

APOLLO

Radioactive decay

SL

Physics

First assessment 2025

9 questions | mark schemes

Mark-scheme answers

Physics SL | Paper 1A | May 2025 TZ2 | Q23 | 1 marks

23. A

Physics SL | Paper 1A | May 2025 TZ3 | Q22 | 1 marks

22. C

Physics SL | Paper 1A | May 2025 TZ3 | Q23 | 1 marks

23. D

3.	a	i	86 ✓		1
3.	a	ii	ALT 1 mass defect = $226.02540 - 222.01757 - 4.00260 = 0.00523$ «u» ✓ $0.00523 \times 931.5 = 4.87$ «MeV» ✓ ALT 2 initial energy = $(226.02540)(931.5) = 210542.66$ «MeV» OR final energy = $(222.01757 + 4.00260)(931.5) = 210537.79$ «MeV» ✓ $210542.66 - 210537.79 = 4.87$ «MeV» ✓	<i>Must see full substitution or answer to at least 2 significant figures.</i>	2
3.	a	iii	$p_\alpha = p_{Rn}$ ✓ «Use of $KE = p^2/2m$ to get $KE_\alpha/KE_{Rn} = 222/4$ so» $KE_\alpha = 222/226$ OR 0.982 ✓		2
3.	b	i	«a few» alpha particles bounce back from the foil ✓ «most» alpha particles pass through «undeflected» ✓ «some» alpha particles were scattered/deviated from their path ✓		2 max
3.	b	ii	«nucleus is» small AND dense ✓ «nucleus is» positively charged OR a nucleus «is postulated» ✓		2

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2225 – 6724M

Question	Answers	Notes	Total
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Mark-scheme answers

Physics SL | Paper 1A | Nov 2025 TZ1 | Q22 | 1 marks

22. C

Physics SL | Paper 1A | Nov 2025 TZ1 | Q23 | 1 marks

23. B

4.	a	i	600 «counts per hr » ✓		[1]
4.	a	ii	ALTERNATIVE 1 Subtract their background rate to 3000 to get the initial count rate e.g. initial count rate 2400 counts per h ✓ Attempt to read t for $\frac{1}{2}$, $\frac{1}{4}$ or $\frac{1}{8}$ this initial count rate plus their background rate ✓ Half-life is 10 h ✓ ALTERNATIVE 2 Use of decay equation with $A_0 = 3000$ (their ai) and one point correctly read from graph ✓ calculate decay constant ✓ Use <i>half life</i> = $\frac{\ln 2}{\lambda}$ to get $T_{1/2} = 10$ h ✓	Allow ECF from a i) Allow ECF from MP1, i.e. max [2] for answer of about 14 h if background rate not used Accept 9 to 11 hours for MP3	[3]
4.	a	iii	The BE «per nucleon» is greater for $^{204}_{82}\text{Pb}$ ✓ Because $^{204}_{82}\text{Pb}$ is more stable/tightly bound than $^{204}_{83}\text{Bi}$ ✓	Award [1] if they recognize Pb as more stable but conclude incorrectly.	[2]
4.	a	iv	The alpha particles would be absorbed / have low penetration / short range / ✓		[1]
4.	b		$\Delta m = 203.932254 - (203.928034 + 0.000549) = 3.671 \times 10^{-3} \text{ u}$ ✓ $Q = 3.671 \times 10^{-3} \times 931.5 \approx 3.42 \text{ MeV}$ ✓	Allow ECF from MP1 Award [1] if electron mass is neglected and $Q = 3.93 \text{ MeV}$ or $6.30 \times 10^{-13} \text{ J}$ Award [2] for a CNA Accept final answer in J (5.48×10^{-13})	[2]

Question	Answers	Notes	Total
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Mark-scheme answers

Physics SL | Paper 1A | Specimen 2025 | Q23 | 1 marks

23. D

4.	a		${}_{95}^{241}\text{Am} \checkmark$ ${}_{93}^{237}\text{Np} + {}_2^4\alpha \checkmark$		2
4.	b		Alpha particles only travel a few cm in air / penetration of alpha particles is poor (and will not escape the chamber) $\checkmark$	OWTTE	1
4.	c		Each alpha gives rise to $\frac{5.5 \times 10^6}{15} = 3.67 \times 10^5$ ion pairs $\checkmark$ So $\frac{3.67 \times 10^5 \times 42000}{3} = 5.13 \times 10^9$ ion pairs per second $\checkmark$ current = $1.6 \times 10^{-19} \times 5.13 \times 10^9 = 0.82 \times 10^{-9}$ «A» $\checkmark$		3

Question	Answers	Notes	Total
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