Serangoon Garden Secondary School
2026 Sec 4 6091 Prelim Suggested Mark Scheme

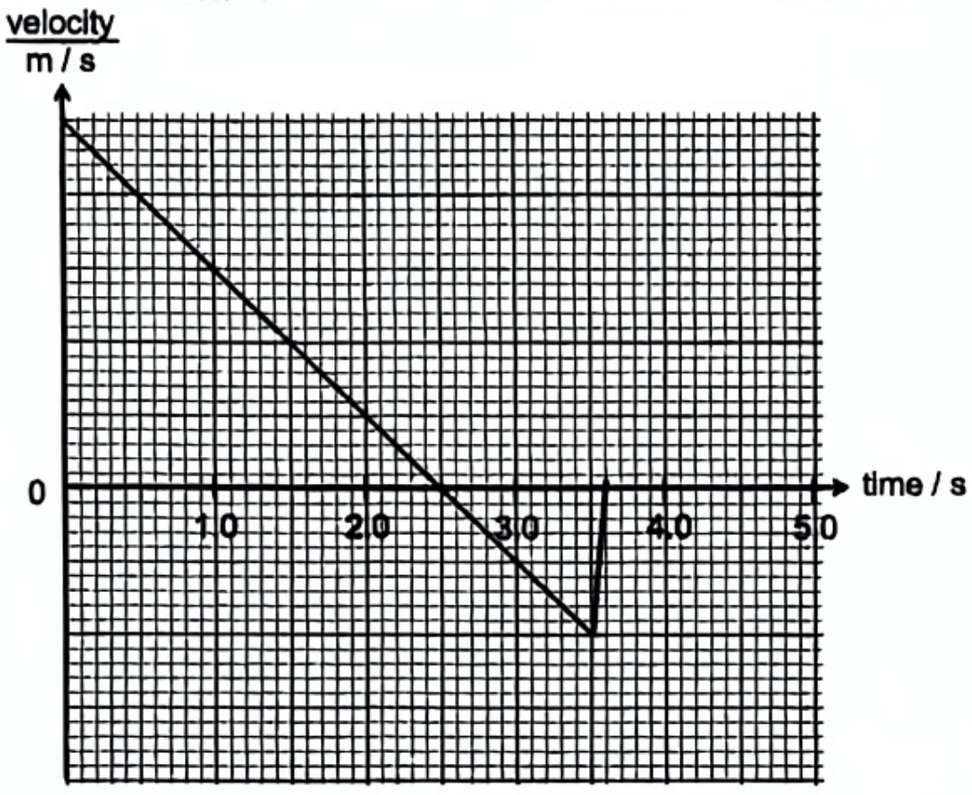
Paper 1: MCQ [40 marks]

1	2	3	4	5	6	7	8	9	10
A	A	C	C	C	B	C	B	C	D
11	12	13	14	15	16	17	18	19	20
D	B	B	A	C	D	B	D	C	B
21	22	23	24	25	26	27	28	29	30
B	B	B	B	D	C	D	B	C	D
31	32	33	34	35	36	37	38	39	40
C	D	B	B	D	C	A	B	C	C

