# Radioactivity

## Question Paper 5

| | |
|---|---|
| Level | IGCSE |
| Subject | Physics |
| ExamBoard | CIE |
| Topic | Atomic Physics |
| Sub-Topic | Radioactivity |
| Paper Type | (Extended) Theory Paper |
| Booklet | Question Paper 5 |

**Time Allowed:** **44 minutes**

**Score:** **/36**

**Percentage:** **/100**

**1** A radioactive source emits only β- particles.

**(a)** A scientist wishes to investigate the deflection of β-particles by an electric field. Draw a labelled diagram to suggest a suitable experimental arrangement.

[3]

**(b)** State how the apparatus would be used to show the deflection of the β-particles by the electric field.

.....

.....

..... [2]

**(c)** State how the results would show the deflection of the β-particles.

.....

..... [1]

**(d)** Explain the direction of the deflection obtained.

.....

..... [1]

[ Total : 7 ]

**2** **(a)** The decay of a nucleus of radium $^{226}_{88}Ra$ leads to the emission of an $\alpha$-particle and leaves behind a nucleus of radon (Rn).
In the space below, write an equation to show this decay. [2]

**(b)** In an experiment to find the range of $\alpha$-particles in air, the apparatus in Fig. 11.1 was used.

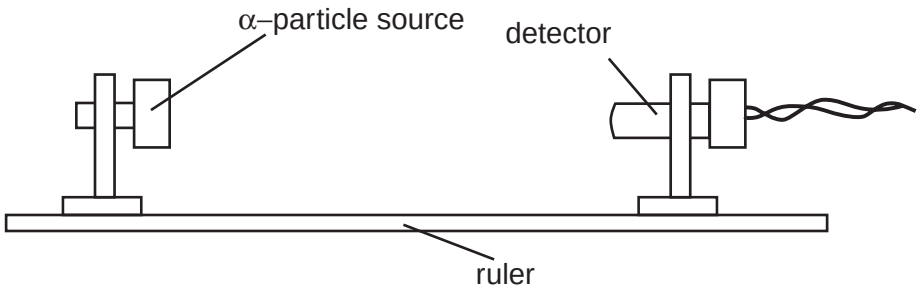


**Fig. 11.1**

The results of this experiment are shown below.

| count rate / (counts/minute) | 681 | 562 | 441 | 382 | 317 | 20 | 19 | 21 | 19 |
|---|---|---|---|---|---|---|---|---|---|
| distance from source to detector/cm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

**(i)** State what causes the count rate 9 cm from the source.

.....

**(ii)** Estimate the count rate that is due to the source at a distance of 2 cm.

.....

**(iii)** Suggest a value for the maximum distance that $\alpha$-particles can travel from the source.

.....

**(iv)** Justify your answer to **(iii)**.

.....

.....

[4]

[Total : 6 ]

**3** **(a)** A radioactive isotope emits only $\alpha$-particles.

**(i)** In the space below, draw a labelled diagram of the apparatus you would use to prove that no $\beta$-particles or $\gamma$-radiation are emitted from the isotope.

**(ii)** Describe the test you would carry out.

.....

.....

.....

.....

**(iii)** Explain how your results would show that only $\alpha$-particles are emitted.

.....

.....

.....

[6]

**(b)** Fig. 11.1 shows a stream of α-particles about to enter the space between the poles of a very strong magnet.

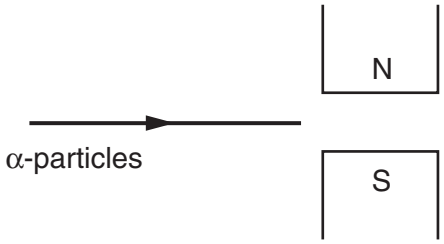


**Fig. 11.1**

Describe the path of the α-particles in the space between the magnetic poles.

.....

.....

.....[3]

[Total : 9]

**4** **(a)** A sodium nucleus decays by the emission of a β-particle to form magnesium.

**(i)** Complete the decay equation below.

$$^{24}_{11}\text{Na} \longrightarrow \quad \text{Mg} \; +$$

**(ii)** Fig. 11.1 shows β-particles from sodium nuclei moving into the space between the poles of a magnet.

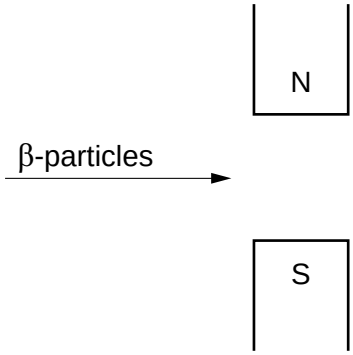


**Fig. 11.1**

Describe the path of the β-particles between the magnetic poles.

.....

.....

.....

[5]

**(b)** Very small quantities of a radioactive isotope are used to check the circulation of blood by injecting the isotope into the bloodstream.

**(i)** Describe how the results are obtained.

.....

.....

.....

.....

**(ii)** Explain why a $\gamma$-emitting isotope is used for this purpose rather than one that emits either $\alpha$-particles or $\beta$-particles.

.....

.....

.....

[4]

[Total : 9]

**5** Fig. 10.1 is part of the decay curve for a sample of a β-emitting isotope.

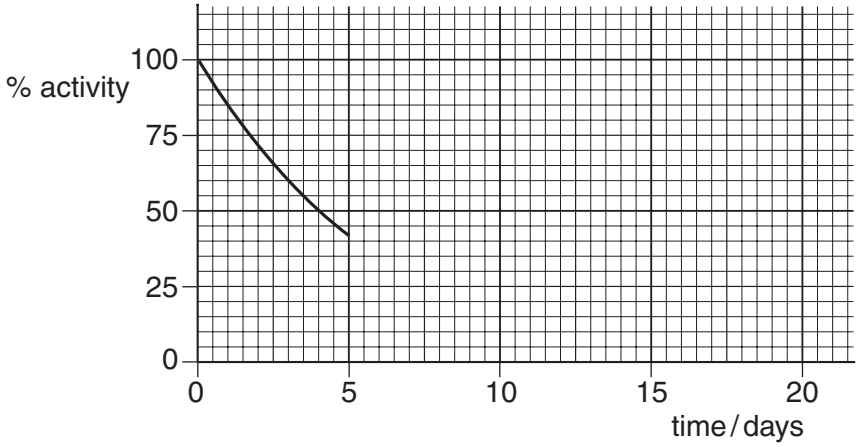


**Fig. 10.1**

**(a)** Use Fig. 10.1 to find the half-life of the isotope.

half-life = ..... [1]

**(b)** Complete Fig. 10.1 as far as time = 20 days, by working out the values of a number of points and plotting them. Show your working. [2]

**(c)** The decay product of the β-emitting isotope is not radioactive.
Explain why the sample of the radioactive isotope will be safer after 20 days than after 1 day. Support your answer by reference to the graph.

.....

.....[1]

**(d)** The isotope used for this decay curve may be represented by the symbol ${}^{A}_{Z}X$.
Write down an equation, by filling in the gaps below, to show the β-decay of this isotope to a decay product that has the symbol Y.

$${}^{A}_{Z}X \rightarrow \quad + \quad Y$$ [2]

[Total : 6]