2024 SSS 4E Sci(Phy) Prelim Paper 2 Section A & B Marking Scheme

Section A

1 **(a)** When a body is in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot. [1]

(b) About the pivot,

sum of clockwise moments = sum of anticlockwise moments

$$(10 \times 0.8) + (15 \times 4.8) = (F \times 3.2) \text{ --- [1]}$$

$$3.2F = 8 + 72 = 80$$

$$F = 25 \text{ N --- [1]}$$

Only 1m to be awarded if perpendicular distance value(s) is/are incorrect

0m to be awarded if student mixed up ACW vs CW moments [2]

[Total: 3]

2 **(a)** $GPE = mgh = (450)(10)(30)$ --- [1]

$GPE = 135000$ J --- [1] [2]

(b) Gain in KE = loss in GPE (20 m)

$GPE = mgh = (450)(10)(20)$ --- [1]

$KE = 90000$ J --- [1] [2]

(c) $KE = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2KE}{m}} = \sqrt{\frac{2(90000)}{450}}$ --- [1]

$v = 20$ m/s --- [1]

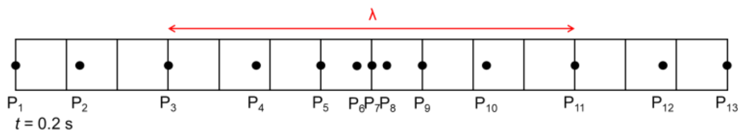
[Total: 6]

3 **(a)** The wave travels <u>parallel</u> to the direction of the medium's particle vibration [1]

(b) $f = \frac{1}{T} = \frac{1}{0.2\times4} = \frac{1}{0.8}$ --- [1]

$f = 1.25$ Hz --- [1] [2]

(c)



[1]

(d) $v = f\lambda = 1.25 \times (8.0 \times 10^{-6})$ --- [1]

$v = 10 \times 10^{-6} = 0.000010$ m/s --- [1] ECF allowed [2]

[Total: 6]

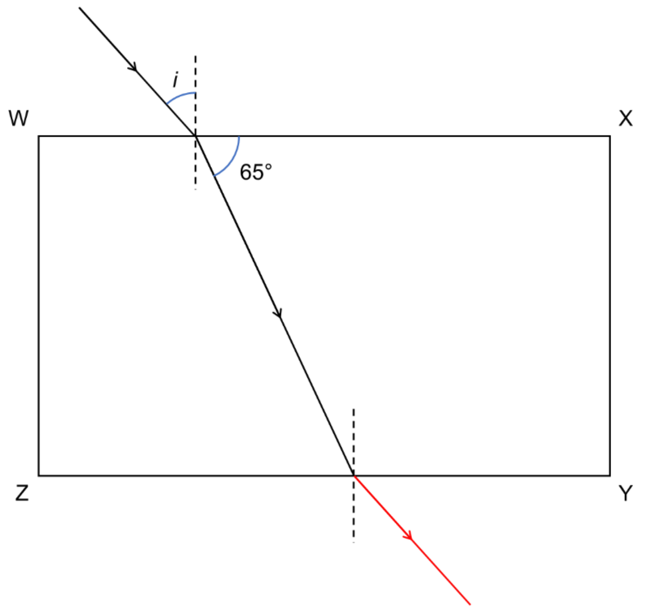
4 **(a)** $n = \frac{\sin i}{\sin r}$

$1.50 = \frac{\sin i}{\sin 25}$

$i = \sin^{-1}(1.50)(\sin 25)$ --- [1]

$i = 39.340 = 39°$ (2 s.f.) OR $39.3°$ (3 s.f.) --- [1] [2]

(b) 1m for correctly drawn emerging light ray parallel to light ray incident on side WX



-1m for missing arrow head [1]

[Total: 3]

5 **(a)** $M = \frac{size\ of\ image}{size\ of\ object} = \frac{5}{15}$ --- [1]

$M = \frac{1}{3} = 0.33333 = 0.33$ (2 s.f.) OR 0.333 (3 s.f.) --- [1] [2]

(b) Camera / eye [1]

