HIGHER TIER

Question			Answer / Explanatory Notes	Marks Available
1.	*(a)*	(i)	2 [A]	1
		(ii)	$R = \frac{6}{2}$ (1 –substitution) = 3 [Ω] (1) **ecf** from (i) (If found for wire in (i) R = 4.8 Ω)	2
		(iii)	3.25 [A]	1
	(b)	(i)	**Lamp** has bigger resistance or converse argument or values given W = 4.8 Ω and L = 5.2 Ω	1
		(ii)	Smaller current through it **or** converse argument or calculations shown (allow temperature increase)	1
	(c)		Beyond about 11 V, W has the bigger current (1) hence W has the bigger power (1) **Or** power calculations at 12 V (1) this is because the current in W is now bigger than in L (1) **Or** at 11 V the powers are equal (1) because the currents are equal (1)	2
			Question total	**[8]**
2.	*(a)*	(i)	Helium nucleus/nuclei / 2 protons and 2 neutrons (accept 2p and 2n)	1
		(ii)	Gamma more penetrating than alpha / so would not be blocked by smoke / wouldn't change the current / weakly ionising. **Any 2 x (1) due to all points being interlinked.** **Or** gamma is more weakly ionising (1) so doesn't cause an electric current (1) (Don't accept gamma is not ionising.)	2
		(iii)	Distance between detector / ceiling and the human body (1) so / hence alpha is easily absorbed by the air / case (1) (Answer must be relevant to this context so **don't accept alpha will be blocked by skin**.)	2
	(b)	(i)	Longer ½-life (1) (don't accept longer to decay) so detector stays active / works longer or doesn't need replacing [as often] (1)	2
		(ii)	I. becquerel [accept [Becquerel!] / Bq / bq	1
			II. 26 000 is half of 52 000 (1 – method) so time is one ½-life = 432 [years] (1) (Accept $\frac{52000}{2}$ as recognition of half-life – don't allow any other value divided by 2).	2
			III. $\frac{864}{432}$ = 2 or 864 years is 2 ½-lives (1) so ¼ of the mass remains = 0.1 [μg] (1)	2
			Question total	**[12]**

Question			Answer / Explanatory Notes	Marks Available
3.			**Indicative content**: The advantage is that the time taken for the given journey is reduced from 4 h to 3.5 h with the increase in speed. The disadvantage is that in the event of an emergency stop being necessary, the total stopping distance is increased from 96 m to 121.5 m, increasing risk of serious injury or death. Relevant factors clearly explained, e.g. tiredness, related to time or speed / separation from vehicle in front. Increased momentum at higher speed related to increased force on vehicle and occupants in the event of a collision. 5 - 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.	6
			Question total	**[6]**
4.	*(a)*		Initial K.E. = 0.5 x 1500 x 15^2 = 168 750 [J] (1) Final K.E. = 0.5 x 1500 x 5^2 = 18 750 [J] (1) Loss = 150 000 [J] (1) (award 1 mark for doing any subtraction but award no marks for use of $(15\text{-}5)^2$.)	3
	(b)		$F = \frac{150000(ecf)}{7.5}$ = 20 000 [N] (1) manip, (1) subst, (1) ans For candidates who present a momentum argument: $\frac{x}{t} = \frac{(u+v)}{2}$ to find time = 0.75 [s](1) momentum change = 15 000 [kg m/s](1) $F = \frac{15000(ecf)}{0.75(ecf)}$ = 20 000 [N] (1)	3
	(c)		F = 20 000 [N] ecf from *(b)*	1
			Question total	**[7]**

Question			Answer / Explanatory Notes	Marks Available
5.	*(a)*		General description of 3 parts (1) Reference to all 3 times (1) Reference to 25 m/s value / value of acceleration (0.125) / deceleration (0.25) (1)	3
	(b)	(i)	Either: a = 0.125 (1) and $F = ma$ = 80 000 (1) x 0.125 (**ecf**) = 10 000 [N](1) **or** F= 80 000(1) x $\{\frac{(25-0)}{200}\}$(1) = 10 000 [N](1)	3
		(ii)	Force is bigger (1 mark only) but force is twice as big (2 marks only) because time is smaller / half as long / gradient is bigger or twice as big (1) (Calculated value for force of 20 000 N gets 2 marks but a statement the force is bigger because the time is halved (1) is still needed.)	3
	(c)	(i)	(300 + 600)(1) x (0.5 (1) x 25)(1) = [11 250 m] N.B. no mark for answer OR Area = (0.5 x 200 x 25)(1) + (300 x 25)(1) + (0.5 x 100 x 25)(1) = 2 500 + 7 500 + 1 250 = [11 250 m] N.B. no mark for answer	3
		(ii)	mean speed = $\frac{11250(ecf)}{600}$ = 18.75 [m/s] [1 for subs, 1 for answer]	2
		(iii)	Area P + area R = area Q [1] accept P + R = Q	1
			Question total	**[15]**

6.	*(a)*		The same atomic / proton number (1) but different mass / nucleon / neutron numbers (1) (Reference to electrons treat as neutral).	2
	(b)		Indicative content: $^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$ (LHS correct with He and n written on RHS, correct nucleon and proton numbers for He, correct nucleon and proton numbers for n.) The collision releases a large amount of energy. Containment is very difficult because of the high pressure needed and in maintaining high temperatures. Difficulty in keeping the plasma away from the container - can be achieved magnetically. Virtually unlimited availability of deuterium from water in the oceans. It releases a large amount of energy per unit mass and no radioactive waste. However the neutrons that are released interact with container causing radiation emissions. 5 - 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.	6
			Question total	**[8]**
7.			$P=I^2R$ quoted (1), common current (1), so bigger P [has larger R] (1), Y has bigger R (1) **OR** $P = V$ x I **and** $V = IR$ must be given (1) ($V = IR$ can be implied) Common current (1) Bigger voltage across Y than X (1) Hence bigger R for Y (1) (Do not credit if more than one equation is written unless it is clear that the appropriate equation is used for the argument.) **Question total**	4 **[4]**
			Total for higher tier paper	**[60]**