1993 A/L MCQ's Answers

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

Answers 1993 Physics (A and B parts)

Part - A

01. (a). Travelling microscope ---------- (01)

(b). (i). 1. α :– length of AB - meter ruler ---------- (01)

2. β :– diameter - micro-meter screw.

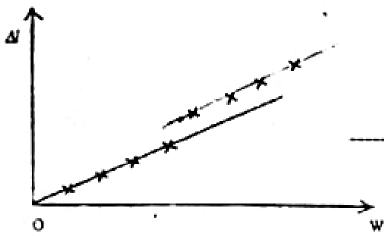
(Do not give markes if its mentioned as radius) -- (01)

(ii). $Y = \dfrac{4 W \alpha}{\pi \beta^2 \Delta l}$ ---------- (01)

[Do not give marks if the outside terms are used.]

(c).(i). The wire is slipped at A or stretching a loop in the coil. ---------- (01)

(ii).



---------- (01)

(No marks for other graphs)
(Any one of the above two)

(d). (i). Density ---------- (01)

(No marks for linera density)

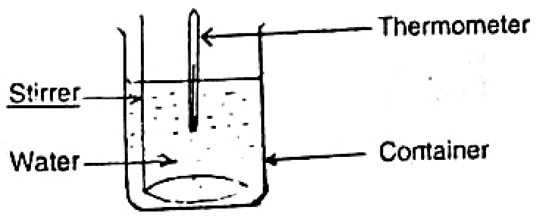
(ii). Mass and the length of the wire ---------- (01)

(e). $V = \sqrt{T/m} = \sqrt{\dfrac{T}{A\rho}} = \sqrt{\dfrac{Y\varepsilon}{\rho}}$ ---------- (02)

TOTAL 10

02. (a). Thermometer. ---------- (01)

(b).



For the complete diagram with marks ---------- (01)

(c). To clearly observe the apperance and the disappear once of dew. ---------- (01)

(d). temperature when the dew is forming temperature when the dew is diappeoring. ---------- (02)

(e). To clearly observe the appearance and the disappearance of dew or to measure the accurate dew point. --- (01)

(f). Due to the formation of large water droplets at the outside of the container and they again do not disappear when the temperature is increased. ---------- (01)
(Cannot take the 2nd reading)

(g). (i). 3×10^3 (Pa) ---------- (01)

(ii). relative humidity $= \dfrac{3 \times 10^3}{4.25 \times 10^3}$ ---------- (01)

$= 0.706$ ---------- (01)

- at 30 °C value between 4.2×10^3 to 4.3×10^3 for s.v.p. is accepted.
- Value between 0.69 to 0.72 for relative humidity is accepted.
- 70.6 % also accepted.)

TOTAL 10

03. (a). Illuminating cross wire or illuminating scitor illuminating scale. ---------- (01)

(No marks for light box without mentioning small bulb, candle or cross wire)

(b). At L since the object is situated between F and 2F, the image is enlarged.

or

Due to the position of it between F and 2F. ---------- (01)

(c). at M ---------- (01)

(d). Applying lense formula for L,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$-\frac{1}{600} - \frac{1}{200} = \frac{1}{f_c}$$ ---------- (01)

$$\frac{1}{f_c} = -\frac{(1+3)}{600} = -\frac{4}{600}$$

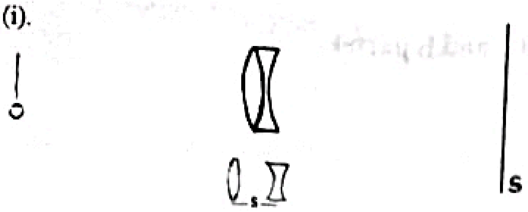
$f_c = -150$ mm (150 mm) ---------- (01)

$f = (a^2 - d^2)/4a$

Only marks for the final answer is given for the above equation.

(e). $4 f_c$ (600 mm) ---------- (01)

✱ (f). (i).

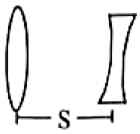


$$\frac{1}{F} = \frac{1}{f_c} + \frac{1}{F_d} - \frac{S}{F_c F_d}$$ ---------------- (01)

(ii). New distance O and S. New displacement of the lens combination. ---------------- (01)

(iii). $\frac{1}{F_c} + \frac{1}{f_d} = \frac{1}{F}$ ---------------- (01)

In (f) (i) above the two lenses can be shown with a gap (s) between them. But, in order to obtain the marks relevant for it, the gap (s) between lenses should be added to the measurements in (f) (ii).



