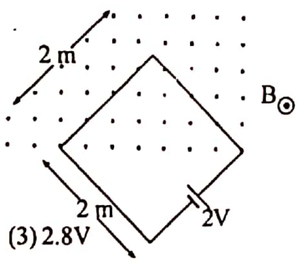


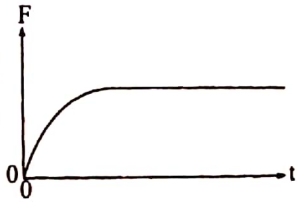
(5)

50. A part of a conducting square wire loop of side length 2m is placed in a uniform magnetic field as shown in the figure. If the magnitude of the magnetic flux density decreases at a constant rate of $0.8 Ts^{-1}$, the net e.m.f. in the circuit would be

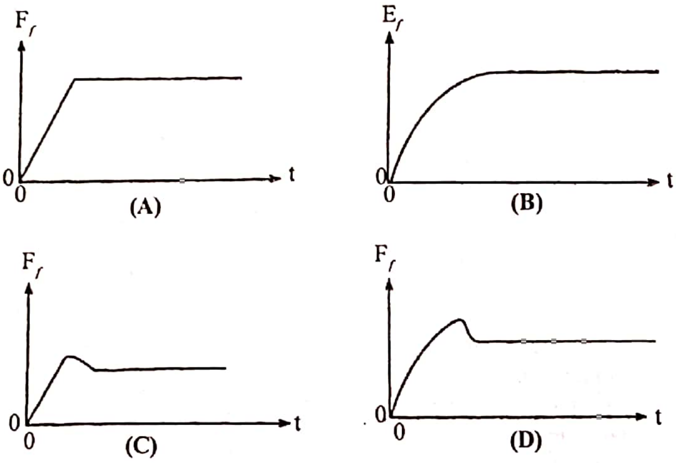


(1) 0.4V (2) 1.2V (3) 2.8V
(4) 3.6V (5) 5.2V

51. A box is placed on a horizontal surface and a horizontal force F is applied on the box. Variation of the magnitude of F with time is shown in the graph.



Which of the following graphs show/s the possible variations of the magnitude of the frictional force F_f acting on the box with time?

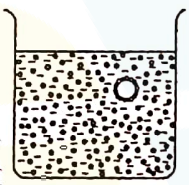


(1) (A) only (2) (B) only (3) (D) only
(4) (B) and (D) only (5) (A) and (C) only

52. An oil drop falling through still air at its terminal velocity υ suddenly explodes to form n number of identical droplets. The subsequent terminal velocity of the droplets would be

(1) $\frac{\upsilon}{n}$ (2) $\frac{\upsilon}{n^{\frac{2}{3}}}$ (3) $\frac{\upsilon}{n^2}$ (4) $n\upsilon$ (5) $\frac{\upsilon}{n^{\frac{1}{3}}}$

53. Water in a tank is uniformly bubbled with small identical air bubbles each having volume υ_0 as shown in the figure.
A sphere of mass M and volume V floats in water as shown due to the attachment of certain number of air bubbles on its surface.

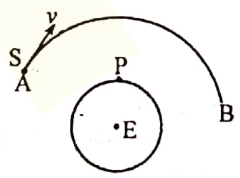


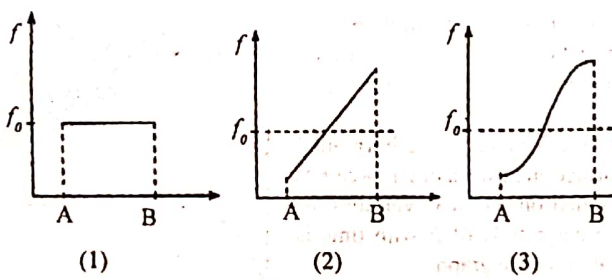
If d_w is the density of water, and the minimum number of air bubbles that is needed to be attached to keep the sphere floating in water is n, then

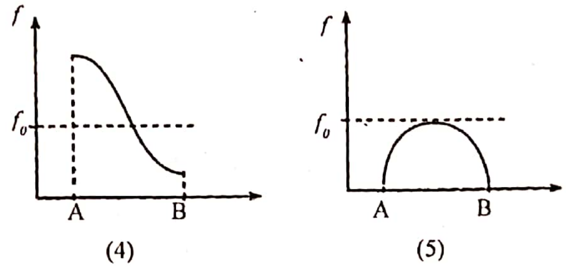
(1) $n = \frac{M - Vd_w}{\upsilon_0 d_w}$ (2) $n > \frac{M - Vd_w}{\upsilon_0 d_w}$ (3) $n < \frac{M - Vd_w}{\upsilon_0 d_w}$

(4) $n > \frac{\upsilon_0 d_w}{M - Vd_w}$ (5) $n < \frac{\upsilon_0 d_w}{M - Vd_w}$

54. A satellite S is moving with constant speed υ relative to the earth (E) along a fixed circular orbit as shown in figure.
The satellite is emitting radio signals of frequency f_0. A station located at P on the earth detects these radio signals.
The variation of the frequency f of the detected signal as the satellite moves from A to B is best represented by

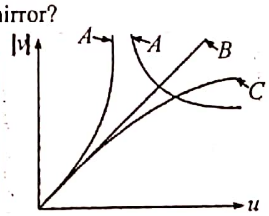




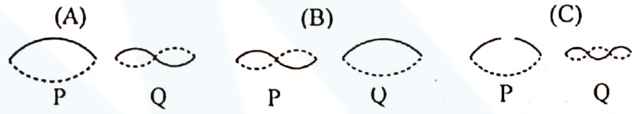


55. The figure shows three curves (A, B and C) of object distance (u) and corresponding magnitudes of image distance (|v|) for three types of mirrors.
Which curve corresponds to which mirror?

	A	B	C
(1)	convex	plane	concave
(2)	concave	plane	convex
(3)	plane	concave	convex
(4)	plane	convex	concave
(5)	convex	concave	plane

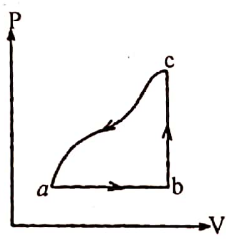


56. Two strings P and Q are identical, and string P is under greater tension than string Q. Figures show three situations in which standing wave patterns exist on the two strings.

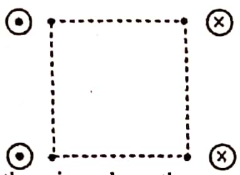


Which of the above situation/s could represent/s the strings vibrating at the same frequency?
(1) only in (A)
(2) only in (A) and (B)
(3) only in (A) and (C)
(4) only in (B) and (C)
(5) all (A), (B) and (C)

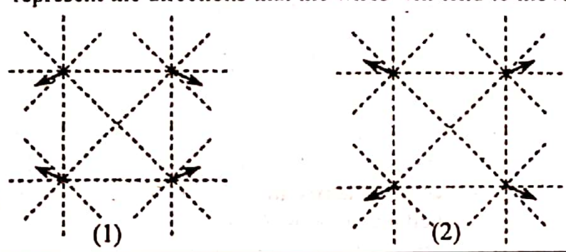
57. Figure shows a closed P- V cycle for an ideal gas. The change in internal energy along path ca is -160J.
The heat transferred to the gas is 200J along path ab, and 40J along path bc.
The work done by the gas along path ab is
(1) 80J (2) 100J (3) 280J
(4) 320J (5) 400J

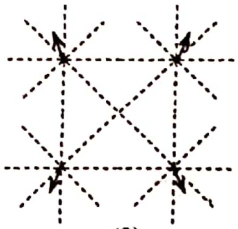


58. Four long, parallel, straight wires run normal to the plane of the paper through vertices of a square as shown in the figure.

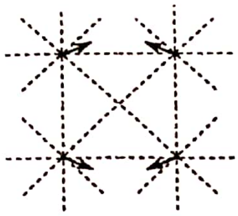


If currents of equal magnitude are set up in the wires along the directions (⊙ or ⊗) shown, and if the wires are free to move, the arrows in which of the following diagrams correctly represent the directions that the wires will tend to move?

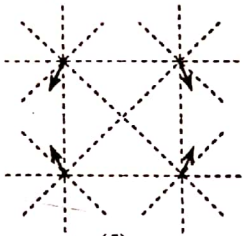




(3)

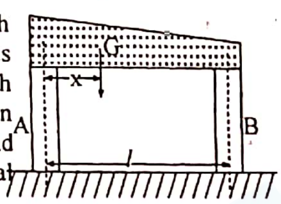


(4)



(5)

59. A and B are two iron columns with exactly the same length. A has a square cross-section of side length a, while B has a circular cross section of diameter a. One end of both A and B are firmly fixed on horizontal ground.

