G.C.E. (Advanced Level) Examination - April 2005

PHYSICS - I

Provisional Scheme of Marking

2005 - Answers

No.	1	2	3	4	5
01	1	X	3	4	5
02	1	2	3	X	5
03	X	2	3	4	5
04	1	X	3	4	5
05	X	2	3	X	5
06	1	2	X	4	5
07	1	2	X	4	5
08	1	2	X	4	5
09	X	2	3	4	5
10	1	2	3	4	X
11	1	2	3	4	X
12	X	2	3	4	5
13	1	X	3	4	5
14	1	X	3	4	5
15	1	2	X	4	5
16	1	2	X	4	5
17	X	2	3	4	5
18	1	2	3	4	X
19	1	X	3	4	5
20	1	2	3	4	X
21	X	2	3	4	5
22	1	2	X	4	5
23	X	2	3	4	5
24	1	2	3	X	5
25	1	2	3	X	5
26	1	X	3	4	5
27	1	X	3	4	5
28	1	X	3	4	5
29	1	2	3	X	5
30	1	2	3	X	5
31	1	2	3	4	X
32	1	2	X	4	5
33	X	2	3	4	5
34	X	2	3	4	5
35	X	2	3	4	5
36	1	2	X	4	5
37	1	2	3	X	5
38	1	2	X	4	5
39	X	2	3	4	5
40	1	2	3	4	X
41	1	2	3	4	X
42	1	X	3	4	5
43	1	X	3	4	5
44	1	X	3	4	5
45	1	2	3	X	5
46	1	2	X	4	X
47	1	2	X	4	5
48	1	2	3	4	X
49	1	2	3	X	5
50	1	2	X	4	5
51	X	2	3	4	5
52	1	X	3	4	5
53	X	2	3	4	5
54	1	2	3	4	X
55	1	X	3	4	5
56	1	2	3	4	X
57	1	2	X	4	5
58	1	2	3	X	5
59	1	X	3	4	5
60	X	2	3	4	5

G.C.E. (Advanced Level) Examination - April 2005

PHYSICS - II

Provisional Scheme of Marking

A - PART

01. (a) set square, Ruler 01

(b) pull/displace the middle weight (any) slightly and check whether it return to the original position.

OR

Displace the system slightly and check whether it return to the original position. 01

(c) 01. Mark the positions of each string by making two dots on the paper by placing the set square perpendicular to the string.

OR

[Place the piece of plane mirror underneath the string and mark two dots at each end of the image while viewing straight through the strings.]

02. Draw the lines, which go through the points Mark two lengths proportional to P and R from the point of intersection of the two inclined positions of the string.

03. Complete the parallelogram and measure the length of the diagonal at the point of intersetion.

04. Find out the weight (force) which corresponds to the length of the diagonal, check whether this is equal to Q

05. Check also whether the direction of the diagonal is vertical [OR along the marked direction of the string attached to the weight Q]

(d) The tensions of the strings must be equal to the hanging weights.

OR the tensions along a string segment must be the same

OR the sides of the force parallelogram must correspond to the weights P and R.

(A student can answer this in the negative way

ex. the tensions alongs a string seqment is not the same)

(e) String / pulleys are not free to move.

OR

due to the friction between the string and the pulleys. 01

(f) weight the pans and add the corresponding weights to P, Q and R

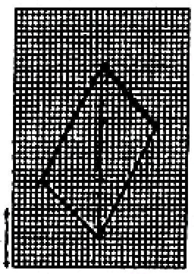
OR

hang the weights without the pans directly from the strings. 01

(g) $2 \times 3N = 6N$ 01

0.6kg

1 cm



(if the studend has identified that the vetical diagonal corres ponds ot the weight of the stone.) 01

02. (a) above the room temperature 01

(b) To minimize the experimental error caused by the heat exchanged with the surroundings.

OR

To compensate the heat exchanged with the surroundings

OR

To equate the heat gained from the surroundings to the heat lost to the surroundings.

