Radioactive Emissions

Questions:

Total mark – 25

1.

. The table gives some information about four radioactive isotopes.

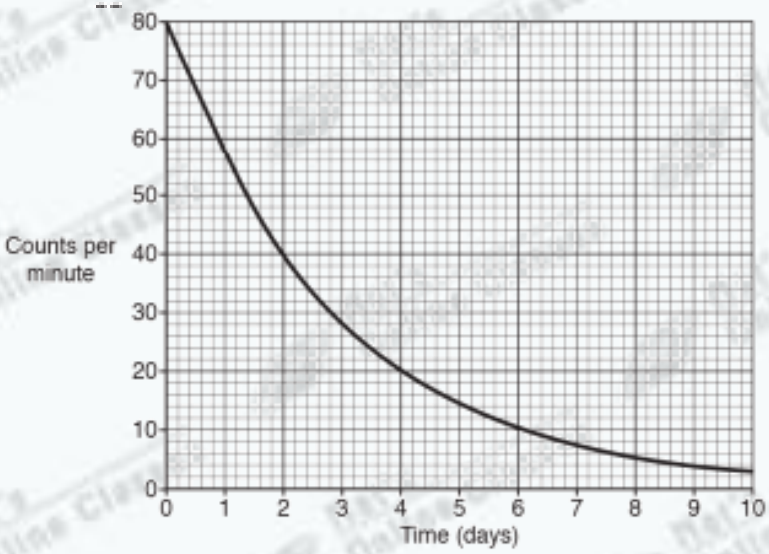
Which isotope is the best to use as a medical tracer?

	Half life	Radiation emitted
A	6 hours	alpha
B	6 hours	gamma
C	6 minutes	gamma
D	6 years	beta

Your answer ☐ **[1]**

2.

A teacher measures the radiation from a radioactive source for 10 days.



What is the half-life of this radioactive source?

A 1 day
B 2 days
C 4 days
D 5 days

Your answer ☐ **[1]**

3.

The information below shows information on radioactive isotopes.

Radioactive isotope	Type of radiation	Half-life	Penetration through human flesh
A	alpha	300 years	2mm
B	beta	7 hours	60mm
C	gamma	7 hours	> 10m
D	alpha	9 seconds	2mm
E	gamma	3 years	> 10m

A doctor implants radioactive isotope **A** into a patient to treat a localised cancer which is a few mm in size.

She intends to remove the isotope in a few weeks.

Use the data to suggest **two** reasons why the doctor uses isotope **A**.

[2]

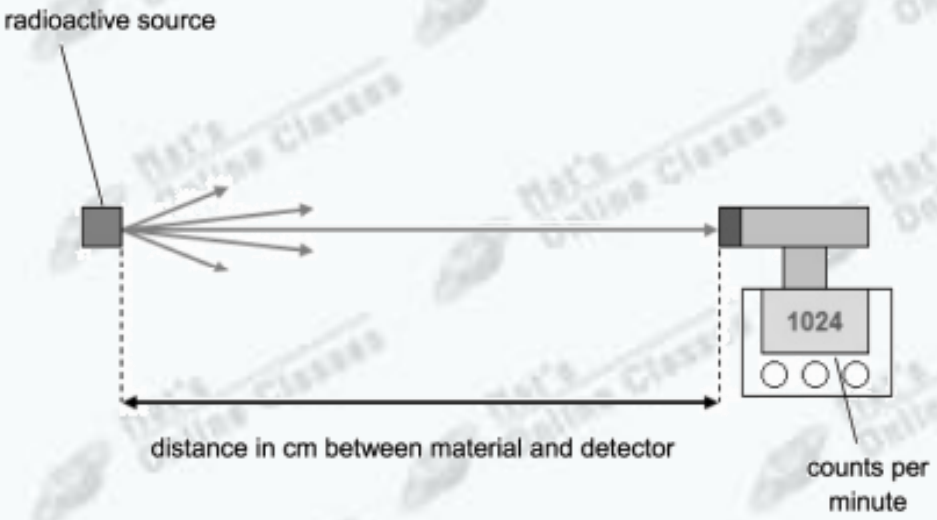
4.

a). Matt experiments with radioactive materials.

