G.C.E. (Advanced Level) Examination - April 2004

PHYSICS - I

Provisional Scheme of Marking

2004 - Answers

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

G.C.E. (Advanced Level) Examination - April 2004
PHYSICS - II
Provisional Scheme of Marking

A - PART

(01) (a) (i) A - Main Scale (linear Scale)
(ii) B - Circular Scale
(iii) C - Thimble
(iv) D - Thimble head

(b) (i) 0.01 mm

(ii) 6.48 mm

(iii) 6.51 mm

(iv) $\frac{0.01}{6.51}$ OR $\frac{0.005}{6.51}$

(v) Thimble head is provided to press the object when taking a measurement which automatcally stops over pressing.

(c) (i)

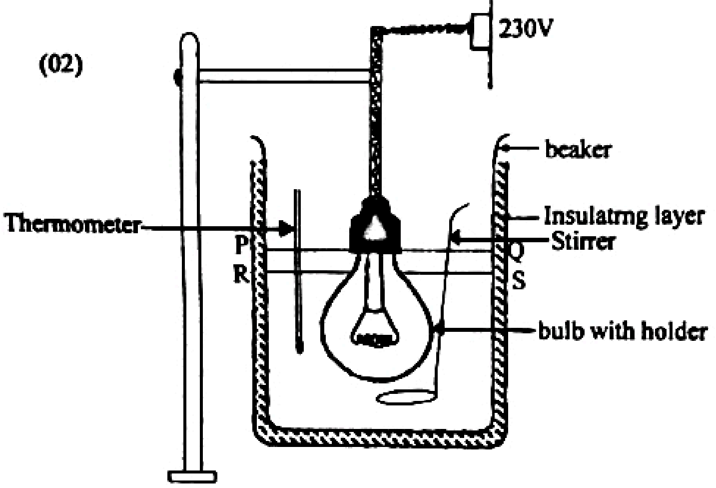
Measurement	**Instrument**
ℓ -	Meter ruler
d_1 -	Micrometer Screw gauge
d_2 -	Vernier Calliper
t -	Micrometer Screw gauge

any two 01
all correct 02

(ii) Take several measurments at different places and get the average 01

(d) Fold the sheet many times so that the thickness is significantly larqer than the least count
OR
Use large number of sheets together so that the thickness is significantly larger than the least count 01

(02)



(a) (i) Thermometer + Stirrer + wire connection 01
(ii) Water level anywhere between PQ and RS 01

(b) (1) Heat absorbs by the beaker is Small
(2) Significant temperature increase can be obtained.
(3) Heat dissipation from the water surface is small
OR Heat loss to the surrounding is small
any Correct two 02
any Correct one 01

(c) Thermometer, Stop watch, balance 01

(d) Heat absorbed by water $= 240 \times 10^{-3} \times 4200 \times 9$

Electrical power transferred to water $= \frac{240 \times 10^{-3} \times 4200 \times 9}{10 \times 60}$

$= 15.12$ W
(15 w - 15.2 w)

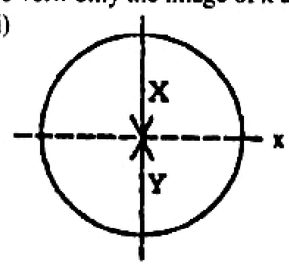
(e) (1) Hcat absorbed by the beaker
(2) Heat loss to the surroundings
(Convection/ radiation / evaporation)
(3) Heat absorb the bulb and the bulb holder.

ang two -01

(f) lamp shade may burn
OR
Bulb and the lamp shade will he over heated
OR
The heat generated by the bulb may damage the lamp shade.