(c) Use small ice pieces

add one ice piece at a time

before adding ice pieces wipe out water on them dry the ice.

avoid splashing of water any three - 02

any two - 01

(d) To prevent ice absorbing heat from outside 01

(e) when the temperature is about 5°C below room temperature step adding ice stir well and obtain the minimum temperature of water. 01

(f) Heat lost by the water and = Heat gained by ice calorimeter

$40 \times (35 - 25) + 100 \times 10^{-3} \times 4 \times 10^{3} \times (35 - 25)$

$= 11 \times 10^{-3} \times L + 11 \times 10^{-3} \times 4 \times 10^{3} \times 25$

(LHS - 01 RHS - 01)

$L = 3 \times 10^{5}\ Jkg^{-1}$ 01

(g) Mass of the addilional ice melted $= (18 - 11) \times 10^{-3}$ kg

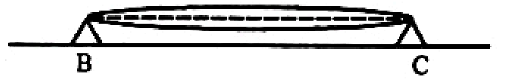
$= 7 \times 10^{-3}$kg

Heat released by the condensation of Water vapour = Heat gained to melt additional ice

$0.86 \times 10^{-3} \times L_v = 7 \times 10^{-3} \times 3 \times 10^{5} + 7 \times 10^{-3} \times 4 \times 10^{3} \times 25$ 01

$L_V = 32.6 \times 10^{5}\ Jkg^{-1}$

03. (a) (i)



01

(ii) Superposition of incident and reflected waves.

OR

Superposition of two transverse waves. of the same speed and wavelength (for frequency) moving in oppsite directions.

(iii) $\lambda_0 = 2l_0$ -01 $\quad \left| \frac{\lambda_0}{2} = l_0 \right.$, $\lambda_0 = 2l_0$

(iv) $f_0 = \frac{1}{2l_0}\sqrt{T/m}$ $\quad \left| V = f\lambda \right.$, $\sqrt{T/m} = f_0 2l_0$

(b) (i) Bring the two pegs X and Y closer together OR start with small values of xy. 01

while pluckung W_1 in the middle increase the distance XY 01

Until paper rider Jumps off.

OR

Bring the two pegs X and Y closer together

OR start with small values of XY 01

While plucking W_1 and W_2 in the middle increase the distance XY until no beats are heard]

(ii) $f_0 = \frac{1}{2l_0}\sqrt{T/m}$

$f_0 = \frac{1}{2 \times 0.125}\sqrt{\frac{4 \times 10}{4 \times 10^{-3}}}$ 01

$f_0 = 400$ Hz 01

(iii) ferequency x $\frac{1}{\text{length xy}}$

400 x $\frac{1}{0.202}$ ②

f x $\frac{1}{0.200}$ ①

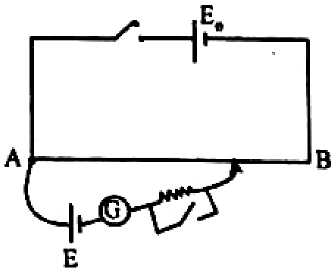
②/① f = $\frac{0.202}{0.2}$ x 400 Hz

f = 404 Hz 01

(iv) beat frequency = 404 Hz - 400Hz
= 4Hz 01

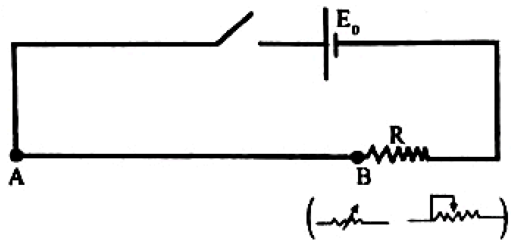
04. (a) (i) 1. High resistance 2. plag key / switch-01

(ii)



01

(b)



01

(c) (i)

1 x 8 = 0.04 E_o = IR + 0.04 $\frac{(2 - 0.04)}{R} = \frac{0.04}{8}$ R = 392 Ω	$\frac{40}{2000} = \frac{8}{R+8}$ R = 392 Ω	$\frac{40}{1960} = \frac{8}{R}$ R = 392 Ω

(ii) V_{AB} = 40 mV l = 600 cm

Thermo - voltage = $\frac{40}{600}$ x 240 mV = 16 mV 01

(iii) 290 °C 01

(iv) Thermo- voltage after two minutes = $\frac{40}{600}$ x 240 mV
= 24 mV

The temperature of molten tin two mintues after the fist measurment = 440 °C

Heat absorbed by the molten tin = energy supplied by the heater

ms $(\theta_2 - \theta_1)$) = pt 02

(m - mass of tin, s - specific heat capacity of tin.
θ_1 - initial temperture, θ_2 - final temperature P - power of heater
t - time elapsed.

