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 α-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 α-particles in air, the apparatus in Fig. 11.1 was used.

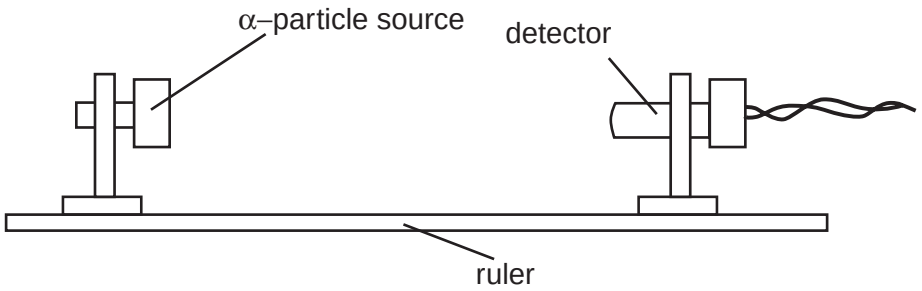

Fig. 11.1

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 α-particles can travel from the source.

.....

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

.....

.....
[4]

[Total : 6]

3 **(a)** A radioactive isotope emits only α-particles.

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

(ii) Describe the test you would carry out.

.....

.....

.....

.....

(iii) Explain how your results would show that only α-particles are emitted.

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.....

.....

[6]

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

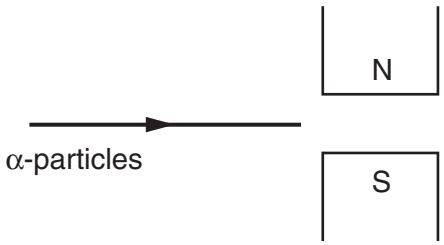

Fig. 11.1

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

.....

.....

.....[3]

[Total : 9]

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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.

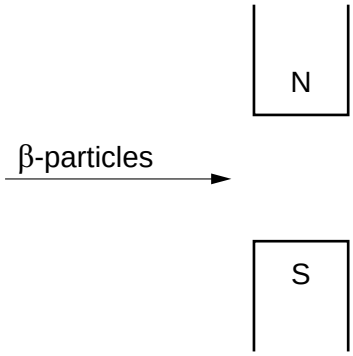

Fig. 11.1

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 γ-emitting isotope is used for this purpose rather than one that emits either α-particles or β-particles.

.....

.....

.....

[4]

[Total : 9]

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

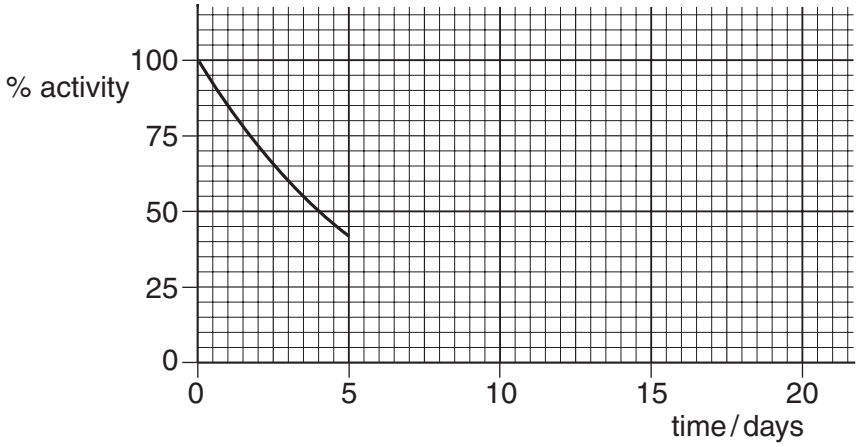

Fig. 10.1

(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.

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

[Total : 6]

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