

Question number	Answer	Notes	Marks														
2 (a)	<p>all three correct ticks = 3 marks;;;</p> <p>two correct ticks = 2 marks;;</p> <p>one correct tick = 1 mark;</p> <table><thead><tr><th>Statement</th><th>Correct (✓)</th></tr></thead><tbody><tr><td>uranium-235 loses a proton to become uranium-236</td><td></td></tr><tr><td>uranium-235 absorbs a neutron to become uranium-236</td><td>✓</td></tr><tr><td>daughter cells are produced when uranium-236 splits</td><td></td></tr><tr><td>the nuclear energy store of uranium-236 increases when it splits</td><td></td></tr><tr><td>two or three neutrons are typically released when uranium-236 splits</td><td>✓</td></tr><tr><td>energy is transferred to the kinetic store of the fission products when uranium-236 splits</td><td>✓</td></tr></tbody></table>	Statement	Correct (✓)	uranium-235 loses a proton to become uranium-236		uranium-235 absorbs a neutron to become uranium-236	✓	daughter cells are produced when uranium-236 splits		the nuclear energy store of uranium-236 increases when it splits		two or three neutrons are typically released when uranium-236 splits	✓	energy is transferred to the kinetic store of the fission products when uranium-236 splits	✓	<p>-1 for 4 ticks</p> <p>-2 for 5 ticks</p> <p>0 marks if all ticked</p>	3
Statement	Correct (✓)																
uranium-235 loses a proton to become uranium-236																	
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energy is transferred to the kinetic store of the fission products when uranium-236 splits	✓																
(b)	neutron / n / neutrons;		1														
(c)	<p>B (a helium nucleus);</p> <p>A is incorrect because this describes gamma radiation</p> <p>C is incorrect because this describes beta radiation</p> <p>D is incorrect because this describes neutron radiation</p>		1														
(d)	beta (minus);	<p>accept β, β^-</p> <p>reject beta plus</p>	1														

Total for Question 2 = 6 marks

Question number	Answer	Notes	Marks
8 (a)	take repeats and find the mean;	allow 'average' for 'mean'	1
(b)	any two from: MP1. mass (being lifted); MP2. height (lifted) / distance; MP3. power supply / circuit being used; MP4. temperature (of motor);	ignore 'same motor' condone weight	2
(c)	conversion of cm to m; substitution into $GPE = \text{mass} \times g \times \text{height}$; e.g. $50 \text{ cm} = 0.5 \text{ m}$ $GPE = 1 \times 10 \times 0.5 (= 5 \text{ J})$	allow 0.5 seen anywhere allow use of $g = 9.8(1) \text{ (m/s}^2\text{)}$	2
(d) (i)	efficiency formula seen; substitution; evaluation; e.g. efficiency = useful energy output / total energy input efficiency = $5 / 12.7 (\times 100\%)$ efficiency = 39.4 (%)	ignore s.f. allow 39, 39.37... reject unsupported incorrect answer	3
(ii)	suitable linear scale chosen (>50% of grid used); axes labelled with quantities and unit; all plotting correct to nearest half square;	ignore orientation ignore plotting at 10V	3
(iii)	acceptable curve of best fit drawn up to a voltage of 6V; straight horizontal line of best fit drawn from 6V onwards;	i.e. curved line with even distribution of points either side by eye	2
(iv)	correctly read voltage from graph consistent with candidate's curve of best fit;	allow range 5.4V - 6.6V allow ecf from (iii)	1

Total for Question 8 = 14 marks

Question number	Answer	Notes	Marks
9 (a)	correct voltmeter symbol; voltmeter connected in parallel with resistor;		2
(b)	light dependent resistor;	allow LDR	1
(c) (i)	9(.0) (V);		1
(ii)	substitution OR rearrangement; evaluation; e.g. $9.0 = \text{current} \times 4500$ OR $\text{current} = \text{voltage} / \text{resistance}$ (current =) 0.0020 (A)	allow ecf from (i) allow 0.002 (A)	2
(iii)	substitution OR rearrangement; evaluation in Ω ; conversion to $k\Omega$; e.g. $3.0 = 0.0020 \times \text{resistance}$ OR $\text{resistance} = \text{voltage} / \text{current}$ (resistance =) 1500 (Ω) (resistance =) 1.5 ($k\Omega$)	allow ecf from (ii)	3
(d)	lamp should be connected in parallel with component X / LDR; resistance of component X increases when it gets dark; voltage across component X increases / becomes greater than 10V when it gets dark;		3

Total for Question 9 = 12 marks

Question number	Answer	Notes	Marks
11 (a)	<p>value of braking distance correctly read from graph; substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation;</p> <p>e.g. braking distance = 78 m $0 = 35^2 + (2 \times a \times 78)$ $(a =) (-) 35^2 / (2 \times 78)$ $(a =) (-) 7.9 \text{ (m/s}^2\text{)}$</p>	<p>allow 77-79 m allow ecf incorrect distance</p> <p>allow 7.75... - 7.95...(m/s²)</p>	4
(b)	<p>any five from:</p> <p>MP1. thinking distance OR braking distance increases as (initial) speed increases; MP2. braking distance increases by a greater amount than thinking distance for the same increase in (initial) speed; MP3. thinking distance is (directly) proportional to (initial) speed; MP4. braking distance has a non-linear relationship with (initial) speed; MP5. idea that braking distance is proportional to (initial) speed squared; MP6. suitable use of data to justify thinking distance relationship; MP7. suitable use of data to justify braking distance relationship;</p>	<p>e.g. gradient of braking distance graph larger than gradient for thinking distance</p> <p>e.g. when initial speed doubles, the braking distance is four times greater / eq. e.g. reading off thinking distance for two values of initial speed and showing they increase by the same factor e.g. reading off braking distance for two values of initial speed and showing they do not increase by the same factor</p>	5

Total for Question 11 = 9 marks

Question number	Answer	Notes	Marks
12 (a) (i)	47 (°);		1
(ii)	$\sin(c) = 1 / n$;		1
(iii)	substitution OR rearrangement; evaluation; e.g. $\sin(47) = 1/n$ OR $n = 1/\sin(c)$ (n =) 1.4	allow ecf from (i) answer is 1.37 to 3sf if (i) is given as 43° then expected answer is 1.5 to 2sf /1.47 to 3 sf	2
(b)	ray is refracting / angle of incidence is less than critical angle; critical angle for water is greater than for acetone; refractive index of water is less than for acetone;	award full marks for a correct calculation of the refractive index of water with correct conclusion e.g. $n_{\text{water}} = 1.33 < n_{\text{acetone}}$ Allow correct conclusion with $n_{\text{water}} = 0.75...$ for 1 mark MAX reject response with otherwise incorrect calculation of n_{water}	3

Total for Question 12 = 7 marks