G.C.E(Adv. Level) Examination, April 1998

Marking Scheme for Physics 1(M.C.Q. Paper)

(1) 2(Two)	(11) 3(Three)	(21) 2(Two)	(31) 1(One)	(41) 2(Two)	(51) 1(One)
(2) 3(Three)	(12) 2(Two)	(22) 3(Three)	(32) 2(Two)	(42) 5(Five)	(52) 4(Four)
(3) 2(Two)	(13) 4(Four)	(23) 4(Four)	(33) 4(Four)	(43) 1(One)e)	(53) 5(Five)
(4) 2(Two) / 3(Three)	(14) 3(Three)	(24) 3(Three)	(34) 3(Three)	(44) 4(Four)	(54) 4(Four)
(5) 5(Five)	(15) 4(Four)	(25) 5(Five)	(35) 3(Three)	(45) 2(Two)	(55) 4(Four)
(6) 5(Five)	(16) 4(Four)	(26) 1(One)	(36) 5(Five)	(46) 2(Two)	(56) 2(Two)
(7) 1(One)	(17) 3(Three)	(27) 2(Two)	(37) 5(Five)	(47) 1(One)	(57) 2(Two)
(8) 2(Two)	(18) 4(Four)	(28) 5(Five)	(38) 4(Four)	(48) 5(Five)	(58) 1(One)
(9) 2(Two)	(19) 1(One)	(29) 4(Four)	(39) 1(One)	(49) 3(Three)	(59) 4(Four)
(10) 2(Two)	(20) 3(Three)	(30) 5(Five)	(40) 4(Four)	(50) 2(Two)	(60) 5(Five)

1998 A/L Physics

Part - A

Marking scheme for (A and B) parts

01. (a). A. Spring balance with a mass range of 150 g — 01
Reason,
It has the maximum sensitivity out of the given spring balances.
(Or because we can obtain an accurate reading) — 01

(b). As the metal ball is not spherical
(Or an answer similar to that) ———— 01

(c). Travelling microscope or micrometer screwgauge ———— 01

(d). Instrument - Vernier calliper
Reason :- As the change in the reading happens at the second decimal place ———— 01

(e). Density $= \dfrac{m - \frac{m}{50}}{\frac{4}{3}\pi\left[\frac{D}{2}\right]^3}$

Or, $= \dfrac{147m}{25\pi D^3}$ ———— 01

(f). (1). Fill water up to the necessary level in the measuring cylinder.
(2). Obtain the reading of the water level ———— 01
(3). Obtain the reading of the water level after ---- 01
(The 1st step is not important)

(g).(1). As the diameter in not uniform, we can avoid the errors that can happen.
(2). In the method of measuring the volume, the volume of the hook is also considered. (or another statement similar to this.)
(3). The errors caused due to the splits and scratches on the surface of the ball can be avoided.
(For any of the 2 answers -- (2) marks. For 1 answer -- (01) mark)

TOTAL 10

02. (a). (i). X_1 = Mass of the steel ball ———— 01
X_2 = Initial temperature of water } ---- 01
X_1 = Final temperature of water
(Even if the order of the symbols are different. five the total marks)

(ii). When changing the ball, bring the cup near the bunson burner the steel ball slowly and steadily to the cup. Closing the cup using a suitable lid.
(For any 02 ---- (02) marks, for any 01 ---- (01) marks)

(b). (i). $X_1C_2(\theta - X_3) = mC_1(X_3 - X_2)$ ———— 01
$\theta = [mC_1(X_3 - X_2)/X_1C_2] + X_3$ ———— 01
[Give the total marks if the expression is correct according to a (i).]

(ii). Vapourization. (No marks for vapourization) --- 01
(iii). (A liquid with a) High biling point ———— 01

(c). No.
The ball turns into liquid state. Or
The melting point of lead reduces than the temperature of the bunson flame. ———— 01

(d). Thermo couple. ———— 01

TOTAL 10

03. (a). A - Eye piece B - Telescope
C - Collimater D - Prism table } ---- 02
(If all are current -- (02). If any 2 are correct -- (01) mark)

(b). A - Focus on the cross wires.
B - Adjust until a parallel beam of light is obtained.
Or. focus on a far object.
C - Adjust to produce a parallel beam of light.
Or. focus the slit on the cross wires.
D - Level the prism table } ---- 02

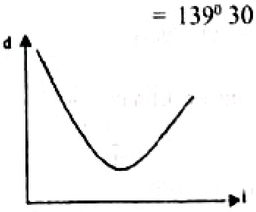
(If all are correct --(02) marks. If any 02 are correct --(01) marks)

(c). 1. Obtain the scale reading without the prism.
(Or by keeping C and B in the same line)
2. Obtain the scale reading when the image of the slit is observed on the cross wires. ———— 01