0.375 x S x (440 - 290) = 100 x 2 x 60

S = 213.3 J kg^{-1} K^{-1} 01
(212 - 214)

PART - B

01. (i) I for a singal panel = $\frac{2(0.6^2 + 1.2^2)}{12}$ + 2(0.4 + 0.6)²

I for the satellite = 2(0.3 + 2) + 6
= 10.6 kgm² 01

(ii) angular Velocity ω $\frac{6}{60}$ x 2π (ω = 2πf)
= 0.63 $rads^{-1}$

kinetic energy = $\frac{1}{2}$ Iω²
= $\frac{1}{2}$ x 10.6 x 0.63²
= 2.1 J 01
(1.90 - 2.15) 01

(iii) New moment of inertia I_{new} = $\frac{4.6}{4}$ + 6 = 1.15 + 6
= 7.15 kgm²

Using conservation of angular momentum

I_{new} ω_{new} = Iω 7.15 x ω_{new} = 10.6 x 0.63 ω_{new} = $\frac{10.6 \times 0.63}{7.15}$ = 0.93 $rads^{-1}$ = (0.89 - 0.95)	7.15 x ω_{new} = 10.6 x 6/60 ω_{new} = 0.15 $revs^{-1}$

(iv) (a) Angular deceleration α = $\frac{\omega - \omega_{new}}{t}$
= $\frac{0.63 - 0.93}{5 \times 60}$
= 0.001 $rads^{-2}$
(0.0009 - 0.0011)

Torque τ = I α 01
τ = 7.15 x 0.001 01
= 7.15 x 10^{-3} Nm

(b) Rotational kinetic energy after folding panels

$E_K = \frac{1}{2} I_{new} \omega_{new}^2 = \frac{1}{2} \times 7.15 \times 0.93^2$ J

Rotational kinetic energy affer changing back to original angular angular velociy

= $\frac{1}{2} I_{new} \omega^2 = \frac{1}{2} \times 7.15 \times 0.63^2$ J

∴ energy required = $\frac{1}{2}$ x 7.15 (0.93² - 0.63²) 01
= 1.7J

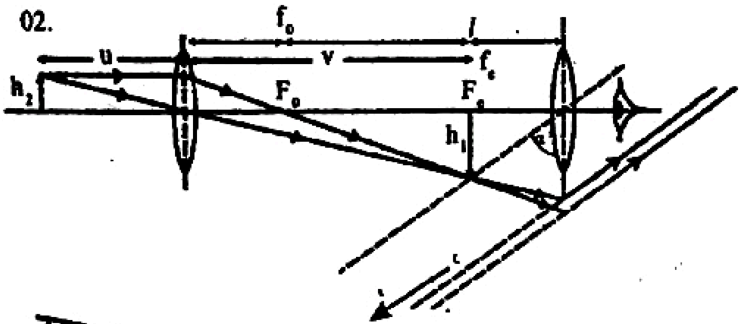
OR

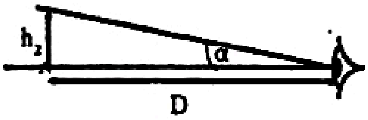
(b) Total angle of rotation durring 5min period

$\theta = \frac{\omega_{new}^2 - \omega^2}{2\alpha} = \frac{0.93^2 - 0.63^2}{2 \times 0.001}$

Work done during this rotation = τθ
= 7.15 x 10^{-3} x $\frac{(0.93^2 - 0.63^2)}{2 \times 0.001}$
= 1.7 J
-01

02.





D

$M = \frac{\alpha^1}{\alpha}$, if α and α' are shown in the above diagrams

OR $M = \frac{\text{Angle subtended on the eye by the final image}}{\text{Argle subtenended on the eye by the object when if is at near point.}}$

OR $M = -.\frac{D}{h}$ OR $M = \frac{h_1 25}{f_e h}$ 01

Applying the lens formula for the objective.

