Paper 1A

MC answer

1	2	3	4	5	6	7	8	9	10
A	B	D	C	A	B	B	B	D	D
A	D	C	A	B	C	D	B	C	A
C	D	C	D	D	B	A	C	B	A
C	A	C							

Paper 1B

1a. Since temperature difference affect the rate of heat loss to the surroundings, for fair test, the temperature difference of the warm water to room temperature should be the same.

1b. The temperature difference decreases when the temperature of warm water decreases, then the rate of heat loss to the surroundings reduced. Decrease in rate of heat loss to the surroundings made the slope less steep.

1ci.

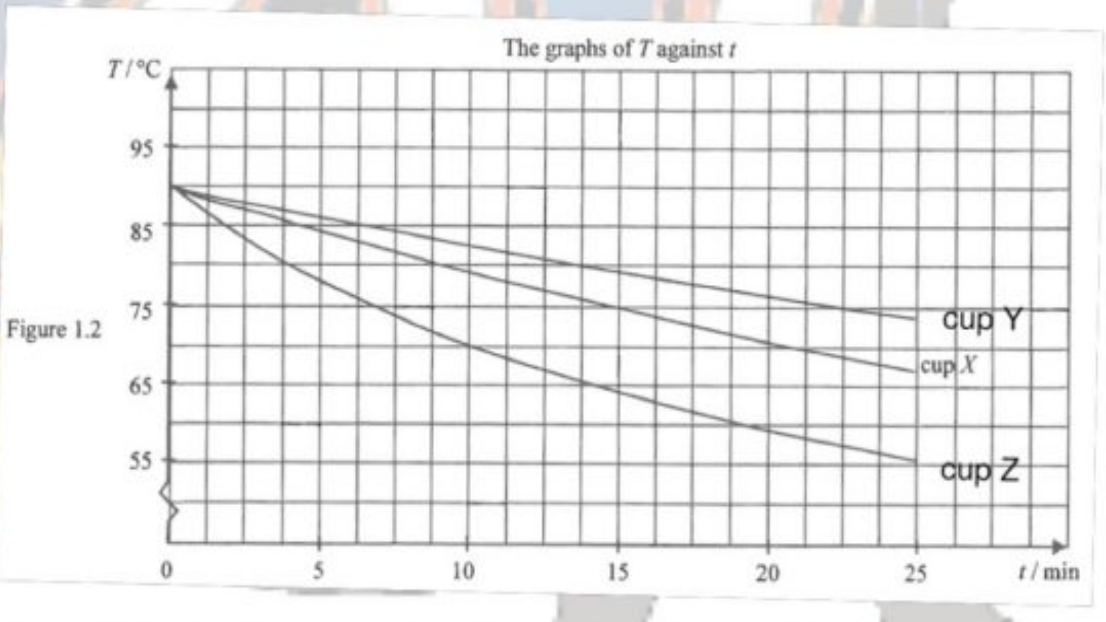


Figure 1.2

1cii. For cup Y, the aluminium wrapping acts as reflector to prevent heat loss from radiation. Moreover, the lid prevents heat loss from convection. Therefore, the rate of heat loss of cup Y is less than that of cup Z, the slope less steep.

1d. Polystyrene.

2ai(I).

$$pV = nRT$$

$$(1.0 \times 10^5)(6.0 \times 10^{-4}) = \frac{N}{N_A}(8.31)(300)$$

$$\therefore \quad N = 1.45 \times 10^{22}$$

2ai(II).

$$E_K = \frac{3RT}{2N_A}$$

$$\therefore \quad E_K = 6.21 \times 10^{-21} \text{ J}$$

2aii(I). Same N. (number of mole of A and B are the same)
Same E_K (temperature of A and B are the same)

2aii(II). Since E_K of A and B are the same,

$$E_K = \frac{1}{2}mc_{rms}^2$$

$$\therefore \quad m_A c_{rms}^2 A = m_B c_{rms}^2 B$$

$$(600)^2 = \frac{1}{5}c_{rms}^2 B$$

$$\therefore \quad c_{rms}B = 1340\ ms^{-1}$$

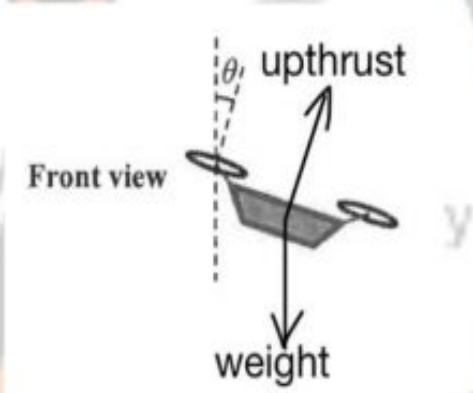
2b. Since they have the same temperature, E_K are the same. According to aii(II), less root-mean-square speed, more mass the gas has. Therefore, the density of gas C is higher than that of air, gas C probably sink at the bottom. However, the movement of particles are random and the particles will collide each other, the particle of gas C may rise due to collision. Therefore, it takes few minutes to diffuse several centimetres.