(d). Rotate the prism table slowly, while looking through the telescope. While moving the telescope. Obtain the image of the slit on the cross wires. At the minimum deviation situation, the image starts to turn backwards.
(Or it starts to travel to the opposite direction) — 01

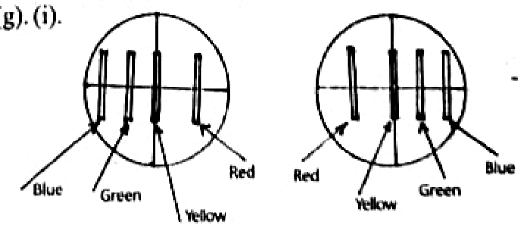
(e). Angle of deviation $= 3^\circ 16' + [360^\circ - 223^\circ 46']$ ---- 01
$= 139^\circ 30'$

(f).



———— 01

(g). (i).

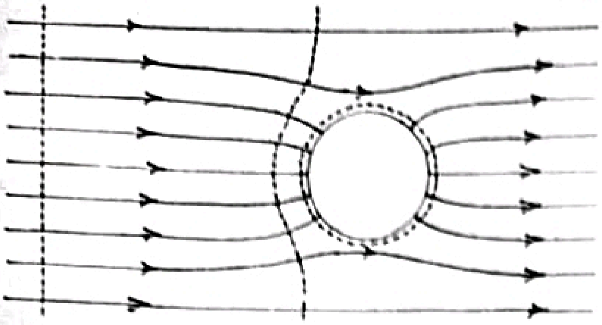


---- 01

(ii). A pure spectrum (of all the colours)
or continous spectrum (of all the colours)
or a beam of light with all the colours -- 01

TOTAL 10

04. (a), (b).



-- 02

[(i). If the electrical force lines are not perpendicular to the surface of the sphere, 01 mark

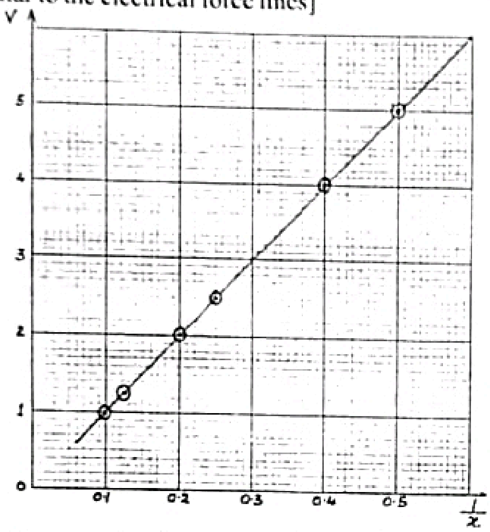
(ii). If the electrical force lines are drawn inside the sphere reduce 01 mark]

Give 02 marks for any correct equipotential lines drawn in 2 different regions. -- 02

(For any one ------- 01 mark)

[To obtain marks, the dotted lines should be perpendicular to the electrical force lines]

(c).



[For using the total scale of the graph paper]

------------------ 01

[For the correct straight lines] ------------------ 01

(d). (i). Gradient = 10 V cm (or 0.1 Vm) ---------- 01

(ii). Identifying the gradient $= \frac{1}{4\pi\varepsilon_0}Q$ ---------- 01

$9 \times 10^9\ Q = 10 \times 10^{-2}$

$Q = {}^1/_9 \times 10^{-10}\,C$ ---------- 01

$= (\text{or } 1.1 \times 10^{-11}\,C)$

(e). No.

the electric potential inside the sphere is constant. Or the gradient is zero.

Or for 1/x value to be higher value, the graph should be parallel to 1/x axis.

Or showing a horizontal line in the graph.

(Do not consider the values marked on the 1/x axis for this answer) -- 01

TOTAL 10

Part - B

01. (i). Kinetic energy of the bullet before the collision

$= {}^1/_2 \times 0.1 \times 60^2$

$= 180\ J$ ------------------------------ 01

(ii) If 'V' is the velocity of the system after the collision. By using the conservation of linear momentum,

$0.1 \times 60 = (1.4 + 0.1)\ V$ ------------------------------ 02

(For the momentums ---- (01) mark

for the correct substitution ---- (01) mark)

Therefore, $V = 4\ ms^{-1}$

Therefore, the kinetic energy of the system after collision

$= {}^1/_2\ 1.5 \times 4^2$

$= 12\ J$ ------------------------------ 01

Therefore, the percentage of loss of kinetic energy

$= \frac{(180 - 12)}{180} \times 100$

$= 93\ \%$ ------------------------------ 01

(or 93.3 %)

No.

The kinetic energy destroyed is converted to energy such as heat and sound. (Or any other energy not mentioned here) ------------------------------ 01

(iii). At the maximum height, the total kinetic energy is converted to the potential energy.

