G.C.E. (Advanced Level) Examination - August 2010

PHYSICS - I

Provisional Scheme of Marking

2010 - Answers

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

G.C.E. (Advanced Level) Examination - August 2010

PHYSICS - II

Provisional Scheme of Marking

A - PART

(1) (a) 0.1 cm OR 1 mm — 01

(b) $E = \frac{1}{2}kx^2$ — 01

(c) $U = Mgh$ — 01

(d) $\frac{1}{2}kx^2 = Mgh$

$h = \left(\frac{K}{2Mg}\right)x^2$ — 01

(e) conservation of (Mechanical) energy — 01

(f) (i) Data Point are not spread out uniformly OR Data has not been taken between $x^2 = 9\times10^{-4}m^2$ and $x^2 = 25\times10^{-4}m^2$ Or Data has not been taken between last two data points OR Data is missing in the middle region. — 01

(ii) Need to choose x so that x^2 can spread out uniformly in the entire range. — 01

(g) $200 = K/2Mg$

$K = 200 \times 2Mg$

$K = 200 \times 2 \times 0.125 \times 10Nm^{-1}$

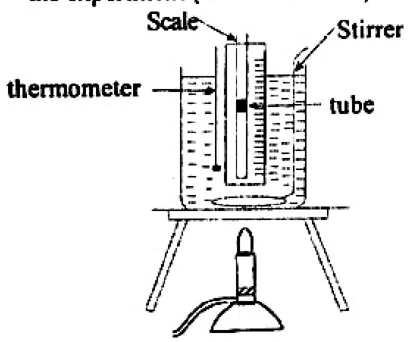
$K = 500Nm^{-1}$ — 01

(h) Mesurement x is smaller than h, OR since x^2 appears in the plot equation x has to be mesured accurately OR to reduce the fractional (percentage) error in x^2 — 01

02. (a) (i) C — 01

(ii) To keep the air volume below the water level throughout the experiment (OR all the time) — 01

(b)



(the tube, scale and thermomter, scale must be as shown or very close to the tube, thermometer should be immersed in the water to a reasonable depth) — 01

labels (any three) — 01

(c) Temperature — 01

length of the air column — 01

(d) (i) $\frac{P_1V_1}{T_1} = \frac{P_2V_1}{T_1}$

$\frac{(100 - P)\times l}{273+\theta} = \frac{(100 - 5)\times 3}{300}$

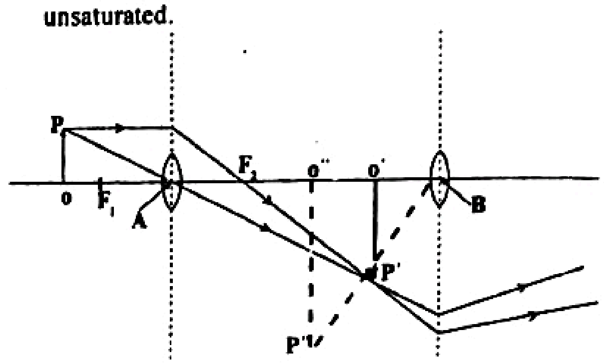
(ii) Pressure due to water thread $= 10^{-2}\times10^3\times10$

$= 10^2Pa$

This pressure is much smaller than the atmospheric Pressure (10^5pa)

(e) Water has completely evaporated or Air volume has become unsaturated.

03.



(a) Drawing the image O'P' — 01

(b) Drawing the image O'' P''

(any two lines should have been drawn in order to determine the position of the image) — 01

(c) (i) Making F_1 ($AF_1 = AF_2$) — 01

(ii) To form a real image by the objective.

OR The image formed by the objective should fall in between the objective and the eyepiece.

OR The image formed by the objective should be in the right side of the objective.