Then, in order to obtain marks for (f) (iii), the relevant formula should be,

$$\frac{1}{F} = \frac{1}{f_c} + \frac{1}{F_d} - \frac{S}{F_c F_d}$$

(g). The combination is diverging.

or

A real image cannot be obtained. ---------------- (01)

TOTAL 10

04. (a). (i). For marking the direction of current from P to Q. ---------------- (01)

(ii). $\frac{BLV}{2r}$ ---------------- (02)

(b). $\frac{BLV}{2r} \times L \times B = \frac{B^2L^2V}{2r}$ ---------------- (01)

(c). (i). Zero ---------------- (01)

(ii). Since the emf induced across PQ is opposite to the emf induced across RS, the resultant emf = 0 -------- (01)

or

Currents are opposite to each other.

or

No change of flux through the loop.

(iii). Zero ---------------- (01)

(d). (i). BLV/r ---------------- (01)

(ii). $2B^2L^2V^2/r$ ---------------- (01)

(iii). Joule heating ---------------- (01)

TOTAL 10

Part - B

01. (a). In an elastic collision, kinetic energy is conserved. But it is not so in an inelastic collision. ---------------- (01)

(No marks for indicating the elastic and inelastic collisions using the coefficient of stress 'e'). Stopping of a bullet after colliding with a wooden block. A clay ball thrown towards a wall getting stuck on it. ---------------- (01)

(Any example where the objects stick together or move together after the collision.)

(i). Let us consider that the velocities of trolleys A and B after the collision are V_1 and V_2 respectively. By applying the conservation of linear momentum.

$$1V = 1V_1 + 1V_2$$ ---------------- (01)

Using the conservation of kinetic energy.

$$\frac{1}{2} \times 1 \times V^2 = \frac{1}{2} \times 1 \times V_1^2 + \frac{1}{2} \times 1 \times V_2^2$$ ---- (01)

$$V^2 = V_1^2 + V_2^2$$

(Marks are awarded also for the expression below.)

$$V_1 - V_2 = -1(V - 0)$$

Then the remaining parts of the question can also be solved using this method. Marks are awarded for the relevant final answers.

Substituting for V_1

$$V^2 = (V - V_2)^2 + V_2^2$$

$$V^2 = V^2 - 2VV_2 + V_2^2 + V_2^2$$

$$V_2 = V$$ ---------------- (01)

and $$V_1 = 0$$ ---------------- (01)

(ii). Let us consider the trolleys B and C are having velocities V_3 and V_4 after the collision.

Then, applying the conservation of linear momentum,

$$1V = 1V_3 + {}^1/_2 V_4$$

by substituting for V_3,

$$\frac{1}{2} \times 1 \times V^2 = \frac{1}{2} \times 1 \times V_3^2 + \frac{1}{2} \times \frac{1}{2} \times V_4^2$$

$$V^2 = V_3^2 + {}^1/_2 V_4^2$$

By substituting for V_3

$$V^2 = (V - {}^1/_2 V_4)^2 + {}^1/_2 V_4^2$$

$$V^2 = V^2 - VV_4 + {}^1/_4 V_4^2 + {}^1/_2 V_4^2$$

Therefore, $V_4 = {}^4/_3 V$

and $V_3 = {}^1/_3 V$

Final velocity of A = 0

Final velocity of B = ${}^1/_3 V$ ---------------- (01)

Final velocity of C = ${}^4/_3 V$ ---------------- (01)

Only one collision occurs after that. ---------------- (01)

(iii). Assume that the velocities of the trolleys B and C after the collision are V_5 and V_6 respectively.

By the law of conservation of linear momentum,

$$1V = 1V_5 + 2V_6$$

By the law of conservation of kinetic energy,

$$\frac{1}{2} \times 1 \times V^2 = \frac{1}{2} \times 1 \times V_5^2 + \frac{1}{2} \times 2 \times V_6^2$$

$$V^2 = V_5^2 + 2V_6^2$$

By using the substitution for V_5,

$$V^2 = (V - 2V_6)^2 + 2V_6^2$$

$$V^2 = V^2 - 4VV_6 + 4V_6^2 + 2V_6^2$$

Therefore, $V_6 = {}^2/_3 V$

and $V_5 = -{}^1/_3 V$

The trolley B turns backwards ---------------(01)

and it collistes with A and comes to rest.

A starts to travel with ${}^1/_3$ V speed.