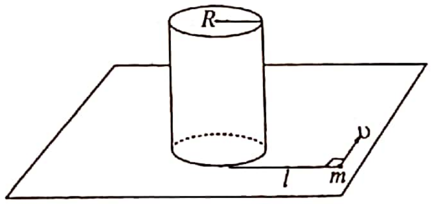


A non-uniform concrete beam is placed over two columns as shown in figure. If the lowre side of the concrete beam remains horizontal, the distance x to the centre of gravity of the beam from the axis of A is given by, (a <<l)

(1) $x = \dfrac{4l}{(\pi + 4)}$ (2) $x = \dfrac{2l}{(\pi + 1)}$ (3) $x = \dfrac{l}{(\pi + 1)}$

(4) $x = \dfrac{\pi l}{(\pi + 1)}$ (5) $x = \dfrac{\pi l}{(\pi + 4)}$

60. One end of a thin inelastic string of length l is attached to a small object of mass m resting on a frictionless horizontal surface and the other end is fixed to a point on the surface of a vertical cylindrical pillar of radius R, so that the string remains horizontal. A velocty υ is given to the object, perpendicular to the string and along the surface as shown in the figure.



The angular velocity of the object around the axis of the pillar when it hits the pillar is

(1) 0 (2) $\dfrac{\upsilon}{R}$ (3) $\dfrac{\upsilon}{l}$

(4) $\dfrac{\upsilon}{\sqrt{R^2 + l^2}}$ (5) $\dfrac{2\upsilon}{R}$

G.C.E. (Advanced Level) Examination - August 2009

PHYSICS - II

Three hours

Answer all four questions. **PART A - Structured Essay** $[g = 10\ N\ kg^{-1}]$

01. Figure (1) shows an experimental setup of Hare's apparatus used in a school laboratory to measure the relative density of a liquid. In the figure, water and liquid are labelled as A and B respectively.

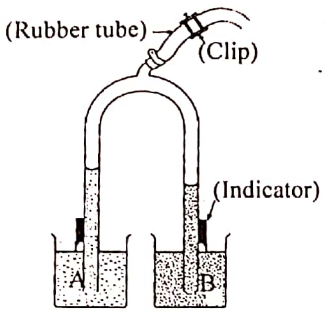


Figure (1)

(a) (i) Give an approximate value for the diameter in cm, of the tube in both arms in a Hare 's apparatus normally used in a school laboratory.

....

(ii) Name the measuring instrument that is **not** shown in the figure given but needed for the experiment.

....

(iii) State clearly how you would **establish** and **maintain** water and liquid columns in the arms of the Hare's apparatus.

....
....
....
....

(iv) What is the special advantage of this method over the U tube method?

....
....

(b)

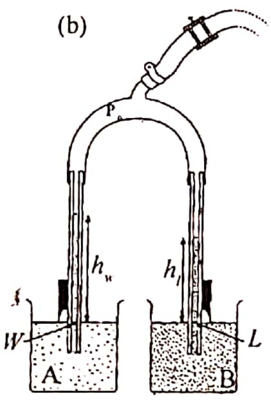


Figure (2)

In order to determine the surface tension as well as the density of a liquid a student has modified the Hare's apparatus by replacing its both arms with identical capillary tubes of internal radius r, as shown in figure (2).

(i) Let P_0 be the pressure of air above the water and liquid meniscus, (h_w, h_l) be the heights of the columns, (d_w, d_l) be the densities and (T_w, T_l) be the surface tensions of water and liquid respectively. If P_w, P_L are the pressures at points W and L respectively, write down expressions for P_w and P_L in terms of relevant parameters. Assume that the contact angles of water and liquid with glass are zero.

P_w : ....
....

P_L : ....
....

(ii) Hence derive an expression for h_w in terms of h_l, d_w, T_w, T_l, r and g in the form of $y = mx + c$.

....
....
....
....
....
....

(iii) If you draw graph of h_w versus h_l, and if you know the values of d_w, T_w, r and g what quantities you should extract from the graph to determine T_l and d_l?

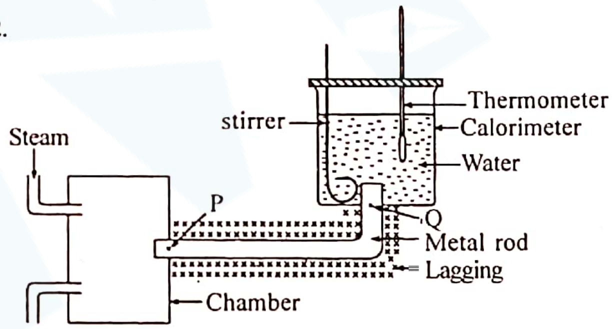
To determine T_l ....

To determine dl ....

(iv) Why is it always suitable to have the heights of the water and liquid columns as large as possible?

....

02.

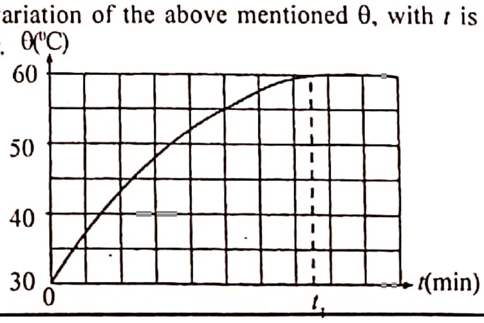


The apparatus shown in the diagram can be used to determine the thermal conductivity of a metal in the form of a rod of uniform cross-section. In this experiment steam at 100 °C is passed through the chamber and the **temperature**, θ, of the water in the calorimeter is measured with **time** t.

(a) Give reasons as to why steam is always used in this type of experiments.

....
....
....

(b) The variation of the above mentioned θ, with t is given below.



(i) According to the graph, after $t = t_1$, θ attains a steady value. What is the reason for this?

....

....

(ii) From 0 to t_1, the variation of θ with t is non linear, and there are two main reasons for this. What are they?

(1) ....

....

(2) ....

....

(iii) What is the temperature achieved by water at the steady state?

....

(c) It has been found from a separate cooling experiment that the rate, R (in watts) of heat dissipation from the calorimeter and its contents at temperature, θ, is given by $R = 0.16\ (\theta - \theta_R)$, where θ_R is the room temperature.

(i) Calculate R at the steady state temperature. ($\theta_R = 30\ ^\circ C$)

....

....

(ii) Hence, determine the thermal conductivity of the metal. The cross-sectional area of the rod = $1.2 \times 10^{-4}\ m^2$, and the length of the rod from P to Q = 0.4m.

....

....

....

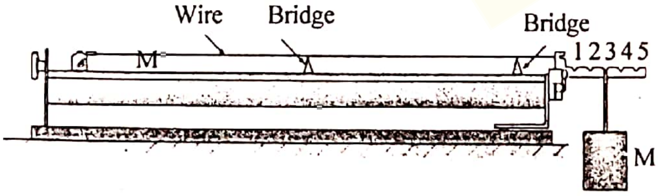
....

(d) If the calorimeter is also lagged well, could you perform this experiment successfully? Explain your answer.

....

....

03. In order to determine the unknown frequency (f) of a given tuning fork, you are provided with a sonometer and a single mass M as shown in figure. In the given sonometer, it is possible to change the tension of the wire by hanging the given mass at different slots of an arm of a lever wihich is pivoted at P. Slots are numbered from 1 to 5 as shown in the figure, and distances to the slots 1, 2, 3, 4 and 5 from P are 1.0, 2.0, 3.0, 4.0 and 5.0 cm, respectively. **Perpendicular distance from P to the wire is also 1.0cm.** Assume that the elogatiob of the wire due to the mass is kept negligibly small.



(a) How do you experimentally find the fundamental resonance length (l) of the sonometer wire that resonates with the given tuning fork?

....

....

....

....

....

(b) Write down an expression for l in terms of f, tension of the wire (T), and mass per unit length of the wire (m).

....

....

(c) The mass M is hung from each slot and corresponding value of l is measured. When the mass is hung from the n^{th} slot (n = 1, 2,3, 4, 5,), the tension of the wire is given by $T = Mgn$. How do you obtain this relationship?

....

....

(d) Obtain an expression for l^2 in terms of Mg, m, f and n.

....

....

(e) The maximum tension that the sonometer wire can bear without producing a significant elongation is 54N. What is the maximum value of M (in kg) which enables you to use all five slots for taking measurements?

....

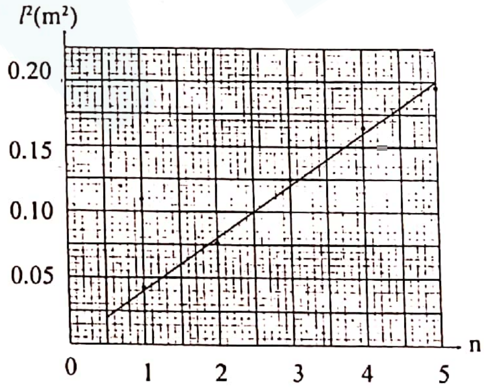
....

(f) You are provided with the density of the material of the sonometer wire. In order to determine the value of m, write down the measurement you have to make, together with the measuring instrument you use for that measurement.