OR To obtain a higher magnification — 01

(d) (i) 25cn OR least distance of distinct vision — 01

(ii) $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{25} - \frac{1}{u} = -\frac{1}{5}$

$u = 4.17$ cm [(4.16 - 4.17)cm OR4.2 cm] — 01

(iii) The image will be formed behind the retina,

OR The image will not be focused on the retina,

OR The image will not be formed on the retina,

OR The distance from the eye (OR BO'') to the final image is less than 25cm — 01

2 Argument is incorrect — 01

3 (e)The object could be placed near the objective.

or More light from the object will enter the objective.

or The length of the microscope will be small — 01

(f) Magnifying power = 3

04. (a) R_θ = Resistance of the wire at temperature θ

R_0 = Resistance of the wire at 0°C

α = Temperature Coefficient of resistance

θ = Temperature difference

All four Correct — 01

(b) (i) (1) Wheatstone Bridge OR meter bridge

(2) Beaker

(3) Bunsen burner — All three correct — 01

(ii) Provide a uniform temperature throughout the bottom surface OR Provide uniform heating throughout the bottom surface. — 01

(iii) (1) thermometer

(2) Stirrer — 01

(c) (i) coconut oil has lower electrcial conductivity OR To have a lower electrical conductivity OR With water the turns of the coil will get short circuited.

(ii) To have a higher Temperature range for the experiment OR Coconut oil has a higher boiling point. 01

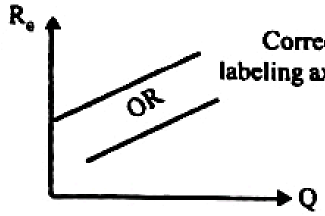
(b) yes

Temperature inside the wire can be higher than the measured Temparatune OR

There can be a temperature qradient inside the wire even at the steady state or

The current may heat the wire 01

(e)



Correct shape 01

labeling axes correctly 01

(f) $x = \frac{\text{gradient}}{\text{intercept}}$ 01

PART B

01. (a) (i) linear momentum of the ball $= mV$ 01

(ii) By Applying $m_1v_1 = m_2 V_2$ (OR Conservation of linear momentum)

$MV = 2m\upsilon$ 01

$V = \frac{2m\upsilon}{M}$ 01

(b) (i) Angular momentum of the ball $= m\upsilon x$ 01

(ii) By Applying Conservation of the Angular momentum

$I\omega = 2mvx$

$\omega = \frac{2mvx}{I}$ 01

(c) (i) linear Velocity at end A

$\upsilon^I = L/2\ \omega$ $[V = r\omega]$ 01

$\upsilon^I = \frac{L}{2} \times \frac{2m\upsilon x}{I}$ $\left(\text{Or } \frac{Lm\upsilon x}{I}\right)$ 01

(ii) V and V' are opposite in direction 01

(iii) For the end A to be at rest

$\upsilon^I = V$

$\frac{L}{2}\ \frac{2m\upsilon x_s}{I} = \frac{2m\upsilon}{M}$ 01

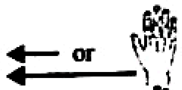
$X_s = \frac{2I}{ML}$ 01

(d) $X_s = \frac{2}{ML} \times \frac{1}{12}\ ML^2$

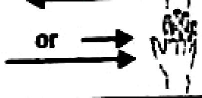
$X_s = L/6$ 01

$X_s = 0.1$ m 01

(e) (i) $x > x_s$; the direction of the force



(ii) $x < x_s$; the direction of the force is



02. (a) Earth quakes

Blasting (Bomb, Blasting of Rocks)

Pile driving with pile drivers

Heavy trucks travelling over potholes or discontinuities

Huge thunders

Demolition any three 01

(b) Amplitude of vibration

Displacement

Velocity OR peak particle velocity, (PPV)

Acceleration (PPA) any one 01

(c) Ruins

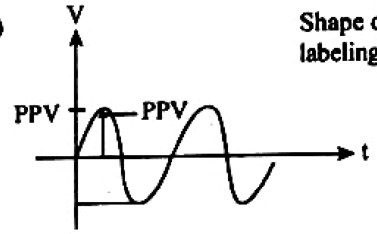
historic buildings

Ancient monuments All three 01

(d) Heavy trucks travelling over potholes <u>Produce higher Vibration amplitudes</u>

