

Radioactivity

Question Paper

Course	CIE IGCSE Physics
Section	5. Nuclear Physics
Topic	Radioactivity
Difficulty	Easy

Time Allowed **60**

Score **/45**

Percentage **/100**

Question 1a

Fig. 12.1 shows the nuclide notation for three isotopes of an element.



Fig. 12.1

- (i) Describe how the nuclide notation shows that each isotope is of the same element.

[1]

- (ii) Describe how the nuclide notation shows the differences between the isotopes.

[1]

[1 mark]

Question 1b

Radioactive sources emit radiation when they decay. State the names of **three** types of radioactive emission.

[2 marks]

Question 1c**Extended tier only**

Radioactive emissions have differing characteristics. One characteristic is their ionising effect.

Complete the statement about ionisation, using words from the box. The words can be used once, more than once or not at all.

electrons negatively neutrons positively neutrally protons
--

When atoms are ionised,

..... may be removed,

leaving charged atoms (ions),

or may be gained,

forming charged atoms (ions).

[4 marks]

Question 1d

Polonium-210 has a half-life of 140 days. A sample of polonium-210 has 8.0×10^{10} atoms. Calculate the number of polonium-210 atoms remaining in the sample after 280 days.

number of atoms =
[2 marks]

Question 2a**Extended tier only**

To ensure the safety of workers in laboratories where radioactive sources are used, describe how radioactive materials

- (i) should be stored, [1]
 - (ii) should be handled. [1]
- [2 marks]

Question 2b

Complete the table below for three types of emission from radioactive sources.

type of emission	nature	range in air	absorbed by
	electromagnetic radiation	several km	
	helium nucleus		0.2 mm paper
	electron		

[3 marks]

Question 2c

Extended tier only

State the type of radiation emitted when

- (i) an americium nucleus ($^{241}_{95}\text{Am}$) decays into a neptunium nucleus ($^{237}_{93}\text{Np}$),

[1]

- (ii) a phosphorus nucleus ($^{32}_{15}\text{P}$) decays into a silicon nucleus ($^{32}_{16}\text{Si}$).

[1]

[2 marks]

Question 3a

Define the term "half-life".

[1 mark]

Question 3b

Complete the sentences.

The particles in _____ radiation have a greater mass than those in _____ radiation.

_____ radiation is a type of electromagnetic radiation and does not have mass.

[3 marks]

Question 3c**Extended tier only**

Three radioactive sources, X, Y and Z, are in a lab. One emits only alpha radiation, one emits only beta radiation and one emits only gamma radiation.

- (i) Draw a line between the type of radiation and its charge.

Alpha	Neutral
Beta	Negative
Gamma	Positive

[2]

- (ii) To determine which source emits which type of radiation, a scientist places a positive charge near the sources, as shown in Fig. 1.1.