The final velocity of A = $-{}^1/_3 V$ ---------------(01)

The final velocity of B = 0 ---------------(01)

The final velocity of C = ${}^2/_3 V$ ---------------(01)

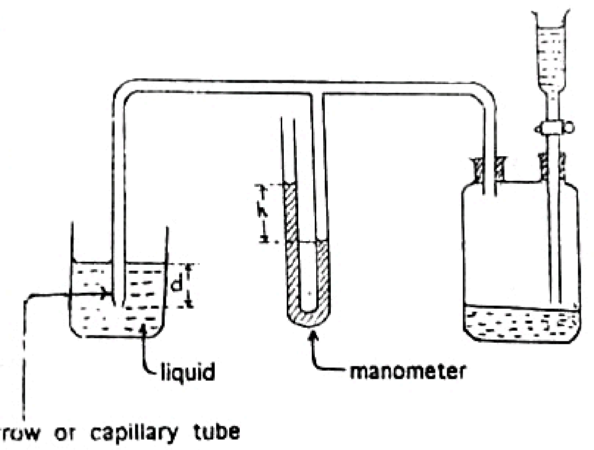
(iv). Yes. (The laws of conservation are still applicable)

The frictional forces of the collision is very small than that of the impulsive forces. Therefore even when the frictional forces act on the objects we can apply the law of conservation of momentum. ---------------(01)

During the collisions the frictional forces in the gutters do not effect the conservation of kinetic energy -------(01)

TOTAL 15

(b).



For the figure (The tube inside the liquid and the manometer) ---------------(01)

For a certain method to change the pressure -------(01)

Naming - Capillary tube, Manometer ---------------(01)

Essential steps

(1).Increase the pressure in the tube until bubbles slowly move out from the tip ---------------(01)

Or

Increase the pressure in the tube until bubbles move out from the tip.

(2).Take down the maximum reading of the manometer --(01)

(3). Measure the depth of the tube inside the liquid --(01)

(4). Measure the radius of the capillary tube

Equations.

$2T/r = g(\rho h - \sigma d)$ ---------------(01)

T - Surface tension of liquid.

r - Radius of the slit.

g - Gravitational acceleration.

ρ - The density of the liquid in the manometer- (01)

h - The difference in the height levels in the manometer

σ - The density of liquid of which we find the surface tension.

d - The distance from the surface of the liquid to the bottom of the tube.

(Correct identification of the 2 densities is sufficient. If the equation is wrong, no marks are given to the identification of the symbols.)

Advantages

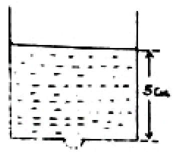
(1). To find the variation of the surface tension with temperature.

(2).To find the variation of the surface tension with the concentration of solute dissolved in the solution.

(3).To find the surface tension of liquid metals.

(4).We can also use this method to find the surface tension of a liquid with an unknown contact angle.

(01 mark each for every 2 points) ---------------(02)



When the height of the water in the bucket increases, only a bubble starts to appear in the hole. When the radius of the bubble ≤ radius of the hole, liquid goes out.

The maximum additional pressure in the bubble,

$= 2T/r_0$ (r_0 - radius of the hole)

$= \frac{2 \times 0.03}{0.1 \times 10^{-3}} = 600\ Nm^{-3}$ ---------------(01)

the additional pressure created by the liquid.

$= h_1 \rho_1 g = 5 \times 10^{-2} \times 800 \times 10$

$= 400\ Nm^{-2}$ ---------------(01)

Therefore, $h_1 \rho_1 g < 2T/r_0$ ---------------(01)

Therefore, the oil does not go out from the hole.

Another method

Assume that the radius of bubble is r,

Therefore, $h_1 \rho_1 g = 2T/r$

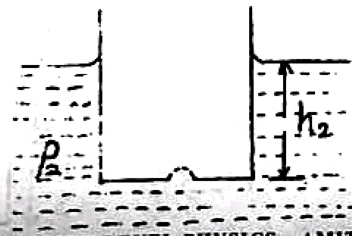
$r = \frac{2 \times 0.03}{5 \times 10^{-2} \times 800 \times 10}$ 01

$= 0.15$ mm 01

$r > r_0$ (0.1 mm) 01

Therefore, the liquid doesn't leak.

If water starts flows into the bucket at a height h_2.