(e) This is because fronsducers measure velocities (and not displacements)

(f)



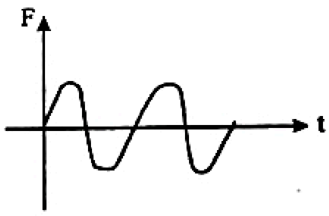
Shape of the curve 01

labeling PPV 01

(g) This is because it take s time for the human body to respond to the excitation 01

(h) (i) As the two eccentric weights rotate in opposite directions horizontal components of the two forces cancel off 01

(ii)



01

(I) (i) $PPV = PPV_{Ref}\left(\frac{10}{D}\right)\left[\frac{E_{EquiP}}{E_{Ref}}\right]^{1/2}$

$= 12.5 \left(\frac{10}{30}\right)\left(\frac{112.5}{50}\right)^{1/2}$

$= \frac{12.5}{3} \times 1.5$ 01

$= 6.25\ mms^{-1}$

$(6.17 - 6.25\ mms^{-1})$

(ii) This value is less than $12.5\ mms^{-1}$ and therefore the office complex is safe 01

(ii) The above PPV value is greater than $2mms^{-1}$ and therefore the ancient monument will be damaged 01

(j) PPVmax for ancient monument is $2mms^{-1}$

$D = \frac{12.5 \times 10 \times 1.5}{2}$

$D = 93.75$ m 01

03. (a) if n is the number of smaller droplets

$n \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$

$\therefore n = \left(\frac{R}{r}\right)^3 = \left(\frac{40 \times 10^{-4}}{10 \times 10^{-4}}\right)^3$

$n = 64$ -01

(b) (i) $6\pi a \eta V_t = \frac{4}{3} \pi a^3 \rho_w g$ -01

$V_t = \frac{2a^2 \rho_w g}{9\eta}$

$V_t = \frac{2 \times (40 \times 10^{-6})^2 \times 10^3 \times 10}{9 \times 1.6 \times 10^{-5}}$ -01

$V_t = 0.22 \text{ ms}^{-1}$
$(0.20 - 0.22 \text{ ms}^{-1})$ -01

(ii) Mean Velocity of the Waler drop $\left(\frac{V_t}{2}\right) = \left(\frac{0.22}{2}\right) = 0.11 \text{ ms}^{-1}$

Time for the water drop to reach ground ; if it moves with the averge velocity

$= \frac{2000}{0.11}$ S OR $\frac{2000}{0.10}$ S 01

= 18182 S.

The time is much greatar than 10 minutes and therefore the water drop would evaporate before reaching qround. 01

Alternative method Distance traveled during a period of 600s if the water droplet moves with the mean velocity = 0.11 x 600m = 0.10 x 600m -01 = 66 m. This distance is much smaller than 2km, and therefore the water drop would evaporate before reaching ground. -01

(c) (i) $P_i - \pi = \frac{2r}{R_1}$ -01

(ii) Pressure at a point just above the lower end of the raindrop $= (p_i + h\rho_w g)$ -01

(iii) For the lower surface
$(P_i + h\rho_w g - \pi) = 2\gamma / R_2$ -01

Compar equation (i) and (iii) = $\frac{2\gamma}{R_1} < \frac{2\gamma}{R_2}$

There fore $R_1 > R_2$ -01

(iv) $\frac{2\gamma}{R_2} - \frac{2\gamma}{R_1} = 2\gamma\left(\frac{R_1 - R_2}{R_1 R_2}\right) = h\rho_w g$

$\therefore R_1 - R_2 = \frac{h \rho_w g \times R_1 R_2}{2\gamma}$

$= \frac{(4 \times 10^{-3} \times 10^3 \times 10)(4 \times 10^{-6})}{2 \times 7.5 \times 10^{-2}}$

$= 1.07 \times 10^{-3}$ m = 1.07 mm
(1.00 mm - 1.1 mm)