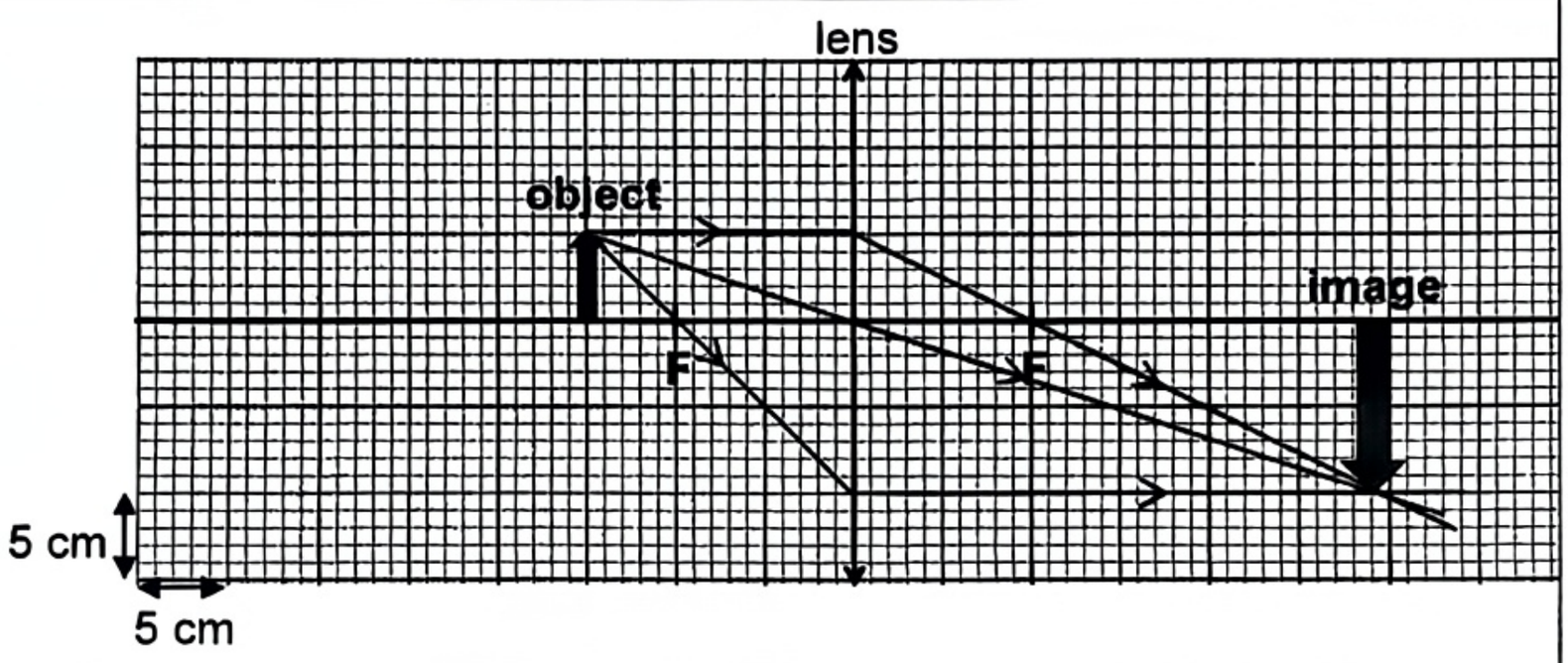
Paper 2: Structured Questions [30 marks]

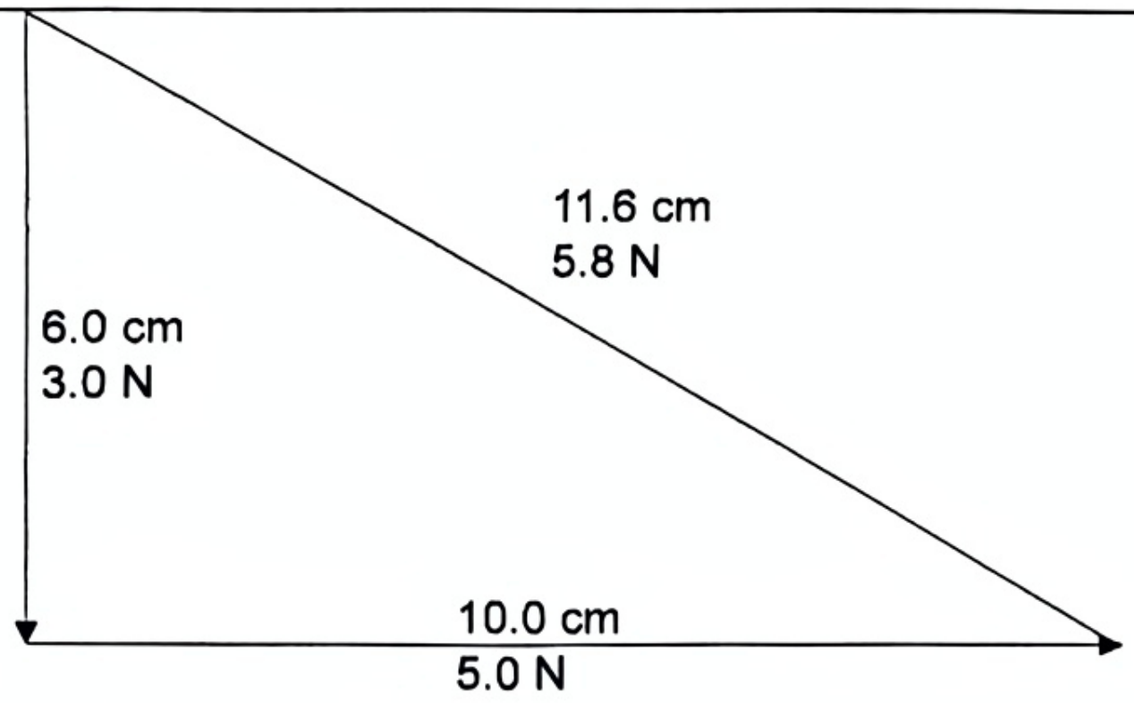
-1m for wrong unit
-1m for wrong s.f. / d.p.
} once per paper for each mistake