$-\frac{1}{v} - \frac{1}{u} = -\frac{1}{f_o}$ OR $\frac{1}{v} + \frac{1}{u} = +\frac{1}{f_o}$ 01

$xv \Rightarrow 1 + \frac{v}{u} = \frac{v}{f_o}$

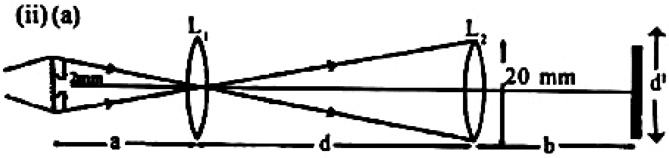
but $\frac{v}{u} = \frac{h_1}{h}$ 01

$\therefore \frac{h_1}{h} = \frac{v}{f_o} - 1$ 01

but $v - f_o = l$

$\therefore M = \frac{25l}{f_e f_o}$

(ii) (a)



1. Linear magnification $= \frac{20}{2}$

$= 10$ 01

$\therefore \frac{d}{a} = 10$ 01

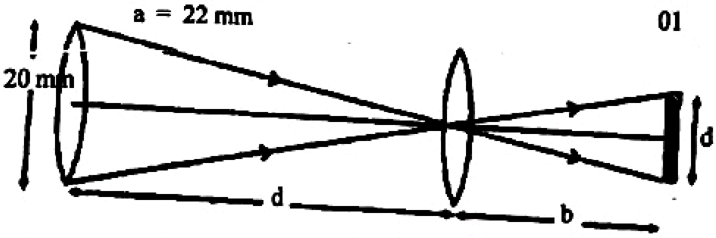
Applying the lens formula for L_1

$-\frac{1}{v} - \frac{1}{u} = -\frac{1}{f_o}$ OR $\frac{1}{v} + \frac{1}{u} = \frac{1}{f_o}$

$1 + d/a = d/20$ OR $\frac{1}{10a} + 1/a = 1/20$ 01

d = 220 mm 01

a = 22 mm 01



(i) Appying the lens formula for L_2

$-1/b - 1/220 = -1/20$ $\frac{1}{b} + \frac{1}{220} = 1/20$

b = 22mm

Let d'/r bethe diameter / radius of the image then

$d^1/20 = \frac{b}{d} = \frac{22}{220}$ OR $r/10 = 22/220$

d = 2 mm OR r = 1 mm

Area illuminated $= \frac{22}{7} \times 1^2 mm^2$

$= 3.14 mm^2$ OR $3.1 mm^2$ 01

03. (i) Avoid using televisions, telephones, computers any electrical appliance that operated on the mains, Unplug all eletrical equipments
Donot switch on trip switches/ Do not replace bulbs,
Donot repair any electrical and telecomunication lines
Donot stay close to metallic frames.
Do not sleep on the floor
Avoid using water coming out of taps.

(ii) if a stroke hits the tree, the current / charge that flows along the tree may Jump from the tree to the person OR may go through the person. 01

(iii) (a) the surface charge density on a pointed object is large. The electric field intensity in the vicinity of a sharp Point is high.

(b) The charge / current in the stroke should flow into the earth so that charge / current flowing along the surface of the ground is avoided. 01

(c) The resistance of the connecting strip should below. otherwise the discharge may follow another path.
OR
to withstand heat generated
OR
to achieve low current densities 01

(iv) (a) it expands due to the fall/ decrease of the atmospheric Pressure

(b) it cools because the expansion is an adiabatic process. OR the gas expands quickly. OR the gas expands with minimum exchangs of heat with the surroundings OR the air does work aginst the surrounding pressure and Thereby loses its internal energy. 01

(v) (a) The magnitude of the electric field intencity (Ei) at P due fo the charge - Q and its image.

$E_1 = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q}{h_1^2} + \frac{Q}{h_1^2}\right]$ OR $E_1 = \frac{2Q}{4\pi\varepsilon_0 h_1^2}$ OR $E_1 = \frac{Q}{2\pi\varepsilon_0 h_1^2}$

Similarly the magnitude of the electric field intensity (E_2) at P due fo the charqe +Q and its image

$E_2 = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q}{h_2^2} + \frac{Q}{h_2^2}\right]$ OR $E_2 = \frac{2Q}{4\pi\varepsilon_0 h_2^2}$ OR $E_2 = \frac{Q}{2\pi\varepsilon_0 h_2^2}$

∴ net electric field intensity (E) at P

$E = E_1 - E_2$ 01

$$E = \frac{1}{2\pi\varepsilon_0}\left[\frac{Q}{h_1^2} - \frac{Q}{h_2^2}\right]$$

(b) $E = 1.8 \times 10^{10} \left[\frac{20}{(3 \times 10^3)^2} - \frac{20}{(6 \times 10^3)^2}\right]$