(d) Maximum hydrostatic pressure occurs just above the lower surface of the raindrop and is given by $h\rho_w g$
The drop becomes unstables and breaks into small droplets when $h\rho_w g > \frac{2\gamma}{R_2}$

Therefore the maximum vertical length of a raidrop is given by

$h_{max} = \frac{2\gamma}{\rho_w R_2 g}$ -01

$= \frac{4\gamma}{\rho_w h_{max} g}$

$\therefore h^2_{max} = \frac{4\gamma}{\rho_w g}$

$h^2_{max} = \frac{4 \times 7.5 \times 10^{-2}}{10^4}$ -01

$h_{max} = 2 \times \sqrt{7.5}$ mm = 2 x 2.7 mm

$= 5.4 \times 10^{-3}$m = 5.4 mm -01
= (5.4 mm - 5.6 mm)

04. (a) (i) $\frac{mV^2}{R} = evB$

$R = \frac{mv}{eB}$

(ii) $f = \frac{v}{2\pi R}$ OR $f = \frac{eB}{2\pi m}$

(b) (i) $B = \frac{2\pi mf}{e}$

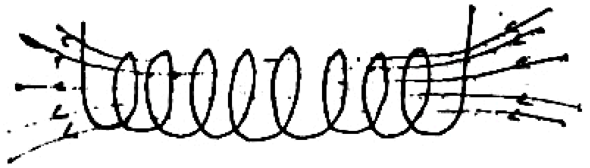
$B = 2 \times \frac{22}{7} \times \frac{2450 \times 10^6 \times 9 \times 10^{-31}}{1.6 \times 10^{-19}}$

B = 0.09 T
(0.0865 - 0.0866)

(ii) (1) $B = \mu_0 nI$
(2) $0.009 = 10^{-6} \times n \times 10$
$n = 9 \times 10^3$ ($865 - 866 \times 10^3$) turns m^{-1} -01

(3) $d = \frac{1}{9000}$
$d = 1.1 \times 10^{-4}$m (OR 0.11mm)
[$(1.1 - 1.2) \times 10^{-4}$m, (0.11 - 0.12)mm]

(4)



-01

(c) (i) Vsinθ Component :-
Magnetic field acts only on the velocity Component Perpendicular to the field (Vsinθ) and it makes the electron to travel in Circle 01

Vcos θ component :-
Magnetic field does not act on the velocity Compo nent Parallel to the field (VCoSθ) but it make, the electron to trarel parallel to the field direction 01

(ii) $R' = \frac{mv\sin\theta}{eB}$

(iii) Period of revolution $= \frac{2\pi m}{eB}$

(iv) $P = V\cos\theta \cdot \frac{2\pi m}{eB}$ $\left(or\ P = \frac{2\pi R^1}{\tan\theta}\right)$

$R^1/P = \frac{1}{2\pi}\tan\theta$ OR $\frac{R^1}{P} = \frac{\sin\theta}{2\pi\cos\theta}$

Therefore R^1/P ratio depends only θ

05. (A) (a) $P = V^2/R$ 01

(b) (i) $P_{R_1} = \left(\frac{10}{800}\right)^2 \times 600$ OR $\frac{7.5^2}{600}$ 01

$= 0.094$ W OR 94 mW 01

$P_{R_2} = \frac{P_{R_1}}{3}$

$\therefore P_{R_2} = 0.031$ W OR 31mW 01

$$\left[\begin{array}{l} P_{R_2} = \left(\frac{10}{800}\right)^2 \times 200 \\ P_{R_2} = 0.031 \text{ W OR } 31 \text{ mW} \end{array}\right]$$

$P_{R_3} = V^2/R$

$= \frac{25}{5 \times 10^3}$

$= 0.005$W OR5 mW

$P_{R_4} = I^2R$

$= \left(\frac{5}{5 \times 10^3}\right)^2 \times 1.8 \times 10^3$

$= 0.0018$ W

2mW OR 0.002 W 01

(ii) Rating of all resistors should be 0.125W 01

(iii) Power Consumed by the element $P = VI$

$= (5 - 1.8) \times 1 \times 10^{-3}$01

$= 3.2$mw OR 0.003W

Total power Consumed by the circuit = 94 + 31 + 5 + 2 + 3 mw

=135 mw OR 0.135W 01

[Total current drawn from the power supply $= I = \frac{10}{800} + 0.001$

$= 13.5$ mA OR 0.0135A 01

Power Consumed by the circuit $= VI$

$= 10 \times 13.5 \times 10^{-3}$

$= 135$ mW OR 0.135 W

(134.5 - 135.5)mW 01]