3a. The propellers push air downwards, according to Newton's 3rd law of motion, outside air exerts an upward force to the propellers with the same magnitude of force, which can balance the weight of the quadcopter. According to the Newton's 1st law of motion, the quadcopter can hover in the air when the net force is zero.

3bi. m_a = density x volume = 1.20 x 0.284 x v x 1 = 0.3408 v kg

3bii.
$$m(v-u) = Ft$$
$$0.3408v^2 = 1.38 \times 9.81$$
$$\therefore \quad v = 6.30\ ms^{-1}$$

3ci.



3cii.
$$F_c = \frac{mv^2}{r} = \frac{1.38 \times 15^2}{50} = 6.21\ \text{N}$$

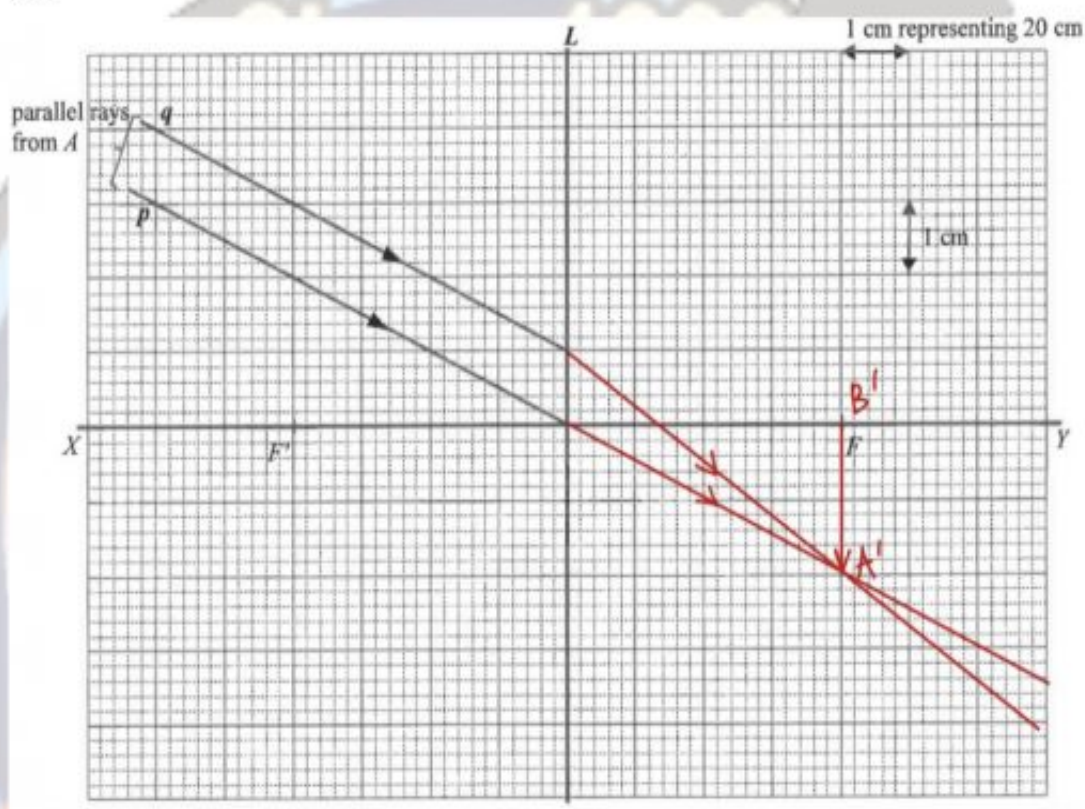
3ciii.
$$F_c = T\sin\theta$$
$$W = mg = T\cos\theta$$
$$\therefore \quad \frac{F_c}{mg} = \tan\theta$$
$$\therefore \quad \theta = \tan^{-1}\left(\frac{6.21}{1.38 \times 9.81}\right) = 24.6°$$

4a. KE = loss in PE = 50 x 9.81 x 1.5 = 736 J

4bi. KE and gravitational PE convert to elastic potential energy.

4bii. $$736 + 50 \times 9.81 \times 0.4 = F \times 0.4$$
$$\therefore \quad F = 2330 \text{ N}$$

5ai.



5aii. Place a screen at F, and a clear image can be seen. This prove that the image is a real image.

5bi.

$$\frac{height\ of\ AB}{distance\ of\ AB\ from\ L} = \frac{height\ of\ A'B'}{image\ distance} = \frac{2\ cm}{4 \times 20\ cm} = 0.025$$

5bii. by 5bi, height of AB = 200 x 0.025 = 5 m

6a. Coherent means both frequency of the source are the same.

6bi. Path difference varies along OY. If the path difference are of $n\lambda$, constructive interference occurred, maximum loudness detected. If the path difference are of $(n+\frac{1}{2})\lambda$, destructive interference occurred, minimum loudness detected. Therefore, sound of alternate max and min loudness is detected along OY.

6bii. Background noise is also detected by the CRO.

6c. path difference = BQ – AQ = 1.5λ

$$\therefore \quad \lambda = 0.273333333 \text{ m}$$

$$v = f\lambda$$

$$\therefore \quad v = 1200 \times 0.273333333 = 328\ ms^{-1}$$

6d. Note that 0.80 m = 2.926839272λ, maximum order of maxima = 2. Since path difference of R = 2λ, so that there is no more maximum can be detected beyond position R.