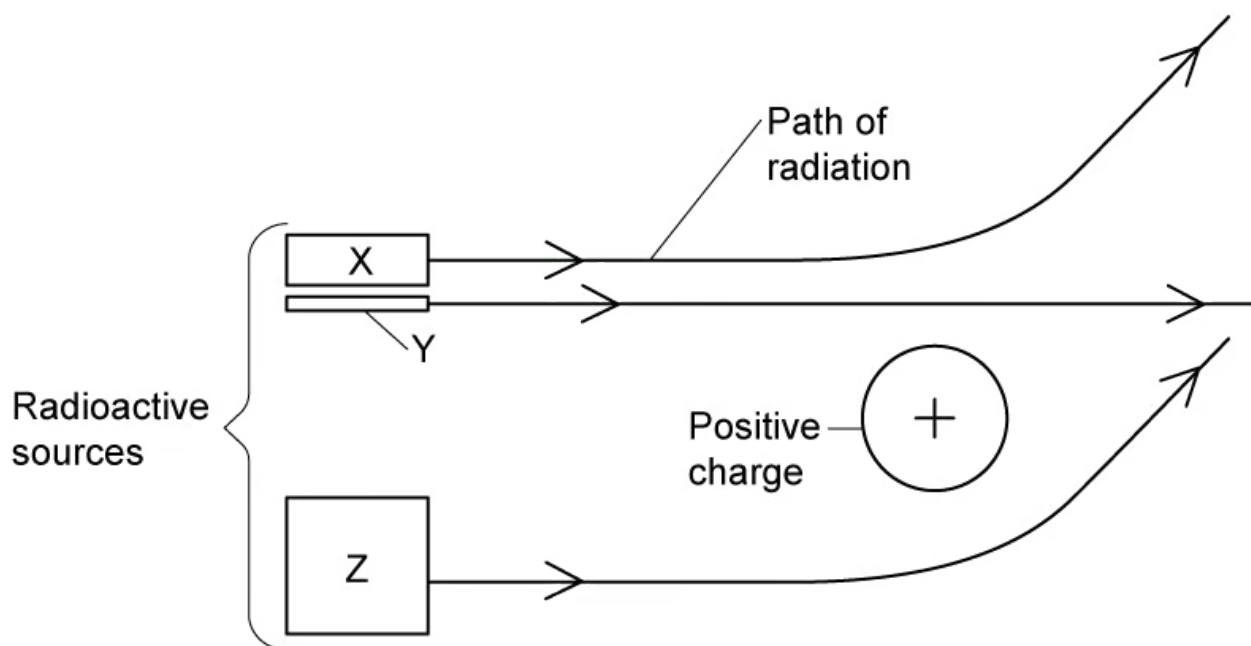


Fig. 1.1

State the type of radiation coming from each source.

[3]
[5 marks]

Question 3d**Extended tier only**

Suggest one safety precaution the scientist might take to protect themselves from the radioactive sources.

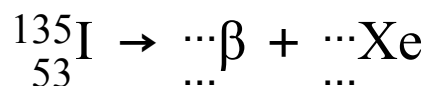
[1 mark]**Question 4a**

An iodine isotope $^{135}_{53}\text{I}$ decays beta emission. The daughter particle is an isotope of xenon (Xe).

State the number of each type of particle in a neutral atom of $^{135}_{53}\text{I}$.

[2 marks]**Question 4b****Extended tier only**

Complete the decay equation:

**[2 marks]**

Question 4c

Extended tier only

A factory makes baking paper. In order to keep the baking paper the same thickness, beta radiation is passed through the paper.

A Geiger counter on the other side of the paper measures how much radiation passes through the paper and the rollers change the thickness of paper accordingly (see Fig. 1.1).