(iv) Heat generated by the circuit in 5min

$= 135 \times 10^{-3} \times 5 \times 60$ 01

Heat absorbed by the piece of silicon

$= 0.9 \times 10^{-6} \times 600 \times (\theta - 30)$ 01

$135 \times 10^{-3} \times 5 \times 60 = 0.9 \times 10^{-6} \times 600 \times (\theta - 30)$ 01

(v) Equivalent resistance (r_{eq}) of the circuit = V/I

[V - supply voltage, I - current drawn from the supply]

$V_{eq} = \frac{10}{13.5 \times 10^{-3}}$ OR $\frac{10^2}{135 \times 10^{-3}}$

$V_{eq} = 740\ \Omega$

Equivalent resistance when fire such circuits are conneeted in parallel

$= \frac{740}{5}$

$= 148\ \Omega$

$\frac{R_{Eq}}{r} = \frac{9.9}{0.1}$

r is the internal resistance of the bettery

$r = 1.5\Omega$ $(1.4 - 1.5\Omega)$ 01

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

$V_P - V_Q = 5 \times 10^{-5}$ V

(ii) $V_x = 0$

(iii) $V_x = 0$

(iv) $V_P = 2.5$ V

$V_Q = 50 \times 5/250$

$= 1$ V 01

$V_P - V_Q = 1.5\text{V} > 5 \times 10^{-5}$ V 01

Therefore the op amp will saturate at 5v OR

$V_x = 5$V 01

(v) yes, there is an advantage.

Output of the circuit will be in saturation all the time. Hence it cannot be used to detect (arbitray) light levels.

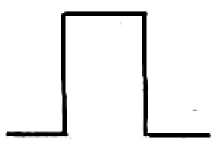
OR

with a fixed resistor, if ambient light level changes, op amp will Saturate even without the external light source.

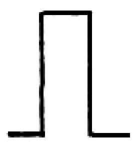
OR

with an LDR the circuit always compensates for ambi ent light 01

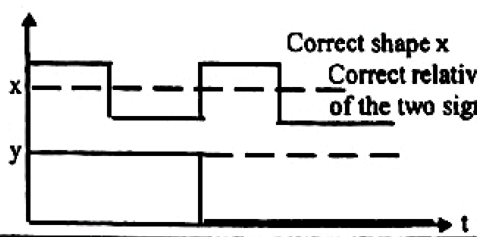
(b) (i) 01



(ii) 01



(c) (i)



Correct shape x 01

Correct relative timing of the two signals 01

(ii)

	x	y
1	0	0
2	1	0
3	0	1
4	1	1

two correct 01
all correct 02

06(A) (a) $PV = nRT$ 01

$$P = \frac{PN_A m}{RT}$$

$$= \frac{420 \times 6 \times 10^{23} \times 6.64 \times 10^{-27}}{8.3 \times 240}$$

$= 8.4 \times 10^{-4}\ Kgm^{-3}$ 01

(b) $Mg + V_B \rho g = V_B \rho_A g$ 01

$$V_B = \left(\frac{M}{\rho_A - \rho}\right)$$

(c) $V_B = \left(\frac{10}{58.4 \times 10^{-4} - 8.4 \times 10^{-4}}\right) m^3$ 01

$= 2 \times 10^3\ m^3$ 01

(d) Namher of the atoms $= \frac{PVN_A}{RT}$ 01

$= \frac{420 \times 2 \times 10^3 \times 6 \times 10^{23}}{8.3 \times 240}$ 01

$= 2.5 \times 10^{26}$ 01

(e) Number of the atoms inside the balloon does not change

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{P_E V_E}{T_E} = \frac{PV}{T}$$

$$V_E = \left(\frac{420}{10^5}\right)\left(\frac{300}{240}\right) \times 2 \times 10^3$$