(i) Measurement to be obtained : ....

(ii) Appropriate measuring instrument : ....

(g) A graph of l^2 versus n drawn in such an experiment is given below.



(i) Obtain the numerical value of the quantity required from the graph in order to determine the value of f.

....

....

....

(ii) If $M = 0.5$kg and $m = 2 \times 10^{-3}$ kg m^{-1}, calculate the value of f.

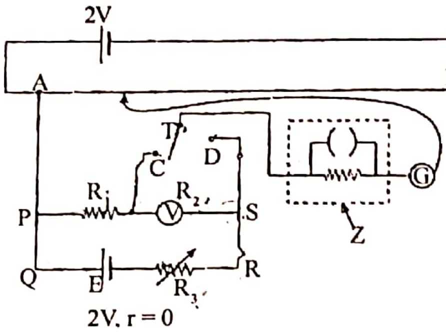
....

....

....

....

04. You are asked to use a potentiometer to measure the internal resistance (R_2) of a voltmeter (V). Its value is known to be of the order of 1000Ω. The full scale deflection of the voltmeter, V is 1.5V. The experimental arrangement that is made for this purpose is shown below.



R_1 is a suitable fixed resistance and R_3 represents the resistance of a resistance box.

(a) What is the importance of having the circuit inside the broken lines marked as Z?

....

(b) Show how you would connect the voltmeter V to circuit *PQRS* properly, by labelling the polarities of the terminals of the voltmeter V with + and - in the circuit given above.

(c) When the circuit is connected, if you observe that the voltmeter reading tends to exceed its full scale deflection, how would you rectify this?

....

(d) Write down the test that you would perform to check if all components of the experimental arrangement are properly connected.

....

....

(e) If the balanced lentgth of the potentionmeter wire when the swtich *T* is connected to *C* and *D* are l_1 and l_2 respectively derive an expression relating l_1, l_2, R_1 and R_2.

....

....

....

(f) Rearrange the expression in (*e*) to plot a graph of l_2 versus l_1 with l_2 as the dependent variable.

....

....

(g) How would you obtain a set of measurements for l_1 and l_2 in order to plot the graph?

....

....

(h) A student has suggested another method to find the internal resistance of the voltmeter *V*. According to his method, the *PQRS* section of the circuit shown above is to be isolated, and the value of R_3 is to be adjusted until the reading of the voltmeter, V becomes 1V.

(i) If you adopt this method, write down the expression that will give the internal resistance of the voltmeter.

....

....

(ii) Give reasons as to why this method is **not** as accurate as the potentiometer method.

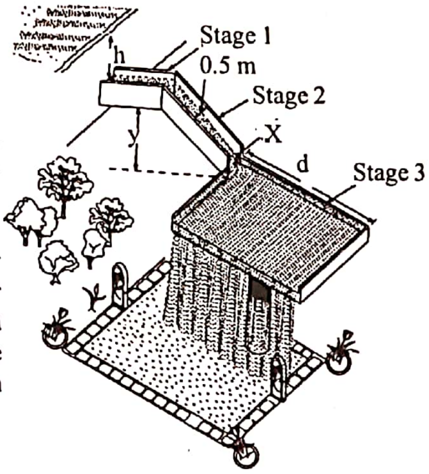
....

....

PART B - Essay

Answer four questions only $[g = 10\ \text{N kg}^{-1}]$

01. Write down Bernoulli's equation and identify each term.
An ancient waterway which supplies water to a pond consists of three stages as shown in figure;



Stage 1: A rectangular horizontal open water channel originating from a rectangular outlet of large reservoir at a depth h from the water level.

Stage 2: Another rectangular open water channel having same floor width as in stage 1 but runs with a slope as shown in figure. Width of the channel floor in stages 1 and 2 is 0.5 m.

Stage 3: The stage 3 linked to the stage 2 is an open **horizontal shallow channel** of rectangular cross-section with much broader floor width, d, of 10m. Water coming from stage 2 enters this channel and starts to flow in orthogonal direction as shown in figure creating a waterfall which provides water to the pond below.

(a) At the steady state waterfall carries 1.5 m³ of water per second. If the speed of water flow at the exit X of the stage 2 is 10ms^{-1}, calculate the height of the water level of the channel of stage 2 at X.

(b) Assuming that the height of the water level of the shallow channel of stage 3 is equal to the height of the water level of the stage 2 at X, calculate the speed with which water flows through the shallow channel.

(c) If the speed of the water flow at the horizontal channel of stage 1 is 5ms^{-1}, calculate the height of the water level of the open channel of stage 1.

(d) Considering a stream line along the top surface of the water flow calculate the height (y) from channel floor of stage 2 at X to channel floor of stage 1 (see the figure.) You may assume that the water leaves to the atmosphere of atmospheric pressure P at the outlet of the reservoir, and water enters the shallow channel at X which is also at pressure P.

(e) Calculate the height h of the water level in the reservoir that has to be maintained for this purpose.

(f) If the water level of the reservoir exceeds the value calculated in (e), propose a method to regulate water flow so that the waterfall carries the same amount of water per second, mentioned in (a).

02. Figure (1) shows a monochromatic ray of light entering a spherical raindrop at A and emerging from C after a single reflection at P.

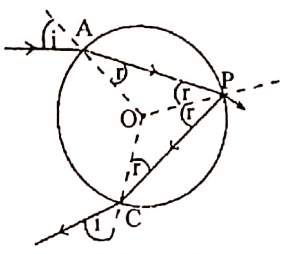


Figure (1)

(a) If the refractive index of water is $\frac{4}{3}$, calculate the critical angle for water air interface (sin 48.6° = 0.750).

(b) Giving reasons, show that the ray of light can **never** be totally internally reflected from the opposite surface of the raindrop for any angle of incidence i.

(c) (i) Write down an expression for the angle of deviation of the ray due to the refraction at A in terms of i and r.
(ii) Write down an expression for the angle of deviation of the ray AP due to the reflection at P in terms of r.
(iii) Write down an expression for the angle of deviation of the ray PC due to the refraction at C in terms of i and r.
(iv) Hence, write down an expression for the total angle of deviation (D) of the emergent ray relative to the incident ray in terms of i and r.

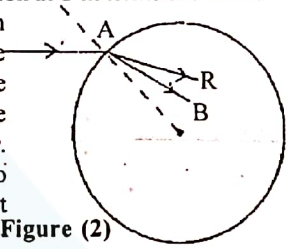


Figure (2)

A rainbow can be seen due to the emergence of incident sunlight from raindrops.
Since sunlight consists of all visible colours, when white light refracts at A it separates into its colours. Figure (2) shows such a refracted red colour ray (R) and blue colour ray (B).

(d) Copy the figure (2) onto your answer sheet and complete the subsequent paths of the red and blue rays.

(e) The expression obtained in (c) (iv) above shows that D varies with i. It has been found that when $i = 52^0$, the blue rays emerge from the raindrop with the angle of minimum deviation.
(i) Determine the corresponding angle of minimum deviation D_{min} for blue rays.
(sin 52° = 0.788, sin 36.25° = 0.591, Take the refractive index of water for blue colour also to be $\frac{4}{3}$).

(ii) Assuming $i = 52^0$ in your ray diagram drawn in (d) above, mark D_{min}.
The light of any colour that emerges from the rain drop with the angle of minimum deviation corresponding to that colour is especially bright as rays bunch up at that angle. These bright colour bands which are deviated with minimum angles of deviation enter the eyes of an observer on the ground, and thereby a rainbow is seen.
(iii) Determine the angle made by the blue colour of the rainbow with the horizontal relative to the observer on the ground.
(iv) Which colour forms the outer edge of the rainbow?

03. (a) Young's modulus E of a material in the form of a wire is given by $E = \frac{F/A}{\Delta l / l}$. Here all the symbols have their usual meaning.
Identify the terms F/A and $\frac{\Delta l}{l}$ in the expression.

(b) Figure (1) is a characteristic curve showing the elastic behaviour of a material. Identify the points X and Y marked on the curve.

(c) Two uniform nylon strings of length l (=10cm) and $2l$(=20cm) of similar area of cross-section A are separately fastened to a rigid oval shaped frame as shown in figure 2 (a). Both strings are just stretched with negligible tension. The strings lay perpendicular to each other and run just touching each other.

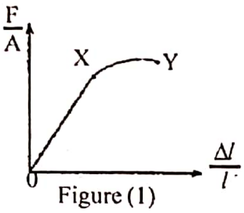
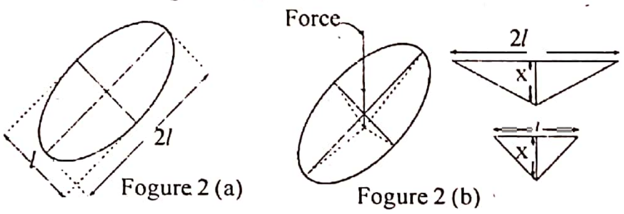


Figure (1)

Now a force is applied to the point of contact of the strings and perpendicular to the plane containing the strings as shown in fogure 2 (b).



