OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

M2 HANDLING DATA

SCORE	PERCENTAGE
/119	%

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Question			Answer/Indicative content	Marks	Guidance
1	a		16 / 16.0 / 16.00 (2) If answer incomplete or incorrect then 48 – 15.65 – 16.35 or 48 – 32 scores (1)	2	
	b		220 (cm) (2) If answer is incorrect or incomplete then: Evidence on graph **showing** a line **or** curve scores (1)	2	**Allow** 216 → 224 (2) **BUT** for a reasonable curve extrapolated allow 216 → 230 (2)
	c	i	Time-period is (directly) proportional to the square root of length / AW (1)	1	**Eg.** x and y are proportional (1) **Eg.** 'As square root of length increases in equal steps, the time period increases in equal steps' (1) **Allow** linear relationship **through the origin** (1) **Allow** examples showing this relationship using numbers **Ignore** merely 'positive correlation'
		ii	3.4 (3) But if answer is incorrect or incomplete then: $6.284\sqrt{\frac{3}{10}}$ or 2 x 3.142 x 0.5477 scores (2) $2 \times 3.142\sqrt{\frac{3}{10}}$ scores (1)	3	**Allow** decimal place error: **Eg.** 3.441 (2) **Allow** 34.4 (2) (**for candidate who has used 300 cm instead of 3 m)** Look for correct substitution **AND** some correct processing **Eg.** (π or) 22/7 for 3.142 Look for the correct substitutions Eg. $2 \times \pi\sqrt{\frac{3}{10}}$ scores (1)

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Question			Answer/Indicative content	Marks	Guidance
		iii	0.3 or 0.25 or 0.253..... etc. (2) But if answer is incorrect or incomplete then evidence of correct substitution (in symbols or numbers) scores (1)	2	Eg. $1 = 2 \times 3.14 \times \sqrt{\frac{L}{10}}$ **Allow** π or 22/7 for 3.142
			Total	**10**	
2	a		14.60/14.6 (1)	1	
	b		16 / 16.0 / 16.00 (2) If answer incomplete or incorrect then 48 – 15.65 – 16.35 or 48 – 32 scores (1)	2	
	c		1.75 (2) But if answer is incomplete or incorrect then: 1.750666 scores (1)	2	
	d	i	All 4 points plotted accurately (1) Straight line (by inspection) (1)	2	**allow** tolerance of +/– ½ square
		ii	Increasing length increases time period / AW (1)	1	
		iii	220 (1) Evidence of working on graph scores (1)	2	**allow** 216 → 224 (1) **allow** ecf from previous parts **allow** value sources from table (rather than graph)
			Total	**10**	

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Question			Answer/Indicative content	Marks	Guidance
3			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 10 000 000 (J) award 4 marks	4	Fourth mark is for correct rounding If answer line has 10 120 000 (J) award 3 marks
			Rearrange to energy = charge × potential difference ✓	(AO2.1)	
			44 000 × 230 ✓	(AO2.1)	m.p.2 can include m.p.1 if equation not written
			10 120 000 ✓	(AO2.1)	
			10 000 000 (2 sf) (J) ✓	(AO1.2)	
			OR Substitute correctly 44 000 (C) = energy ÷ 230 (V)✓		
			Rearrange to energy = 44 000 (C) × 230 (V) ✓		m.p.2 can include m.p.1 as above
			= 10 120 000 (J) ✓		
			= 10 000 000 (2 sf) (J) ✓		
					Examiner's Comments There was an erratum with this question to correct the units to joules. The figures in this question were difficult, and many candidates coped well with the large numbers and also the rearrangement of the equation. Some candidates rearranged the equation before substitution and others after. Fewer candidates were able to round 10 120 000 J to two significant figures (e.g. 10 000 000 J). OCR support Mathematical Skills Handbook http://www.ocr.org.uk/Images/310651-mathematical-skills-handbook.pdf
			Total	4	

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Question			Answer/Indicative content	Marks	Guidance
4	a		momentum ✓ kinetic energy or KE ✓	2 (AO 2 × 1.1)	IGNORE mass conserved If more than two answers mark the first two answers (unless one of them is mass). Eg 'KE, mass, momentum ✓✓ Eg. PE, KE, momentum ✓ Examiner's Comments Kinetic energy and momentum were the answers here. Full marks (in 10% of cases) were attained by more able candidates only. Just less than a half gained 1 mark only. 'Energy' or 'potential energy' (rather than kinetic energy) was often seen along with mass, velocity.
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINES If answers = 8.4 (kgm/s) and 6.75 / 6.8 (kgm/s) award 3 marks 2 × 4.2 2.5 × 2.7 ✓ A: 8.4 (kgm/s) ✓ B: 6.75/6.8 (kgm/s) ✓	3 (AO 1.2) (AO 2.2) (AO 2.2)	8.4 and 6.7 scores ✓✓ (incorrect rounding of one of the values) Examiner's Comments The great majority calculated both values of momentum correctly and gained 3 marks.