$= 10.5\ m^3$

(f) Balloon will sink
When Temperature decreases and the gas inside the balloon cools down and contracts and cause the balloon to sink
OR
When the temperature decreases and of the effect due to decrease in the volume is larger than that due to the increase in the density of the atmosphere then balloon will sink.

ballon goes up
when the temperature decrease and it the effect due to decrease in the Volume is less than that due to increase in the density of the atmosphere then balloon goes up. (OR if the above mentioned two effects are equal the balloon will stay stationary.)

6.(B) (a) (i) Work funcfion $= hf - eVstop$ 01
$\varnothing = 6.6 \times 10^{-34} \times 7.2 \times 10^{14} - 1.6 \times 10^{-19} \times 0.05$
$= 4.67 \times 10^{-19}\ J$ 01
$(4.6 - 4.8 \times 10^{-19}\ J)$

(ii) Energy of a Photon of green colour radiation
$= 6.6 \times 10^{-34} \times 5.6 \times 10^{14}\ J$ 01
$= 3.7 \times 10^{-19}\ J$

In order to remove electrons from the surface of the photocathode each incident photon must have energy of at least 4.67×10^{-19}J, But the energy of photons of green colour is 3.7×10^{-19}J. Therefore there will not be any current for green colour. 01

(b) (i) Photocathode A must be selected. It has the work function which is less than the energy of photons of green colour radiation.
(ii) Violet colour produces photoetectrons with maximum kintic ehergy 01

$K_{max} = hf - \varnothing$
$= 6.6 \times 10^{-34} \times 7.2 \times 10^{14} - 3.4 \times 10^{-19}$
$= 1.35 \times 10^{-19}$J 01
$(1.3 - 1.4)$

(c) (i) number of photoelectrons emitted per second for

green light $= n_G = \frac{i_G}{e} = \frac{400 \times 10^{-6}}{e}$

where i_G is the current in the circuit for green colour light
Number of photons of green light incident per second on the photocathode $n_G = \frac{n_G}{0.1} = \frac{i_G}{0.1e}$ —— (1)

Similarly, for Photons of violet colour radiation

$$N_V = \frac{n_V}{0.15} = \frac{i_V}{0.15e}$$

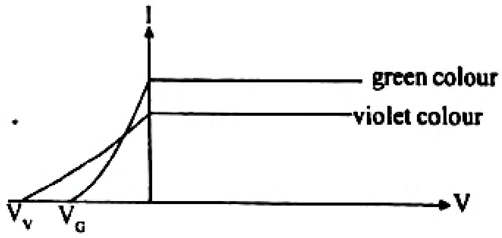
The ratio $\frac{N_G}{N_V} = \left(\frac{0.15}{0.1}\right)\frac{i_G}{i_V}$

$= \frac{3 \times 400}{2 \times 240}$

$= 5/2$

$= 2.5$

(ii)



(iii) let E_G be the energy incident per unit time per unit Area on the earth is surface due to photons of green colour light

$$E_a = \left(\frac{hf_G}{A}\right)\left(\frac{N_G}{0.1}\right) \text{OR } E_G = \left(\frac{hf_G}{A}\right) N_G$$

$$= \left(\frac{hf_G}{A}\right)\left(\frac{i_G}{0.1e}\right)$$

A is the cross sectional area of the light beam

$$= \left(\frac{6.6 \times 10^{-34} \times 5.6 \times 10^{14}}{5 \times 10^{-5}}\right)\left(\frac{400 \times 10^{-6}}{0.1 \times 1.6 \times 10^{-19}}\right)$$

$= 184.8\ Wm^{-2}$

Percentage of energy due to green photons $\frac{184.8}{1200} \times 100\%$

$= 15.4\%$ 01
$= (15 - 16\%)$