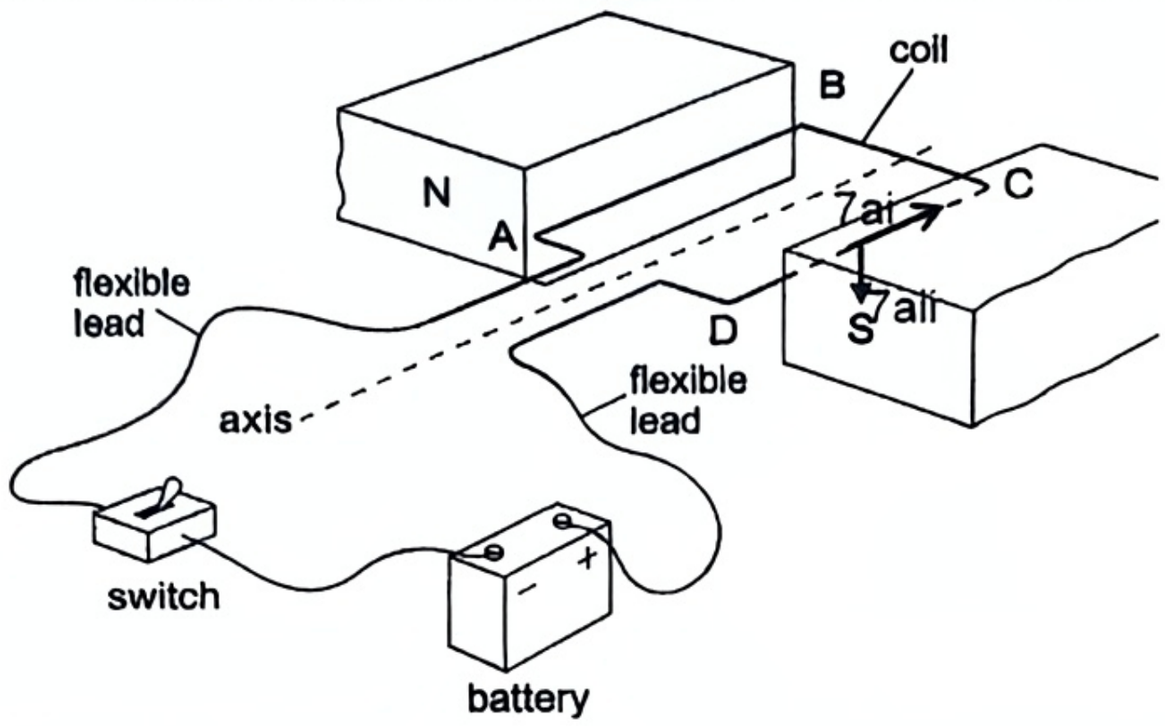
accept 2 s.f. or 3.s.f. for all calculations

