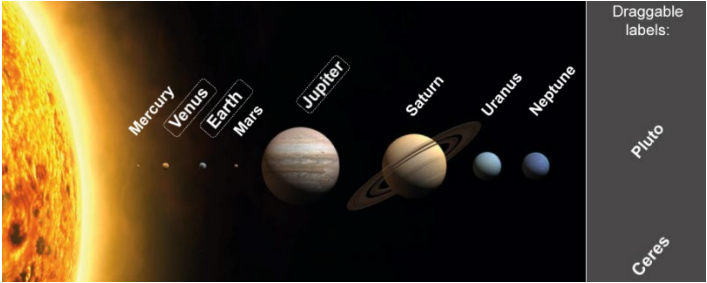
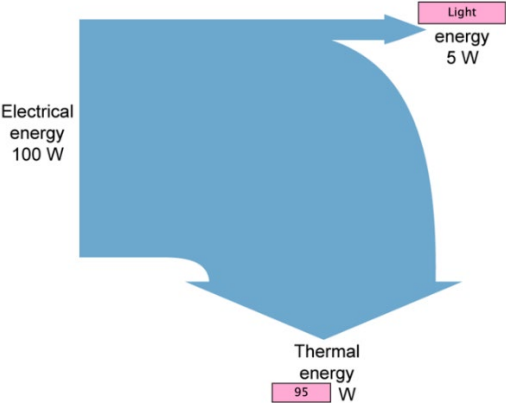
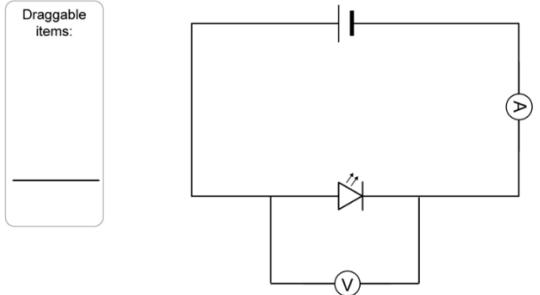


Question	Answers	Notes	Tot	Crit
1	<p>a</p>  <p>Two planets in correct location</p> <p>All three planets in correct location</p>	<p><i>Planets added by candidates are Venus, Earth and Jupiter</i></p>	2	A
	<p>b</p> <p>Accept any object from the list, [max 1]</p> <ul style="list-style-type: none"> • Comets • Asteroids • Minor Planets / Dwarf planets • Moons 	<p><i>Do not accept objects made by humans eg rockets, satellites</i></p>	1	A
	<p>c</p> <p>Accept any two points, for example [max 2]</p> <ul style="list-style-type: none"> • a star is luminous • a star undergoes nuclear fusion in the core • a star is more massive • a star has a greater temperature 	<p>WTTE</p> <p><i>Do not accept the sun is star. Comparison can be implied</i></p>	2	A
	<p>d</p> <p>Accept any three points, [max 3]</p> <ul style="list-style-type: none"> • Galaxies moving apart (with greater speed) imply the universe is expanding • The universe was once in a hot, dense state • The universe is finite in age or the age of the universe is 13.7 billion years • The universe was smaller in the past 	<p>WTTE</p>	3	A
	<p>e</p> <p>Accept any reasonable disadvantage, for example [max 1]</p> <ul style="list-style-type: none"> • conversions are more difficult • people could be unfamiliar with non-SI units • inconsistency with other areas of physics <p>Accept any reasonable advantage, for example: [max 1]</p> <ul style="list-style-type: none"> • Simplifies use of very large numbers • less need for scientific notation 		2	D

2	a	Protons = 6 Neutrons = 8		2	A
	b	Beta Electron / Beta <u>particle</u> or anti neutrino		2	A
	c	5500±100 (years)		1	A
	d	13 000±500 (years)		1	A
	e	At 40 000 the remaining number of C-14 atoms would be very small or close to zero or the graph only shows C-14 data for 40 000 years (So after 65 million years) the remaining C-14 would be too small a sample to detect or measure reliably or (So after 65 million years) C-14 dating is not appropriate or cannot be used in this way		2	A

3	a	 <p>Electrical energy 100 W</p> <p>Light energy 5 W</p> <p>Thermal energy 95 W</p> <p>Light</p> <p>95</p>		2	A
	b	 <p>Draggable items:</p> <p>Correct arrangement of ammeter (series with LED)</p> <p>Voltmeter in parallel with the LED</p>		2	A
	c	<p>Use of $P = VI$</p> <p>0.05 (W)</p>	<p><i>Seen or implied, award two marks for correct answer</i></p>	2	A
	d	<p>Efficiency of filament bulb is 5 %</p> <p>Efficiency for LED is $0.02 / 0.05 = 40 \%$</p> <p>Efficiency for an LED is higher than a filament bulb</p>	<p><i>Only award the 3rd marking point if marking points 1 and 2 are awarded</i></p>	3	A