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Question			Answer/Indicative content	Marks	Guidance
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3.4 (m/s) award 3 marks (8.4 + 6.75) × 4.5 ✓ 3.37 / 3.366666667 (m) ✓ 3.4 (rounding to 2 sf) ✓	3 (AO 2.2) (AO 2.2) (AO 1.2)	 ECF for momentum values eg. (A + B) ÷ 4.5 Wrong answer but evidence of correct rounding ✓ Eg. 6.75 to 6.8 ✓ <u>Examiner's Comments</u> Just under a half of candidates calculated this correctly to two significant figures. About a third did gain any credit at all and gave attempts of calculations that were incorrect or difficult to follow.
			Total	8	
5			D ✓	1 (AO1.2)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
6		i	AWARD **ALL** CANDIDATES 2 MARKS	**2** (AO1 × 2.1) (AO1 × 1.2)	<u>Examiner's Comments</u> We have adjusted the mark scheme to allow for a typo within this question.
		ii	KE transferred to thermal energy / heat in brakes / surroundings / AW ✓✓ OR (KE of car) is reduced / transferred ✓ Brakes gain / absorb thermal energy / heat ✓	**2** (AO1.1) (AO1.2)	**ALLOW** surroundings gain thermal energy / heat dissipated to surroundings **IGNORE** just brakes get hot <u>Examiner's Comments</u> The majority of candidates knew that the kinetic energy store would decrease or be transferred and so were credited with one mark. Fewer candidates gained the second mark as although they referred to heat or thermal energy they did not specify that the energy was transferred to the brakes or surroundings (i.e. into a thermal energy store).
		iii	AWARD **ALL** CANDIDATES 3 MARKS	**3** (AO2 × 2.1) (AO1.2)	
			Total	**7**	

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Question			Answer/Indicative content	Marks	Guidance
7			C ✓	1 (AO 2.2)	<u>Examiner's Comments</u> Higher ability candidates added an extra column to the table to calculate the change in temperature. These candidates were also more likely to write down their workings, even for multiple choice questions. See exemplar 1 Exemplar 1 6 A student wants to find out which heater produces the largest temperature rise. Look at the results she collects and the calculations she makes. Heater / Starting temperature (°C) / Finishing temperature (°C) / Change in temperature (°C) A / 18 / 28 / 20 10 B / 18 / 36 / 16 18 C / 18 / 44 / 26 26 D / 18 / 51 / 23 33 Which heater has results that are correctly calculated? Your answer C ✓
			Total	1	
8			C ✓	1 (AO 2.2)	<u>Examiner's Comments</u> About two-thirds of the candidates got this question correct: the commonest wrong answer here was A, presumably looking at the symmetry in the bottom part of the diagram.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
9			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.75 (s) award 3 marks Recall: (Reaction) time = (Thinking) distance ÷ Speed ✓ 6÷8 or 12÷16 or 24÷32 ✓ = 0.75 (s) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	IGNORE correct substitutions if NOT rearranged Examiner's Comments 10% of candidates recalled the speed equation and rearrange it as *reaction time = thinking distance ÷ speed*. The majority of the candidates were unable to interpret the data from the table and very few realised that the reaction time depended on the thinking distance before calculating the answer.
			Total	3	
10			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 120 (N/cm^2) award 3 marks Recall: pressure = force ÷ area ✓ 12000 ÷ 100 OR 40000÷ 25 ✓ = 120 (N/cm^2)	3 (AO 1.2) (AO 2.1) (AO 2.1)	ALLOW 12000÷25 for one mark ALLOW for two marks 480 (N/cm^2) Examiner's Comments Candidates are advised to start their response to this type of question by writing down the appropriate equation. They should then substitute the numbers from the stem of the question into the equation before they calculate the answer. Making sure to write down each stage of the process. A common error was candidates who had not allowed for the four tyres and gave a final answer of 480 N/cm^2.
			Total	3	