Qn	Solution	Mark Scheme
1ai	$v = u + at$ $0 = u + (-10)(2.5)$ $u = 25.0$ m/s	1
1aii	*height* = area under graph $= \frac{1}{2} \times 2.5 \times 25.0 + \left(\frac{1}{2} \times 1 \times (-10)\right)$ $= 31.25 - 5$ $= 26.3$ m (3s.f.) accept 2 s.f. too. Alternate method for average speed accepted.	1 1
1b	 Generally ok	1
1c	$KE = \frac{1}{2}mv^2$ $= \frac{1}{2} \times 1.0 \times 10^2$ $= 50J$ KE lost = w.d. $w.d. = F \times d$ $50 = F \times \left(\frac{1}{2} \times 0.1 \times 10\right)$ $F = 100N$ Students did not stick to 'using ideas about energy'. This is an instruction, not a suggestion. You can use your method to check, but will only be awarded if energy is being used.	1 - KE 1 - KE lost = w.d. 1
		Total: 7m

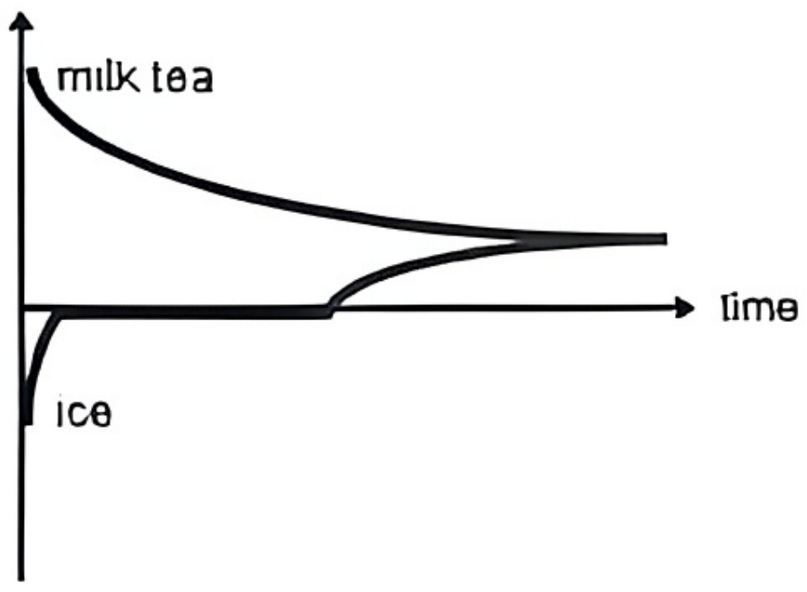
2a	The principle of moments states that for a system to be in rotational equilibrium, the sum of all clockwise moments about any pivot must be equal to the sum of all anticlockwise moments about that same pivot. Mostly well done by students. Some forgot 'sum/total'	**1 – SUM of CWM = SUM of ACWM** **1- about the same pivot**
2b	By principle of moments, Taking the bottom left corner of the retort stand as the pivot, Sum of ACWM = Sum of CWM $W \times 5.0 = 15 \times 10$ $W = 30N$ $W = mg$ $30 = m \times 10$ $m = 3.0\ kg.$ 3kg rejected No ecf within the question.	**1 – correct substitution and distance** **1- weight** **1- conversion to mass**
2c	The action-reaction pair of the weight of the load is the gravitational force exerted by the load on the Earth. 'force' rejected.	**1**
2d	This leads to the centre of gravity of the retort stand set-up to be higher, which reduces the stability of the retort stand. EL error – c.g. 'increase' instead of 'higher' accepted. Students generally couldn't do this question. Talked about line of action being the same, but not stability. Stability depends on area of base and height of c.g. (stability refers to the range of angle of tilt that the object can withstand)	**1 – higher c.g.** **1- less stable**
		Total: 8m