(c) The image will be magnified and the distance between the image and the lens will increase (image will be further behind the lens) [2]

[Total: 5]

6 **(a)** **(i)** Effective resistance of whole circuit $= \left(\frac{1}{5} + \frac{1}{15}\right)^{-1} + (5)$ --- [1]

$= 8.75$ Ω (3 s.f.) --- [1] [2]

(ii) $V = IR$

$I = \frac{V}{R} = \frac{12.0}{8.75}$ --- [1]

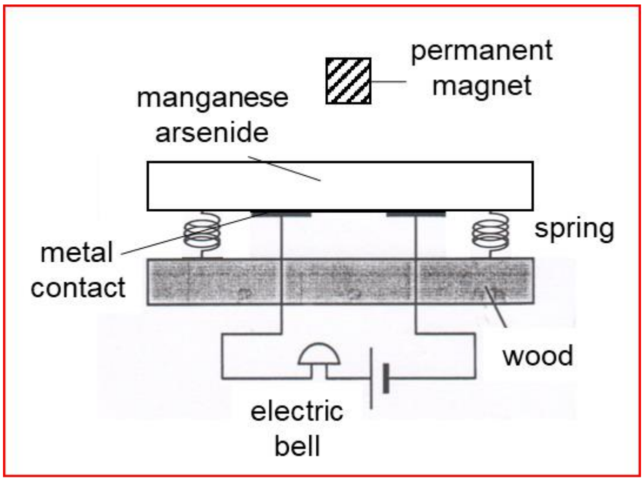
$I = 1.3714 = 1.37$ A (3 s.f.) --- [1] [2]

(b) Effective resistance of whole circuit $= \left(\frac{1}{5} + \frac{1}{5}\right)^{-1} + (5)$ --- [1]

$= 7.50$ Ω (3 s.f.) --- [1] [2]

[Total: 6]

7 **(a)** [1] manganese arsenide dropped away from magnet touching both metal contacts (close circuit)



[1]

(b) When the surrounding temperature is 45 °C or higher, manganese arsenide becomes non-magnetic and is no longer attracted by the magnet.

[1] the weight of the slab of manganese arsenide and the tension in the springs pull it down to touch both metal contacts.

[1] This closes the circuit which causes the electric bell to ring. [2]

[Total: 3]

8 **(a)** [1] when the switch is closed, the solenoid will become a temporary magnet / electromagnet. The iron rods will be magnetized by induction such that the same ends will have the same polarity (pole).

[1] Since like poles repel, the iron rods will repel from each other.

0m awarded for “iron rods will be magnetised by current” / “iron rods will become electromagnets” [2]

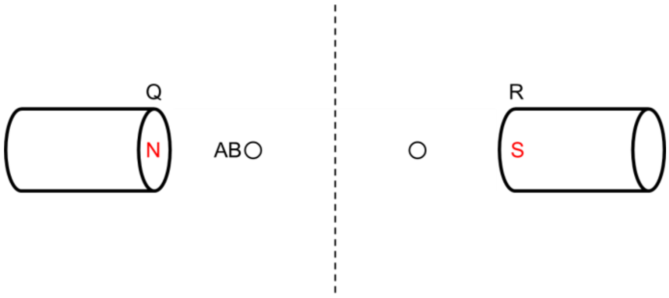
(b) [1] when the switch is opened, the iron rods will lose its magnetism easily (since iron is a soft magnetic material).

[1] the iron rods will drop to the bottom of the solenoid / return to their original positions (due to their weight).

DNA “iron rods will be demagnetised” / “the rods will be attracted to each other” [2]

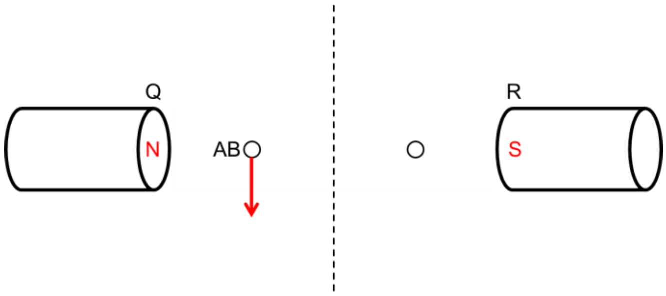
[Total: 4]

9 **(a)** Q: North, R: South (no ½ mark)



[1]

(b) downward force



[1]

(c) [1] When current flows through the coil, <u>the magnetic field of the electromagnets interact with the magnetic field of the wire AB</u>. <u>Based on Fleming's Left Hand rule</u>, (the direction of the force is perpendicular to the direction of magnetic field and current).