Fogure 2 (a) Fogure 2 (b)

If x is the depression of the point of contact of strings (see figure 2(b)) due to the application of force,

(i) write down expressions for the increase in length of the two strings in terms of x and l.

(ii) derive expressions for the tensions of the two strings in terme of E, A, l and x where E is the Young's modulus of the material of the nylon strings.

(iii) If $x = 0.5$ cm, substitute the values given for l and x, and **hence** show that the tension of the shorter string is higher than that of the longer string.

[When x = 0.5 cm and l = 10cm, take $\sqrt{x^2+l^2} = 10.0125$ cm and $\sqrt{x^2 + \frac{l^2}{4}} = 5.025$ cm]

(d) (i) Explain qualitatively how the two tensions behave as the applied force to the point of contact of strings is increased.

(ii) Draw rough sketches of the tension (T) versus extension Δl curves for both strings on the same graph and label them.

(iii) Suggest a method which enables both strings to reach the condition depicted by point X shown in figure (1) simultaneously.

04. Letters, numbers, images etc. printed by certain computer printers consist of a large number of very small circular dots just touching one another. The number of such dots printed per unit length is normally used to express the quality of the printers.

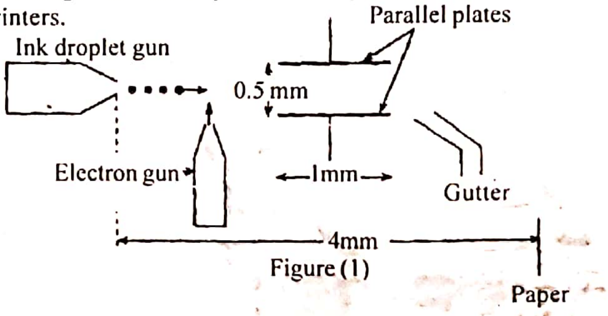


Figure (1)

A simplified diagram of a system, which illustrates only the relevant parts of the ink delivering process of such a printer, is given in figure (1). Use the dimensions shown in figure (1) in answering the questions, whenever necessary.

As shown in figure (1), the ink droplet gun sends a stream of neutral spherical ink droplets towards the paper on which the printing is to be done, and the appropriate movements of the system will give rise to printing. In order to print letters, numbers and images on the paper, only some of these droplets must be allowed to hit the paper and the rest of the droplets must be prevented from reaching the paper. This is done by charging only those droplets. that must be prevented from hitting the paper, using an electron gun and deflecting them into a gutter by means of an electric field produced by a pair of parallel plates.

(a) (i) Assume that each **spherical** droplet emitted from the ink droplet gun has a diameter D and each droplet produces a **circular dot** whose diameter is 25% larger than D when it strikes the paper. Find the value D must have for the printer to be able to print 200 dots per cm.

(ii) Ink droplet gun shoots droplets **horizontally** towards the paper with a velocity of 20ms^{-1}. Calculate the vertical displacement of a neutral droplet due to gravity when it hits the paper which is placed vertically 4mm away from the ink droplet gun. Show that this deflection is much smaller then the diameter of a dot printed on the paper.

(b) Each droplet, which has to be deflected into the gutter is given a charge of -1.6×10^{-10} C by allowing a very narrow beam of electrons from the electron gun to strike the droplets, under suitable conditions. A potential difference of 50V is applied between the parallel plates.

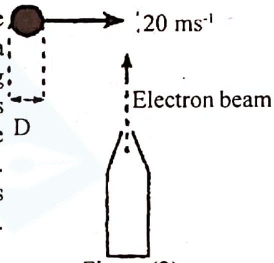


Figure (2)

(i) If the droplets move across the electron beam as shown in figure (2) find the time required for a droplet to pass the electron beam.

(ii) Assuming that all electrons, which strike the droplet are uniformly distributed over the surface of the droplet, calculate the electric current due to the emitted electrons from the electron gun during the charging process.

(c) (i) Find the electric field intensity between parallel plates.

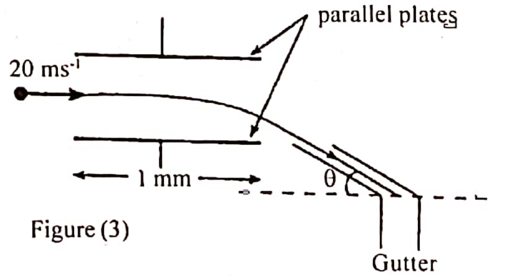


Figure (3)

(ii) What must be the direction of the electric field?

(d) The mass of a charged droplet is given as 4.0×10^{-11} kg. Find the angle (θ) that the gutter must make with the horizontal direction so that the charged droplets travel straight into the gutter as shown in figure (3). (Neglect the effect of gravity.)

05. Answer either part (A) or part (B) only.

(A)(a) Show that the ratio of currents, $\frac{I_2}{I}$, in the circuit shown is figure (1) can be given as $\frac{I_2}{I} = \frac{R_1}{R_0 + R_1 + R_2}$

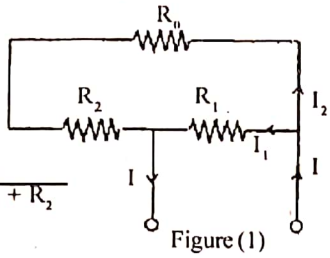


Figure (1)

(b)

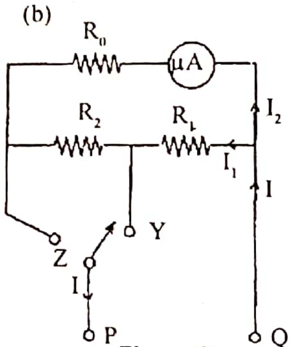


Figure (2).

Figure (2) shows a circuit of a multi-range ammeter which can be used to measure currents in the ranges, 0 - 0.01A and 0 - 0.1 A using a microammeter (μA) with a full scale deflection of 100 μA, and internal resistance R_0 of 1000Ω. Internal resistance R_0 is shown separately in the circuit for convenience. *P* and *Q* represent the terminals of the multi-range ammeter, and the microammeter is calibrated to read currents in both ranges. The necessary range can be selected by connecting the terminal *P* either to *Y* or *Z*.

(i) If you want to measure currents in the 0-0.01A range (smaller range) which terminal (*Y* or *Z*) do you use with *P*? explain your answer.

(ii) Calculate suitable values for R_1 and R_2 which enable you to use the circuit as a multi-range ammeter for the current ranges given above. Give your answers to the nearest integer.

(iii) Write down separate expressions, for the internal resistance of the multi-range ammeter in terms of R_0, R_1 and R_2 when it is set to measure currents in 0 - 0.01 A and 0 - 0.1 A ranges respectively.

(iv) Show by drawing a circuit diagram how you would extend the circuit shown in figure (2) to include another range, 0 - 1 A. Clearly identify the terminals to be used for each range. It is not necessary to calculate the values of the relevant resistors.

(B) (a) Write down an expression relating the voltages V_0, V_1, V_2 and the open loop gain *A* of the operational amplifier shown in figure (1).

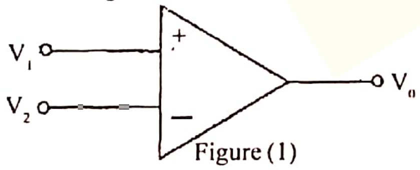


Figure (1)

(b) Input resistance of a 741 operational amplifier is approximately 2MΩ. Give a rough estimate of the expected input current when a voltage of 5V is applied between the inputs.

(c) Water level of a water tank is to be monitored and displayed remotely by a linear vertical array of LED[S] as shown in figure (2).

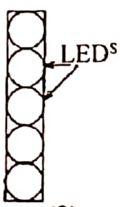


Figure (2)

Height of the water level in the tank is to be proportional to the number of LED[S] that glows from the bottom. A water level detector mounted in the tank will provide a voltage, which is proportional to the height of the water level, and is used to light the LED array.

An **incomplete** diagram of a circuit designed for this purpose is shown in figure (3). Positive saturation voltage of 5V from operational amplifier outputs are used to light the LED array.

(i) Copy the figure (3) onto your answer sheet and complete the circuit by

(1) connecting the other input terminals of the operational amplifiers to the appropriate points in the circuit.

(2) clearly indicating the non-inverting and inverting inputs of the operational amplifiers with + and - signs according to the circuit requirements.