4	a	Accept any RQ with height of drop linked to height of the first bounce	WTTE	1	B
	b	IV – drop height only DV – height of the first bounce only All controls – kind of ball, surface and temperature only		3	B
	c	0.31 or 31 m or cm	Award unit mark independently	2	C
	d	Gravitational potential energy mentioned Energy transformed into heat or sound or wasted on impact (so) height of first bounce is lower	Do not accept deformation of the ball on impact	3	B
	e	0.25(66666) 0.26 correctly stated to 2 decimal places	Award 2 marks if only 0.26 is seen	2	C
	f	Height of bounce is difficult to measure accurately Effect of random errors is minimized or allows for the calculation of an average	WTTE Do not accept references to accuracy for the second marking point	2	C
	g	(Graph B selected) Accept any two points from the list [max 2] <ul style="list-style-type: none"> • Data points cover more than half of the area • Allows the curve of the graph to be seen clearly • Allows a correct trendline to be fitted • The straight trend line has a non-zero intercept (which is illogical) 	No mark for graph selection although graph B must be selected to be awarded the marking points	2	C
	h	As drop height increases, the bounce height increases Curved trendline or trendline is not straight or Doubling the drop height does not double the bounce height or As the drop height increases, the height of the bounce does not increase proportionally so the prediction is incorrect	Award first mark separately, third point can only be awarded if the first two are also seen	3	C

5	a	<p>Accept any reasonable suggestion, for example [max 1]</p> <ul style="list-style-type: none"> • Simple equipment can be used to measure height (but not speed) • Speed is changing • Measuring height gives less random error than measuring speed 	Do not accept measuring speed is more difficult than measuring height	1	B																					
	b	No height of bounce or the ball would not bounce or no speed of rebound	WTTE	1	A																					
	c	<table border="1"> <thead> <tr> <th colspan="3">Table Object</th> </tr> <tr> <th>Drop height (h_1) / m</th> <th>Average height of first bounce (h_2) / m</th> <th>Coefficient of restitution (e)</th> </tr> </thead> <tbody> <tr> <td>0.50</td> <td>0.34</td> <td>0.82</td> </tr> <tr> <td>1.00</td> <td>0.65</td> <td>0.81</td> </tr> <tr> <td>1.50</td> <td>0.94</td> <td>0.79</td> </tr> <tr> <td>2.00</td> <td>1.21</td> <td>0.78</td> </tr> <tr> <td>2.50</td> <td>1.44</td> <td>0.76</td> </tr> </tbody> </table> <p>Results in order</p> <p>Units added for drop height column header only</p> <p>Drop heights converted to unit consistent with header</p> <p>Evidence of e value calculated correctly (0.77781...)</p> <p>e correctly rounded to 2 or 3 sig figs 0.78 or 0.778</p> <p>Rounded to consistent DPs for drop height and two DP for e column</p>	Table Object			Drop height (h_1) / m	Average height of first bounce (h_2) / m	Coefficient of restitution (e)	0.50	0.34	0.82	1.00	0.65	0.81	1.50	0.94	0.79	2.00	1.21	0.78	2.50	1.44	0.76	<p>Accept cm or m</p> <p>Seen or implied</p> <p>Do not accept addition of 0 to achieve consistent DP</p>	6	C
	Table Object																									
Drop height (h_1) / m	Average height of first bounce (h_2) / m	Coefficient of restitution (e)																								
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d	<p>e values change or are not constant</p> <p>e values decrease with height</p> <p>(so) hypothesis is incorrect</p>	<p>Accept e depends on height</p> <p>First marking point is implied by the second</p> <p>Do not award the third mark unless the first two marking points are awarded</p>	3	C																						
e	<p>KE = $\frac{1}{2}mv^2$</p> <p>Coefficient of restitution is the ratio between speeds whereas KE is related to speed squared</p> <p>0.5 speed means 25 % kinetic energy remains or 75 % is wasted</p>	Seen or implied	3	C																						

6	a		1	2	3	4	14	B	
		Variables	Height implied as only dependent variable or thickness implied as only independent variable	IV of thickness and DV of height stated	IV, DV and one CV stated	IV, DV and one CV stated and justified			
		Hypothesis	Attempt at a hypothesis linked to either thickness or height	Hypothesis links to thickness and height of first bounce	Hypothesis links to thickness and height of first bounce with attempted explanation not linked to science	Hypothesis links to thickness and height of first bounce with explanation linked to energy transformations, dissipation of energy or forces			
		Equipment	Equipment to measure height						
		Data	Reference to different thickness or trials	At least five different thicknesses or three trials	At least five different thicknesses and three trials				
		Method	Method is described, could be followed, will produce relevant data	Method is described, could be followed, will produce relevant data with consideration of how to minimize errors					
	b	<p>Research question: Any relevant research question</p> <p>IV: Accept any reasonable IV, for example [max 1]</p> <ul style="list-style-type: none"> • Surface • material of ball • pressure of ball • temperature of ball <p>Control variables: accept any two reasonable CV, for example [max 2]</p> <ul style="list-style-type: none"> • drop height • temperature of ball • surface 				<p><i>Do not accept drop height or thickness of sponge layer for IV</i></p>		4	C

7	a	Heat is transferred to surroundings, insulation is poor (in actively heated houses) or Good insulation minimizes heat losses (in passively heated houses) (so) less additional heat is needed to maintain comfortable temp (as less is lost in passively heated houses)	ORA	2	D
	b	Conduction is heat transfer through solids Air or air gaps are a poor <u>conductor</u> or a good <u>insulator</u>		2	D
	c	Air (particles) will move from areas of higher pressure to areas of lower pressure If there is a leak or a gap, the air will escape or (so) higher pressure inside the house wall causes air to move from inside to outside the house Enabling the location of the leak to be found		3	D
	d	15±1%		1	C
	e	Reduced fossil fuels needed to meet energy requirements Hence less pollution from burning fuels to generate energy or lower impact on climate change		2	D

