

Radioactivity

Mark Scheme 4

Level	IGCSE(9-1)
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2P)
Topic	Radioactivity and Particles
Sub-Topic	Radioactivity
Booklet	Mark Scheme 4

Time Allowed: 40 minutes

Score: /33

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	775%	70%	60%	55%	50%	<50%

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)	<p>top line correct e.g. 228; bottom line correct e.g. 88 and 2; e.</p> $ \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 style="text-align: center;">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																									
alpha	(✓)																											
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neutrons			✓																									
protons	✓																											
	b	i	<p>any sensible suggestion (however phrased); e.g.</p> <ul style="list-style-type: none"> 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} 	<p>Allow RA condone phrases such as</p> <ul style="list-style-type: none"> air particles interact with alpha air particles interfere with alpha <p>ignore</p> <ul style="list-style-type: none"> react diffracting to create a vacuum 	1																							

		ii	<p>any TWO results from:</p> <p>MP1. most went (straight) through;</p> <p>MP2. (the paths of) a few were deflected at an acute/small angle;</p> <p>MP3. (the paths of) very few were {deflected through an obtuse angle / backscattered};</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"> • large • $>90^\circ$ <p>for backscattered</p> <ul style="list-style-type: none"> • bounced off the gold foil 	2
	c		<p>MP 2, 4 can be shown on a diagram</p> <p>any FOUR explanations or deductions from:</p> <p>MP1. Small nucleus;</p> <p>MP2. mostly empty space;</p> <p>MP3. because not many α deflected / because most α go straight through;</p> <p>MP4. Positive OR high mass nucleus;</p> <p>MP5. which causes deflection of positive (or low mass) α;</p>	<p>Ignore ALL comments about electrons</p> <p>NB to get MP 3, 5 a causal link is needed</p> <p>allow protons are in the centre repulsion, recoil idea that α 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>benefits of nuclear fuel MP1. no CO₂ 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>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; MP10. decommissioning costs are very high; MP11. increased security risk/ terrorist attack;</p>	<p>allow other sensible points</p> <p>no green-house effect</p> <p>Allow waste</p>	6

	<p>benefits of biomass MP12. abundant sources / uses waste products from farms /houses/renewable; MP13. uses materials which would produce CO₂ 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>disadvantages of biomass 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>causes acid rain</p>		
				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"> • '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
(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)	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
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(Total for Question 5 = 7 marks)