$h_2 \rho_2 g = 2T_2 / r_0$

$h_2 = \dfrac{2 \times 0.075}{10^3 \times 10 \times 0.1 \times 10^{-3}}$ ---------- (01)

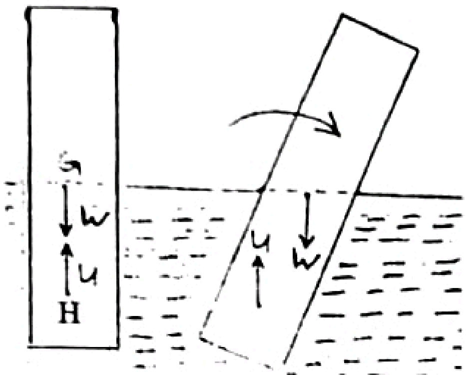
$= 0.15$ m ---------- (01)

TOTAL 15

02. Archimedes principle.

When a object is totally or partically immersed in a fluid incompressible, the up thrust acting on that object is equal to the weight of fluid displaced by the object.

Vertical position ---------- (02)



G - Center of gravity

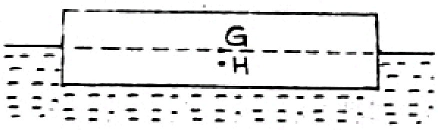
H - The point at which the upthrust acts.

G is situated above H.

GH distance is large ---------- (01)

∴ it's unstable equilibrium ---------- (01)

Horizontal position.

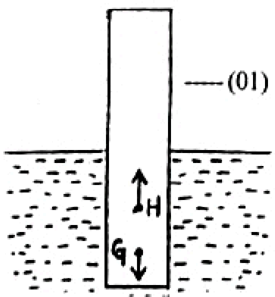


H is situated near G ---------- (01)

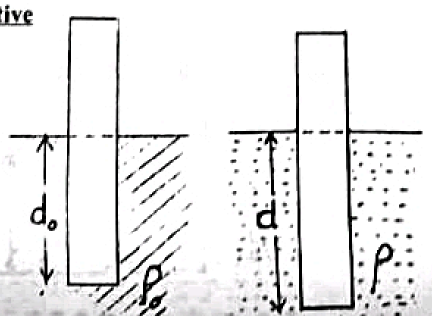
Therefore, it's in stable equilibrium ---------- (01)

In order to float it vertically, add a mass to the bottom. ---- (01)

(Therefore, G is situated below H H, stable equilibrium)



Finding the relative density



Measure the depth d_0, by retting the cylinder float on water & then float it on the liquid and one caure d ---- (01)

Weight of cylinder W.

Surface area - A. density of water ρ_0

In water, $W = A d_0 \rho_0 g$

In liquid, $W = A d \rho g$ ---------- (01)

Therefore $d_0 \rho_0 = d \rho$

Therefore relative density.

$\dfrac{\rho}{\rho_0} = \dfrac{d_0}{d}$ ---------- (01)

Up thrust = $(1.2 - 0.8) \times 10 = 4$ N ------ (01)

Readings of X and Y.

$= (2 + 0.4)/2$

$= 1.2$ kg ---------- (01)

Volume of the Brass block (V_b)

$V_b \times 10^3 \times g = 0.4 \times g$

Therefore $V_b = 4 \times 10^{-4}$ m^3 ---------- (01)

Mass of the Brass block - M_b

Mass of Copper in the block - M_C

Mass of Zinc in the block - M_x

Volume of Copper in the block - V_C

Volume of Zinc in the block - V_Z

Then, $M_C + M_Z = M_b$ ---------- (01)

$M_C + M_Z = 1.2$

$V_C + V_Z = V_b$ ---------- (01)

Therefore, $\dfrac{4 \times 10^{-4}}{\rho_b} = \dfrac{M_C}{\rho_C} + \dfrac{M_Z}{\rho_z}$

$4 \times 10^{-4} = \dfrac{1.2 - M_z}{9 \times 10^3} + \dfrac{M_z}{7 \times 10^3}$

[or

Density of Brass

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

$= 3 \times 10^3$ kg m^{-3} 01]

[As this value, is lesser than the values given to copper and Brass, we cannot get a considerable value for the amount of Zinc in the block] 01

TOTAL 15

03. (i). Let P^1 be the pressure at 127°C

By using, $\dfrac{P_1}{T_1} = \dfrac{P_2}{T_2}$ ---------- (01)

$\dfrac{1.0 \times 10^5}{(273+27)} = \dfrac{P^1}{(273+127)}$ ---------- (02)

((01) mark for right hand side (R.H.S), 01 mark for (L.H.S))

Therefore $P^1 = \dfrac{1.0 \times 10^5 \times 400}{300} = 1.33 \times 10^5$ Pa — (01)

Total pressure on the lid of the vessel,

$= (1.33 - 1.0) \times 10^5$

$= 0.33 \times 10^5$ Pa ———— (01)

Therefore, minimum value of W,

$= 0.33 \times 10^5 \times 1 \times 10^{-4}$

$= 3.3$ N (0.33 kg) ———— (01)

———— (01)

No marks are given, if the units are not mentioned.