Therefore, $1.5 \times 10 \times h = 12$ ------------------ 01

$h = 0.8\ m$ ------------------ 01

(iv). Total momentum, before the collision

$= 0.1 \times 60 - 1.5 \times 4$ ------------------ 01

$= 0$

As the bullet and the block travels together after the collision. The velocity of the block = 0 ------------------ 01

or. The momentum of the block and the bullet is equal and opposite to the momentum of second bullet.

Therefore, Total momentum = 0 ------------------ 01

Therefore, Velocity of the block = 0 ------------------ 01

(v). If the springs constant of the string is K,

$1.4 \times 10 = K \times 0.2$ ------------ 01

$K = \frac{1.4 \times 10}{0.2}$

$= 70\ Nm^{-1}$

the elastic energy inside the string

$= {}^1/_2 \times 70 \times 0.2^2$ ------------ 01

(or the elastic energy deposited)

$= {}^1/_2\ Fe = {}^1/_2\ 14 \times 0.2$]

Therefore, the total energy of the system after the collision.

$= {}^1/_2 \times 70 \times 0.2^2 + 12$ ------ 01

[Or ${}^1/_2 \times 7.0 \times 0.1 \times 12$]

If h_1 is the maximum height obtained by the block. The total energy of system.

$= {}^1/_2 \times 70 \times 0.1^2 + 1.5 \times 10\ h_1$

${}^1/_2 \times 70 \times 0.2^2 + 12 = {}^1/_2 \times 70 \times 0.1^2 + 1.5 \times 10 \times h_1$ --- 01

$h_1 = 0.87\ m$ ------------------ 01

TOTAL 15

02. (a). Bernoulli's equation.

$P + \frac{1}{2}\rho r^2 + \rho g h = \text{constant}$ -------- 01

Here, P = Pressure (of liquid)
r = Velocity (of liquid)
ρ = Density (of liquid)
h = Height
(Above the ground level 1)
(g - acceleration due to gravity) ---- 01

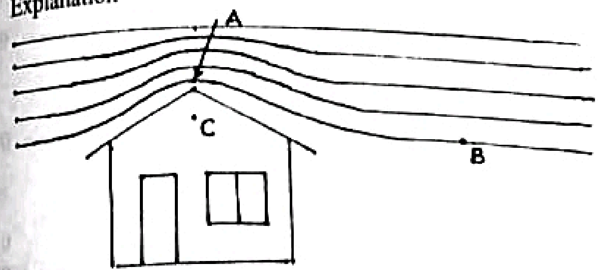
Definition of each term

P = Pressure (or pressure force)
$\frac{1}{2}\rho r^2$ = Kinetic energy per unit volume of liquid. (or dynamic energy)
ρgh = Potential energy per unit volume of liquid ---- 02

(for any 02 ------- (01) mark)

Requirements
Streamline (Streamline flow)
Non-viscous
Incompressible ------------ 01

Explanation



When we consider the streamlines going through the points A and B. As point B is far away, the motion of air is neglegible. By applying Bernoulli's equation for this stream line flow. $P_A + \frac{1}{2}\rho V_A^2 = P_B$ ------------------ 01

Therefore, $P_A < P_B$

As the air inside the house is at rest we can assume that $P_C = P_B$.

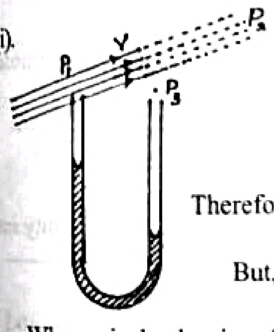
Therefore, $P_A < P_C$ ------------------------------ 01

The area of the roof is large,

Therefore, A large upthrust force is created on the roof.

Therefore, It is removed. ------------------------ 01

(i).



$P_1 + \frac{1}{2}\rho V^2 = P_3$

Therefore, $\frac{1}{2}\rho V^2 = P_3 - P_1$ ----- 01

But, $P_3 - P_1 = h\rho g$ ------- 01

When ρ is the density of oil,

Therefore, $V = \left[\frac{2 h\rho_1 g}{\rho}\right]^{1/2}$

$V = \left[\frac{2 \times 2.4 \times 10^{-2} \times 800 \times 10}{12}\right]^{1/2}$

$= 17.9\ ms^{-1}$ or $(18 \pm 0.3)\ ms^{-1}$ ------- 01

(ii). Rate of flow of mass of air (m)

= Volume per second x ρ
= $A r \rho$ ------------------------ 01
= $10^{-4} \times 18 \times 1.2$
= $2.15 \times 10^{-3}\ kg\ s^{-1}$ ------------------ 01
$(2.15 \pm 0.05)\ 10^{-3} kg\ s^{-1}$

(iii). Power = Energy/Seconds
= $\frac{1}{2} m V^2$ ------------------------ 01
= $\frac{1}{2} \times 2.15 \times 10^{-3} \times 18^2$
= 0.34 W ------------------------ 01
= (0.34 ± 0.2) W

Another method,

Power = $\frac{\text{Energy}}{\text{Volume}}$ x Volume per second ----- 01
= $\frac{1}{2} A\rho V^2 V = \frac{1}{2} A\rho V^3$
= 0.34 W ------------------------ 01
(0.34 ± 0.02) W

TOTAL 15

(b). (i). Interference, Diffraction, Polarization.

