REVISION QUESTION: RADIO-ACTIVITY

10 (a) Fig. 10.1 is the decay curve for a radioactive isotope that emits only β-particles.

For Examiner's Use

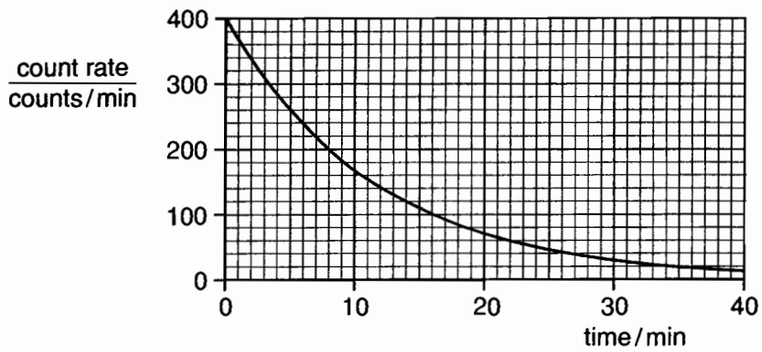

Fig. 10.1

Use the graph to find the value of the half-life of the isotope.

Indicate, on the graph, how you arrived at your value.

half-life ..... [2]

(b) A student determines the percentage of β-particles absorbed by a thick aluminium sheet. He uses a source that is emitting only β-particles and that has a long half-life.

(i) In the space below, draw a labelled diagram of the apparatus required, set up to make the determination.

[2]

(ii) List the readings that the student needs to take.

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.....

.....

..... [3]

For Examiner's Use

11 (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.

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

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[6]

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

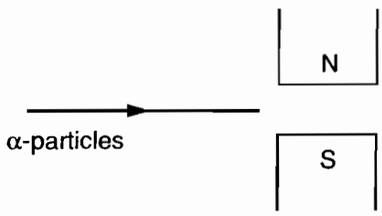

Fig. 11.1

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

.....

.....

.....[3]

For Examiner's Use

11 (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.

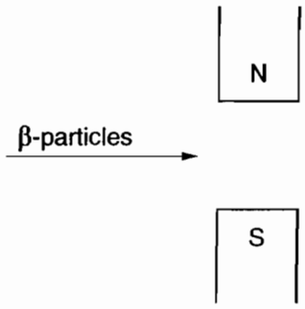

Fig. 11.1

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

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.....

.....

[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.

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(ii) Explain why a γ-emitting isotope is used for this purpose rather than one that emits either α-particles or β-particles.

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[4]

For Examiner's Use

(a) α-particles can be scattered by thin gold foils.

Fig. 11.1 shows part of the paths of three α-particles.
Complete the paths of the three α-particles. [3]

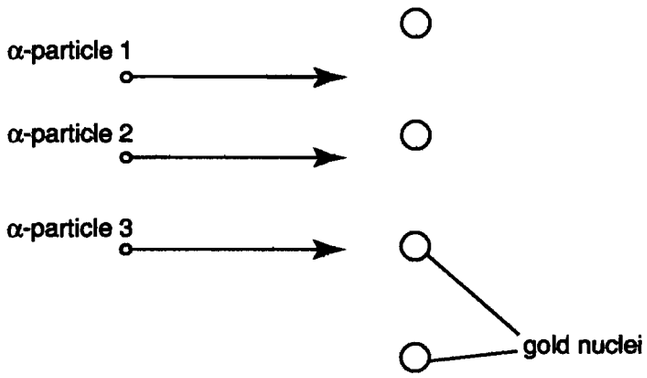

Fig. 11.1

(b) What does the scattering of α-particles show about atomic structure?

.....

.....

.....[2]

(c) State the nucleon number (mass number) of an α-particle.

nucleon number = ...[1]

For Examiner's Use

10 (a) Fig. 10.1 shows the faces of two ammeters. One has an analogue display and the other a digital display.

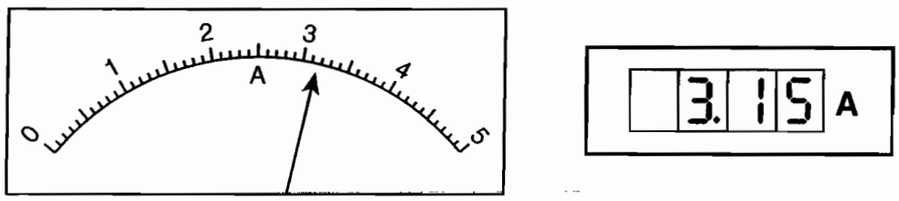

Fig. 10.1

State what is meant by the terms *analogue* and *digital.*

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.....[2]

(b) (i) Name the components from which logic gates are made.

.....[1]

(ii) In the space below, draw the symbol for an AND gate.
Label the inputs and the output. [1]

(iii) Describe the action of an AND gate with two inputs. [2]

For Examiner's Use

11 (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.

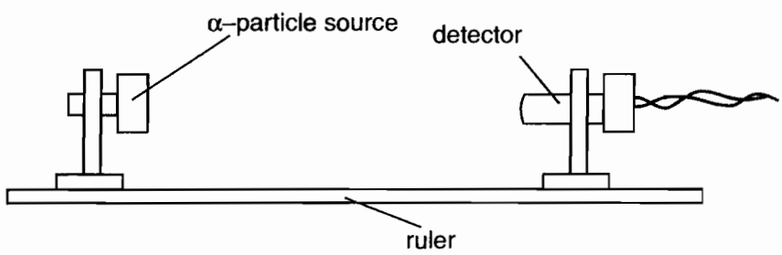

Fig. 11.1

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]

For Examiner's Use

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

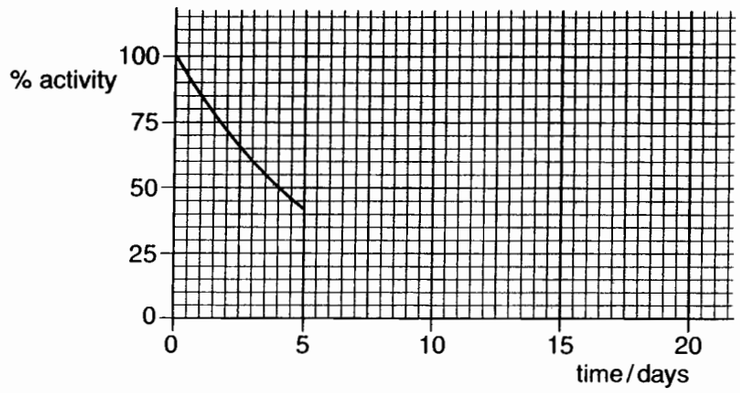

Fig. 10.1

(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.

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.....[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]