GET BETTER AT PHYSICS · MARK SCHEME

Radioactive Decay & Half-Life: tiered multiple choice

AQA A-level Physics · 7408 · Specification 3.8.1.3 · 7 questions · 7 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5	Q6	Q7
A	B	B	A	D	B	A

Easy

Questions 1–3

1 **A**

What randomness means for decay · AQA June 2023 · A-level Paper 2 · Q28

Radioactive decay is random, so it is impossible to predict when a particular nucleus will decay. The behaviour of a large number of nuclei (activity, half-life) can still be predicted.

How students did: At least 70% of students got this right in June 2023.

2 **B**

Decay constant from the half-life · AQA June 2017 · A-level Paper 2 · Q28

$\lambda = \ln 2 / T_{½} = 0.693 \div 3500 = 2.0 \times 10^{-4}\ s^{-1}$.

3 **B**

Order of magnitude of λ · AQA June 2022 · A-level Paper 2 · Q28

$\lambda = 0.693 \div 0.010 = 69\ s^{-1}$, which lies between 10 and $10^2\ s^{-1}$.

Watch out: Convert 10 ms to 0.010 s before dividing.

Medium

Questions 4–6

4 **A**

What the rate of decay is proportional to · AQA November 2020 · A-level Paper 2 · Q29

Activity = λN. For a given nuclide λ is constant, so the rate of decay is proportional to N, the number of undecayed nuclei.

How students did: Between 30% and 50% of students got this right in November 2020.

5 **D**

Initial number of nuclei from an activity graph · AQA June 2023 · A-level Paper 2 · Q32

The activity falls from 14.0 MBq to 7.0 MBq in 30 s, so $T_{½} = 30$ s and $\lambda = 0.693 \div 30 = 0.0231\ s^{-1}$. $N_0 = A_0 / \lambda = 14.0 \times 10^6 \div 0.0231 = 6.1 \times 10^8$.

Watch out: Read the half-life from the graph first, then use A = λN with the initial activity.

6 **B**

Two samples with equal nuclei after 18 minutes · AQA November 2021 · A-level Paper 2 · Q28

18 minutes is 6 half-lives of X and 2 half-lives of Y. Y has N/4 left. X then has $N_X / 2^6 = N_X / 64$. Setting them equal: $N_X = 64N / 4 = 16N$.

Watch out: Count half-lives separately for each nuclide.

Hard

Question 7

7 **A**

Age of a rock from its lead-to-uranium ratio · AQA June 2024 · A-level Paper 2 · Q32

For every 4 atoms of U-235 there is 1 atom of Pb-207, so the uranium remaining is 4/5 of the original. $N / N_0 = 0.8 = e^{-\lambda t}$, so $t = T_{½} \times \ln(1.25) / \ln 2 = 0.71 \times 0.322 = 0.23$ billion years.

> **Watch out:** The original amount of uranium is 4 + 1 = 5 parts, not 4.

How students did: Fewer than 35% of students got this right in June 2024, and the correct answer was not the most popular choice.

End of mark scheme. Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

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