03. (a) To avoid obstructions from other objects for a clear veiw.
OR
To veiw only the image of x and y 01

(b) (i)

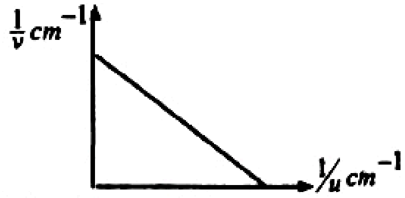


01

(ii) (I) There is a relative motion between y and image of x 01
(II) Y and image of x move together 01

(c) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\left(\frac{-1}{v} - \frac{1}{u} = \frac{-1}{f}\right)$ 01

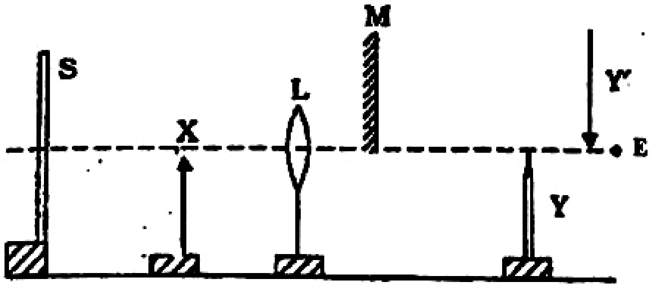
(d)



For labeling the axes of the graph with correct unit 01
For drowing the straightline properly 01
For identification of the intercept
as $\frac{1}{f}$

$0.1 = \frac{1}{f}$

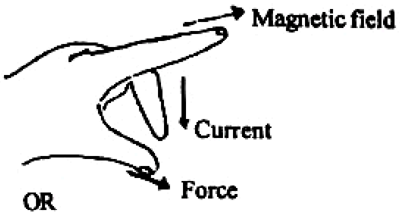
$f = 10$ cm (9.8 cm - 10.2 cm)



(e) For drawing M and Y' in the above diagram.

04. (a) (i) $F = BIL \sin\theta$

(ii)



OR

When the middle finger, fore finger and the thumb of the leff hand are held at right angles of one another so that the middle finger is in the direction of the current and the fore finger is in the direction of the magnetic field, then the direeton of the magnetic force is in the direction of the thumb.

(b) (i) Magnetic foree acting on PS $= BINa$

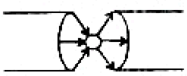
Magnefic force acting on QR $= BINa$

Couple due to the magnetic forces $= BINa \times b \cos\alpha$

$= BINA \cos\alpha$

(ii) Force acting on the arms PQ and RS are equal and opposite and act along the same line therefore the couple duc to these force is zero 01

OR

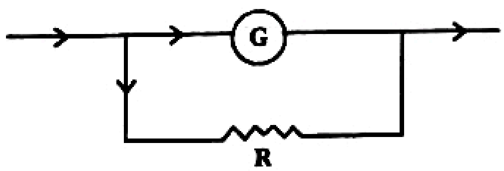


(c) (i) In the galvanometer the coil is placed in a radial magnetic field so that the direction of the magnetic field is in the plane of the coil for any position of the coil. Thre fore $\alpha = 0$ and $\cos\alpha = 1$

(ii) $NIBA = C\theta$

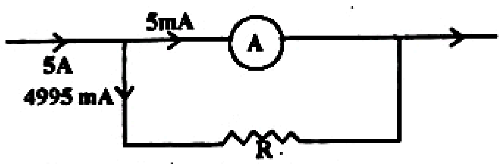
$$I = \frac{C}{(NAB)} \times \theta$$

(iii)



OR A resistor must be connected in parallel with the galvanometer 01

(iv)



$20 \times 5 \times 10^{-3} = R \times 4995 \times 10^{-3}$

$R = 0.02\ \Omega$ 01

(v) Radial magnetic field can be increased /Number of turns of the coil can be increased / suspension wire of a very small torsion constant can be used

Area of the coil can be increased ony one 01

Part B

(01) (i) (a) Using $V^2 = u^2 + 2as$ OR $mgh = \frac{1}{2} mv^2$

$30^2 = 0 + 2 \times 10 \times H$ 01

$h = 45\ m$ 01

(b) change of momentum of a collision

$= 0.1 \times 30 - 0.1 \times (-20)$ 01

$= 5\ kgms^{-1}$ 01

Momentum transfer to the floor ot a collision (of ball at a collision)

= change of momentum

$= 5\ kg\ ms^{-1}$ 01

(c) Time at first collision $t_1 = \frac{30}{10} = 3S$

Time taken for the second collision after the first collision $t_2 = \frac{2 \times 20}{10} = 4S$