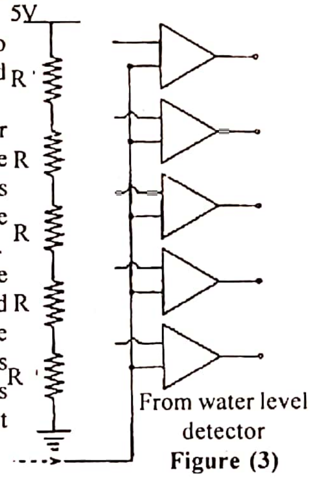
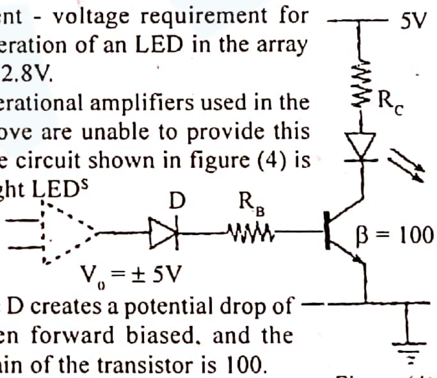


Figure (3)

(ii) Values of the resistors (*R*) should be determined so that they draw only 1 mA from the power supply. Calculate a suitable value for resistors *R*. Assume that the currents drawn by operational amplifier inputs are negligible.

(iii) The current - voltage requirement for proper operation of an LED in the array is 20mA - 2.8V.

As the operational amplifiers used in the circuit above are unable to provide this current the circuit shown in figure (4) is used to light LED[S]



The diode D creates a potential drop of 0.7V when forward biased, and the current gain of the transistor is 100.

Figure (4)

Assume that the transistor operates just at the saturation level and the collector current I_C can still be given by $I_C = BI_B$.

(1) Calculate a suitable value for R_C.

(2) If $V_{BE} = 0.7V$ and $V_0 = 5V$ calculate a suitable value for R_B.

06. Answer either part (A) or part (B) only.

(A) An electric kettle as shown in the figure contains 0.8 kg of water at 20 °C. A person switched ON this kettle and left the water in it to boil.

He however, has forgotten to switched OFF the kettle in time and finally when he switcher it OFF only 50% of water was found to be left in the kettle at its boiling temperature of 100 °C. The heater H in the kettle is rated as 2025W. Assume during the heating process only 80% of the heat produced by the heater goes to heating of water.

(a) (i) Calculate the amount of heat that is produced by the heater H before the kettle is switched OFF.

(ii) How long the kettle would have been in the ON position? Give your answer to the nearest minute.

(iii) At what rate the boiling water would have evaporated? Give your answer in kg s^{-1}.

(iv) Assuming that the water vapour in the kettle behaves like an ideal gas, write down an expression for its density ρ in terms of pressure P of the vapour, gas constant R, temperature T of the vapour and molar mass of the water M.

(v) If the spout S of kettle has a cross-sectional area of 3.73×10^{-4} m^2, using the result of part (iii) above and the expression from part (iv) above, calculate the speed υ with the water vapour would have escaped from the spout of the kettle.
Assume that the water vapour could escape only through the spout of the kettle and the pressure of water vapour in the kettle is at the atmospheric pressure of 10^5Nm^{-2}.

Specific heat capacity of water is 4200J kg^{-1} K^{-1};
Specific latent heat of vaporization of water is 2.25×10^6 J kg^{-1};
Gas constant R = 8.3 J mol^{-1} K^{-1}; Molar mass M of the water = 0.018kg mol^{-1}.

(b) Once the water in the kettle has reached the temperature of 95^{0}C, 200 cm^3 of water is poured into a glass cup which is initially at 25 °C. The mass of the cop is 250 g. calculate the maximum temperature attained by the cup of water. Assume that there is on heat loss to the surroundings. Take the specific heat capacity of glass as 840 J kg^{-1} K^{-1} and density of water as 10^3 kg m^{-3}.

(B) Read the following passage and answer the questions given below.
The Sun which provides the energy necessary to sustain all forms of life on the earth, is a star in our Galaxy. At present, the Sun contains about 74% hydrogen and 24% helium by mass and remaining 2% makes up some of the heavier elements. All these elements are in a completely ionized gaseous state, also known as a plasma state. The photosphere is the lowest of the three layers comprising the Sun's atmosphere and has a blackbody spectrum. Most of the visible light from the Sun comes from this photosphere which has a relatively small thickness. Immediately above the photosphere is a dim layer of less dense gas called the chromosphere. The outermost region of the Sun's atmosphere, the corona, extends several million kilometres from the chromosphere. Because the corona is the farthest region in the Sun's atmosphere from the surface of the Sun, it is expected that the temperature in that region to be the lowest. But it has been found that the highest temperature of the Sun's atmosphere which is around 1.5×10^6 K, is in the coronal region. Astrophysicists have suggested that this unexpected rise in temperature of the corona is due to the release of energy carried from the interior of the sun by complex magnetic fields that exist in the Sun.
Region below the photosphere is considered to be the interior of the Sun and has a radius of $R_\odot = 7 \times 10^8$ m, which is also considered as the solar radius, and a mass $M_\odot = 2 \times 10^{30}$ kg. The region closer to the centre of the Sun where the temperature and pressure are very high is known as the core. Because of very high temperature and pressure fusion of hydrogen nuclei takes place at the core of the Sun. This hydrogen fusion reaction can be written as follows;

$$4H \rightarrow He + 2e^+ + \text{neutrinos} + \text{energy}$$

The generated energy travels to the surface of the Sun and is released from there. When answering the following questions take Wien's constant to be 3×10^{-3} mK.

(a) What is meant by the plasma state of matter?
(b) What are the **three** regions exist in the Sun's atmosphere?
(c) Which region of the Sun's atmosphere has the highest temperature? Give a reason for that regior to have the highest temperature?
(d) Calculate the wavelength associated with the maximum intensity of the radiation emitted from the corona. To which region of electromagnetic spectrum does this radiation belong?
(e) If the wavelength corresponding to the maximum intensity of the light emitted from the photosphere is 500nm, what is the temperature of the photosphere (i.e.the temperature of the surface of the Sun)
(f) Find the energy, $L_\odot$, released from the surface of the Sun per second which is also known as the solar luminosity. Take the Stefan constant as $0 = 6 \times 10^{-8}$ Wm^{-2} K^{-4}, and the emissivity of the solar surface as 1.
(g) (i) If the mass of a hydrogen nucleus is 1.67×10^{-27} kg and mass of a helium nucleus is 6.65×10^{-27} kg. calculate the mass difference (Δm) between four hydrogen nuclei and one helium nucleus. Hence calculate the energy released in a single fusion reaction using $\Delta E = (\Delta m)c^2$. Here $c = 3 \times 10^8$ ms^{-1}. Assume that the positrons and neutrinos have negligible masses.
(ii) Assuming that the energy released at the core of the Sun entirely contributes to the solar luminosity that you have obtained in (f) above, calculate the number of the hydrogen nuclei, which is converted into helium within its core each second.
(iii) If it is assumed that hydrogen is converted into helium at the present rate, how long will it take to convert entire mass of hydrogen inside the Sun into helium? [For this part of the question take the mass of a hydrogen nucleus as 2×10^{-27}kg.]

G.C.E. (Advanced Level) Examination - August 2009

PHYSICS - I

Provisional Scheme of Marking

2009 - Answers					
01	☒	2	3	4	5
02	☒	2	3	4	5
03	1	2	3	4	☒
04	1	2	3	4	☒
05	1	☒	3	4	5
06	1	2	3	4	☒
07	1	2	☒	4	5
08	1	2	☒	4	5
09	1	2	3	☒	5
10	1	2	3	☒	5
11	1	2	☒	4	5
12	☒	2	3	4	5
13	1	2	3	☒	5
14	☒	☒	☒	☒	☒
15	1	☒	3	4	5
16	1	2	3	☒	5
17	☒	2	3	4	5
18	1	2	3	☒	5
19	1	2	3	4	☒
20	1	2	3	☒	5
21	1	2	3	☒	5
22	☒	2	3	4	5
23	1	☒	3	4	5
24	1	2	3	4	☒
25	1	☒	3	4	5
26	1	2	3	4	☒
27	1	☒	3	4	5
28	1	2	☒	4	5
29	1	2	☒	4	5
30	1	☒	3	4	5
31	1	2	☒	4	5
32	1	2	☒	4	5
33	1	☒	3	4	5
34	1	2	☒	4	5
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36	1	2	3	4	☒
37	☒	2	3	4	5
38	1	2	3	☒	5
39	1	2	☒	4	5
40	1	2	3	4	☒
41	1	2	3	☒	5
42	1	2	3	☒	5
43	1	2	☒	4	5
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48	1	2	☒	4	5
49	☒	2	3	4	5
50	1	2	3	☒	5
51	1	2	3	☒	5
52	1	☒	3	4	5
53	1	☒	3	4	5
54	1	2	3	☒	5
55	1	☒	3	4	5
56	1	2	☒	4	5
57	☒	2	3	4	5
58	☒	2	3	4	5
59	1	2	3	4	☒
60	☒	2	3	4	5

G.C.E. (Advanced Level) Examination - August 2009

PHYSICS - II

Provisional Scheme of Marking

A - PART

01. (a) (i) Any value 0.4 cm - 1cm 01

(ii) Meter ruler / Meter scale / Half meter ruler / Scale attached to the Board 01

(iii) Suck or Remove air from the tube using mouth close the clip OR Using the clip close the tube 02

(iv) Because it can be used even for liquids which are miscible OR can be used for liquids which are miscible with water.

