



Question number	Answer	Notes	Marks
1 (a)	A – alpha particle;		1
(b)	A – alpha particle;		1
(c)	B – 50 cm;		1
(d)	D - the proton number increases by 1;		1

Total 4 marks

Question number	Answer	Notes	Marks
2 (a)	top line correct e.g. 228; bottom line correct e.g. 88 and 2; e.  $  \begin{array}{c}  \boxed{232} \\  \boxed{90}  \end{array}  \text{Th} \rightarrow  \begin{array}{c}  \boxed{228} \\  \boxed{88}  \end{array}  \text{Ra} +  \begin{array}{c}  \boxed{4} \\  \boxed{2}  \end{array}  \alpha  $		2
(b) (i)	idea that {alpha/beta} is {absorbed by / unable to penetrate} {aluminium / glass};	allow stops / blocks for absorbs  ignore references to paper, air, lead ignore references to gamma, unqualified 'radiation'	1
(ii)	any 2 of:  MP1. idea of radiation being ionising;  MP2. (radiation) causes cancer / cell mutation / kills cells / blindness;  MP3. {alpha / beta} will travel this short distance (between lens and eye);  MP4. idea that astronomer is likely to suffer prolonged exposure;	ignore references to gamma          allow (eye) within penetrating range of {alpha / beta}	2

Total 5 marks

Question number		Answer	Notes	Marks																								
3	a	<table border="1"> <thead> <tr> <th>Type of radiation</th> <th>Deflected upwards</th> <th>Deflected downwards</th> <th>Not deflected</th> </tr> </thead> <tbody> <tr> <td>alpha</td> <td>(✓)</td> <td></td> <td></td> </tr> <tr> <td>beta</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>gamma</td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>neutrons</td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>protons</td> <td>✓</td> <td></td> <td></td> </tr> </tbody> </table> <p>each correct ; ; ; ;</p>	Type of radiation	Deflected upwards	Deflected downwards	Not deflected	alpha	(✓)			beta		✓		gamma			✓	neutrons			✓	protons	✓				4
Type of radiation	Deflected upwards	Deflected downwards	Not deflected																									
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protons	✓																											
	b	i	<p>any sensible suggestion (however phrased); e.g.</p> <ul style="list-style-type: none"> <li>alpha has a small range in air</li> <li>alpha would not hit the gold leaf</li> <li>alpha would be deflected</li> <li>alpha would collide with the air {particles/molecules/RA}</li> <li>alpha would ionise the {air/particles/molecules}</li> </ul>	<p><b>Allow RA</b> condone phrases such as</p> <ul style="list-style-type: none"> <li>air particles interact with alpha</li> <li>air particles interfere with alpha</li> </ul> <p>ignore</p> <ul style="list-style-type: none"> <li>react</li> <li>diffracting</li> <li>to create a vacuum</li> </ul>	1																							
		ii	<p>any TWO <b>results</b> from:</p> <p>MP1. most went (straight) through;</p> <p>MP2. (the paths of) a <b>few</b> were deflected at an <b>acute/small angle</b>;</p> <p>MP3. (the paths of) <b>very few</b> were {deflected through an <b>obtuse angle / backscattered</b>};</p>	<p>NB: no mark for structure of atom or deductions</p> <p>allow bent</p> <p>allow for obtuse</p> <ul style="list-style-type: none"> <li>large</li> <li>&gt;90°</li> </ul> <p>for backscattered</p> <ul style="list-style-type: none"> <li>bounced off the gold foil</li> </ul>	2																							
	c		<p><b>MP 2, 4 can be shown on a diagram</b> any FOUR explanations or deductions from:</p> <p>MP1. Small nucleus; MP2. mostly empty space; MP3. because not many <math>\alpha</math> deflected / because most <math>\alpha</math> go straight through;</p> <p>MP4. Positive OR high mass nucleus; MP5. which causes deflection of <b>positive</b> (or <b>low mass</b>) <math>\alpha</math>;</p>	<p>Ignore ALL comments about electrons</p> <p><b>NB to get MP 3, 5 a causal link is needed</b></p> <p>allow protons are in the centre repulsion, recoil idea that <math>\alpha</math> same charge as nucleus</p>	4																							
				total = 11 marks																								

Question number	Answer	Notes	Marks
4	<p>6 marks from with a MAX of 2 from any one area</p> <p><b>benefits of nuclear fuel</b>  MP1. no CO<sub>2</sub> emitted / no smoke emitted;  MP2. does not contribute to global warming;  MP3. reliable/not weather dependant;  MP4. small volume of waste;  MP5. concentrated energy source/ not much transport costs to bring fuel;  MP6. power stations are relatively small;</p> <p><b>disadvantages of nuclear fuel</b>  MP7. difficult to dispose of <b>waste</b>;  MP8. accidents can spread radiation widely / risk of radiation leak;  MP9. nuclear fuel is toxic / harmful / radioactive / difficult to handle / long half-life;  MP10. decommissioning costs are very high;  MP11. increased security risk/ terrorist attack;</p> <p><b>benefits of biomass</b>  MP12. abundant sources / uses waste products from farms /houses/renewable;  MP13. uses materials which would produce CO<sub>2</sub> anyway, so no net emission;  MP14. can be used to create different products (e.g. manure) as well as energy;  MP15. reduces landfill;  MP16. (source is) relatively cheap;</p> <p><b>disadvantages of biomass</b>  MP17. relatively inefficient;  MP18. can increase methane in atmosphere/can increase green-house gases;  MP19. may require more land;  MP20. high transport costs to collect raw material;  MP21. can be smelly;  MP22. often seasonal power source /variable output source;  MP23. can be storage costs for biogas;</p>	<p>allow other sensible points</p> <p>no green-house effect</p> <p>Allow waste</p> <p>causes acid rain</p>	6
		total = 6 marks	

Question number	Answer	Notes	Marks
5 (a)	(All) the alpha particles would go (straight) through (the foil);	Reject idea that not all alpha particles will go through so do not accept e.g. some, most, nearly all	1
(b) (i)	Idea that result(s) does not fit/match/concur with the pattern/trend;	Ignore <ul style="list-style-type: none"> <li>• 'unexpected' or 'different' unless correctly qualified</li> <li>• references to alpha particle scattering</li> </ul> Allow idea related to a graph, e.g. results far away from the line of best fit Accept outlier	1
(b) (ii)	Either (check and) repeat the measurement/experiment ; OR Work out why the anomalous result(s) occurred;	Accept idea of discarding/excluding from average or graph  formulate a new theory	1
(c)	(there is a large) repulsion; OR like charges repel;  Idea that charge is concentrated (at the centre of the atom);	Ignore deflection as it is the stem on page 8  Allow idea of a region of high charge density	2

(d)	<p>Any TWO reasonable ideas e.g.</p> <ul style="list-style-type: none"> <li>to make (new) discoveries;</li> <li>to check/validate (existing) theories;</li> <li>to disprove (existing) hypotheses/theories;</li> <li>to confirm (other scientists') findings;</li> <li>to test (new) hypotheses;</li> <li>to develop (better) understanding;</li> <li>to improve (students) skills;</li> <li>to gather (new) evidence;</li> </ul>	<p>Allow to give (practical) demonstrations;</p> <p>} accept similar appropriate ideas</p> <p>Allow prove for validate</p>	2
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(Total for Question 5 = 7 marks)