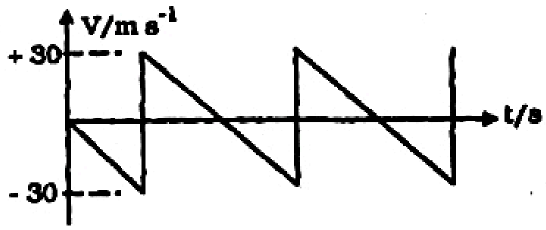
[Using the corresponding triangles

$\frac{30}{3} = \frac{20}{t}$, $t = 2S$

$t_2 = 2 \times t_1 = 2 \times 2 = 4S$ - 01]

The Value $t = t_1 + t_2 = 3 + 4 = 7S$ 01

(ii)



(iii) (a) Time interval between two collisions $= \frac{2}{2 \times 10^3}$ 01

$= 10^{-3}\ S$

Rate at which the particle collides with one of the walls $= \frac{1}{10^{-3}}$

$= 10^3$ 01

(b) Mometum transfer Per Collision $= 2 \times 6 \times 10^{-26} \times 2 \times 10^3$

Rate of which the particle transfer momentum to the wall

$= 2 \times 6 \times 10^{-26} \times 2 \times 10^3 \times 10^3$ 01

$= 2.4 \times 10^{-19}\ kgms^{-2}$ 01

(c) Total rate of momentum transfer by 2×10^{23} Partrcles

$= 2.4 \times 10^{-19} \times 2 \times 10^{23}$ 01

Force acting on the floor = total rate of momntum transfer by particles 01

Pressure exerted by the particles on a wall

$$= \frac{2.4 \times 10^{-19} \times 2 \times 10^{23}}{1 \times 1}$$

$$= 4.8 \times 10^{4}\ Nm^{-2}\ (Pa) \qquad 01$$

02. (i) Amplitude of the wave 01

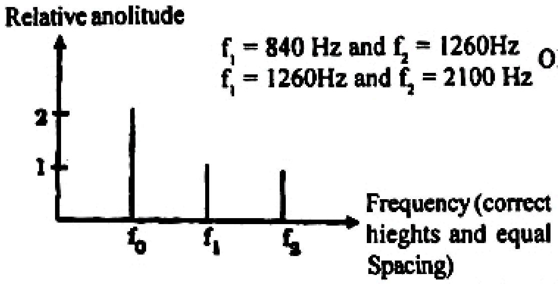
(ii) Frequency of the wave 01

(iii)(a) Frequency of the 3rd overtone $= 4 f_0$

$= 4 \times 400$

$= 1600$ Hz 01

(b) 0.2 01

(iv) 

$f_1 = 840$ Hz and $f_2 = 1260$Hz OR

$f_1 = 1260$Hz and $f_2 = 2100$ Hz

(v) Three **electrical Signals** having frequencies of, f_1 and f_2 and respective **relative amplitude** 1, 1/2 and 1/2 are **superrimposad** (mixed)

All Correct - 02

Any two - 01

(vi) In electric guitars the sound of the strings is **amplified electronically.** 01

(vii) $f_0 = \frac{1}{2l}\sqrt{\frac{T}{m}}$

(viii) $330 = \frac{1}{2 \times 0.68}\sqrt{\frac{T}{m}}$ —— Ⓐ 

$440 = \frac{1}{2 \times L^1}\sqrt{\frac{T}{m}}$ —— Ⓑ 

Ⓐ/Ⓑ ⇨ $\frac{330}{440} = \frac{L^1}{0.68}$ 01

$L^1 = 0.51$ m OR $L^1 = 0.17$ m 01

(ix) (a) $2L = \lambda = \frac{V}{f_0} = \frac{340}{262}$ 01

$L = \frac{340}{2 \times 262} = 0.65$ m 01

(0.64 m - 0.65 m)

(b) $V \alpha \sqrt{T}$

$$\frac{V_{300}}{V_{243}} = \frac{340}{V^1} = \sqrt{\frac{27 + 273}{-30 + 273}} = \sqrt{\frac{300}{243}}$$

$$V^1 = \sqrt{\frac{243}{300}} \times 340 = 306\ ms^{-1}$$

$$f = \frac{V^1}{2L} = \frac{306}{2 \times 0.65} = 235.4\ Hz \qquad 01$$

(235 - 239)

03. Particles expcriences a decleration, Stop at a certain distance, starts to move back along the same path with an accleration whose magnitude equal to that of the deceleration and leaves the electric field with the speed V 03