(For any 02 ------ (01) mark)

(ii). When the wave length of the wave is greater than the depth of water and when the amplitude is lesser than the depth of water. ------------------------ 01

(iii). Changing the speed of the wave.

Or ------------------------ 01

To produce 2 mediums for the proporgation of waves

(iv). (a). $V = \sqrt{gh}$
$V = f\lambda$

Therefore, $\lambda_1 \alpha \sqrt{h_1}$ and $\lambda_2 \alpha \sqrt{h_2}$ --------------- 01

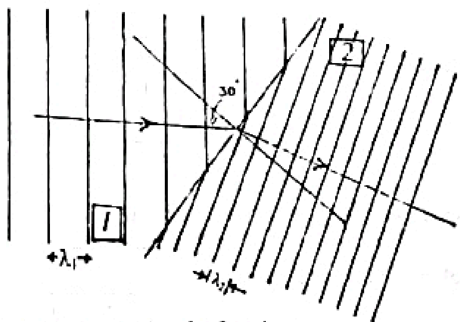
The ratio of the wave lengths,

$\left(\frac{\lambda_1}{\lambda_2}\right) = \frac{\sqrt{h_1}}{\sqrt{h_2}} = \frac{\sqrt{4}}{\sqrt{1}}$

$= 2$ ------------------------ 01

(b). The direction of the wave fronts is changed ------ 01

Drawing the wave fronts such that (λ_1 and λ_2) $\lambda_2 = \frac{1}{2}\lambda_1$ ------------------------ 01



Let r be the angle of refraction.

Then, $\frac{\sin 30^0}{\sin r} = \frac{V_1}{V_2}$ ------------------------ 01

$= \frac{\sqrt{h_1}}{\sqrt{h_2}} = \frac{\sqrt{4}}{\sqrt{1}} = 2$

$\sin r = (\sin 30^0)/2$

$r = 14^0\ 25'(\pm 10')$ ------------------ 01 (v). both of the 2 ----- are vibrated from the same source --01

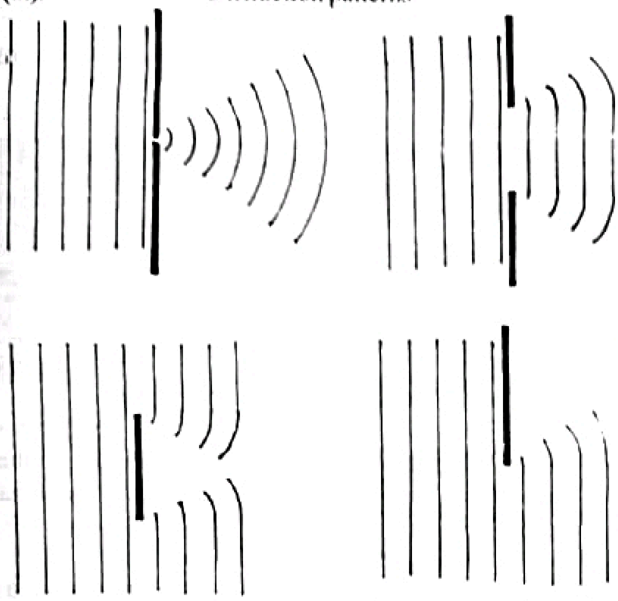
(vi). Wave length of the wave = 20/5 ---------- 01

= 4 ---------- 01

(vii). Water waves are transverse while sound waves are longitudinal ---------- 01

(viii). The source should be kept in the 2nd region. The speed of water waves in teh 2nd medium is lesser than in the 1st medium ---------- 01

(ix). Diffraction patterns



(For any one ---- 01 mark)

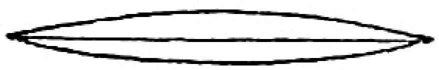
TOTAL 15

03. Velocity $V = \sqrt{T/m}$ ---------- 01

$V = f\lambda$ ---------- 01

$\lambda = 2d$ ---------- 01

$f = \frac{1}{2d}\sqrt{\frac{T}{m}}$ ---------- 01

 ---------- 01

(i). The weight of x length of rope = mgx ---------- 01

Therefore, the tension T of the rope at a height x

= mgx ---------- 01

(ii). Velocity of at a height x $V = \sqrt{\frac{mgx}{m}}$ ---------- 01

$= \sqrt{gx}$ ---------- 01

(iii). Velocity of the wave at the bottom end (x = 0)

$V_1 = 0$ ---------- 01

velocity at the upper end,

$V_2 = \sqrt{gL} = \sqrt{10 \times 10}$

$= 10\ ms^{-1}$ ---------- 01

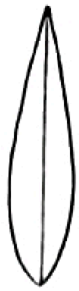
(iv). Average velocity = $(V_1 + V_2)/2 = (0 + 10)/2$

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

Time taken = $10/5$

= $2\ s$ ---------- 01

(v).