(ii). Partical pressure the gas

$= 1.0 \times 10^5 - 3.7 \times 10^3$

$= 96.3 \times 10^3$ Pa ———— (01)

Assume that the partical pressure on the gas at 127 °C is P".

By using, $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{96.3 \times 10^3}{300} = \frac{P''}{400}$

$P'' = \frac{4}{3} \times 96.3 \times 10^3$

$= 1.28 \times 10^5$ Pa

(For the correct substitution) ———— (01)

Total pressure in the vessel.

$= (1.28 + 2.5) \times 10^5$

$= 3.78 \times 10^5$ Pa ———— (01)

Therefore minimum value for W,

$= (3.78 - 1.0) \times 10^5 \times 1 \times 10^{-4}$

$= 27.8$ N (2.78 kg) ———— (01)

(iii). Water is under a certain pressure ———— (01)
& the pressure increases with the boiling point -- (01)

(iv). the value of the pressure is equal to that in (i) —(01)
This value changes in (ii). Earlier at 27°C, there's no water for evaporation. Therefore the air is unsaturated with water vapur. ———— (01)

TOTAL 15

04. (a). In the experiment of finding the latent heat of fusion of ice using the method of mixtures, we need to choose the initial and final temperature of the mixture a few degrees higher and lower than the room temperature. ——(01)

(i). Consider the mass of water and the liquid in the calorimeter as m_1, m_2 respectively and the specific heat capacities as S_1, S_1 respectively. The as the experiment is done between 35 °C and 25 °C temperately the amount of heat released to the environment is negligible.

The amount of heat absorbed by the piece of ice,

$= (30 \times 10^{-3}) \times 3 \times 10^5 + 30 \times 10^{-3} \times 4200 \times 25$ --(01)

$= 30 \times 405 \quad = 12\,150$ J

The amount of heat given out by water and the calorimeter. $= (m_1 s_1 + m_2 s_2) \times 10$ —(01)

Therefore

$(m_1 s_1 + m_2 s_2)\,10 = 12\,150$ ———— (01)

Consider that the amount of heat released to the surrounding is H, after doing the experiment at initial temperature 42°C.

Therefore, the amount of heat absorbed by the piece of ice. $= (30 \times 10^{-3}) \times 3 \times 10^5 + 30 \times 10^{-3} \times 4200 \times 31$ —(01)

$= 30 \times 430.2$

$= 12\,906$ J

The amount of heat released by the calorimeter and water

$= (m_1 s_1 + m_2 s_2) \times 11$ ———— (01)

The amount of heat absorbed by ice + The amount of heat absorbed by the surrounding
= The amount of heat released by water and the calorimeter

Therefore,

$12\,906 + H = (m_1 s_1 + m_2 s_2) \times 11\,0$ or ——(02)

$= \frac{12\,150}{10} \times 11$

$H = 13\,365 - 12\,906$

$= 459$ J ———— (02)

(If the unit is incorrect 01 mark is reduced)

(ii). When the rate of dissolution is increased by 2 times, the amount of heat release to the surrounding.

$= 459/2$

$= 229.5$ J ———— (01)

As teh change in teh temperature in both of the 2 occasions (i) and (ii) are the same, the rate of heat less to the surrounding is alos the same for both. ———— (01)

But in (ii) the rate of dissolution of ice is 2 times as that in (i). the time taken in (ii) to arive to the final temperatur is as half of the time taken in (i).

Therefore, the heat loss in (ii) = H / 2 ———— (01)

or

$\frac{459}{t} \propto 0$ 01

$\frac{H'}{(t/2)} \propto 0$ 01

Therefore, H' = 229.5 J 01

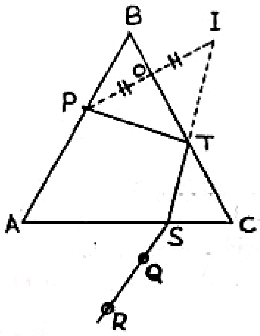
TOTAL 15

05. **(a).** Requirements.