[Come back along the same path 01

Decelerates, stops, acclerates and come back along the same path -02]

(i) Time taken by P to move from x = 0 to x = L, $t_1 = \frac{L}{V_1}$

Distance traveled by Q during time $t_1 = \frac{L}{V_1} V_2$ 01

$$\therefore d = L - \left(\frac{LV_2}{V_1}\right) = L\left(1 - \frac{V_2}{V_1}\right) \qquad 01$$

(ii) Particle P penetrates more into the electric field and Therefore E_{min} must be Calculate for P 01

Applying $V^2 = u^2 + 2as$ 01

Magnitude of $a = \frac{q E_{min}}{m}$, $v = o$, $u = v_1$, $s = H$ 01

$E_{min} = mV_1^2 / 2gH$ 01

[alternative method , Conservatiom of energies

$\frac{1}{2}mv^2 = qv$ 01

$V = E_{min}$ H 01

$E_{min} = \frac{mV_1^2}{2qH}$ 01

(iii) $E > E_{min}$

Applymg $V = u + at$ 01

Magnitude of $a = \frac{qE}{m}$ ⟵

$V = O$, $u = v_1$, $t = \frac{t_p}{2}$ $\left[\begin{matrix} F = ma \\ q\epsilon = ma \end{matrix}\right]$ 01

$\overrightarrow{O} = V_1 - \frac{qE}{m} \times \frac{t_p}{2}$ $a = \frac{q\epsilon}{m}$

$t_p = \frac{2mV_1}{qE}$ 01

$t_Q = \frac{2mV_2}{qE}$ 01

(b) Total trme spent both P and Q are the same 01

Considering the tine spent by P and Q in the field free region and in the electic field region we can write

$$\frac{L}{V_2} + \frac{2mV_1}{qE_0} = \frac{L}{V_2} + \frac{2mV_2}{qE_0} \qquad -01$$

04. $Q = \frac{\pi r^4 \Delta P}{8\eta \ell}$ -01

Q = Volume rate of flow of the liqud

r = Radius of corss section of the tube

ΔP = Pressure difference across the tube

η = Viscosity of the liquid (Cofficient of Viscosity of the lquid)

l = length of the tube 02

(any three 01

all corrct - 02)

(i) The flow should be laminar
Tube should be Straight and / or horizontal
Tube Should be narrow
The flow should be steady (constant rate)
The liquid should be compressible 02
(any two 02 any one 01)

(ii) (a) $F = \Delta P \pi r^2$

(b) Dimension of Q $= [L]^3 [T]^{-1}$ $\left[\frac{F}{A} = P\right]$

Dimension of r $= [L]$ $F = A \times P$

Dimension of v $= [L] [T]^{-1}$

Dimension of $\frac{Q}{\pi r^2}$ $= \frac{[L]^3 [T]^{-1}}{L^2} = [L] [T]^{-1}$

= Dimension of V 01

(c) rate of work done = force x $\frac{\text{distance}}{\text{time}}$

$= \Delta P \pi r^2 \times \frac{Q}{\pi r^2}$

$= \Delta PQ$ - 01

(iii)(a) Blood vessels are not Horizontasl
OR not straight
Blood vessels are elastic
Blood vessels do not have uniform cross sections
Blood flow is not steady
Blood is not homogeneous ony two - 02
one - 01

(b) $\Delta P = \frac{8 \eta \ell Q}{\pi r^4}$

$= \frac{8 \times 4 \times 10^{-3} \times 20 \times 10^{-2} \times 2.5 \times 10^{-6}}{\pi \times (2 \times 10^{-3})^4}$ m^{-2} - 01

$= 3.2 \times 10^2 \, Nm^{-2}$ - 01

(3.1 - 3.2)

(c) (i) New pressure difference - ΔP^1

$\Delta P^1 = \frac{8 \eta \ell Q}{\pi (\frac{r}{2})^4} = \frac{8 \eta \ell Q}{\pi r^4} \times 16$

$= \Delta P \times 16$

Therefore the pressure difference will have to be increased by 16 times 01

(ii) Rate of work done by the heart under original pressure difference $w = Q \Delta P$