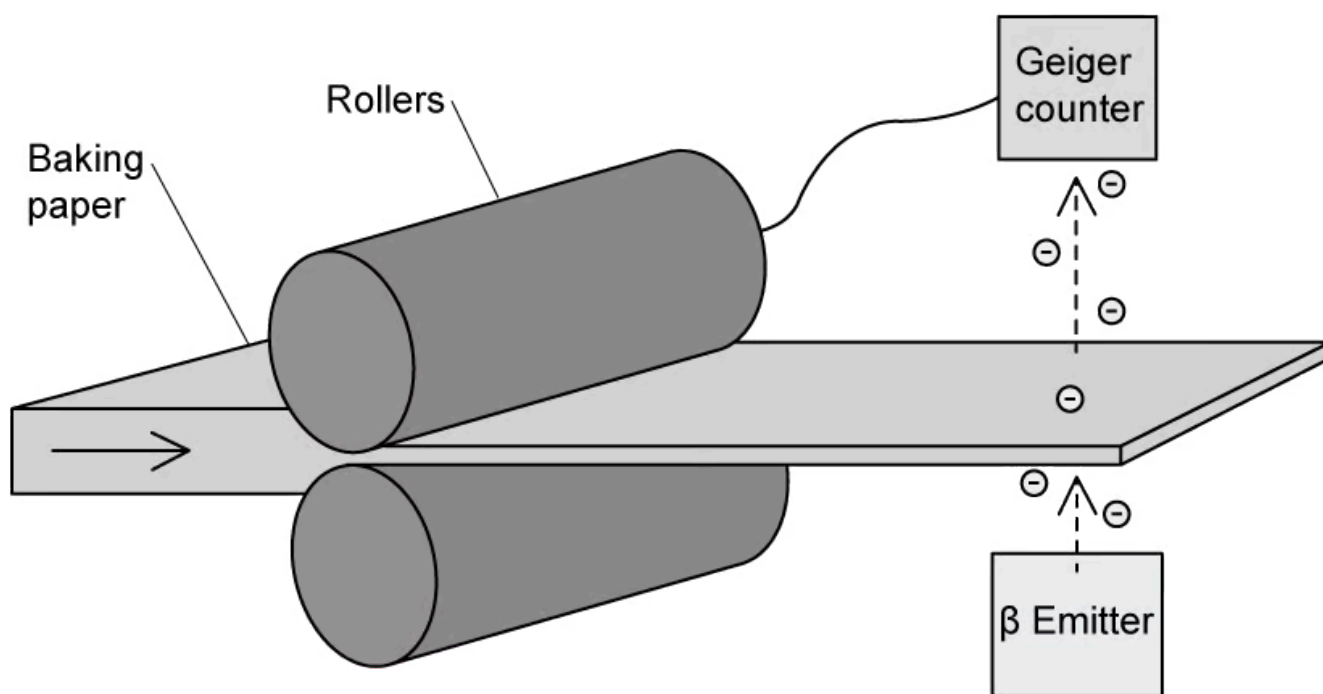


Fig. 1.1

(i) Explain why alpha radiation is not used.

[2]

(ii) Explain why gamma radiation is not used.

[2]

(iii)

A worker bumps into the rollers. The Geiger counter now detects a greater count rate. Describe how the thickness of the paper has changed.

[1]

[5 marks]

Question 5a**Extended tier only**

A student records the following data in a table when using a Geiger counter on two radioactive sources at the same.

Complete the table.

Source	Recorded count rate (counts/s)	Background count rate (counts/s)	Corrected count rate (counts/s)
Radium	104		100
Americium	25		

[3 marks]

Question 5b

The half-life of the radium isotope is 30 days. Calculate the count rate from the radium source from part **(a)** after 60 days.

[3 marks]

Question 5c

Extended tier only

Another source has an initial activity of A_0 .

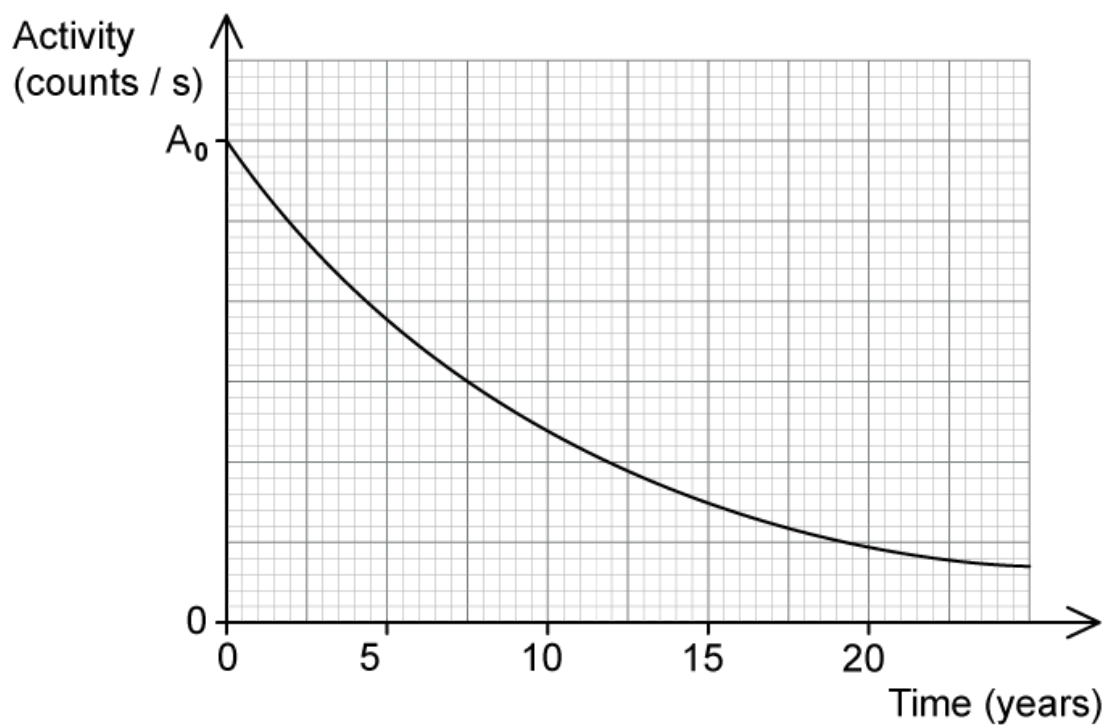


Fig. 1.1

Use Fig. 1.1 to determine the half-life of the source.

[2 marks]

Question 5d**Extended tier only**

Medical tracers are radioactive sources that can be inserted into the body to track the movement of blood.

Explain why the isotope from part **(c)** would be an inappropriate radioactive source for this purpose.

[2 marks]