(b) (i) $P_w = h_w d_w g - \frac{2T_w}{r} + P_0$

$P_L = h_l d_l g - \frac{2T_l}{r} + P_0$

(ii) $P_W = P_L = \pi$

$h_w d_w g - \frac{2T_w}{r} + P_0 = h_l d_l g - \frac{2T_l}{r} + P_0$

$h_w = \left(\frac{d_L}{d_w}\right) h_l + \frac{2}{r d_w g} (T_w - T_l)$

(iii) To determine T_l : Intercept

To defermine d_l : Gradient

both Correct 01

(iv) To reduce the fractional/ Percentage error of the height measurements. 01

02. (a) The end (P) of the rod could be maintained at constant / Steady (100^0C) temperature / OR

The temperature of the steam could be maintained at constant temperature (at 100^0C) throughout. OR steam can be transferred from the boiler to the chamber without changing its temperature. 01

(b) (i)Rate of heat absorbed/ heat absorbed per unit time/ heat absorbed. Per second by the calorimeter and water is equal to the rate of dissipation of heat/ loss of heat perunit time / loss of heat per second / by the calorimeter and water to the surroundings. OR

Rate of heat dissipation / the rate of loss of heat/ loss of heat per unit time/ loss of heat per second/ from the colorimeter and water is equal to the rate of flow of heat / flow of heat perunit time / flow of heat per second / through the rod. 01

(ii) (1) The rate of loss of heat / Rate of heat dissipation/ loss of heat per unit time / loss of heat per second from the calorimeter and water increased with time. 01

(2) The flow of heat per unit time/ The rate of flow of heat per second through the rod decreases with time OR The rate of absorption of heat/ heat absorbed per unit time/ heat absorbed per second by the calorimeter and water decreses with time. 01

(iii) 60^0C 01

(c) (i) $R = 0.16 (0 - 0_R)$

$R = 0.16 (60 - 30)$

$R = 4.8$ W 01

(ii) $R = KA \left(\frac{\Delta\theta}{\Delta t}\right)$

$4.8 = K \times 1.2 \times 10^{-4} \times \frac{40}{0.4}$ 01

$K = 400$ Wm^{-1}K^{-1} (Wm^{-1} ^{0}C^{-1}) 02

(01 mark unit)

(d) No

Steady flow of heat connot be maintained. OR Aconstant (steady) temperature gradient cannot be achieved OR steady state condition can't be acheved OR The temperature of water will reach 100 ^{0}C eventually. 01

03. (a) Increase the vibrating length of the wire from a smaller value /Zero using movable bridge. 01

Vibrate the turning for k and place it on the sonometer box and adjust the length until the paper rider placed on the middle region Jumps off the wire.

[Pulck the wire in the middle region and adjust the vibrating length using the movable bridge until a note of approximately. the same frequency the tuning fork is heard. 01

Pluck the wire and vibrate the tuning fork at the same time and adjugt the length until no beats are heard.] 01

(b) $V = f\lambda$, $\lambda/2 = l$ $\lambda = 2l$

$\sqrt{T/m} = f\,2l$

$l = \frac{1}{2f}\sqrt{T/m}$ 01

(c) By taking moments around P and equating to zero 01

P $T \times l = Mg \times n$ 01

(d) $T = Mgn$

$l^2 = \frac{1}{4f^2}\left(\frac{Mg}{m}\right) n$

(e) $5 \times M \times g \times = 54$

Maximum value of $M = \frac{54}{50}$

$M_{max} = 1.08$ Kg 01

(f) (i) The diameter of the wire

(ii) Micrometer screw gauge 01

(g) (i) Graient of the graph (m) = $0.04m^2$ 01

(ii) Gradient $G = \frac{1}{4f^2}\left(\frac{Mg}{m}\right)$

$\therefore f^2 = \frac{1}{4G}\left(\frac{Mg}{m}\right)$

$f^2 = \frac{1}{4 \times 0.04}\left(\frac{5}{2x10^{-3}}\right)$ 01

$f = \frac{1}{2 \times 0.2} \times 50$

$f = 125H2$ 01

04. (a) To protect / Safeguard the galvanometer OR to prevent large current. Flowing through the galvanometer. 01

(b) + (V) -

(c) Increase the resistance of the resistance box OR Incrcase the value of R_3 01

(d) Touch the two ends of the potentiometer wire with the Sliding key. Galvanometer should show deflections in opposite directions. 01

(e) $IR_1 = K\ell_1$ OR $IR_1 \propto \ell_1$

$I(R_1 + R_2) = K\ell_2$ OR $I(R_1 + R_2) \propto \ell_2$ 01

$\frac{Kl_2}{Kl_1} = \frac{I(R_1 + R_2)}{I R_1}$ $\quad \frac{l_2}{l_1} = \frac{R_1 + R_2}{R_1}$

(f) $l_2 = \left(\frac{R_1 R_2}{R_1}\right) l_1$ or $l_2 = \left(1 + \frac{R_2}{R_1}\right) l_1$

(g) By Varying R_3 (Changing, increasing, decreasing are acceptable.)

01

(h) (i) $R_2 = R_1 + R_3$ or $R_1 + R_3$ 01

(ii) (i) 2V cell may have a non zero internal resistance.
(ii) Voltmeter may have not calibrated properly
(iii)It may not be possible to adjust the resistance box so that the voltmeter reads exactly 1V. 01

PART - B

01. Bernoullis equation

$P + \frac{1}{2}\rho V^2 + \rho gh = K$ (constant) 01

P - Pressure / Pressure energy per unit volume. 01

$\frac{1}{2}\rho V^2$ - Kinetice energy per unit volume 01

ρgh - Graritational potential energy per unit volume 01

(a) Height of water level at X $= \frac{\text{flow rate}}{\text{Speed x width of the channel}}$

$(A_1 V_1 = A_2 V_2)$

$= \frac{1.5}{10 \times 0.5}$

= 0.3m (30cm) 01

(b) Speed of water flow through shallow channel = $\frac{1.5}{10 \times 0.3}$ 01

= $0.5ms^{-1}$ ($50cms^{-1}$) 01

$A_1V_1 = A_2V_2$

10 x 0.3 x V = 0.5 x 0.3 x 10 01

V = $0.5\ ms^{-1}$ ($50\ cms^{-1}$) 01

(c) Height of water level of stage 1 = $\frac{1.5}{10 \times 0.5}$

= 0.6m (60cm) 01

(d) Applying Bernulli's eq. to a steam line along the top surface.

$P + \frac{1}{2}\rho(5)^2 + \rho \times 10(y + 0.6) = p + \frac{1}{2}\rho(10)^2 + \rho \times 10 \times 0.3$

(LH.s -01
R.Hs. -01)

Y = 3.45m 01

(answr 3.75m then award only 2 marks)

Applying Bernullis equation

(e) $P + \odot + 10\rho H = P + \frac{1}{2}\rho(5)^2 + \odot$ 01

H = 1.25m 01

(f) Use a sluice gate OR Reduce the area of cross- section of the reservoir. 01

02. (a) $n = 1/\sin C$ or $\sin C = 3/4$ 01

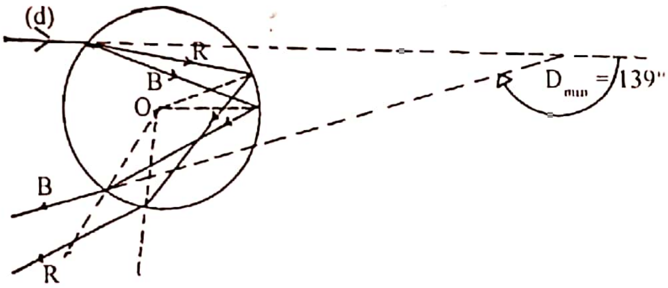
Sinc = 0.75

C = 48.6^0 ($48^0\ 36^1$) 01

(b) If the ray suffers total internal reflection at P, the angle of incidence at P. or the value of r should be greater than the critical angle or C 01
If thi's happen's the angle of reflaction at a will be greater than the critical angle or C
This is imposible since the angle of incidence at Aori has to be less than or equal of 90^0 0

(c) (i) i - r 01
(ii) 180 - 2r 01
(iii) i - r 01
(iv) D = 180 + 2i - 4r 01

(d)