$E = 3 \times 10^4\ Vm^{-1}\ (NC^{-1})$ -01 [Do not merk if the unit is incorrect]

it is pointing upwards at the surface of the earth 01

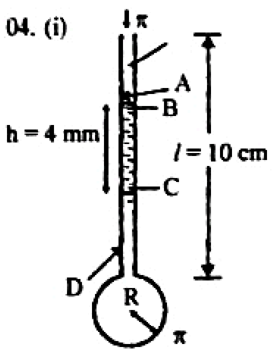
induced charge density (σ) $= \varepsilon_0 E$
$= 8.85 \times 10^{-12} \times 3 \times 10^4$
$= 2.66 \times 10^{-7}\ cm^{-2}$

(vi) energy relerased $= 5 \times 10^8\ J$ [E = QV] 01

Energy is dissipated as heat, light, sound, molecular excitation, creation of ions, kinetic energy of particles, radiation
any two - 01

(vii) The distance between the front and back legs of the cow is sufficient enough to generate a high potential difference so that the current / charge will flow through the body of the cow rather than along the earth surface. 01

04. (i)



$P_A = \pi$

$P_B = \pi - \frac{2T}{r}$

$P_C = \pi - \frac{2T}{r} + h\rho g$

$P_D = \pi - \frac{2T}{r} + h\rho g - \frac{2T}{r}$

$P_D = \pi + h\rho g$ 01

$P_D = \pi + \frac{4T}{R}$ 01

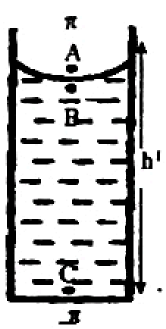
$\cancel{\pi} + h\rho g = \cancel{\pi} + \frac{4T}{R}$

$\therefore T = \frac{h\rho g R}{4}$ - 01

$$T = \frac{4 \times 10^{-3} \times 1050 \times 10 \times 2.5 \times 10^{-3}}{4}$$

$T = 0.026\ N\ m^{-1}$ 01
(0.025 - 0.027)

(ii) (a)



$P_A = \pi$

$P_B = \pi - \frac{2T}{r}$

$P_C = \pi - \frac{2T}{r} + h'\rho g = \pi$

$\frac{2T}{r} = h'\rho g$ 01

$$h' = \frac{2 \times 0.026}{0.8 \times 10^{-3} \times 1050 \times 10}$$

$= 6.2$ mm 01

(6.1 - 6.3)

(b) $P_A = \pi$

$P_B = \pi - \frac{2T}{r}$

$P_C = \pi - \frac{2T}{r} + H\rho g$

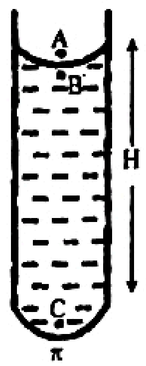
$\pi - \frac{2T}{r} + H\rho g = \frac{2T}{r} + \pi$ 01

$H = \frac{4T}{r\rho g}$ 01

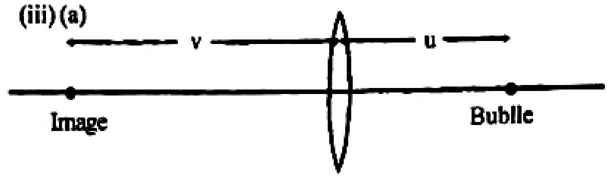
$$H = \frac{4 \times 0.026}{0.8 \times 10^{-3} \times 1050 \times 10}$$

$H = 12.4$ mm 01

(12.2 - 12.6)



(iii) (a)



Radius of the image at time t = 0, $5^1/_2$ mm

Radius of the bubble at time t = 0, $= \left(\frac{u}{v}\right) \times \frac{51}{2}$

$= \frac{15}{27} \times \frac{51}{2}$ mm 01

= 14 mm 01

= (14-17 mm)

Radius of the bubble at (t + 30s) $= \left(\frac{u}{v}\right) \times \frac{36.5}{2}$

= 10 mm

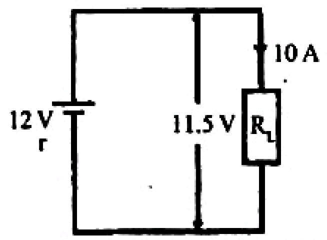
(iii) (b) using $R^4 = \frac{-Tr^4t}{2\eta l} + A$ (η - cofficient of viscosty of air)