---------- 02

(02 marks or 0 marks)

TOTAL 15

04. (a). (i). Mass of air inhaled in one breath.

$= 5 \times 10^{-4} \times 1.2$

$= 6 \times 10^{-4} kg$ ---------- 01

Amount of heat given out to the air in one breath.

$= 6 \times 10^{-4} \times 1.0 \times 10^{3} \times (37 - 27)$ ---- 01

$= 6\ J$

Rate of heat given out to the air,

$= 6 \times 12/60$ ---------- 01

(multiplying by 12/60)

$= 1.2\ W$ ---------- 01

(ii). Substitute, considering v as the final volume,

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ ---------- 01

$\frac{5 \times 10^{-4}}{300} = \frac{V_2}{310}$ ---------- 01

$V = 5.17 \times 10^{-4}\ m^3$ or

$(5.2 \times 10^{-4}\ m^3)$ ---------- 01

(iii). Work done by the lungs during one exhale,

$= P\Delta V$ 01

$= 1.0 \times 10^{5} \times 5.17 \times 10^{-4}$ ---- 01

Therefore, rate of work done by the lungs

$= 5.17 \times 10 \times {}^{12}/_{60}$

$= 10.34\ W$ or $(10.4\ W)$ ---- 01

(iv). The amount of heat removed from the body during exhale, due to vapourization of water.

$= 2.1 \times 10^{-5} \times 2.5 \times 10^{6}$ ---- 01

$= 52.5\ J$

Therefore, rate of loss of heat from the body due to vapourization of water. = $52.5 \times 12/60$

$= 10.5\ W$ ---------- 01

(v). Amount of water vapour collected in one minute inside the bus due to 40 passengers.

$= 2.1 \times 10^{-5} \times 12 \times 40$ ---------- 01

$= 10.08\ 10^{-3}\ kg\ min^{-1}$

Therefore, the rate of increase of relative humidity inside the bus. $= 10.08/600$ ---------- 01

$= 0.0168\ min^{-1}$

or $(0.02\ mon^{-1})$ ---------- 01

or 1.7 % or 2 %

TOTAL 15

(b). (i). Surface area of the sun.

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

Total power radiated to the surrounding.

$= \sigma A T^4$ ---------- 01

$= 5.7 \times 10^{-8} \times 4\pi (7.0 \times 10^{8})^2 \times (6000)^4$

$= 4.6 \times 10^{26}$ W ---------- 01

$= (4.6 \pm 0.2) \times 10^{26}$ W

(ii). Ultra violent, visible, infra-red --- (For all 03 -- 01 mark)

(iii). $\lambda_m T$ = constant ---------- 01

(iv). Let the decay of mass of the sum during one second be Δm, By using $\Delta E = \Delta mc^2$

$\Delta m = \frac{4.6 \times 10^{26}}{(3 \times 10^8)^2}$ ---------- 01

$= 5.1 \times 10^9$ kg ---------- 01

Therefore, decay of mass during one year.

$= 5.1 \times 10^9 \times 365 \times 24 \times 60 \times 60$ ---------- 01

Multiplying by the number of seconds in a year

$= 1.6 \times 10^{17}$ kg ---------- 01

$= (1.6 \pm 0.2) \times 10^{17}$ kg

(v). Total amount of energy incident on one square meter of the earth surface during 1 second without any absorption.

$= \frac{4.6 \times 10^{26}}{4\pi (1.5 \times 10^{11})^2}$ ---------- 01

$= 1.63 \times 10^3\ Wm^{-2}$ ---------- 01

Total amount of energy incident on one square meter of the earth surface during 1 second with absorption.

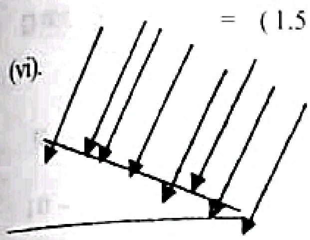
$= 1.63 \times 10^3 \times 90/100$ ---------- 01

[01 mark for (90/100) 01]

$= 1.47 \times 10^3\ wm^{-2}$

$= (1.5 \pm 0.2) \times 10^3$ Wm ---------- 01

(vi).



The surface area of the body which is perpendicular to the rays of the sun.

$= 0.8 \times \cos 30^0$ ----- 01

Therefore, rate of absorption of energy by the body.