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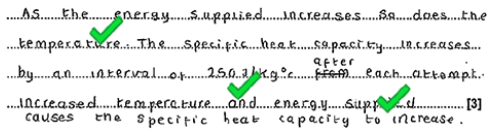
Question			Answer/Indicative content	Marks	Guidance
11	a		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 12 (m/s) award 2 marks Rearrange formula - 4 × 3 ✓ 12 (m/s) ✓	2 (AO 2.1) (AO 2.1)	<u>Examiner's Comments</u> Higher ability candidates wrote out in a recognisable form that *change in velocity = acceleration × time = 3 × 4 = 12 (m/s)*. A common misconception was to divide the acceleration by time taken (i.e. 3 × 4 = 0.75). Candidates should be encouraged to put the numbers into the given equation which will help them to identify if they will need to rearrange the formula.
	b		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 800 (kg) award 3 marks Recall: force = mass × acceleration ✓ 4000 ÷ 5 ✓ 800 (kg) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	ALLOW 0.8 for two marks <u>Examiner's Comments</u> Some candidates divided their calculated answer by 1000 so that there answer was actually in tonnes rather than kilograms. Because the equation uses force in N and acceleration in m/s^2 the computed mass will be kilograms. Other candidates divided 4000 by 5^2 perhaps thinking that 5 m/s^2 implied it needed to be squared.
			Total	5	

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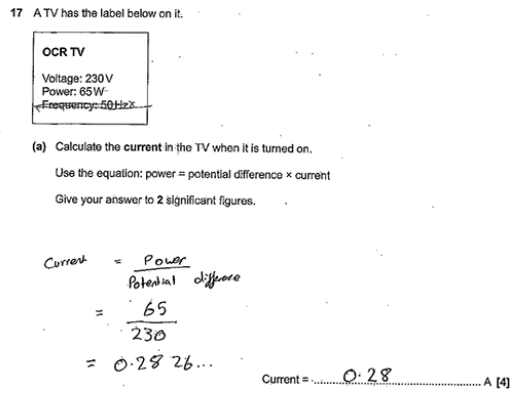
Question			Answer/Indicative content	Marks	Guidance
12	a	i	5250 (J/kg°C) ✓	1 (AO1.2)	<u>Examiner's Comments</u> Most candidates (≈ 90%) were able to calculate the mean specific heat capacity efficiently.
		ii	**Any three from:** specific heat capacity increases with temp rises ✓ specific heat capacity increases with energy supplied ✓ temp rise increases with energy supplied ✓ different amounts of energy were supplied ✓ all of the s.h.cs. are close together (within 5%) / within the range 5000 – 5500 ✓ the experiment was repeated / done 3 times ✓	3 (AO3 × 3.2b)	**ALLOW** other reasonable observation, e.g. s.h.c. increases with longer heating <u>Examiner's Comments</u> This question expected the candidate to describe the patterns in the tabulated data and to recognise that the table recorded values from three repeats of the experiment with the control variable changed. There were a number of different marking points to allowed candidates to achieve full marks. However, most candidates' answers were too brief and only described one or two possible conclusions. **AfL** For this style of question which is assessing AO3 it is important to encourage candidates to write about a minimum of three different conclusions that could be drawn. The space provided is indicative of the expected answer, so in this example describing four "conclusions" briefly (Exemplar 4) would be a better approach than one "conclusion" described in greater detail (Exemplar 3). Exemplar 3 (ii) Describe the conclusions that can be drawn from the data. As the energy supplied increases, the specific heat capacity also increases. [3]

Question			Answer/Indicative content	Marks	Guidance
					Exemplar 4 {(ii)} Describe the conclusions that can be drawn from the data.  As the energy supplied increases so does the temperature. The specific heat capacity increases by an interval of 250 J/kg°C after each attempt. Increased temperature and energy supplied causes the specific heat capacity to increase. [3]
	b	i	**Any two from:** more energy (than expected) heated the water ✓ energy losses must have occurred/not all the energy went into the water ✓ energy transferred to environment /AW ✓	2 (AO2 × 3.2b)	**ALLOW** heat for energy **Examiner's Comments** Only a very few candidates answered this question well. These candidates realised that a "higher" calculated value of specific heat capacity meant that more energy had to be transferred to the beaker than was expected. These candidates concluded that much energy had been lost to the environment.
		ii	**Any two linked answers from:** part of the immersion heater is out of the water ✓ make sure the heater is fully in the water/use a larger/deeper beaker ✓ beaker is not lagged/insulated ✓ lag/insulate the beaker ✓ there is no lid on the beaker ✓ put a lid on the beaker ✓ the temperature rises are quite small ✓ apply more energy to the water ✓ insufficient data ✓ take more readings ✓	4 (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b)	**Examiner's Comments** Most candidates appeared not to appreciate how the story of the topic being assessed was developed through Q18 and in particular how their answer to Q18(b)(i) should help them in answering Q18(b)(ii). Most candidates offered random comments unrelated to Q18(b)(i). A popular response was the suggestion that a Bunsen burner should be used rather than an electrical immersion heater.
			Total	**10**	