The incident ray should be in the dense medium -- (01)

The angle of incidence should be greater than the critical angle ———— (01)

Experiment



(i). Keep the prism on the white paper and draw the outline of the prism.

(ii). Fix the pin P so that it is contact with the surface AB -- (01)

(iii) By looking at the image of P formed by the BC surface through the AC surface, move the eye form C to A (Clock-wise direction until the image of P is slighly not seen)- (01) (Or, move the eye until you slightly see the image of P)

(iv). Later, fix the 2 pins Q and R so that they are clearly in line with the image of P. ---------- (01)

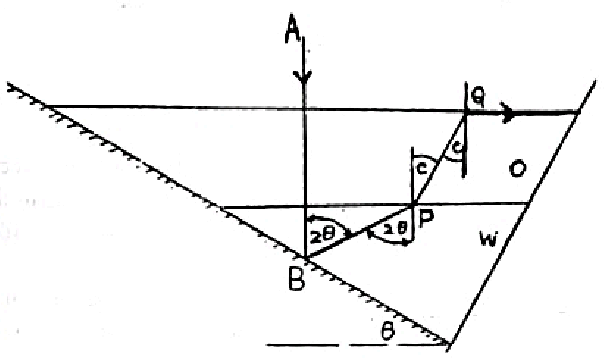
(v). Remove the prism.
Draw a perpendicular to BC, and mark the point I so that PO=07 ---------- (01)

(vi). Draw the line RQ, so that it cuts the surface AC at S. Join SI, so that it cuts line BC at T. ---------- (01)

(vii). Measure the angle PTS, consider it as 2C.

(viii). Therefore, $n = 1/\text{Sin C}$ ---------- (01)

[Marks are given to (ii), (v) and (vi) only if they are shown in the diagram clearly.]



For identifying that $A\hat{B}P$, 2θ ---------- (01)

For identifying $\hat{C}$ ---------- (01)

$$\frac{1}{\text{Sin C}} = \frac{7}{5}$$ ---------- (01)

$$o^n w = \frac{\text{Sin C}}{(\text{Sin } 2\theta)}$$ ---------- (01)

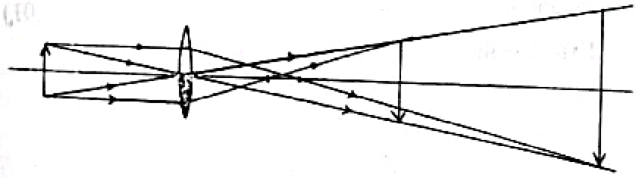
$$\frac{5}{7} \times \frac{4}{3} = \frac{5}{7} \times \frac{1}{\text{Sin } 2\theta}$$ ---------- (01)

$\text{Sin } 2\theta = 3/4 : 2\theta = 48\ 36'$ ---------- (01)

$\theta = 24^0 (18')$ ---------- (01)

TOTAL 15

*(b). (i). 2 images can be formed on S - (O) or ---------- (02)



For the correct ray diagrams
(02 marks for each) ---------- (04)
(If a total image is not shown reduce 01 mark each)

(ii). Consider F' as the focal lenght of the upper half of the lense.

$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$ ---------- (01)

$$\frac{1}{f'} = (1.5-1)\left(\frac{-1}{28} - \frac{1}{28}\right)$$ ---------- (01)

$$\frac{1}{f'} = \frac{-1}{28}$$

Consider that V^1 is the distance to the image from the lense, for the image formed by the upper half of the lense.

Now, by using . $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ ---------- (01)

$$\frac{1}{v'} - \frac{1}{60} = \frac{-1}{28}$$ ---------- (01)

$v' = -52.5$ cm (52.5 cm) ---------- (01)

(The (-) sign is not required.)

The height of the image $= \frac{52.5}{60} \times 4$

$= 3.5$ cm ---------- (01)

Consider that f^{11} is the focal length of the bottom half of the lense.

Then, $\frac{1}{f''} = (1.7-1)\left(\frac{-2}{28}\right)$

$$\frac{1}{f''} = \frac{-1}{20}$$

Consider that V^{11} is the distance from the lense to the image, fro the image formed by the bottom half of the lense.