$= 0.7 \times 1.47 \times 10^3 \times 0.8 \cos 30^0$

$= 7.13 \times 10^2$ W ---------- 01

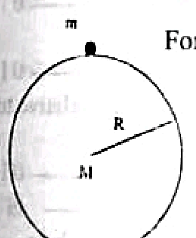
$(7.1 \pm 0.2)\ 10^2$ W

TOTAL 15

05. Newton's law of gravitation.

$F = G\frac{m_1 m_2}{r^2}$ ---------- 01

G = Universal gravitational constant
r = Distance between the masses
$m_1 m_2$ = Masses
F = Force between the 2 masses } ----- 01

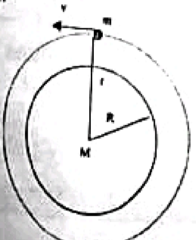


For an object closer to the earth surface,

$mg = G\frac{Mm}{R^2}$

$gR^2 = GM$ or $g = \frac{GM}{R^2}$ ------ 01

(i).



For the motion of the satellite.

$\frac{mV^2}{r} = G\frac{Mm}{r^2}$ ---------- 01

$V^2 = G\frac{M}{r}$

By using this expression, for g,

$V^2 = gR^2/r$

Time, $T = 2\pi r/V$ ---------- 01

Therefore, $\frac{gR^2}{r} = \left[\frac{2\pi r}{T}\right]^2$

$r^3 = gR^2T^2/4\pi^2$

$T = \frac{24 \times 60 \times 60}{10}$ ---------- 01

$= 8640$ s

$r^3 = \frac{10 \times (6.4 \times 10^6)^2 \times (8640)^2 \times 7^2}{4 \times 22^2}$ -- 01

$r = 9.2 \times 10^6$ m

The height from the earth surface.

$= r - R$ --- (for the substraction ---- 01 mark) --- 01

$= 9.2 \times 10^6 - 6.4 \times 10^6$

$= 2.8 \times 10^6$ m

(ii). Total energy of the satellite

= Kinetic energy + Potential energy

$= \frac{1}{2} mV^2 + [-G\ ^{Mm}/r]$

$= \frac{1}{2} G \frac{Mm}{r} - G\frac{Mm}{r}$

$= -\frac{1}{2}\frac{GMm}{r}$ ---------- 01

$= \frac{1}{2} g \frac{R^2 m}{r}$

$= -\frac{1}{2} \times \frac{10 \times (6.4 \times 10^6) \times 10^3}{9.2 \times 10^6}$ ---- 01

(For the correct substitution 01 mark)

$= (-)\ 2.2 \times 10^{10}$ J

(iii). Minimum energy required,

Potential energy at the orbit - Potential energy at the ground.

$= -G\frac{Mm}{r} - \left[-G\frac{Mm}{R}\right]$

$= -G\frac{Mm}{r} + G\frac{Mm}{R}$ ---------- 01

$= -2 \times 2.2 \times 10^{10} + gRm$

$= -4.4 \times 10^{10} + 6.4 \times 10^{10}$ ---------- 01

$= (+) 2.0 \times 10^{10}$ J

(For the correct substitution)

(iv). the energy calculated in part (ii) shows the total energy of the satellite, while the energy calculated in (iii) shows a part of the total energy. ---------- 01

(v). For a geo-stationary satellite.

Time T_1 = 24 hours

= 10 T

r_1 (radius) can be found.

$r_1 = r \times 10^{2/3}$

$= 9.2 \times 10^6 \times 4.64$

$= 42.4 \times 10^6$ m

Height from the earth $= r_1 - R$

$= (42.4 - 6.4) \times 10^6$

$= 36 \times 10^6$ m = 36000 km 01

(or for the correct substitution 01 mark)

(vi). Radius is decreased, velocity increases.

(Therefore,) $V = \sqrt{Gm/r}$ ------ 01

(For any one, 01 mark)

TOTAL

06. (i). The maximum electro-motive force is created when it is parallel to loop B. -- 01

The angular velocity of E F or GH side.

$= \omega . b/_2$

Therefore, the electro-motive force created through EF

$(V_{EF}) = Ba\ b/_2\ \omega$ ------------------ 01

Similarly,

$V_{GH} = Ba\ b/_2\ \omega$

Therefore, electro-motive force produced by the coil

$E = ab B \omega$

for N turns $E = Nab B\omega$ ---------- 01

Another method.

$E = -\frac{d}{dt}(Nab B \cos \theta)$ ------------ 01

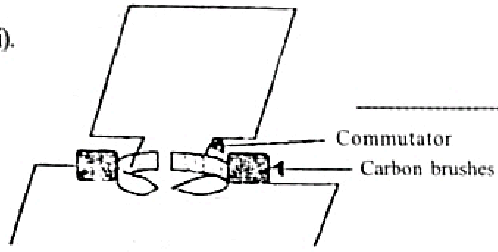
$= -\frac{d}{dt}(Nab B \cos \omega t)$

$= (Nab B\omega \sin \omega t)$ ----------- 01

The maximum electro-motive force created.