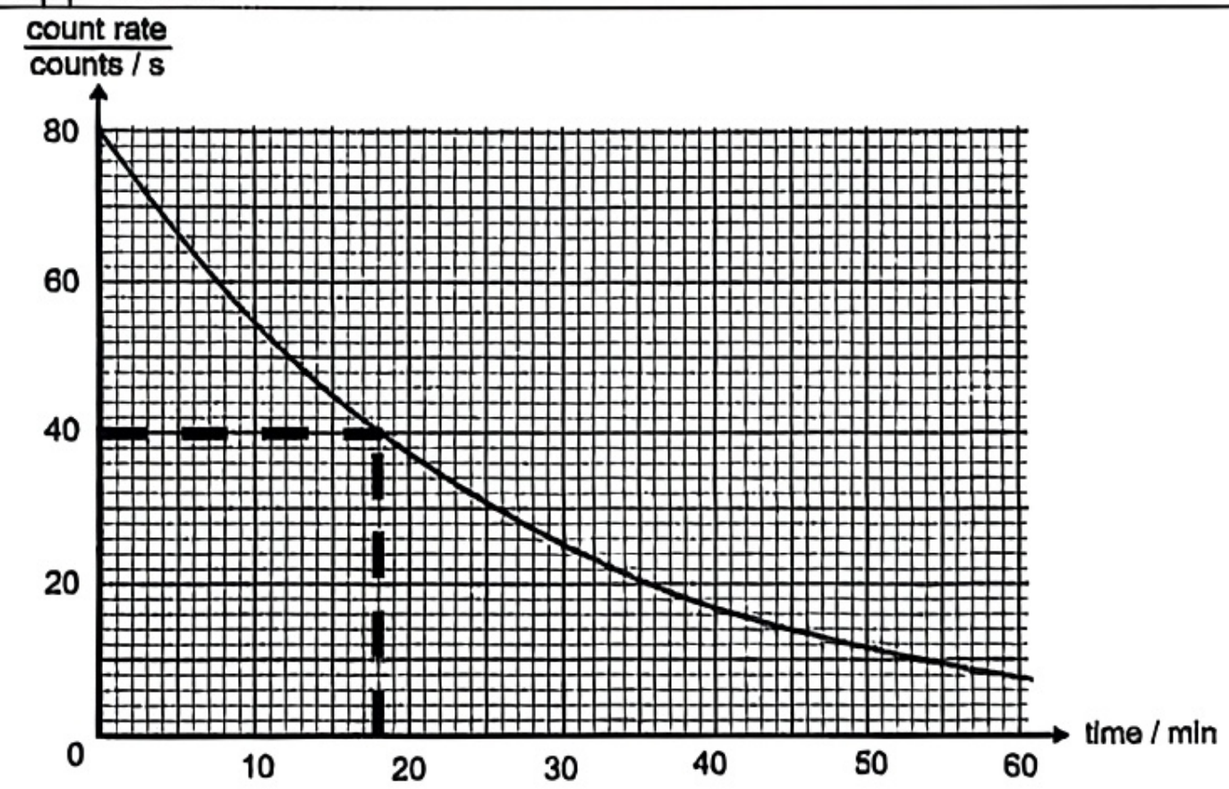
3a	$P = h\rho g + \text{atm}$ $= \frac{300}{1000} \times 13600 \times 10 + 1.0 \times 10^5$ $= 140800$ $= 141000$ Pa (3s.f.) Not very well done, some converted wrongly. Some forgot how to calculate pressure due to a water column.	**1 – hpg** **1 – final ans**
3b	As the gas supply is heated up, the particles in the gas supply move more rapidly in random directions. The increased speed leads to a higher frequency of collision between the walls and the particles and greater force each collision. As pressure is the average force acting per unit area, the pressure of the gas supply increases, causing the mercury level on the left to decrease and the right to increase. accept if only force or frequency of collisions increased. More collisions accepted, more force (need to be average force) accepted. Accepted 'difference increases' if explanation above given, but can be more specific.	**1 – effect due to temperature** **1 – increased f** OR **force of collisions** **1 – change in mercury level**
3c	At the 150mm level, the left-end has a pressure equal to the atmospheric pressure but the 150mm level at the right-end has a pressure equal to that plus 300mmHg of pressure. Since the pressure on the right is greater, mercury is pushed through the manometer until the mercury levels are at the same pressure and height. Not awarded if students mention pressure on both ends are the same. Most of the students didn't mention the initial state. (Both sides has P_{atm}, according to students, it would not move if it is both P_{atm} only?)	**1** **1**
		Total: 7m
4a		**1 – for correct position and labelling of object** **1 – at least 2 rays drawn correctly** **1- correct position and labelling of image**
4b	The image gets **bigger,** **but it is still diminished** As the object moves towards the lens by 5 cm, the image **remains real and inverted.** Reject if student writes 'image is magnified' (magnified ➔ reference to object)	**1** **1**
		Total: 5m