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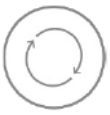
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Question			Answer/Indicative content	Marks	Guidance
13	a		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.28 (A) award 4 marks Rearrange equation current = power ÷ potential difference/ I = P ÷ V ✓ I = 65 ÷ 230 ✓ I = 0.2826086 ✓ I = 0.28 (A) ✓	4 (AO1.2) (AO2.1) (AO2.1) (AO1.2)	NOTE If answer not to 2 sig figs max 3 marks ALLOW one mark for any calculated answer to 2sf Examiner's Comments Higher ability candidates rearranged the equation, substituted the numbers and wrote the answer as 0.2826 before rounding the answer as 0.28 (two significant figures). A number of candidates wrote their answer exactly from the calculator as 0.28 which was not acceptable for two significant figures. Exemplar 1  17 A TV has the label below on it. OCR TV Voltage: 230 V Power: 65 W Frequency: 50 Hz (a) Calculate the current in the TV when it is turned on. Use the equation: power = potential difference × current Give your answer to 2 significant figures. Current = Power / Potential difference = 65 / 230 = 0.28 26... Current = 0.28 A [4] This candidate has clearly rearranged the equation and then substituted the correct numbers from the data box. It is then clear that the candidate has then calculated the correct answer before rounding it correctly to two significant figures.

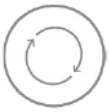
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Question			Answer/Indicative content	Marks	Guidance
					The candidate has perhaps helpfully crossed out the frequency as this is not needed for this part. Candidates need to be careful about crossing out quantities as the crossed out quantities might be needed in later parts. Underlining the quantities needed is probably a better method.  AfL For calculations, candidates should show their working. The following steps are useful: 1 Recall equation or select the appropriate equation from the data sheet (if not given in the question) 2 rearrange equation, if necessary 3 substitute the numbers into the equation 4 calculate the answer 5 consider significant figures or decimal places.
	b		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 117000 (or 116000) (J) award 4 marks E = P x t ✓ Unit conversion 30 minutes = 1800 seconds ✓ E = 65 x 1800 ✓ E = 117000 (J) ✓	4 (AO1.2) (AO1.2) (AO2.1) (AO2.1)	ALLOW ECF from (a) E = Q x V or I x t x V E = 0.28 ×1800 × 230 ALLOW ECF for incorrect time conversion ALLOW three marks for 1950 (J) E = 116000 (J) ✓ <u>Examiner's Comments</u> Candidates did not always know which equation to use. Many recalled correctly the equation relating energy, power and

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Question			Answer/Indicative content	Marks	Guidance
					time but did not always remember that the energy needed to be measured in seconds. Higher ability candidates clearly showed their working including the conversion of 30 minutes to 1800 seconds. Some candidates recalled that E = Q × V and Q = I × t or E = I × t × V and used the answer from 17(a). This was correct physics and thus gained full credit.  AfL When carrying out calculations, candidates should consider units. Normally time is measured in second. Candidates should be aware of exceptions to the normal units, e.g. when energy transferred is measured in kW h, then the power is measured in kilowatt, kW and time in hour h. Similarly, if a speed is measured in measured in km / h, then the distance should be measured in kilometre, km and the time in hour, h.
			Total	8	

