

Radioactive Emissions

Q1.(2018)

D ✓

Q2.a(2018)

(Average) time taken ✓

for number of (un-decayed or unstable) **nuclei** to halve /
for activity to halve /
for count rate to halve ✓

2

2 × 1.1

ALLOW how long it takes
IGNORE half the time taken

IGNORE for half of it to disappear
IGNORE for the radioisotopes to halve
ALLOW for the radioactivity to halve
IGNORE for the reactivity to halve

Q2.b(2018)

Q
AND

activity is high(er) for a longer /
it takes longer to become less active /
lower or smaller gradient (throughout) ✓

1

3.2a

BOTH needed

ALLOW does not drop as fast
ALLOW activity decrease less rapidly
ALLOW less steep

Q3.(2018)



Correct symbol of Xe ✓

(Xe) correct mass and atomic number (131 and 54) ✓

e correct mass and atomic number (0 and -1) ✓

3

3 × 1.1

ALLOW Xe and beta in any order
ALLOW β or β⁻ or e⁻ for e

Q4.a(2018)

4 ✓

1

2.2

ALLOW 4:1
DO NOT ALLOW 1:4
DO NOT ALLOW units e.g. 4 Bq

Q4.b(2018)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 8 (days) award 2 marks

(Ratio of 4:1 implies) 2 half lives (have elapsed) / AW ✓
2 half lives = 16 days so half life = 8 (days) ✓

2

2 × 2.2

DO NOT ALLOW 8 as the answer if 131 has been used in the calculation

ALLOW ECF from (c)(i)
e.g. ratio of 2:1 implies 1 half life

Q5.(2019)

B ✓

Q6.(2019)

D ✓

Q7.a(2019)

Mean is all the numbers added together and then divided by the total number ✓	3	3 × 1.2	ALLOW Mean is the average AND 14.3 / 14
Mode is the number which occurs most often AND 14 ✓			ALLOW the number that occurs twice/most frequent/most popular / AW AND 14
Median is the middle number AND 14 ✓			ALLOW method to find the median AND 14 if no other marks awarded ALLOW correct values for mode AND median for one mark

Q7.b(2019)

Half-life = 4 (throws) ✓	1	2.1	IGNORE decimal answers that round to 4
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Q8.a(2019)

use a Geiger counter / G-M tube (as detector) ✓	4	4x1.2	ALLOW answers from a labelled diagram
use of paper AND a drop in count rate/no count rate means alpha / AW ✓			ALLOW paper stops alpha
use of aluminium AND a drop in count rate/no count rate means beta / AW ✓			ALLOW any appropriate material e.g. aluminium/thin metal/glass/wood stops beta
use of lead AND a drop in count rate/no count rate means gamma / AW ✓ OR aluminium AND no drop/no change in count rate means gamma / AW ✓			ALLOW lead/concrete stops gamma ALLOW any appropriate material e.g. aluminium/thin metal/glass/wood lets gamma through

Q8.b(2019)

When an <u>electron</u> drops energy levels ✓	1	1.1	ALLOW <u>electron</u> from excited energy level to ground / <u>electron</u> from higher shell to lower shell IGNORE just when electrons move between energy levels DO NOT ALLOW ideas of ionisation / when an electron moves up and down
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Q8.c(2019)

radio /microwave / infra-red / (visible) light / named
coloured light e.g. red light / ultra-violet / X-rays ✓

1

1.1

DO NOT ALLOW gamma or γ

Q9.(2020)

B

Q10.(2020)

(Atoms of same element) with different numbers of
neutrons / AW ✓

1

1.1

ALLOW same atomic/proton number but different
mass number

Q11.a(2020)

Beta ✓

Q11.b(2020)

Mass: stays the same / unchanged ✓

Charge: increases by 1 ✓

Q12.(2020)

Electron absorbs/gains radiation/photon ✓
Electron lost (from atom) / AW ✓

2

1.1

1.1

ALLOW ionisation is the loss/gain of electrons
(from atom)

Q13.(2020)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 8:1 award 3 marks

3

(17100 $\Rightarrow$) 3 half lives ✓
(Amount left $(1/2)^3 =$) 1/8 ✓
(Ratio $\Rightarrow$) 8:1 ✓

2.1

2.1

2.1

ALLOW 17100 $\div$ 5700 = 3 for 1 mark

ALLOW 8.1 or 8 to 1 for 3 marks

Q14.(2021)

A

Q15.(2021)

C

Q16.(2021)

Change in mass of nucleus: -4 ✓
Change in charge on nucleus: +1 ✓

2

2 $\times$ 1.2

ALLOW decreases by 4
ALLOW increases by 1

Q17.a(2021)