$E = Nab B \omega$ ---------------------- 01

(ii).

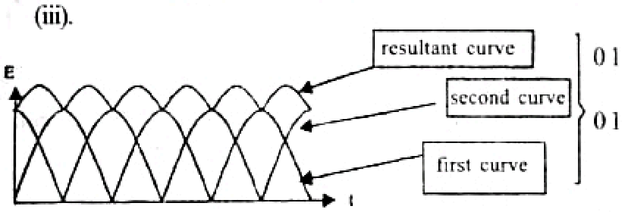


---------------------- 01

[Using slip rings instead of carbon brushes] -------01

(For the diagram with the names -------- 02 marks)

(iii).



01

01

(For naming atleast 2 curves ----- 01 mark)

(For the approximate electro-motive force ---- 01 mark)

(For the production of an increased electro-motive force 01 mark)

(iv). by a coil which is rotated inside the magnetic field. (Production of an electro-motive force only 01 mark is awarded.) -- 01

This e.m.f is opposite to the external voltage.

Back electro-motive force $= V - IR$ ----------- 01

$= 200 - 6 \times 10$

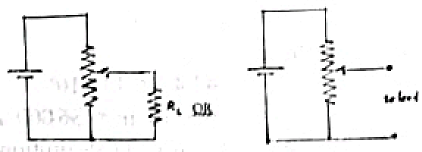
$= 140\ V$ ----------- 01

At the amarture is at rest, initial ----- is no inverse electro-motive force.

$I = V/R = 200/10 = 20A$ — 01

TOTAL 15

07. (a). (i).

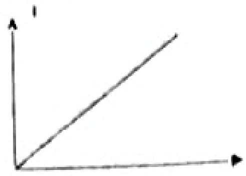


-- 02

For the correct connection of R_L or (For showing the ends where the load should be connected --- 01 mark)

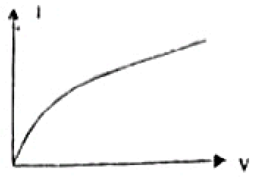
(01 mark each is given for each circuit diagram)

(a). For a uniform resistance.



(For a straight line through the origin ------ 01 mark)
(To obtain these marks the axes should be named)

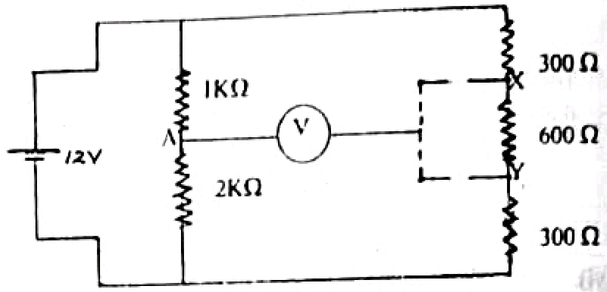
(b). For a tungston filament bulb.



Explanation.
(To obtain marks, the axes should be named)
The Ohm's law for uniform resistance (is true) ---- 01

(or current t_j(I) is propotional to potential difference (V))
For the filament bulb, When V increases as heat is produced resistance increases ------------------------ 01

Therefore, for given V, when comparing with (a), I is lesser.
------------------------ 01



(ii). (a). the current through XY is obtained.

$(300 + 600 + 300) I = 12$ -------------- 01

$I = 12/1200$

$= 0.01\ A$ ----------- 01

(b). The current through 1 kΩ and 2 kΩ,

$= 12/[(1+2) \times 10^3]$

$= 4 \times 10^{-3}\ A$

Therefore, potential at A relative to the negative terminal

$= 2 \times 10^3 \times 4 \times 10^{-3}$

$= 8\ V$ -------------------- 01

Therefore potential at X $= 900 \times 0.01$

$= 9\ V$ -------------------- 01

Therefore, when the tap key is at X, the voltmeter reading relative to point A.

$= 9 - 8$

$= 1\ V$ -------------------- 01

Potential at Y $= 300 \times 0.01$

$= 3\ V$ -------------------- 01

When the tap key is at Y, the voltmeter reading relative to point A. $= 3 - 8$

$= -5V$ -------------------- 01

(c). No. -- 01

the given voltmeter can only read positive values
(or yes. By changing the ends of the voltmeter) ---- 01
As the potential differences have opposite signs
[Another method to solve part b.

Potential drop through 1 k Ω $= 10^3 \times 4 \times 10^{-3}$

$= 4\ V$ ------ 01

The voltage drop through 300 Ω. Above point X,

$= 300 \times 0.01$

$= 3\ V$ ———————— 01

The reading relative to A. When the tap key is at X.