Then, $\frac{1}{V''} - \left(\frac{1}{60}\right) = \frac{-1}{20}$

$V'' = -30$ cm (30 cm) ---------- (01)

Height of the image $= \frac{30}{60} \times 4$

$= 2$ cm ---------- (01)

(iii). The bright intensity of the image formed by a lense made up of only one glass material is higher than that of the images formed above. ---------- (01)

TOTAL 15

06. $\gamma = \frac{c_p}{c_v}$ or the ratio of the main specific heat capacities of air ---------- (01)

P - Pressure of the gas

ρ - Density of the gas

$V = LT^{-1}$

$P = ML^{-1}T^{-2}$

$\rho = ML^{-3}$ ---------- (01)

$\sqrt{\gamma P/\rho} = (MLT^{-2} L^{-2} M^{-1} L^{3})^{1/2}$

$= LT^{-1}$ (Dimensions of velocity)(01)

For an ideal gas,

$PV = nRT$ ——— (01)

But $\rho = nM/V$ ——— (01)

Therefore, $\dfrac{P(nM)}{\rho} = nRT$

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

$V = \sqrt{\dfrac{\gamma RT}{M}}$ ——— (01)

(i). Speed of sound in air.

$= \dfrac{209}{0.6}$ ——— (01)

$= 348.3\ ms^{-1}$ ——— (01)

(ii). $V \alpha \sqrt{T}$ ——— (01)

$\dfrac{348.3}{\sqrt{T}} = \dfrac{330}{\sqrt{273}}$

$T = 304.1\ K$

(Any value between 303 K to 305 K) -- (01)

Temperature of air

$= 31.1\ ^{\circ}C$

(Any value between 30°C to 32 °C) ----- (01)

(iii). $330 = \sqrt{\dfrac{1.403 \times 8.3 \times 273}{M}}$ ——— (01)

[or

$348.3 = \sqrt{\dfrac{1.403 \times 8.3 \times 304}{M}}$]

$M = 0.029\ kg$ ——— (01)

(iv). No

The density of dry air is higher than the density of wet air. (02 Marks or 0) ——— (02)

or

Due to the presence of water vapour density is less.

(If it says that the density changes only 01 mark is awarded)

07. (a). (i).

Current used for A	(6 W, 6 V)	=	1 A
Current used for B	(2W, 05 A)	=	0.5 A
Current used for C	(27 W, 9 V)	=	3 A

(Calculating the current for A and C) ——— (01)

Therefore, the total current that should be provided.

$= 3 + 0.5 + 1$

$= 4.5\ A$ ——— (01)

(ii). the voltage at the ends of a battery, when a single battery is used. $= 10 - 4.5 \times 0.5$ ——— (01)

$= 7.75\ V$

This voltage is insufficient for the activity of C. —(01)

(iii). Assume thatn 'n' is the no. of batteries required to produce a voltage of 9V. ——— (01)

$10 - \dfrac{0.5}{n} \times 4.5 = 9$ ——— (01)

(Only 01 mark is awarded for 0.5/n)

Therefore, the minimum amount of batteries = 3 —(01)

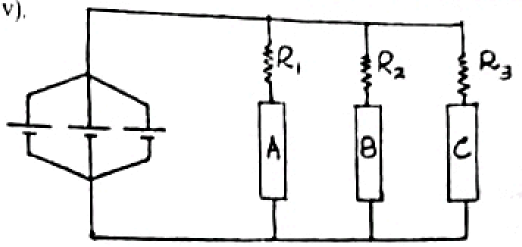
[**or**

The voltage drop through every battery should be through the internal resistance and it is 1V each ——— 01

The maximum current that can be obtained from 1 battery is 2 A ——— 01

Therefore to obtain 4.5A current, you need 3 batteries --- 01]

(iv).



For every branch in the circuit with A,B,C 01 mark is awarded (Number of batteries are not considered) — (03)

(v). Total current $I = 4.5\ A$

The voltage difference,

$V = E - Ir$

$= 10 - 4.5 \times 0.5/3$

$= 10 - 0.75 = 9.25\ V$ ——— (01)

By applying Ohm's law to R_1, R_2, R_3 in the circuit

$I \times R_1 = 9.25 - 6$

$R_1 = 3.25\ \Omega$ ——— (01)

Voltage through B,

$= 2/0.5 = 4\ V$ ——— (01)

$0.5 \times R_2 = 9.25 - 4$

$R_2 = 5.25 \times 2$

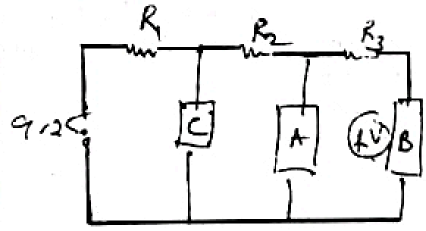
$= 10.5\ \Omega$ ——— (01)

$3R_3 = 9.25 - 9$

$R_3 = 0.25/3 = 0.083\ \Omega$ ——— (01)

TOTAL 15

[



$R_3 = 2/0.5 = 4\ \Omega$ 01

$R_2 = 3/1.5 = 2\ \Omega$ 01

$R_1 = 0.25/4.5\ \Omega$ 01

For finding 9.25 V 01

03 marks is awarded to the diagrams.]