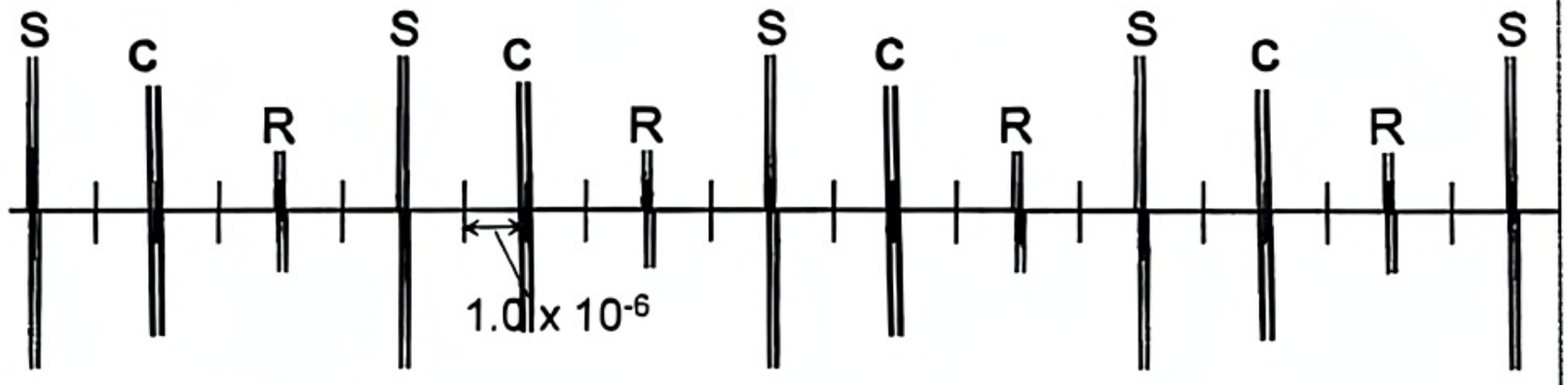
5	 scale – 1cm : 0.5 N magnitude of the force – 5.8 N ± 0.3 N angle between the newton meter and the ceiling – 31˚ ± 2˚ penalized for sf for 1.d.p. when using protractor penalized for 1cm = 0.5 N 'equal' sign.	**-1 for any diagram error or lack of labels** **1 + diagram** **1** **1**
		Total: 3m
6ai	$V_{thermistor} = \frac{3R}{4R} \times 240V$ $= 180V$ Some students let resistance of fixed resistor = 1 then continue. This shows the p.d. for only 1 value of the fixed resistor and not the general term. Some students go through the long way of V=IR when they can use potential divider rule.	**1** **1**
6aii	As the temperature of the thermistor increases, the resistance of the thermistor decreases. The fixed resistor is a higher proportion of the total resistance now, hence the reading of the voltmeter increases. some students conclude that p.d. across thermistor decreases, but do not talk about the p.d. across the fixed resistor. (wrong end point)	**1 – resistance of thermistor decrease** **1 – reason increase in p.d. of fixed R**
6bi	The fixed resistor.	**1**
6bii	To increase the **power of the air-conditioner, P = VI, the potential difference across the air-conditioner should be increased**. Connecting the air-conditioner parallel to the fixed resistor will lead to an increased potential difference across the air-conditioner as the **potential difference across a parallel circuit is the same.** Allow e.c.f. for connected in parallel same voltage. Rejected some students writing 'connect in parallel the voltage is constant.' →same does not have the identical meaning as constant.	**1 – how to increase power** **1 – parallel voltage same**
		Total: 7m