Ray diagram 02
01

(e) (i) $\frac{Sin52^0}{Sinr} = 4/3$

Sin r = $4/3$ Sin 52^0 ; r = 36.25^0

D = 180 + 2 x 52 - 4 x 36.25

D = 139^0 ($138^0\ 20'$) 01

(ii) Marking D or Dmin or 139^0 01
(iii) 41^0 ($41^0\ 40'$) 01
(iv) Red 01

03. (a) $E = \dfrac{F/A}{\Delta l / l}$

F/A = Tensile stress 01

$\Delta l / l$ = Tensile strain 01

(b) X - Proportional limit
Y - Breaking Point } 01

(c) (i) Extension in the longer string = $2\left(\sqrt{x^2 + l^2} - l\right)$

Extension in the shorter string =

$$2\left(\sqrt{x^2/4 + l^2/4} - l/2\right)$$

(ii) Applying = $F/A = E\, \Delta l / l$

Tension of the longer string = $EA \dfrac{2\left(\sqrt{x^2 + l^2} - l\right)}{2l}$ 01

$= \dfrac{EA\left(\sqrt{x^2 + l^2} - l\right)}{l}$ 01

Tension of the shorter string = $\dfrac{EA\, 2\left(\sqrt{x^2/4 + l^2/4} - l/2\right)}{l}$

$= \dfrac{2EA}{l}\left[\sqrt{x^2 + l^2/4} - l/2\right]$

01

(iii) $x = 0.5$cm , l - 10cm , $\sqrt{x^2 + l^2} = 10.0125$ and

$\sqrt{x^2 + l/4} = 5.025$

∴ Tension the longer string = $\frac{EA}{10}$ (10.0125 - 10)

= 0.00125EA 01

Tension in the shorter String $= \frac{2EA}{10}$ (5.025 - 5)

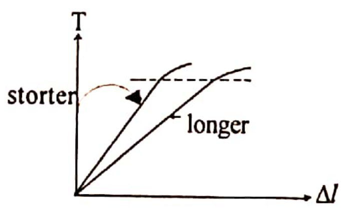
= 0.005EA 01

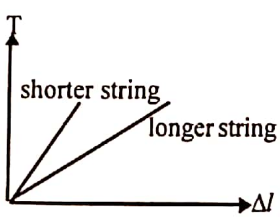
∴ Tension in the longer string < Tension in the shorter string 01

(d) (i) As the applied force is increased the tension in the storter string will reach the proportional limit earlier than the longer string. 01

After that most of the force will act on the longer string. 01

(ii)





(iii) Initially apply a suitable fixed tension to the longer string.

01

04. (a) (i) Diameter of a dot on the paper = $\frac{1}{200}$ cm

∴ $1.25D = 5 \times 10^{-5}$ $\left[\frac{125}{100} D = \frac{1}{200} \times 10^{-2}\right]$

$D = 4 \times 10^{-5}$m 01

(ii) Let the vertical displacement of the ink Droplet when it reaches the paper be H

$\rightarrow\ S = Ut + \frac{1}{2} at^2$

$4 \times 10^{-3} = 20t$ 01

$t = 2 \times 10^{-4}$ S

$\downarrow S = Ut + \frac{1}{2} at^2$

$H = \frac{10}{2}(2 \times 10^{-4})^2$ 01

$H = 2 \times 10^{-7}$ m

$H = 2 \times 10^{-7}$ m is smaller than the diameter of a dot (5×10^{-5}m) Therefore effect of gravity on the position of the droplet is negligible. 01

(b) (i)Time taken by the droplet to pass the electron Beam

$= \dfrac{\text{Diameter of the Droplet}}{\text{Velocity}}$

$= \dfrac{4 \times 10^{-5}}{20}$

$= 2 \times 10^{-6}$ s (2μs) 01

(ii) There fore; the current of the emitted electron beam

$= \dfrac{1.6 \times 10^{-6}}{2 \times 10^{-6}}$

$= 8 \times 10^{-5}$ A (80μA) 01

(c) (i) Electic field between the plates = E

$= V/d$

$= \dfrac{50}{0.5 \times 10^{-3}}$

$E = 10^5\ Vm^{-1}$

(ii) Direction of the electic field is vertically upwards OR ↑

(d) Horizontial velocity of the droplet $V_x = 20ms^{-1}$ Accleration in the vertical directon (→)

$\rightarrow\ F = ma$

$qE = ma$

$a = \dfrac{qE}{m}$

$a = \dfrac{1.6 \times 10^{-10} \times 10^5\ ms^{-2}}{4.0 \times 10^{-11}}$ 01

$= 4 \times 10^5\ ms^{-2}$

Vertical Velocity of the droplet = Vy

Vy = at

t is the time of travel through the electric field

$$t = \frac{10^{-3}}{20} = 5 \times 10^{-5}\ s$$

$$V_y = 5 \times 10^{-5} \times 4 \times 10^{5}$$

$$V_y = 20\ ms^{-1} \qquad 01$$

therefore $\tan\ \theta = \frac{V_y}{V_x} = \frac{20}{20}$ 01

$$\theta = 45^0 \qquad 01$$

05. (A) (a) Applying kirchhoffs lows.

$I_2\ (R_0 + R_2) = I_1 R_1$ 01

$I_1 + I_2 = I$

$I_2\ (R_0 + R_2) = (I - I_2)\ R_1$ 01

$I_2\ (R_0 + R_1 + R_2) = IR_1$

$$\frac{I_2}{I} = \frac{R_1}{R_0 + R_1 + R_2}$$

Alternative method

$I_1 R_1 = I_2\ (R_0 + R_2)$ OR

$$\frac{I_2}{I_1} = \frac{R_1}{R_0 + R_2}$$

$$\frac{I_2}{I_1 + I_2} = \frac{R_1}{R_0 + R_1\ R_2}$$

$$\frac{I_2}{I} = \frac{R_1}{R_0 + R_1 + R_2}$$

(b) (i) The terminal Z 01

As the current through the micro-ammeter should be limited of 100μA a shunt with lower resistance. (R_1) should be used when the ammeter receives a higher current, and vice versa. Therefore when the lower current range (0 - 0.01A) is seclected a shunt with the higher resistance ($R_1 + R_2$) Shoud be used. 01

(ii) Fer 0 - 0.01 a range.

$$\frac{I_2}{I} = \frac{R_1}{R_0 + R_1 + R_2} \qquad 01$$

$$\frac{R_1 + R_2}{R_0 + R_1 + R_2} = \frac{100 \times 10^{-6}}{0.01} \qquad 01$$

$100\ (R_1 + R_2) = R_0 + R_1 + R_2$

$R_0 = 1000\Omega \Rightarrow$

$100R_1 + 100R_2 = 1000 + R_1 + R_2$

$99R_2 = 1000 - 99R_1$

$$(R_1 + R_2) \times 10^{-2} = (R_0 + R_1 + R_2)\ 100 \times 10^{-6}$$

$$(R_1 + R_2)\,10^{-2} = (10^3 + R_1 + R_2)\ 10^{-4}$$

$$(R_1 + R_2)\ (10^{-2} - 10^{-4}) = 10^3 \times 100 \times 10^{-6}$$

$$(R_1 + R_2)\ \left(\frac{1}{100} - \frac{1}{1000}\right) = 10^{-1}$$

$$(R_1 + R_2)\ (99) = 10^{-1} \times 10^4$$

$$R_1 + R_2 = {}^{10^3}\!/_{99}$$

For 0 - 0.1 range $\quad \frac{I_2}{I} = \frac{R_1}{R_0 + R_1 + R_2}$

$$\frac{R_1}{R_0 + R_1 + R_2} = \frac{100 \times 10^{-6}}{10^{-1}}$$

OR $10^3 R_1 = R_0 + R_1 + R_2$

$R_0 = 1000\Omega$

$R_2 = 999R_1 - 1000$ ②

① $99\ (999R_1 - 1000) = 1000 - 99R_1$

$R_1 = \frac{100}{99} = 1.01\Omega$

$= 1\ (1.01)\ \Omega$ 02

$R_2 = \frac{999 \times 100}{99} - 1000$

$= 9\Omega\ (9.09\Omega)$

$$[0.1R_1 = 100 \times 10^{-6}\ (10^3 + R_1 + R_2)$$

$$R_1 (10^{-1} - 10^{-4}) = 100 \times 10^{-6} (10^3 + R_2)$$

$$R_1\ 999 = 10^3 + R_2$$

$$R_1\ 999 - R_2 = 1000$$

$$1000R_1 = 1000 + \frac{1000}{99}$$

$$R_1 = 1 + {}^{1}\!/_{99}$$

$$R_1 = 1.01\ \Omega\ (1\Omega)]$$

$$R_2 = \frac{10^3}{99} - (1 + {}^{1}\!/_{99})$$

$$R_2 = \frac{10^3}{99} - \frac{1}{99} - 1$$

$$R_2 = \frac{999}{99} - 1$$

$$R_2 = 10.09 - 1$$

$$R_2 = 9.09\Omega\ (9\Omega)$$

(iii) Internal resistance (Ri) of the ammeter in the 0- 0.01 range is given by

$$\frac{1}{R_i} = \frac{1}{R_1 + R_2} + \frac{1}{R_1}$$

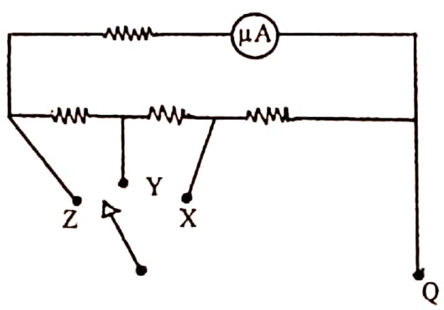
$$R_1 = \frac{R_0\ (R_1 + R_2)}{R_0 + R_1 + R_2}$$