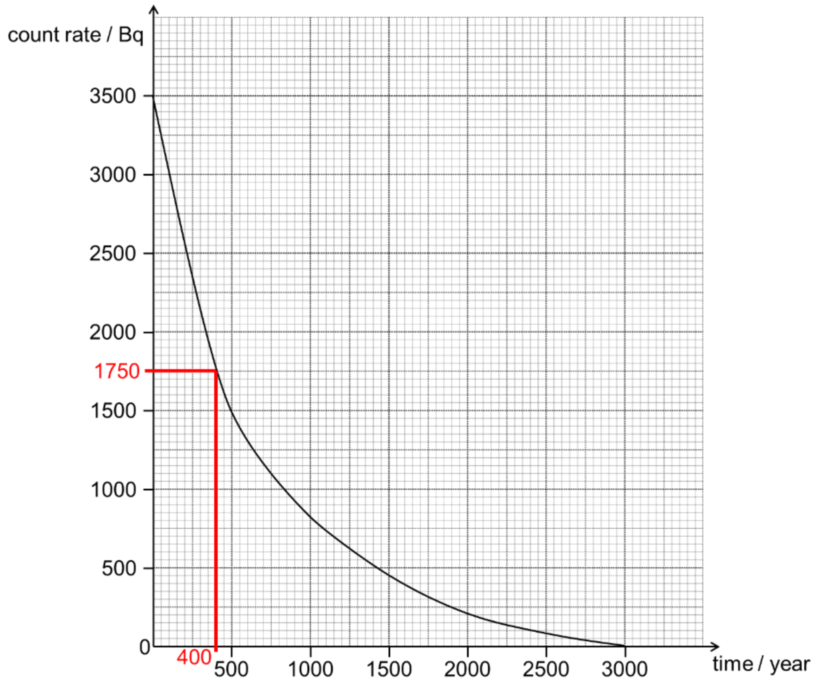
[1] hence, <u>an downward force acts on wire AB</u> and <u>a upward force acts on the other side of the coil</u>, <u>producing a turning effect</u>. [2]

[Total: 4]

10 **(a)** protons = 2, neutrons = 2 --- [1] for both correct [1]

(b) **(i)** [1] half of 3500 = 1750 Bq

[1] half life = 400 years



-1m if no line drawn on graph to show how answer is determined [2]

(ii) [1] beta and gamma radiation will penetrate smoke

[1] no change in the count rate would be detected (alarm will not sound) [2]

[Total: 5]

11 **(a)** **(i)** Conduction [1]

(ii) Convection / radiation [1]

(b) **(i)** Cooling fins <u>increase the surface area</u> to gain / lose thermal energy faster. [1]

(ii) [1] aluminium OR any other metals

[1] metals are <u>good conductors of thermal energy / radiation</u> which gain / lose thermal energy faster. [2]

(iii) [1] black OR any other dark colour

[1] dark colours are <u>good emitters of radiation</u> which lose thermal energy faster. [2]

(c) $P = \frac{E}{t} = \frac{100}{20} = 5$ W --- [1]

For every 1 W of power, temperature increases by 4 °C

Hence, for 5 W of power, temperature increases by 5×4

$= 20$ °C --- [1] [2]