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Question			Answer/Indicative content	Marks	Guidance
14	a	i	Bar C drawn to the correct height of 12s ✓	1 (AO1.2)	Examiner's Comments Most candidates drew the correct bar in (a)(i) and then went on to carry out an accurate calculation of the mean time.
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 12 (s) award 2 marks 14 + 10 + 12 = 36 / (14 + 10 + 12)/3 without the 36 ✓ 36 ÷ 3 = 12 (s) ✓	2 (AO3.1a) (AO1.2)	ECF from (a)(i) ECF from mp1 above Examiner's Comments Most candidates drew the correct bar in (a)(i) and then went on to carry out an accurate calculation of the mean time.
		iii	Lift B ✓ Takes the least time (power is work done ÷ time taken)/AW ✓	2 (AO3.1b) (AO1.2)	If A chosen and correct explanation (for B) given, award mp2 but not mp1 Examiner's Comments Many candidates identified lift B uses the most power correctly but did not provide an explanation of why it use the most power for the second mark. Some candidates clearly thought the highest bar in the bar chart indicated a greater height reached by the lift and so chose lift A.

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Question			Answer/Indicative content	Marks	Guidance
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4166.7 (W) award 4 marks	4	
			P = *E* ÷ *t* / power = work done ÷ time taken ✓	(AO1.2)	ALLOW energy (transferred) ÷ time taken
			P = 50000 ÷ 12 ✓	(AO2.1)	
			P = 4166.666667 (W) ✓	(AO2.1)	ALLOW 4166.7 for 2 marks if more dp not given
			P = 4166.7 (W) (1dp)✓	(AO1.2)	ECF own calculated power to 1 dp <u>Examiner's Comments</u> Part (i): required candidates to round their answer to one decimal place. Many candidates did the calculation well and gained 4/4, or 3/4 with incorrect rounding. Any calculation error in finding the power of the lift could still earn the candidate the last mark if their result was rounded correctly. Part (ii) was done correctly by the majority of candidates. The stem of the question contained some data that they did not need to complete the calculation, which made this a more challenging task than it may appear to be.
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3000 (J) award 3 marks ✓	3	
			Work done = force × distance ✓	(AO1.2)	
			W = 750 x 4 ✓	(AO2.1)	
			W = 3000 (J) ✓	(AO2.1)	
			Total	12	

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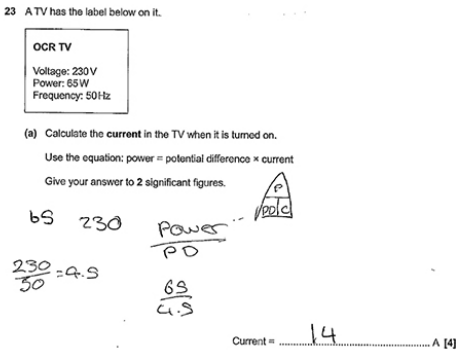
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Question			Answer/Indicative content	Marks	Guidance
15	a		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.28 (A) award 4 marks	4	
			Rearrange equation current = power ÷ potential difference/ I = P ÷ V ✓	(A1.2)	
			I = 65 ÷ 230 ✓	(A2.1)	
			I = 0.2826086 ✓	(A2.1)	NOTE If answer not to 2 sig figs max 3 marks
			I = 0.28 (A) ✓	(A1.2)	ALLOW one mark for any calculated answer to 2sf Examiner's Comments In their response to this question candidates earned a marks for the correct rearrangement of the given equation, a mark for substitution of the appropriate values, a mark for evaluation, and a mark for expressing the evaluated result to 2 significant figures. Error-carried-forward applied here, as shown in Exemplar 9. The first mark was earned by the power/p.d. quotient; it would have been cleared if they had included a subject to make it into a clear equation). There was no obvious logic to their other workings, but the final expression written is 65/4.5 = 14.4444 which (expressed to 2 s.f.) is 14, so earned second mark was given. Examiners are expected to mark positively and although the candidate has not set their workings out sensibly the examiner has assumed 65/4.5 and 14 to be the candidate's final decision.

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Question			Answer/Indicative content	Marks	Guidance
					Exemplar 9  23 A TV has the label below on it. OCR TV Voltage: 230 V Power: 65 W Frequency: 50 Hz (a) Calculate the **current** in the TV when it is turned on. Use the equation: power = potential difference × current Give your answer to **2** significant figures. 65 230 Power / PD 230/50 = 4.5 65/4.5 Current = 14 A [4]
	b		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 117000 (or 116000) (J) award 4 marks E = P x t ✓ Unit conversion 30 minutes = 1800 seconds ✓ E = 65 x 1800 ✓ E = 117000 (J) ✓	4 (A1.2) (A1.2) (A2.1) (A2.1)	ALLOW ECF from (a) E = Q x V or I x t x V E = 0.28 x 1800 x 230 ALLOW ECF for incorrect time conversion ALLOW three marks for 1950 (J) E = 116000 (J) ✓ <u>Examiner's Comments</u> This calculation, the last on the paper, required recall of the energy/power/time relationship and conversion of minutes to seconds, resulting in a large value answer. One candidate did calculate 117000 J correctly and then wrote 'Wrong!' next to it: However, the examiner ignored this comment and the candidate was credited with full marks for the question.
			Total	8	