Radioactive decay is a random process / AW ✓

1

1.1

ALLOW answers referring to background radiation

Q17.b(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE

If answer = 9 (days) award 2 marks

(Ratio of 1:4 implies) 2 half-lives ✓

(2 half lives = 18 so half-life =) 9 (days) ✓

Q17.c(2021)

(Y is irradiated because) Y is exposed to the radiation from
X / radiation from X reaches Y / AW ✓

(Not contaminated because) X does not touch Y / there is
not a radioactive source touching Y / AW ✓

Q17.d(2021)

(Y is irradiated because) Y is exposed to the radiation from
X / radiation from X reaches Y / AW ✓

(Not contaminated because) X does not touch Y / there is
not a radioactive source touching Y / AW ✓

Q18.(2022)

D ✓

Q19.(2022)

C ✓

Q20.(2022)

The nucleus contains protons and neutrons ✓

The nucleus has a positive charge ✓

2

2 × 1.1

Each correct tick = 1 mark

Three ticks with two correct = 1 mark
Three ticks with one correct = 0 marks
More than three ticks = 0 marks

Q21.(2022)

As time increases, mass decreases / OR A ✓

(Mass decreases) at a decreasing rate / decreasing gradient ✓

2

2 × 3.1a

ALLOW inversely related / inversely proportional
IGNORE negative correlation

ALLOW at the beginning the mass decreases and then it slows down

ALLOW marking points combined e.g. mass decreases at a decreasing rate / as time goes on the less the mass decreases / as time continues it loses mass more slowly = 2 marks

IGNORE references to half-life or activity

Q22.(2023)

A

Q23.(2023)

Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

Level 3 (5–6 marks)

Detailed explanation of half-life supported with an accurate representation on the graph

AND

Detailed description of an experiment to measure half-life

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)

Clear explanation of half-life with half-life represented on the graph

OR

Clear explanation of half-life with a clear description of an experiment to measure half-life

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

Basic explanation of half-life or basic representation on the graph

OR

Basic description of an experiment to measure half-life

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

6

2 × 1.1
2 × 1.2
2 × 2.2

AO1.1 - Demonstrates knowledge and understanding of half-life and how it is represented on a graph

- time taken for activity (of isotope) to halve
- time taken for mass (of isotope) to halve
- time taken for number of (undecayed) nuclei to halve
- time taken for a fixed proportion of the nuclei to decay is constant
- half-life is constant

ALLOW time taken to halve at Level 1 only
DO NOT ALLOW time for a nuclei / an atom / a nucleus to halve

AO1.2 / 2.2 – Demonstrates and applies knowledge and understanding of scientific techniques to measure half-life

- measure the activity with no isotope present / measure background radiation
- measure number of counts
- measure number of counts in a fixed time / measure the time it takes for activity to halve
- use a Geiger(-muller) tube / use a Geiger counter / use a becquerel counter
- use a radiation detector at a fixed distance from the isotope
- repeat the measurements for a period of time
- draw on the graph to show how the half-life can be represented by the time taken for the activity to halve

Q24.(2024)

C

Q25.a(2024)

Either circles around:

^{238}U **AND** ^{234}U

Or

^{234}Th **AND** ^{230}Th ✓

Reason:

Same charge (on nucleus) / same proton number / same atomic number / same number of protons ✓

Or

Different mass (number) / different number of neutrons ✓

2

2.1

ALLOW correct isotopes identified on answer lines but graph takes precedence

Needs to be clear that U and U connected and/or Th and Th connected

1.1

IGNORE both thorium / both uranium / same element

Q25.b(2024)

(Charge) increases by 1 ✓

(Mass) stays the same ✓

2

2 × 1.1

IGNORE just quoting numbers from the graph

IGNORE just 'it goes up' / it increases

Q25.c(2024)

Beta ✓

Q25.d(2024)

$^{222}_{86}\text{Rn} \rightarrow ^{218}_{84}\text{Po} + ^4_2\text{He}$ ✓ ✓

2

1.2

ALLOW He correct for 1 mark

2.2

ALLOW atomic numbers for Rn and Po correct for 1 mark

Q25.e(2024)

(Nucleus is) stable / (isotope) not radioactive ✓

Q25.f(2024)

First check the answer on the answer line
If answer = 1 : 15 award 3 marks

$$1.8 \times 10^{10} \div 4.5 \times 10^9 \text{ or } 4 \text{ half-lives } \checkmark$$

$$\frac{1}{16} \text{ or } \frac{15}{16} \text{ seen } \checkmark$$

$$(\text{Ratio} =) 1 : 15 \checkmark$$