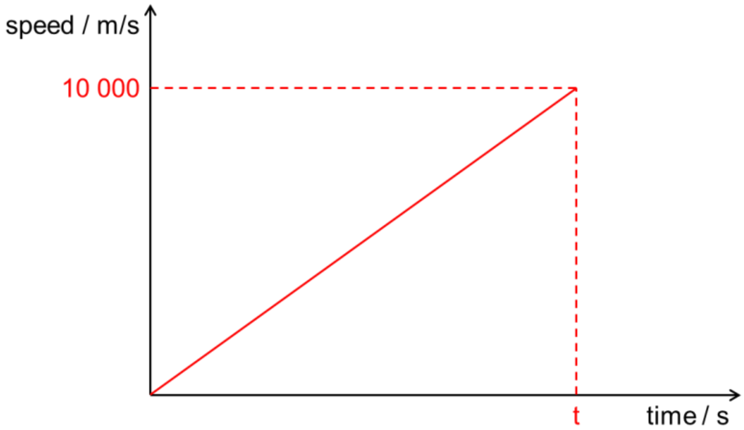
(d) The temperature stops increasing after some time because the gain in thermal energy from electronic board = loss in thermal energy to surrounding air [1]

[Total: 10]

Section B

12 **(a)** **(i)** [1] for correct shape of graph (straight line diagonal = constant gradient = constant acceleration)

[1] label 10000 m/s (breaking speed)



[2]

(ii) Distance travelled = area under speed-time graph

$825000 = \frac{1}{2} \times 10000 \times t$ --- [1]

$t = 165$ s --- [1] [2]

(iii) $a = \frac{v-u}{t} = \frac{10000-0}{165}$ --- [1]

$a = 60.606 = 60.6$ m/s^2 (3 s.f.) --- [1] [2]

(iv) $F_R = ma = (22500)(60.606) = 1363635$ N --- [1]

$F_R = thrust - W$

$thrust = F_R + W$

$thrust = ma + W = 1363635 + (22500)(10) = 1588636.36 =$

1590000 N (3 s.f.) --- [1] [2]

(b) [1] when there is no engine thrust and air resistance, the resultant force acting on the rocket is 0 N.

[1] since $F_R = ma$, the acceleration of the rocket is 0 m/s^2 (no acceleration) and its speed remains constant. [2]

[Total: 10]

13 (a) Live and neutral wire connected to heating element &

Earth wire connected to metal case

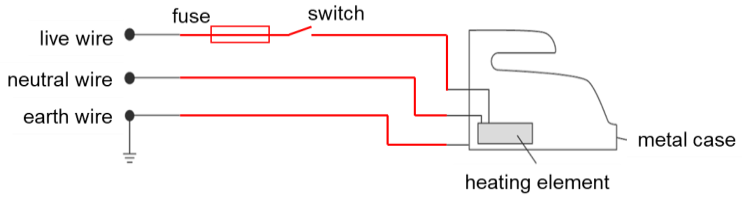
2m for all 3 wires drawn correctly

1m for earth wire drawn correctly OR both live and neutral wires drawn correctly

0m for no wires drawn correctly OR only one live or neutral wire drawn correctly [2]

(b) 1m for correctly drawn symbols for both components & both MUST be located on the live wire

0m for any mistakes



No ½ mark [1]

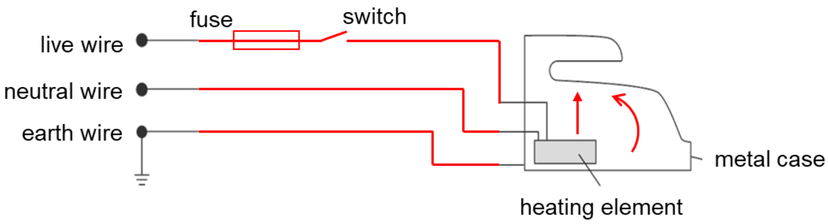
(c) (i) $E = Pt = (1200)(150)$ --- [1]

$E = 180000$ J --- [1] [2]

(ii) [1] movement: the water molecules will change <u>from sliding over one another freely to moving randomly at high speeds</u>

[1] arrangement: the water molecules will change <u>from closely packed in random manner to very far apart in random manner</u> [2]

(iii) [1] for either one upward pointing arrow



[1]

(iv) [1] since the temperature of water remains constant, the average kinetic energy of the water molecules remains constant

[1] work is done to overcome intermolecular attractive forces between the molecules and provide energy to push back on the atmosphere for the water particles to escape. The potential energy increases, as separation between particles increases. [2]

[Total: 10]