He investigates how the activity of radiation changes with distance.

The radiation moves from the source to the detector.

He measures the counts per minute from a radioactive source.



The table shows the results from the experiment.

Distance between the source and the detector (cm)	**Count rate (counts per minute)**
10	1024
20	256
40	64
80	16
160	**6**
320	**0**

As the distance is increased to 160 cm and 320 cm the results do not follow the same pattern as the other results.

What do you think these results should have been?

Explain the anomalies in the last two results.

[3]

(b). Describe using the data in the table how the count rate changes as the detector is moved away from the source.

[2]

5.

(a). Decay equations are used to show the type of emission from different radioactive elements.

i. Complete the decay equation for **alpha** emission.

$$^{230}_{92}U \rightarrow {}^{4}_{2}He + {}^{.....}_{.....}Th$$ **[2]**

ii. Complete the decay equation for **beta** emission.

$$^{214}_{83}Bi \rightarrow {}^{.....}_{.....}\beta + {}^{214}_{84}Po$$ **[2]**

iii. Complete the decay equation for **gamma** emission.

$$^{235}_{.....}U \rightarrow {}^{0}_{0}\gamma + {}^{.....}_{92}U$$ **[2]**

(b). Carbon is a common element. Carbon has two different isotopes called carbon-12 and carbon-14. Both of these isotopes have six protons in the nucleus.

i. Carbon-14 is radioactive and carbon-12 is **not** radioactive.

Explain why some isotopes are radioactive.

[1]

ii. Describe how the nucleus of carbon-12 is different to the nucleus of carbon-14.

[1]

6.

a). The teacher measures the activity of isotope **B**.

She starts taking activity measurements after 20 minutes.

Table 23.1 shows her results for isotope **B**.

Time (minutes)	Activity (counts per minute)
0	
10	
20	84
30	64
40	52
50	40
60	32
70	25
80	20
90	16

Table 23.1

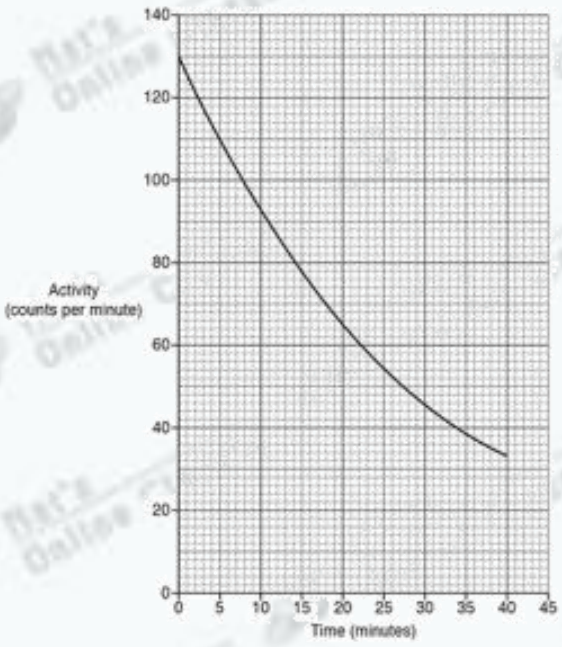
Predict the activity of isotope **B** at 0 minutes.

Use the information in **Table 23.1** to help you.

Activity = ... counts per minute **[2]**

(b). A teacher measures the activity of different radioactive isotopes.

Fig. 23.1 is a graph of her results for isotope **A**.



Use **Fig. 23.1** to calculate the half-life of isotope **A**.

Show your working on the graph in **Fig. 23.1**.

Half-life = ... minutes **[2]**

7.

The half-life of americium-241 is 432 years.

i. Explain what is meant by **half-life**.

[1]

ii. Explain why the half-life of americium-241 is suitable for a smoke detector.

[1]

iii. The table shows some data for two radioactive sources.

Source	Half-life (years)	Radiation emitted
Americium-241 (Am-241)	432	Alpha
Thorium-228 (Th-228)	2	Alpha

Both sources start with the same number of radioactive nuclei.

Which source is a greater health risk? Explain your answer.

[2]