Rate of workdone by the heart under new pressure difference is

$w^1 = Q \Delta P^1$
$= Q \Delta P \times 16$
$= w \times 16$

Therefore the rate of work done will increase by 16 times.
01

(d) When η is decrased, the same flow rate can be maintained with a lower pressure difference P. Therefore it reduces blood pressure of the patient.
OR
When η decreased, the resistance to blood flow decreases
01

05. (a) (i) Power P fransferred by a battery = I^2R

$I = \left[\frac{12}{R+2}\right]^2 R$ 01

(a) $R = 1\Omega$ $P = \left[\frac{12}{1+2}\right]^2 \times 1 = 16$ W

(b) $R = 2\Omega$ $P = \left[\frac{12}{2+2}\right]^2 \times 2 = 18$ W

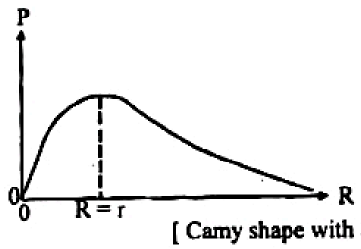
(c) $R = 3\Omega$ $P = \left[\frac{12}{3+2}\right]^2 \times 3 = 17.3$ W

(two correct - 01)

(d) R = O P = O 01

(e) R = ∞ P = O 01

(ii)



02

[Camy shape with amaximum - 01]

(iii) R = r 01

(iv) (a) At the maximum power transfer power dissipated by R = Power dissipated by r. 01

Voltage across r = 12/2 = 6V

Power dissipated in r $= V^2/r$

= 36/2 = 18w 01

= Power dissipated by r

Since each bulb dissipates 0.36W

total number of bulbs = 18/0.36 = 50 01

Alternative method.

Resistance of a bulb $= V^2/P$

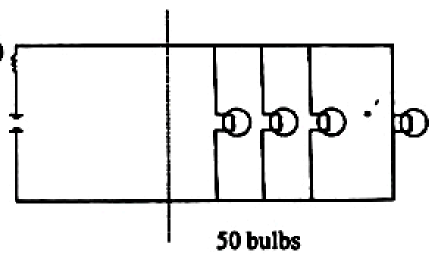
$= 36/0.36 = 100 \ \Omega$

At the maximum power transfer

R = 2 Ω 01

Operation of each bulb at 6V and R = 2 can be obtained by Connecting 50 such bulbs in parallel - 01

(b)



01

(iv) (a) Current drown from the battery = 12/4 = 3A - 01
Therefore the battery can be used for 30hrs - 01

(b) Power dissipated inside the battery
$= I^2r = 9 \times 2 = 18w$

If is the increase of temperature

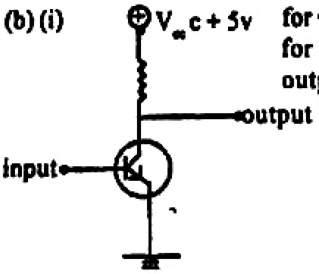
$ms\,\theta = Pt$

$15 \times 900 \times \theta = 18 \times 30 \times 60$ - 01

$\theta = 12/5\ ^\circ C$

$\theta = 2.4\ ^\circ C$ - 01

(b) (i)



for Circuit - 01
for labels (power supply, input and output) - 01

(ii)(a)

A (volts)	B (volts)	X (volts)	
0.0	0.0	0.0	-01
0.0	5.0	4.8	} - 01
5.0	0.0	4.8	
5.0	5.0	4.8	- 01

OR

(b) The circuit is on or gate - 01
Truth table

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

- 01

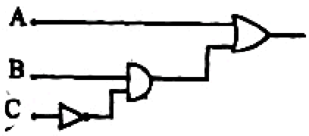
(iii) (a) $X = A + B.\bar{C}$

(A + - 01 and $B.\bar{C}$ - 01)

OR $X = A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC + \bar{A}B\bar{C}$

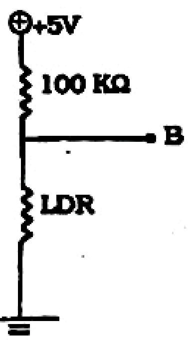
(any threecorrect terms - 01 all correct - 02)

(b)