For t = 0 $(14 \times 10^{-3})^4 = A$
$3.84 \times 10^{-8} = A$ 01

For t = 30S, $(10 \times 10^{-3})^4 = \frac{0.026 \times (0.8 \times 10^{-3})^4 \times 30}{2\,\eta \times 10 \times 10^{-2}} + 3.84 \times 10^{-8}$ 01

$\eta = 5.6 \times 10^{-5}\ Nsm^{-2}$ 01
(5.5 - 5.7)

05. (A)
(i) (a) E = 12.0v 01



E = Ir + V

12 = 10r + 11.5 01

$r = \frac{0.5}{10}$

$r = 0.05\ \Omega$ 01

(b) Total power disspation from both head lamps = VI
= 10 x 11.5W
= 115 W 01

Power disspation from each head lamp

$P = \frac{1}{2} \times VI$

$= \frac{1}{2} \times 115$ W

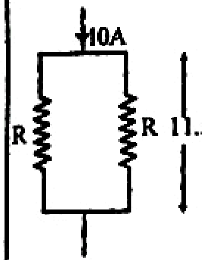
= 57.5 W

(b) [Alternative Method

For the Head Lamps

$10 \times R_L = 11.5$ 01

$R_c = 1.15\ \Omega$



Let R be the resistance of each head lamps

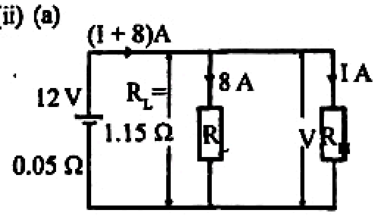
$\frac{1}{R_L} = \frac{1}{R} + \frac{1}{R} \Rightarrow R = 2R_L$

$R = 2.3\ \Omega$ 01

Heat dissipation by each head lamp.

$P = V^2/R = \frac{11.5^2}{2.3} = 57.5\ W$ 01

(ii) (a)



For the head lamps.

$V = IR$

$11.5 = 10 \times R_L$

$R_L = 1.15\ \Omega$

Voltage across the head lamps

$V = IR$

$V = R_L \times 8 = 1.15 \times 8.0$ 01

$V = 9.2\ V$

Let I be the current through the starter moter

$12 = (i + 8.0) \times 0.05 + 9.2$

$0.05i + 0.4 = 12 - 9.2$

$0.05\ I = 2.4$

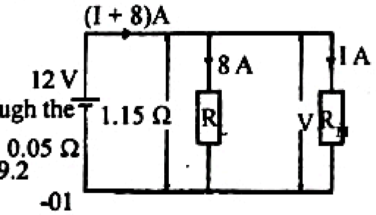
$i = 48 A$ 01

it is not possible fo start the car 01

(a) Voltage across the head lamps

$V = R_L \times 8 = 1.15 \times 8.0$ -01

$= 9.2\ V$



Let i be the current through the starter motor

$12 = (i + 8) \times 0.05 + 9.2$

$i = 48\ A$ -01

it is possible to start the car -01

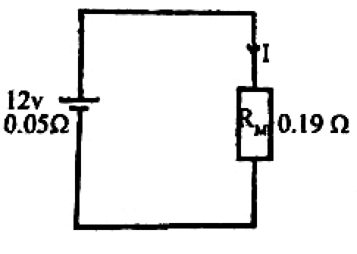
(b) From the above diagram

$R_M = \frac{9.2}{48}$

$= 0.19\ \Omega$

(0.190 - 0.192) -01

(c) Let I be the current through the starter motor



$I = V/R_M + r$

$I = \frac{12}{0.05 + 0.19} = \frac{12}{2.4}$

$= 50\ A$ (49.6 A) 01

It is possible to start the car 01

(iii) (a) increase of internal resistance of the battery cause a drop of current through the starter motor It this drop is below the minimum required car may not get started. 01

(b) Current required to ligth the bulb $= \frac{6W}{12V} = 0.5A$

Smaller current such as 0.5A can be drawn from the battery. 01

05. (B) (i) (a) Current through the load resistor $i_L = \frac{10}{100} = 0.1A$ 01

