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

PHYSICS - I

Provisional Scheme of Marking

2009 - Answers

Q	Answer	Q	Answer	Q	Answer
01	1	21	4	41	4
02	1	22	1	42	4
03	5	23	2	43	3
04	5	24	5	44	3
05	2	25	2	45	2
06	5	26	5	46	4
07	3	27	2	47	2
08	3	28	3	48	3
09	4	29	3	49	1
10	4	30	2	50	4
11	3	31	3	51	4
12	1	32	3	52	2
13	4	33	2	53	2
14	1, 2, 3, 4, 5	34	3	54	4
15	2	35	1	55	2
16	4	36	5	56	3
17	1	37	1	57	1
18	4	38	4	58	1
19	5	39	3	59	5
20	4	40	5	60	1

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°C) temperature / OR

The temperature of the steam could be maintained at constant temperature (at 100°C) 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°C 01

(c) (i) $R = 0.16 (\theta - \theta_R)$

$R = 0.16 (60 - 30)$

$R = 4.8$ W 01

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

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

$K = 400\ Wm^{-1}K^{-1}\ (Wm^{-1}\ {}^{\circ}C^{-1})$ 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 °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 x M x g x = 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) $\overset{+}{-}$(V)$\overset{-}{-}$

(c) Increase the resistance of the resistance box OR Increase 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

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

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

(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

$$\left[\begin{array}{ll} A_1V_1 = A_2V_2 & \\ 10 \times 0.3 \times V = 0.5 \times 0.3 \times 10 & 01 \\ V = 0.5\ ms^{-1}\ (50\ cms^{-1}) & 01 \end{array}\right]$$

(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.

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

(L.H.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

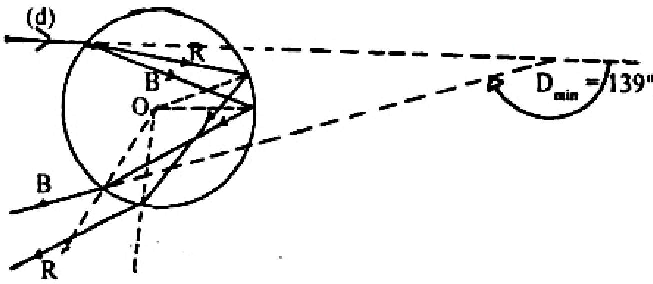
02. (a) $n = {1}/{\sin C}$ or $\sin c = {3}/{4}$ 01

Sinc = 0.75
C = 48.6° (48° 36') 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° 01

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

(d)



Ray diagram 02

(e) (i) $\frac{Sin52^0}{Sinr} = {4}/{3}$ 01

Sin r = ${4}/{3}$ Sin 52° ; r = 36.25°

D = 180 + 2 x 52 - 4 x 36.25

D = 139° (138° 20') 01

(ii) Marking D or Dmin or 139° 01
(iii) 41° (41° 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 } 01
Y - Breaking Point }

(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 = 0.5cm , 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

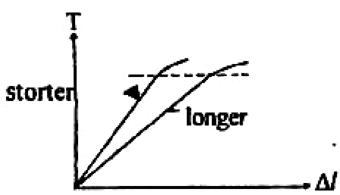
Tension in the shorter String = $\frac{2EA}{10}$ (5.025 - 5)
= 0.005EA 01

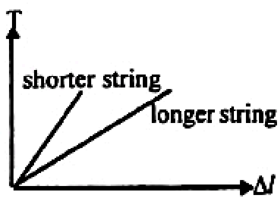
∴ Tension in the longer string < Tension in the shorter string 01

(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 = 5×10^{-5} $\left[\frac{125}{100} D = \frac{1}{200} \times 10^{-2}\right]$
D = 4×10^{-5}m 01

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

→ $S = Ut + \frac{1}{2} at^2$

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

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

↓ $S = Ut + \frac{1}{2} at^2$

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

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

H = 2×10^{-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

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

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

$= 2 \times 10^{-6}$, (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

$= V/d$

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

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

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

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

→ F = ma

qE = ma

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

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

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

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

$\theta = 45^0$ 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

$I_2 (R_0 + R_1 + R_2) = I R_1$

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

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

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

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

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

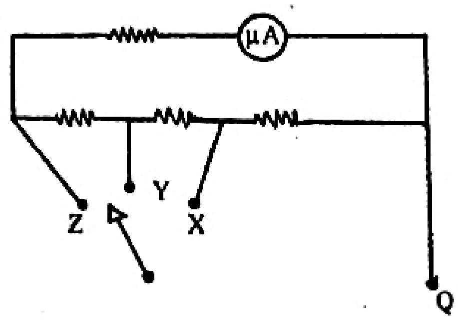
$$R_1 = \frac{R_0 (R_1 + R_2)}{R_0 + R_1 + R_2}$$

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

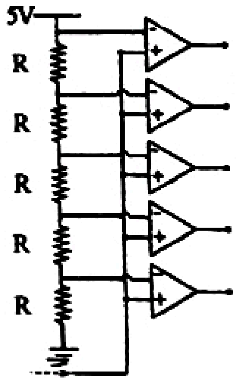
Current range 01

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

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

$= 2.5\mu A$

(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

$R = 1k\Omega$ (1000Ω) 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

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

$= 1169$ kJ   01

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

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

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

(ii) Let t be the time taken.

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

$t = 721.5$ S $= 12$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

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

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

[Time taken for evaporation

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

The rate that the boiling water would have evaporated

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

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

(iv) $PV = n RT$

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

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

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

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

$m = AV\rho$

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

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

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

$v = (3.32 \pm 0.01)$ 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

$T = 81$ °C   - 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, $\lambda_{max} = \frac{3 \times 10^{-3}}{T} = \frac{3 \times 10^{-3}}{1.5 \times 10^6}$

$= 2 \times 10^{-9}$ m $= 2$ 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 $L_{s} = \sigma T^{4} \times 4 \pi R_{s}^{2}$

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

$= 4.8 \times 10^{26}\ W$ 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 $1.25 \times 10^{18}\ S$

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