- 01

(c) (i)



voltaqe divider concept - 01
LDR & resister - 02

(2) At dark resistance of LDR = 10M Ω
Therefore $V_B = \dfrac{5 \times 10 \times 10^6}{(10 \times 10^6 + 100 \times 10^3)}$

$= 5V$

(4.95 V - 5.00 V)

(d) The lamp will not function properly
When power fails at night the lamp will turn on. Then if light from the lamp itself falls on the LDR, if will cause the lamp to turn off again. There fore until power returns. the lamp will keep turning on and off repeatedly. 01

06. (a) (i) Pressure and the amount of gas remain the same

$\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$ 01

$\dfrac{42 \times 10^{-3}}{280} = \dfrac{V_2}{300}$ 01

$V_2 = 4.5 \times 10^{-2}\ m^3$ 01

(ii) Pressure, Volume and temperature change but the amount of gas remains the same.

$\dfrac{P_1V_1}{T_1} = \dfrac{P_2V_2}{T_2}$

Lef P_1 be the pressure inside the balloon at the ground level.

$\dfrac{P_1 \times 4.5 \times 10^{-2}}{300} = \dfrac{\frac{2}{3} P_1 \times V_2}{275}$

$6.19 \times 10^{-2} m^3 = V_2$
(6.1 - 6.3)

(iii) (a) The balloon enters the low - Pressure area very solwly. Threfore the process in isothermal.

(1) Temperataure remains the same 01
(2) gas absorbs heat from the surroundings 01
(3) $dQ = du + dw$
$du = 0$ (T is constant)
$dw = dQ$ 01

OR

Internal energy remains the same since T is not changed. The heat absorbed will provide energy to do work.

(b) The balloon enters the low - Pressure area very rapidly. Therfore the process is adiabatic.
(1) The temperture decreases. 01
(2) No exchange of heat 01
(3) $dQ = du + dw$
$o = du + dw$
$dw = -du$ 01

(OR internal energy of the gas will be reduced by Providing energy to do work)

(c) For an isothermal process

$P_1V_1 = P_2V_2$

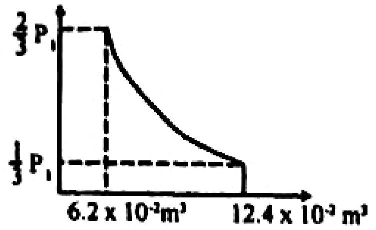
$\frac{2}{3} P_1 \times 6.19 \times 10^{-2} = \frac{1}{3} P_1V_2$

$V_2 = 12.38 \times 10^{-2}\ m^3$

$(12.4 \pm 0.2) \times 10^{-2}\ m^3$

(or twice the value obtained under (ii) - 02)

(d)



06. (b) (i) Total energy per unit time Per unit Area Corresponding to all wavelengths emitted by the black body.

OR

Total intensity corresponding to all wavelengths. emitted by the black body. 01

(ii) $E = h\nu$ 01

$f = C/\lambda$ 01

$E = \frac{hc}{\lambda}$

$= \frac{(6.63 \times 10^{-34}) \times (3.0 \times 10^{8})}{724.5 \times 10^{-9}}$ 01

$= 2.74 \times 10^{-19}$ J 01

(2.74 ± 0.1)

(iii)(a) $T \times 500 = 4000 \times 724.5$ 01

$T = 5796$ K 01

(b) $W = \sigma T^4 \times 4\pi R^2$

$= (5.67 \times 10^{-8}) \times (5796)^4 \times 4 \times \pi \times (7.0 \times 10^{8})^2$ 01

$= 4.0 \times 10^{26}$ JS^{-1} 01

(4.0 ± 0.1)

(c) Let R be the distance to the star

$\frac{W}{4\pi R^2} \times \frac{40}{100} = 4.0 \times 10^{-11}$ 01

Subsitiuting for the power emitted by the star

$W = 4 \times 10^{26}$ J 01

$R^2 = \frac{(4 \times 10^{26}) \times 40}{4\pi \times (4.0 \times 10^{-11}) \times 100}$

$R = 5.64 \times 10^{14}$ km 01

(5.64 ± 0.1)

(iv) $T \times 570 = 4000 \times 724.5$

$T = 5084$ K

Not black body Radiation

If so the temperature of 5084 k would burn the firefly. 01