Internal resistance (Ri) of the ammeter in the 0 - 0.1 range is given by

$$\frac{1}{Ri} = \frac{1}{R_0 + R_2} + \frac{1}{R_1} \quad \text{or}$$

$$Ri = \frac{R_1\ (R_0 + R_2)}{R_0 + R_1 + R_2} \qquad 01$$

(iv)



Identification of all terminals

Terminals P - X for 0 - 1A

Terminals P - Y for 0 - 0.1A

Terminals P - Z for 0 - 0.01A

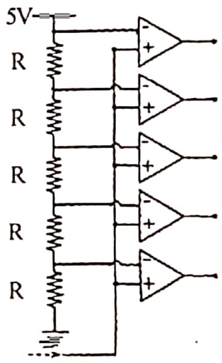
Current range 01

05. (B) (a) $V_0 = A(V_1 - V_2)$ 01

(b) Input current $\simeq \frac{1}{2 \times 10^6}$

$= 2.5\mu A$

(c) (i)



All conectrons correct 02

Correct ±sign allocation all correct -02

{At least three allocations are correct 01]

(ii) $5R = \frac{5}{1 \times 10^{-3}}$ $\left(R = \frac{1}{10^3}\right)$ 01

$R = 1k\Omega \ (1000\Omega)$ 01

(iii) (1) Applying kirchhoff's laws to the output circuit

$I_C R_C + 2.8 + V_{CE} = 5$ 02

$[I_C R_C + 2.8 + 0.1V = 5]$

For $V_{CE} = 0.1V$

$R_C = \frac{2.1}{20 \times 10^{-3}}$

$R_C = 105\Omega$ 01

$[V_{CE} = 0, R_C = 110\Omega]$ -01

(2) $I_B = {}^{I_C}/_{\beta}$

$= \frac{20 \times 10^{-3}}{100}$

$I_B = 2 \times 10^{-4}$ 01

Applying kirehhoff's law to the input circuit

$0.7 + I_B R_B + 0.7 = 5$ $[0.7 + I_B R_B + V_{BE} = 5]$ 01

$\therefore \ R_B = \frac{3.6}{2 \times 10^{-4}}$

$R_B = 1.8 \times 10^4 \ (18k\Omega)$ 01

06. (A) (a) (i) Heat energy absorbed by the water

$= \{0.8 \times 4200 \times (100 - 20)\} + \left\{\left(\frac{0.8 \times 50}{100}\right) \times 2.25 \times 10^6\right\}$

$= 1169 \text{ kJ}$ 01

$\frac{80}{100} Q = 1169 \times 10^3$

$Q = \frac{1169 \times 10^3}{80}$

$Q = 1.461 \times 10^3 \text{ KJ} \ [(1.45 - 1.47) \times 10^3 \text{ KJ}]$ 01

(ii) Let t be the time taken.

$2025 \times t = 1461 \times 10^3$ 01

$t = 721.5 \text{ S}$ $=12\text{min}$ 01

(iii) Let m be the mass of the evaporated water and t be the time taken to evaported if

$\left(\frac{80 \times 2025}{100}\right)\Delta t = m \times 2.25 \times 10^6$ $\left[\frac{80}{100} W \times \Delta t = mL\right]$

The rate that the boiling water would have exaporated

$= \frac{m}{\Delta t} = \frac{80 \times 2025}{100 \times 2.25 \times 10^6}$

$= 7.2 \times 10^{-4} \text{ kgs}^{-1}$ 01

[Time taken for evaporation

$\Delta t = \frac{\left(\frac{0.8 \times 50}{100}\right) \times 2.25 \times 10^6 \times 100}{80 \times 2025} = 555.6 \text{ s}$ 01

The rate that the boiling water would have evaporated

$= \frac{0.8 \times 50}{100} / 555.6\text{s}$

$= 7.19 \times 10^{-4} \text{ Kgs}^{-1}$ $(7.1 - 7.2 \times 10^{-4} \text{ kgs}^{-1})$ 01]

(iv) $PV = nRT$

$P = \frac{m}{V.M} RT$

$P = \frac{\rho RT}{M}$

$\rho = \frac{PM}{RT}$

(v) The rate that the boiling water would have evaporated can be written as

$m = AV\rho$

$(3.73 \times 10^4) v\rho = 7.2 \times 10^{-4}$

$3.73 \times 10^{-4} v \frac{PM}{RT} = 7.2 \times 10^{-4}$

$v = \frac{7.2 \times 10^{-4} \times 8.3 \times 373}{1 \times 10^5 \times 3.73 \times 10^{-4} \times 0.081}$

$v = (3.32 \pm 0.01) \text{ ms}^{-1}$

(b) Heat lost by water = heat gained by the cup

$200 \times 10^{-6} \times 10^3 \times 4200 \times (95 - T) = 250 \times 10^{-3} \times 840 \times (T - 25)$ - 02

$T = 81 \ ^0C$ - 01

06. (B) (a) Completely ionized gaseous state of matter is known as plasma state

(b) Photosphere, chromosphere and corona 01

(c) Corona has the highest temperature 01

Reason : Because the energy is transmitted from the interior of the sun to the corona by complex magnetic fields of the sun and released in the corona

(d) win's displaument law, $\lambda_{max} = \frac{3 \times 10^{-3}}{T} = \frac{3 \times 10^{-3}}{1.5 \times 10^6}$

$= 2 \times 10^{-9} \text{ m} = 2 \text{ nm}$

This wavelength is in the high energy ultaraviolet region OR low energy X - ray 01

(e) Wien's displacement law, $T = \frac{3 \times 10^{-3}}{\lambda max} = \frac{3 \times 10^{-3}}{500 \times 10^{-9}}$

$= 6000\ K$ 01

(f) Stafan's law $L_0 = \sigma T^4 \times 4 \pi R_0^2$

$= 6 \times 10^{-8} \times (6 \times 10^3)^4 \times 4 \times \frac{22}{7} \times (7 \times 10^8)^2$

$= 4.8 \times 10^{26}\ W$ 01

$(4.50 - 4.90) \times 10^{26}\ W$

(g) (i) Mass of four Hydrogen atoms $= 1.67 \times 4 \times 10^{-27}\ Kg$

$= 6.68 \times 10^{-27}\ Kg$

Mass of a Helium atom $= 6.65 \times 10^{-27}\ Kg$

Mass difference $= 0.03 \times 10^{-27}\ Kg$

Energy released in a single fusion reaction

$= 0.03 \times 10^{-27} \times (3 \times 10^8)^2\ (E = mC^2)$

$= 2.7 \times 10^{-12}\ J$ 01

(ii) Number of H nuclei lost per second $= \frac{4.8 \times 10^{26} \times 4\ Js^{-1}}{2.7 \times 10^{-12}\ J}$

$= 7.1 \times 10^{38}\ S^{-1}$

$(6.6 - 7.3) \times 10^{38}\ S^{-1}$

(iii) Total number of H nuclei in the sun

$= \left(\frac{74}{100}\right) \frac{2 \times 10^{30}}{2 \times 10^{-27}}$ OR $\left(\frac{74}{100}\right) \frac{2 \times 10^{30}}{1.67 \times 10^{-27}}$

$= 7.4 \times 10^{56}$ OR 8.86×10^{56}

Time for the fusion of all H nuclei

$= \frac{7.4 \times 10^{56}}{7.1 \times 10^{38}} S$ OR $\frac{8.86 \times 10^{56}}{7.1 \times 10^{38}} S$

$= 1.04 \times 10^{18}\ S$ OR $1.25 \times 10^{18}\ S$

$= (1.0 - 1.4) \times 10^{18}\ S$

Tofal mass of hydrogen in the sun $= \frac{74}{100} \times 2 \times 10^{30}\ Kg$

$= 1.48 \times 10^{30}\ Kg$

Rate of loss of Hy drogen mass $= 7.1 \times 10^{38} \times 2 \times 10^{-27}$ OR

$7.1 \times 10^{38} \times 1.67 \times 10^{-27}$

Time for the fusion of all H nuclei

$= \frac{1.48 \times 10^{30}}{1.42 \times 10^{12}}$ OR $\frac{1.48 \times 10^{30}}{1.19 \times 10^{12}}$

$= 1.04 \times 10^{18}\ S$ OR $1.25 \times 10^{18}\ S$

$(1.0 - 1.4) \times 10^{18}\ S$