7ai **7aii**	 -1 for any missing label (max -1)	**1** **1**
7b	By Fleming's Left hand rule, CD experiences a downward force and BA experiences an upward force. This leads to a resultant clockwise moment and the coil turns clockwise. After passing the vertical position, for CD, the current and magnetic field remains in the same direction, which now results in a anti-clockwise moment, similarly for BA. Hence, the rotation comes to a stop and turns anti-clockwise. This continues and the coil oscillates about the vertical position OR comes to a stop at the vertical position after a few oscillations due to resistive forces. accepted if only explain CD, but answers should include BA. Most students cannot get the 2nd and 3rd point. Explanations should only stop if the motion is continuously the same. Poorly done	**1- clockwise moment on both sides** **1 – anti clockwise moment on both side** **1 – oscillate about vertical or stop**
7c	As the coil turns clockwise to the vertical position, the **momentum of the coil allows it to continue rotating through the vertical position**. The split-ring commutator **reverses the current direction** from BA to AB and CD to DC, the resultant moment is then always clockwise as it repeats every half a revolution. Students can see the issue of the vertical position, from 7b, but do not address it in 7c. Most students can get the purpose of split ring.	**1 – continue due to momentum** **1 – use of split ring**
		Total: 7m

8a	The person does not receives an electric shock / current flows through the earth wire. (Nothing happens) Wire B is the earth wire and it is connected to the metal casing, which offers a path of lower resistance for current to flow through instead of going through the person. Some students hyperfocused on faulty live, but did not see wire B earthing the case.	**1 – no electric shock** **1 – current flows through earth wire**
8b	$R = \frac{V}{I}$ $= \frac{230}{0.3}$ $= 766.7\Omega$ $= 767\ \Omega$ (3sf) Generally ok	**1** **1**
8c	$P = VI$ $= 230 \times 0.3$ $= 69W$ $E = Pt$ $= \frac{69}{1000}\text{kW} \times 8\text{h} \times 30$ $= 16.56\text{kWh}$ $\text{cost} = 16.56 \times 0.40$ $= \$6.62$ only accept 2 d.p. for cost. Generally ok	**1** **1**
		Total: 7m

9a	It means that 330J of thermal energy is required to change 1 g of a substance from solid to liquid at its melting point, <u>at constant temperature.</u> Accept ice to water, as its still contextual in this case. Reject if student did not mention 330J in their answer. Reject if answer does not state 'at constant temperature'.	**1**
9b	$Q = mc\Delta\theta$ $= 400\times4.1\times(10-30)+120\times3.5\times(10-36)$ $= -43720$ J $= -43700$ J (3sf) Accept positive number	**1** **1**
9c	$Q = mc\Delta\theta_{ice} + ml_f + mc\Delta\theta_{water}$ $43720 = m(2.1\times15+330+4.2\times10)$ $m = 108$ g (3s.f.) Poorly done. Only a few students could see that they needed - Ice to change temperature to 0°C - Ice to melt - Melted ice (water) to change temp to 10°C allow e.c.f. from **9b**	**1 –** $mc\Delta\theta_{ice}$ **+** ml_f **1 –** $mc\Delta\theta_{water}$ **1 – final answer**
9d	 accept if lines are straight instead of curve, but lines must reach equilibrium temperature at the same time. Accept if students meet but don't continue the graph at equilibrium temperature.	**1 – meet at equilibrium temperature** **1 – 3 phases**
		Total: 8m

