

Question	Answers	Notes	Total	Criterion	
1	a	speed of sound=330 ms ⁻¹ and speed of light = 300 000 000 ms ⁻¹		1	A
	b	<u>time between lightning and thunder</u> use speed = distance / time to find distance using speed of sound in air	<i>Accept velocity, displacement</i> <i>Can be implied, award separately</i>	3	A
	c	moving with constant / unchanging speed or it is not accelerating any additional point, for example <ul style="list-style-type: none"> • moving towards and then away from student • it passes at a distance of 1 km • it passes overhead 		2	A
	d	values from graph to give 12 (km hr ⁻¹)	<i>Seen or implied</i> <i>Ignore incorrect unit if present</i>	2	A
2	a	<u>electrons are transferred from the small upward moving crystals to the water drops</u>		1	A
	b	R=500 000/20 000 R=25 correct unit Ω	<i>Seen or implied</i>	3	A
	c	ΔQ = I Δt ΔQ = 0.6 (C)	<i>Seen or implied from</i> <i>20 000 x 30 x 10⁻⁶</i> <i>Award 1 mark for 600000 (°C)</i>	2	A
	d	metal is a better conductor / has a lower resistance than buildings current/charge from lightning will flow through the conductor current/charge passes to earth (without passing through building)		3	A

3	a	<p>All three correct</p> <div style="border: 1px solid black; padding: 5px; width: fit-content;"> Draggable: ${}^0_{-1}\beta$ ${}^4_2\alpha$ </div> ${}^{241}_{95}\text{Am} \rightarrow {}^{237}_{93}\text{Np} + {}^4_2\alpha$ ${}^{210}_{84}\text{Po} \rightarrow {}^{206}_{82}\text{Pb} + {}^4_2\alpha$ ${}^{240}_{93}\text{Np} \rightarrow {}^{240}_{94}\text{Pu} + {}^0_{-1}\beta$		1	A
	b	atomic number = 107 mass number = 270 bohrium or Bh	Award all marks independently	3	A
	c	high energy or high frequency or short wavelength electromagnetic waves or radiation or photon	Do not accept particle	2	A
	d	Carbon-14 after 10 000 years the change in abundance will be noticeable or the half-life is appropriate to the situation it exists in nature	WTTE	3	A

4	a	<p>Image Object</p> <table border="1"> <thead> <tr> <th>Independent variable</th> <th>Dependent variable</th> <th>Control variables</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/> Drop height</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/> Internal air pressure</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/> Bounce height</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/> Size of ball</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/> Bouncing surface</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/> Material of the ball</td> </tr> </tbody> </table> <p>Text/MCQ/Mini-Cloze Object</p> <p>Independent: only internal air pressure chosen</p> <p>Dependent: only bounce height chosen</p> <p>Two control variables correct</p> <p>All control variables correct</p>	Independent variable	Dependent variable	Control variables	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Drop height	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Internal air pressure	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Bounce height	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Size of ball	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Bouncing surface	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Material of the ball		4	B
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	b	<p>Text/MCQ/Mini-Cloze Object</p> <p>Measurements each 10 kPa; 3 repetitions at each pressure</p> <p>comment for reliability, for example [max 1]:</p> <ul style="list-style-type: none"> allows a mean to be calculated reduces experimental uncertainty <p>sufficient data or data across the full range</p>		3	B																					

	<p>c Safety factor linked to the question is stated, for example [max 1]:</p> <ul style="list-style-type: none"> • use a safe method to drop from height • avoid bouncing into the face • avoid over pressurizing the ball <p>Justification, for example [max 1]:</p> <ul style="list-style-type: none"> • to avoid falling injury • to avoid injury • the ball might explode 	<p><i>Consider both response boxes when awarding marks for this question part</i></p>	<p>2</p>	<p>B</p>
	<p>d 83±0.5</p> <p>kPa</p>	<p><i>Notes award 1 mark 12.5 PSI if unit is also present</i></p> <p><i>Do not accept kpa for the unit mark</i></p>	<p>2</p>	<p>D</p>
	<p>e line must go through all of the data points</p>		<p>1</p>	<p>C</p>
	<p>f 0.63 – 0.65 (m)</p>		<p>1</p>	<p>C</p>
	<p>g y intercept corresponds to bounce height approx. 0.40 m</p> <p>ball is deflated when its pressure is 0 kPa</p> <p>so in reality it will not bounce at all</p>		<p>3</p>	<p>C</p>
	<p>h if the relationship was proportional, the line would go through the origin of the graph</p> <p>the line does not go through the origin – it is not proportional</p>		<p>2</p>	<p>C</p>

5	a	<p>Identification of incorrect step in the method from this list <u>only</u> [max 2]</p> <ul style="list-style-type: none"> • ruler not used correctly – eg at an angle, not placed on the floor • different ball used • bounce height measured incorrectly • ball is dropped at a different angle or height <p>Effect of the error on the measurement [max 2]</p> <ul style="list-style-type: none"> • the measurement of bounce height will be inconsistent <p>Improvement linked with the step identified [max 2]</p> <ul style="list-style-type: none"> • hold the ruler vertically • place the ruler on the floor • use the same ball for all repeats 	<p>WTTE</p> <p>Consider all three responses for each step when awarding marks</p>	6	C C																
	b	<p>evidence of method of conversion to m</p> <p>0.51(33)</p>	<p>No ECF from first marking point, ignore sig fig errors</p>	2	C																
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	d	data point plotted correctly (0.51, 1.8) X axis: drop height/m and Y axis: bounce height/m	<i>ECF part b</i> <i>Accept incorrect use of brackets, metres</i> <i>There must be a clear difference in the two types of height measured. Do not accept height alone</i>	2	C
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7	a	wind		1	A
	b	both global temperature and the amount of CO ₂ increases use of values from the graph for both temperature and CO ₂		2	D
	c	increased use of fossil fuels because of industrialization	WTTE	2	D
	d	Any two reasonable consequences of increasing temperature, for example [max 2] <ul style="list-style-type: none"> • as the temperature rises, the polar ice sheets melt • changing environmental conditions reduce plant growth Any two correctly linked impacts, for example [max 2] <ul style="list-style-type: none"> • rising ocean levels • desertification 		4	D
	e	One type of technology, for example [max 1] <ul style="list-style-type: none"> • wind power • carbon capture • electric vehicles A strength of using this technology to reduce CO₂, for example [max 1] <ul style="list-style-type: none"> • no fossil fuels are burnt • existing technology can be used • converts wind energy to electrical energy • CO₂ is stored underground • electric vehicles do not produce CO₂ A limitation of using this technology, for example [max 1] <ul style="list-style-type: none"> • visual impact, noisy • unknown impact of long-term storage • electric vehicles use new technology that is still being developed An additional point, either a strength or limitation [max 1]	Accept any reasonable specific technology	4	D

8		1	2	3	4	11
	Health and well-being	A simple comment on a health or well-being impact for one of the methods	A health or well-being impact for both methods or a linked explanation for how one method impacts health	A health or well-being impact for both methods with a linked explanation for how the method impacts health for either method	A health or well-being impact for both methods with a linked explanation for how the method impacts health for both methods	
	Economic or social impacts	A simple comment on an economic or social impact for one of the methods	An economic or social impact for both methods	An economic or social impact for both methods with a linked explanation for either method	An economic or social impact with a linked explanation for both methods	
	Comparison	Comparison of health impacts for each method or Comparison of economic impacts for each method	Comparison of health impacts for each method and Comparison of economic impacts for each method			
	Final recommendation	Recommendation of one method over another supported with justification (may be seen above)				