Current through $R = 0.1 + 0.01 = 0.11A$ -01

$(I = R_{IL} + R_i)$

Thre fore $12 = IR + 10$

$12 - 10 = 0.11R$

$R = \frac{2}{0.11}$

$= 18\ \Omega$ -01

(18.0 - 18.2)

(b) (1) when the switch is closed

Power dissipation (E) $= VI$

$= 10 \times 0.01\ W$

$= 0.1\ W$ -01

(2) When the switch is open

Zenor Current $I_z = \frac{12 - 10}{2/0.11}$ OR $\left(\frac{12 - 10}{18}\right)$

$= 0.11A$

Power dissipation (E) $= VI$

$= 10 \times 0.11\ W$

$= 1.1\ W$

$= (1.09 - 1.11)$

Therefore minimum power rating = 1.1W

(ii) (a) Voltage aross load resistor $= V_z - 0.6 = 10.6 - 0.6$

$= 10V$ 01

Therefore the device gets correct supply voltage

$\frac{10}{100} = 0.1\ A$ -01

(b) I_E (Emither current)

$I_E = (I + \beta) I_B$ OR $I_C \approx I_E = 0.1\ A$

and $I_C = \beta I_B$

$\therefore I_B = \frac{0.1}{99+1} A$ $I_B = \frac{0.1}{99}$

$I_B = 0.001\ A$ -01 $I_B = 0.001\ A$

(c) Maximum power dissipation occurs when the switch is open 01

Then current through the diode

$120\ I_z = 12 - 10.6$

$I_z = \frac{12 - 10.6}{120}$

$= 0.012\ A$

$\therefore$ Powor dissipation (W) $= VI$

$= 10.6 \times 0.012$

$= 0.13\ W$ -01

$= (0.11 - 0.15\ W)$

This power dissipatron is lessthan 1/4 W

Therefore 1/4 W rating is sufficient -01

(ii) (d) Muximum power dissipation in the zener diode is 1.1W in the first circuit and 0.13W in the second. Therefore the advantage of the second circuit is low power wastage in the zener diode. OR
ability to use a zener diode with lower power rating -01

06. A (i) Using $Q = KA\left(\frac{\theta_{in} - \theta_{out}}{d}\right)$ -01

Rate of heat transfer through the wall

[OR wall Area $= 100 - 7 = 93 m^2$
Qwall $= 0.6 \times 93 \times \frac{(30-25)}{10 \times 10^{-2}}$
$= 2.8 \times 10^3 W$]

$Q_{wall} = 0.6 \times 10^2 \times \frac{(30-25)}{10 \times 10^{-2}}$
$= 3 \times 10^3 W$

Rate of heat tranfer through the door

$Q_{Door} = 0.1 \times 3 \times \frac{(30-25)}{2 \times 10^{-2}}$

$= 0.75 \times 10^2 W$

Rate of heat transfer through the window

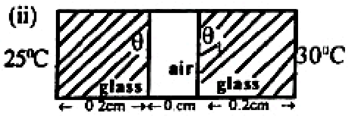
$Q_{Window} = 0.8 \times 4 \times \frac{(30-25)}{0.5 \times 10^{-2}}$

$= 3.2 \times 10^3 W$

The rate of heat trarsfer from the surrounding s into the building

$= 3 \times 10^3 + 0.75 \times 10^2 + 3.2 \times 10^3$ 01
$= (3 + 0.75 + 3.2) \times 10^3 W$
$= 6.275 \times 10^3 W$
$= (6.0 - 6.3)$

(ii) -01



The rate of heat tranfer through the outer glass plate.

$Q_1 = 0.8 \times 4 \times \frac{(30 - \theta_1)}{0.2 \times 10^{-2}}$

The rate of heat franfer through the air gap

$Q_2 = 0.03 \times 4 \times \frac{(\theta_1 - \theta_2)}{0.1 \times 10^{-2}}$

The rate of heat transfer through the inner glass plate

$Q_3 = 0.8 \times 4 \times \frac{(\theta_2 - 25)}{0.2 \times 10^{-2}}$

under steady conditions $Q_1 = Q_2 = Q_3 = Q$

① ⇒ $30 - \theta_1 = \frac{0.2 \times 10^{-2} Q}{4 \times 0.8}$

② ⇒ $\theta_1 - \theta_2 = \frac{0.1 \times 10^{-2} Q}{4 \times 0.03}$

③ ⇒ $\theta_2 - 25 = \frac{0.2 \times 10^{-2} Q}{0.8 \times 4}$

$30 - 25 = \left(\frac{2 \times 10^{-3}}{3.2} + \frac{1 \times 10^{-3}}{0.12} + \frac{2 \times 10^{-3}}{3.2}\right) Q$