10a	$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n$	**1**
10b	Nuclear Fission. Uranium-235 <u>nuclei splits into a barium and krypton nuclide</u> (usually into two parts) and <u>releases a huge amount of energy.</u> Accept if student reference the nuclides above. Accept fission for now, but phrasing is bad.	**1** **1**
10c	Beam A: Gamma radiation as it is undeflected by a magnetic field because it has no charge. Beam B: Beta-particle as it is deflected by the magnetic field and Fleming's left hand rule tells us it is a negatively charged. Reject answer if no explanation given Accept if resultant force downwards for fleming left hand rule.	**1** **1**
10d	There is no <u>change in half-life</u> as the decay process is <u>spontaneous / unaffected by external conditions.</u> Some people are confused with general reactions where temperature reduces the rate of reaction.	**1** **1**
10e	Cosmic radiation Radon gas from rocks and soil Trace amounts of radioactive substances in everyday items. any one accepted rocks, soil, sun. But let's be specific and improve our answers to the above. 100% O level approved.	**1**
10f	 18 min / 18 minutes / 1080 s Some students have no working on graph. Some students have no working in the space. Show your working!	**1 – working on fig** **1 – final ans**
10f	<u>Store the sample in a lead-lined container</u> because <u>lead absorbs ionising radiation and reduces radiation exposure.</u> <u>Minimise the time spent handling the sample</u> to <u>reduce the ionising radiation exposure</u>. <u>Use tongs to handle the radioactive sample</u> to <u>keep sample away and reduce ionising radiation exposure.</u> any one of the above lead lined is sufficient	**1** **1**
		Total: 12m

11a	Any frequency above 20 kHz or 20000Hz Students cannot recall the range for ultrasound	**1**
11b	R has a smaller amplitude because energy is lost. As the wave travels through the metal, the metal absorbs some of the energy OR not all the ultrasound is reflected at the back surface (some is transmitted/absorbed).	**1** **1**
11c	 Poorly done.	**1 – size smaller than S, bigger than R** **1 – position & label**
11d	$v = f\lambda$ $3\times10^{8} = 2.5\times10^{18}\times\lambda$ $\lambda = 1.2\times10^{-10} m$ Generally ok	**1 – speed of light** **1 – final ans**
11e	X-ray is a transverse wave but ultrasound waves are longitudinal waves. X-ray does not require a medium to travel but ultrasound waves require a medium to travel. any one above. Rejected if student wrote 'sound waves' instead of longitudinal wave. Accepted it is a transverse wave because of the way that question is stated, but good practice is to compare.	**1**
11f	X-rays can lead to <u>cell death / cell mutation / organ failure.</u> X-rays are high energy radiation that can <u>ionise</u> atoms in the cell.	**1** **1**
		Total: 10m

12a	When the switch is closed, the compass needle <u>deflects momentarily and then returns to its original position.</u> The sudden increase in current in coil A causes a changing magnetic field for coil B which results in an induced e.m.f. and hence current in coil B. When the magnetic field becomes constant, no induced current is produced. Same as d.c. motor question. Continue describing the observation until it stops changing.	**1** **1**
12bi	When the <u>potential difference across the lamp is 2.5 V,</u> the lamp transfers energy to the surroundings at <u>a rate of 5 J per second.</u> Conditional of the 2.5V and power of 5J/s not established for most students.	**1**
12bi i	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$ $\frac{10}{40} = \frac{2.5}{V_s}$ $V_s = 10.0 \text{ V}$ As the <u>potential difference across lamps P and Q are greater than its rating,</u> both lamps will operate at a larger power and will be <u>brighter than normal.</u>	**1** **1**
12bi ii	$P = \frac{V^2}{R}$ $R = \frac{V^2}{P}$ $= \frac{2.5^2}{5}$ $= 1.25 \ \Omega$ Accept if students find I = 2A first too.	 **1**
12bi v	e.c.f allowed $R_t = \left(\frac{1}{1.25} + \frac{1}{1.25}\right)^{-1}$ $= 0.625 \ \Omega$ $I = \frac{V}{R}$ $= \frac{10}{0.625}$ $= 16 \text{ A}$ Accept if find current for 1 bulb then x2. e.c.f. 10/R.	 **1** **1**
12b v	$P = VI$ $= 10 \times 16$ $= 160 \text{ W}$ Accept ecf using previous 12bii and 12biv answer.	**1**

12b vi	$\frac{N_p}{N_s} = \frac{I_s}{I_p}$ $\frac{10}{40} = \frac{16}{I_p}$ $I_p = 64$ A **OR** $I_p V_p = I_s V_s$ $I_p = \frac{I_s V_s}{V_p}$ $= \frac{160}{2.5}$ $= 64$ A **e.c.f. allowed for both.**	**1** **1**