6e. Increase.

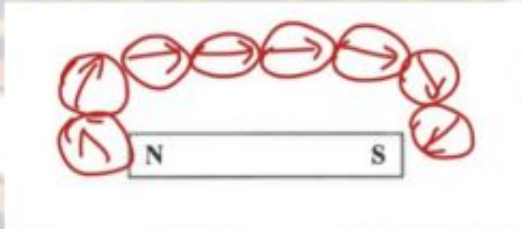
7ai. A: S

B: S

7aii. Bottom

7aiii. The iron filings will be stick onto the bar magnet, and it is hard to collect the iron filings after the experiment.

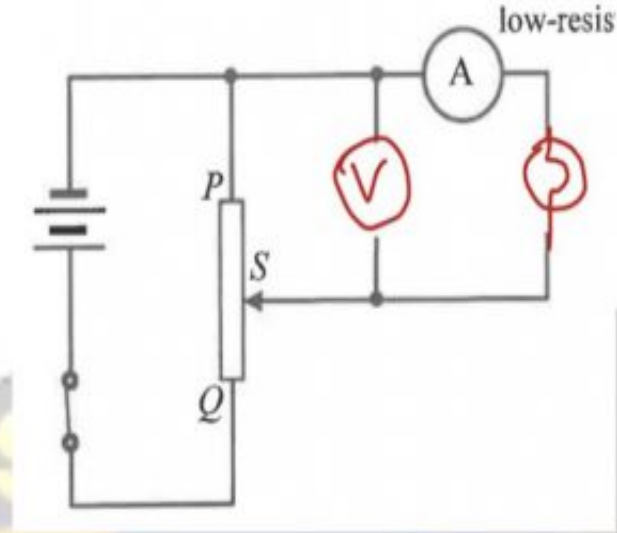
7bi.



1. Place the compass at one end of the bar magnet.
2. Place another compass at the direction of tip of the needle of the previous one.
3. Repeat 1 and 2 until the tip of the compass point to the other end of the compass.
4. Draw the arrows followed the direction of the compass by the pencil, which is the magnetic field lines of the bar magnetic.
5. Repeat 1 to 4 to trace several field lines.

7bii. Plotting-compass method can show the direction of magnetic field lines.

8ai.



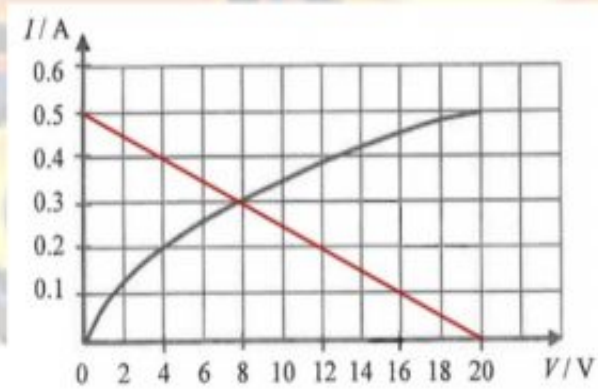
8aii. Increase.

8bi. At V = 20 V, I = 0.5 A,

$$\therefore \quad R = \frac{20}{0.5} = 40\ \Omega$$

8bii. When voltage increase, the current increases. When the current increases, temperature of the light bulb increases, the resistance increases with temperature.

8ci.

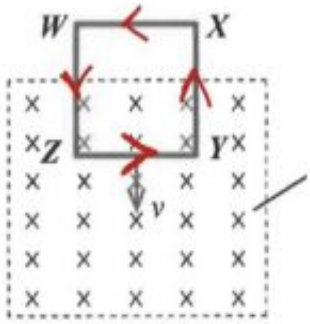


From the graph, the intersection point satisfied both the criteria,

∴ I = 0.3 A.

8cii. Power = V x I = 8 x 0.3 = 2.4 W

9a.



9b. $\varepsilon = Blv$

$$0.01 \times 0.15 \times 4 = 0.03 \times 0.10 \times v$$

$$\therefore \quad v = 2\ ms^{-1}$$

9bi. p.d V_{YZ} = p.d V_{XY} + p.d V_{WX} + p.d V_{ZW} = 0.01 x 0.15 x 3 = 0.0045 V

9bii. Induced emf $\varepsilon = 0.01 \times 0.15 \times 4 = 0.006$ V

$\therefore$ V_{YZ} is not equal to induced emf across YZ.

10a. mass defect for 1 reaction = 2.014102 x 2 - 3.016029 – 1.008665 = 0.00351 u

$\therefore$ max energy in 1 mole

$$= 0.00351 \times 931 \times \left(\frac{6.02 \times 10^{23}}{6420}\right) \div 2 = 1.53 \times 10^{20}\ \text{MeV}$$

10b. ${}_{1}^{3}\text{H} + {}_{1}^{1}\text{p}$

10c. 1. Hydrogen is abundant on Earth.

2. The products have no radioactive.