$5 = 10^{-3} Q \left(\frac{20}{32} + \frac{100}{12} + \frac{20}{32}\right)$

$5 = 10^{-3} Q \left(\frac{60 + 800 + 60}{96}\right)$

$Q = \frac{5 \times 96 \times 10^3}{920}$

$Q = 5.23 \times 10^2 W$, (4.80 - 5.60)

The percentage reducton in the heat tranfer rate through the window.

$= \frac{(Q_{old} - Q_{new})}{Q_{old}} \times 100\%$

$= \frac{(3.2 \times 10^3 - 5.28 \times 10^2)}{(3.2 \times 10^3)} \times 100\%$

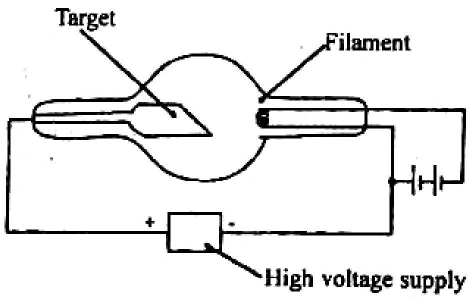
$= 83.5\%$
(82.5 - 85.0)

(b) (i) Relative Humidity $= \frac{\text{SV P at dew point}}{\text{S.V.P. at room temperature}}$

$\frac{80}{100} = \frac{\text{S.V.P at } 25^\circ C}{30}$

Relative Humidity inside the building $= \frac{16}{\text{S.V.P. } 25^\circ C} \times 100\%$ -01

$= 66.7\%$
(66.67)



labeling	any two	02
	any one	01

(ii) when the filameat is heated electrons inside the metal are emitted due to thermionic emission
OR By heating the filament -01

(iii) To avoid minimize collisions
OR To avoid minimize scattering
To make the electrons reach the target
to avoid energy loss of electrons 01

(iv) Supply Vcltage = 100KV (correct unit) 01

(v) Wevelergth $\lambda = \frac{hc}{E}$ 01 01

$\lambda = \frac{(6.6 \times 10^{-34}) \times (3 \times 10^8)}{100 \times 10^3 \times 1.6 \times 10^{-19}}$

$= 0.12 \times 10^{-10} m$

$= 0.12 A^\circ$ 01

(vi) (a) Annual effective background dose $= 2mSv$

Background effective dose rate $= \frac{20 \times 10^3}{365 \times 24}$ -01

$= 0.228\ \mu Svhr^{-1}$ -01

(b) Maximum permissible annual effective dose $= 20$ mSV

Number of hours the radiation worker works $= 40 \times 40$ hr

Maximum effective dose rate allowed in the lab $= \frac{20 \times 10^3}{40 \times 40}$

$= 12.5\ \mu SVhr^{-1}$ -01

(c) (1) effective dose rate due to X - rays $= 0.57 IEa\ \mu Svhr^{-1}$ 01

$= 0.57 \times (9.4 \times 10^9) \times 0.1 \times (0.027)\ \mu Svhr^{-1}$

$= 1.45 \times 10^6\ \mu Svhr^{-1}$

Dose received due to x - rays $= 1.45 \times 10^6 \times \frac{0.1}{3600} \times \mu Sv$

$= 40\ \mu Sv$

(38 - 42)

(2) Dose received by 1 kg mass $= 40\ \mu Sv$

$= 40 \times 10^{-6}$ Sv

amount of energy absorbed by 1kg mass $= 40 \times 10^{-6}$ J -01

amount of energy absorbed by 5kg mass $= 5 \times 40 \times 10^{-6}$ J

$= 2 \times 10^{-4}$ J

Energy of an X - ray Photon $= 100$keV

$= 100 \times 10^3 \times 1.6 \times 10^{-19}$ J

$= 1.6 \times 10^{-14}$ J -01

number of X - ray photons abgorbed $= \frac{2 \times 10^{-4}}{1.6 \times 10^{-14}}$

$= 1.25 \times 10^{10}$ Photons -01

(1.19 - 1.31)