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Question			Answer/Indicative content	Marks	Guidance
16		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.06 (m / s) award 3 marks Speed = 0.6 × 0.1 ✓ Speed = 0.06 (m / s) ✓	2 (AO2 × 2.1)	
		ii	Distance is measured with a metre-rule OR tape measure ✓ Time is measured with a stop-watch ✓	2 (AO2 × 1.2)	ACCEPT metre-ruler DO NOT ALLOW ruler
		iii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.08 (m / s) award 3 marks Speed = distance ÷ time ✓ = 2.4 ÷ 30 ✓ = 0.08 (m / s) ✓	3 (AO1 × 1.2) (AO2 × 2.1)	
		iv	Uncertainty/difficulty in measuring distance ✓ OR Human reaction time in starting/stopping stopwatch ✓	1 (AO3.2a)	ALLOW AW
			Total	8	

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Question			Answer/Indicative content	Marks	Guidance
17		i	Point 1,1 correctly plotted within ½ small square ✓ Suitable curved line of best-fit drawn ✓	2 (AO2.2 x 2)	Should be within 1 small square of each point. May not be extrapolated to (0,0,)
		ii	Current increases as potential difference increases/AW ✓ Rate of increase reduces/current increases more slowly with potential difference/AW ✓	2 (AO3.1a) (AO3.1a)	**IGNORE** it is a straight line **ALLOW** (they are) not proportional / not linear **ALLOW** resistance increases as current goes up/filament gets hotter
		iii	Change lamp for a (fixed) resistor ✓ Measure current for different potential differences/AW ✓	2 (AO1.2 x 2)	**ALLOW** repeat the experiment
		iv	Straight line (through the origin)/ current is (directly) proportional to voltage ✓ Resistance is constant./not changing/ fixed✓	2 (AO1.2 x 2)	**ALLOW** obeys Ohm's Law
			Total	**8**	

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Question			Answer/Indicative content	Marks	Guidance
18		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.5 (N/cm) award 3 marks (Spring constant =) force ÷ extension ✓ 2.0 ÷ 4.0 ✓ = 0.5 (N / cm) ✓	3 (AO1.2) (AO2.1) (AO2.1)	ALLOW 3 marks for 50 N/m Needs algebraic or arithmetic rearrangement for this m.p. Choice of *F, ext* for wrong data point loses mp2 but can get mp3 for evaluation ecf.
		ii	Any two from: Repeat readings and calculate a mean/average ✓ Use more forces ✓ Plot data on a graph (and use a line of best fit) ✓ Use equipment with a higher resolution✓ Repeat experiment with different equipment (and compare results) ✓	2 (AO3.3b x 2)	
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
19	a		Tape measure / metre rule(r)/stick **AND** Stop clock/watch✓	1 (AO1.2)	**IGNORE** just ruler **ALLOW** light gates
	b	i	Mean = 2(.00) ✓ Median = 2.02 ✓ Mode = 2.08 ✓	3 (AO1.2 x 3)	**ALLOW** 2.04 for mean (for ignoring 1.84) **ALLOW** 2.06 for median if 2.04 calculated for the mean
		ii	(They have a) wide spread/range / AW ✓	1 (AO3.2a)	**ALLOW** (they are) not all close together / don't have a small difference / not similar / AW **ALLOW** they are too different / have a big gap / not concordant / 0.24 gap **IGNORE** not consistent
		iii	Improvement must be linked to error Error: Reaction time / difficulty in starting/stopping timer at exact time / AW ✓ Improvement: Video/record the drop (and replay using timings from the recording) / use an electronic timing method / light gates / A/W ✓ **OR** Error: Not dropping ball from exact height / AW Improvement: Indication of marking the point from where it should be dropped / A/W	2 (AO3.3b) (AO3.3a)	Marks can be awarded for errors/improvements in either section **IGNORE** difficulty in timing without reason **IGNORE** human error unless qualified **ALLOW** use larger distances (so that % error in time is reduced)
			Total	7	

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