(b). A (i). The coil is converted to an electric magnet. ---- (01)
or
It providdes or magnetic field.
The soft metal becomes magnetic.
Then it is attracted towards the coil ---------------- (01)

(ii). No. Even when the direction of the current is changed, the soft iron gets attracted towards the coil -------- (02)

(iii). Steel obtains a static magnetism. ------------ (02)

B. (i). (5 - 0.5) By adding a shunt resistor parallely so that it carries A curret. -------------------- (01)
If R_P is the value of the resistor required,

$R_P \times 4.5 = 0.5 \times 0.5$ ---------------- (01)

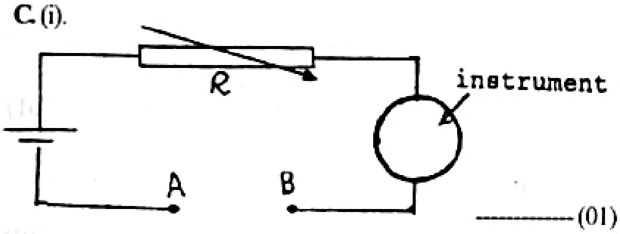
$R_P = 0.056\ \Omega$ ---------------- (01)

(ii). by adding a resistor (in series) that can reduce the voltage by (5 - 0.25) V. amount
(or as shown in a diagram) ---------------- (01)
If R_S is the required resistor,

$\frac{4.75}{R_S} = \frac{0.25}{0.5}$ ---------------- (01)

$R_S = 9.5\ \Omega$ ---------------- (01)

C. (i).



------------ (01)

(ii). Explanation.
Short the connection of the space AB ------------ (01)
Change R until a full scale deflection is given — (01)
and callibrate the instrument.

TOTAL 15

08. **Similarities**
both,
- It obeys the inverse-square law of the forces.
- Are forces with a wide range/force α $^1/r^2$ / forces act along the line.
- Are conserved forces.
(01 mark each maximum 02) -------------------- (02)

Differences
Gravitational forces depend on the product of the magnitudes of masses but electro-static forces depend on the product of the magnitudes of charges. --------------- (01)
Gravitational forces are always attractions but electrostatic forces can be attractions or repulstions. ----------- (01)

The gravitational force between the 2 protons.

$= G m m / r^2$

$= \frac{6.67 \times 10^{-11} \times (1.67 \times 10^{-27})^2}{(10^{-2})^2}$ ---------- (01)

$= 1.9 \times 10^{-60}$ N ---------------- (01)

the electrostatic force between the 2 points

$= \frac{1}{4 \pi \varepsilon_0} \frac{qq}{r^2}$

$= \frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{(10^{-2})^2}$ ---------------- (01)

$= 2.3 \times 10^{-24}$ N ---------------- (01)

Therefore, when comparing with the electrostatic force, gravitational forces are neglegible.

(i). The electric field intensity acting on proton P.

$= \frac{e}{4 \pi \varepsilon_0 r^2}$

$= \frac{9 \times 10^9 \times 1.6 \times 10^{-19}}{(10^{-2})^2}$ ---------------- (01)

$= 1.4 \times 10^{-5}$ NC^{-1}

(ii). $I = e f$

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

The magnetic flux density at the center.

$= \mu_0 I / 2r$

$= \frac{4\pi \times 10^{-7} \times 1.6 \times 10^{-19} \times 10^3}{2 \times 10^{-2}}$ ------ (01)

$= 10^{-20}$ T ---------------- (01)

The field acts on teh plane perpendicular to the paper. ---------------- (01)

(iii). A force is not created on P by the magnetic field as proton P is stable (or not moving) ---------------- (01)

(iv). Electric field intensity = 0 ---------------- (01)
(As there is not much of charges in the wire)
magnetic flux density = 10^{-20} T ---------- (01)

TOTAL 15