$= 4 - 3$

$= 1\ V$ ———————— 01

The voltage drop through (300 + 600) Ω above Y

$= 900 \times 0.01$

$= 9\ V$ ———————— 01

Therefore, the reading relative to A, when the tap key is at Y

$= 4 - 9$

$= -5\ V$ ———————— 01

TOTAL 15

(b).(i). (a). When compared with the emitter as the base is of a higher potential the B-E junction is forward biased.

———— 01

The potential at the collector = 3 V (given)
Therefore, collector is more positive than the base

———— 01

Collector is of n-type, while the base is of P-type.

———— 01

Therefore, Base-collector junction is reverse -biased

———— 01

In the activated region B-E junction is forward biased, B-C junction is reverse biased.

(b). base current it I_B

$I_B \times 100 \times 10^{-3} + 0.7 = 6$ ———— 01

$I_B = 5.3 / 10^5$

$= 53\ \mu A$ ———— 01

or $5.3 \times 10^{-5}\ A$

(c). Collector current $= \beta I_B$ ———— 01

$= 50 \times 5.3 \times 10^{-5}$

$= 2.65 \times 10^{-3}\ A$ ———— 01

$R_C = (6 - 3)/I_C = 3 / I_C$ ———— 01

$= (3/2.65) \times 10^3\ \Omega$ ———— 01

$= 1.13\ k\Omega$

(d). Capacitor - C :
The capacitor keeps the base biased.

———— 01

or B - E voltage is kept at 0.7 V.
or The current given out from the base is covered.
or Only allows alternative current signals to be taken in.

(ii). Decimal numbers 2 = Binary numbers 10
Decimal numbers 3 = Binary numbers 11
Truth table for the circuit

A	B	F
0	0	0
0	1	0
1	0	1
1	1	1

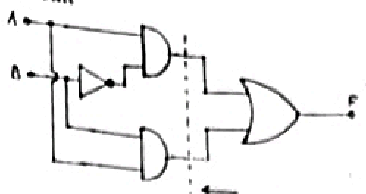
(If all are correct ------ 01 mark)

Boolean expression for the circuit

$p = \overline{A}\overline{B} + AB$

(If all are correct ------ 01 mark)

Circuit

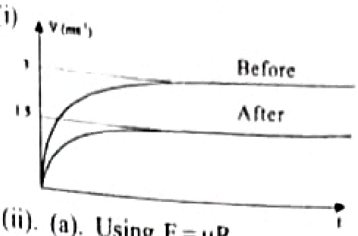


———— 02

(To obtain ----- 01 mark, it should be correct)

TOTAL 15

08. (i)



Before ———— 01

After ———— 01

(ii). (a). Using $F = \mu R$ ———— 01

Frictional force on the block.

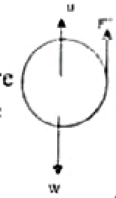
$F = 0.4 \times 0.1 \times 10$ ———— 01

$= 0.4\ N$

Tension of the string $T = F$ ———— 01

Therefore, $T = 0.4\ N$ ———— 01

(b). W - Weight of the sphere
U - Upthrust force on the sphere
F - Vertical force on the sphere



When it reaches the terminal velocity

$U + F' = W$ ———— 01

Using $F' = 6\pi\eta ar$ ———— 01

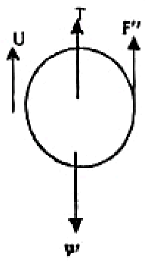
Therefore,

$U + 6\pi\eta \times 2 \times 10^{-2} \times 3 = W$ ------ (A) ———— 01

During the terminal velocity when the sphere is attached to the string.

$T + U + F' = W$ ———— 01

$T + U + 6\pi\eta \times 2 \times 10^{-2} \times 1.5 = W$ ---- (B) -- 01

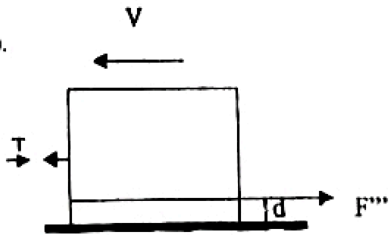


(A), (B) $\rightarrow T = 6\pi\eta \times 2 \times 10^{-2} [3 - 1.5]$

Therefore, $0.4 = 6\pi\eta \times 2 \times 10^{-2} \times 1.5$

$\eta = 0.7\ N\,sm^{-2}$ ———— 01

(d).



Viscous force on the block F"

$F'' = \eta\ ^{AV}/_{d}$ ———— 01

$= 0.7 \times 2.5 \times 10^{-4} \times \frac{V}{1 \times 10^{-3}} = T$ ---- 01

(b) By using the expression for T in (b)

$T = 6\pi \times 0.7 \times 2 \times 10^{-2} \times [3 - v]$

$6\pi \times 0.7 \times 2 \times 10^{-2} (3 - v) = 0.7 \times 2.5 \times 10^{-4} \times \frac{V}{1 \times 10^{-3}}$

Therefore, $V = 1.8\ ms^{-1}$ ———— 01

TOTAL 15