

APOLLO

Radioactive decay

HL

Physics

First assessment 2025

9 questions | mark schemes

Mark-scheme answers

Physics HL | Paper 1A | May 2025 TZ1 | Q36 | 1 marks

36. A

Physics HL | Paper 1A | May 2025 TZ1 | Q37 | 1 marks

37. A

Physics HL | Paper 1A | May 2025 TZ2 | Q37 | 1 marks

37. A

Physics HL | Paper 1A | May 2025 TZ2 | Q38 | 1 marks

38. C

Physics HL | Paper 1A | May 2025 TZ3 | Q35 | 1 marks

35. C

Physics HL | Paper 1A | May 2025 TZ3 | Q36 | 1 marks

36. D

Physics HL | Paper 1A | Nov 2025 TZ1 | Q37 | 1 marks

37. 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 $half\ life = \frac{\ln 2}{\lambda}$ 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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6.	a	${}_{95}^{241}\text{Am} \checkmark$ ${}_{93}^{237}\text{Np} + {}_2^4\alpha \checkmark$		2
6.	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
6.	c	Half-life = $\frac{\ln 2}{5.08 \times 10^{-11}} \approx 10^{10} \text{ s} \checkmark$ Idea that this is much longer than lifetime of other components $\checkmark$ Reasoned comparison by conversion to reasonable unit eg $\approx 430 \text{ year} \checkmark$		3
6.	d	Each alpha gives rise to $\frac{5.5 \times 10^6}{15} = 3.67 \times 10^5 \text{ ion pairs} \checkmark$ So $\frac{3.67 \times 10^5 \times 42000}{3} = 5.13 \times 10^9 \text{ ion pairs per second} \checkmark$ current = $1.6 \times 10^{-19} \times 5.13 \times 10^9 = 0.82 \times 10^{-9} \text{ «A»} \checkmark$		3

Question	Answers	Notes	Total
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