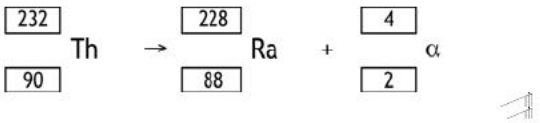
Question number	Answer	Notes	Marks
1 (a)	A – alpha particle;		1
(b)	A – alpha particle;		1
(c)	B – 50 cm;		1
(d)	D - the proton number increases by 1;		1

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. 		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

<table>
<tr><th colspan="3">Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>3</td><td>a</td><td></td><td>
<table>
<tr><th>Type of radiation</th><th>Deflected upwards</th><th>Deflected downwards</th><th>Not deflected</th></tr>
<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>
</table>
each correct ;;;;
</td><td></td><td>4</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>b</td><td>i</td><td>any sensible suggestion (however phrased);
e.g.
• alpha has a small range in air
• alpha would not hit the gold leaf
• alpha would be deflected
• alpha would collide with the air {particles/molecules/RA}
• alpha would ionise the {air/ particles/molecules}</td><td>Allow RA
condone phrases such as
• air particles interact with alpha
• air particles interfere with alpha

ignore
• react
• diffracting
• to create a vacuum</td><td>1</td></tr>
<tr><td></td><td></td><td>ii</td><td>any TWO results from:

MP1. most went (straight) through;

MP2. (the paths of)a few were deflected at an acute/small angle;

MP3. (the paths of) very few were {deflected through an obtuse angle / backscattered};</td><td>NB:
no mark for structure of atom or deductions

allow bent

allow
for obtuse
• large
• >90°
for backscattered
• bounced off the gold foil</td><td>2</td></tr>
<tr><td></td><td>c</td><td></td><td>MP 2, 4 can be shown on a diagram
any FOUR explanations or deductions from:

MP1. Small nucleus;
MP2. mostly empty space;
MP3. because not many α deflected / because most α go straight through;

MP4. Positive OR high mass nucleus;
MP5. which causes deflection of positive (or low mass) α;</td><td>Ignore
ALL comments about electrons

NB to get MP 3, 5 a causal link is needed

allow
protons are in the centre
repulsion, recoil
idea that α same charge as nucleus</td><td>4</td></tr>
<tr><td></td><td></td><td></td><td></td><td>total = 11 marks</td><td></td></tr>
</table>

Question number			Answer	Notes	Marks
4			6 marks from with a MAX of 2 from any one area	allow other sensible points	6
			benefits of nuclear fuel		
			MP1. no CO_2 emitted / no smoke emitted;		
			MP2. does not contribute to global warming;	no green-house effect	
			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;		
			disadvantages of nuclear fuel		
			MP7. difficult to dispose of **waste**;		
			MP8. accidents can spread radiation widely / risk of radiation leak;		
			MP9. nuclear fuel is toxic / harmful / radioactive / difficult to handle / long half-life;	Allow waste	
			MP10. decommissioning costs are very high;		
			MP11. increased security risk/ terrorist attack;		
			benefits of biomass		
			MP12. abundant sources / uses waste products from farms /houses/renewable;		
			MP13. uses materials which would produce CO_2 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;		
			disadvantages of biomass		
			MP17. relatively inefficient;		
			MP18. can increase methane in atmosphere/can increase green-house gases;	causes acid rain	
			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;		
				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 • 'unexpected' or 'different' unless correctly qualified • references to alpha particle scattering Allow idea related to a graph, e.g. results far away from the line of best fit Accept outlier	1
(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)	Any TWO reasonable ideas e.g. to make (new) discoveries; to check/validate (existing) theories; to disprove (existing) hypotheses/theories; to confirm (other scientists') findings; to test (new) hypotheses; to develop (better) understanding; to improve (students) skills; to gather (new) evidence;	Allow to give (practical) demonstrations; accept similar appropriate ideas Allow prove for validate	2

(Total for Question 5 = 7 marks)