Name..... Set..... Don.....

Winchester College
Physics

3rd year Revision Test

Radioactivity

Common Time 2010

Answer all the questions.
Total 43 marks.

Allow 40 minutes.

Remember to show your working where applicable.
Calculators are allowed.

For Examiner's Use

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

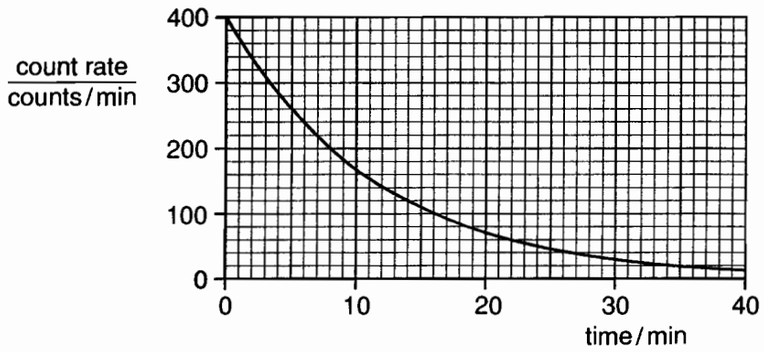

Fig. 10.1

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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.....

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..... [3]

For Examiner's Use

2. **(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.

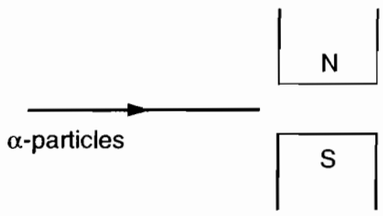

Fig. 11.1

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

.....

.....

.....[3]

For Examiner's Use

3 **(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.

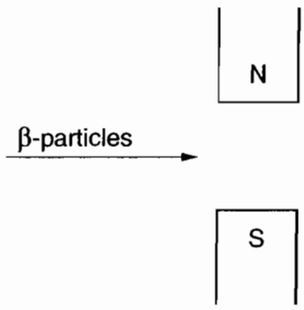

Fig. 11.1

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.

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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

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

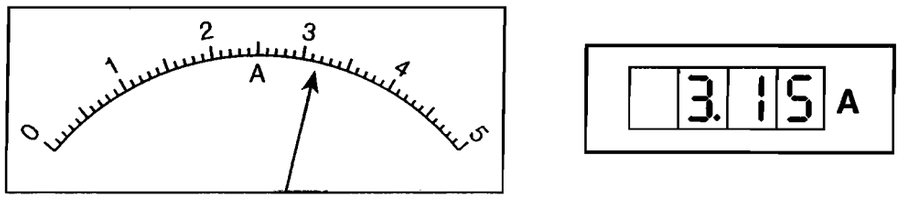

Fig. 10.1

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

.....

.....

.....[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]

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5. **(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]

For Examiner's Use

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

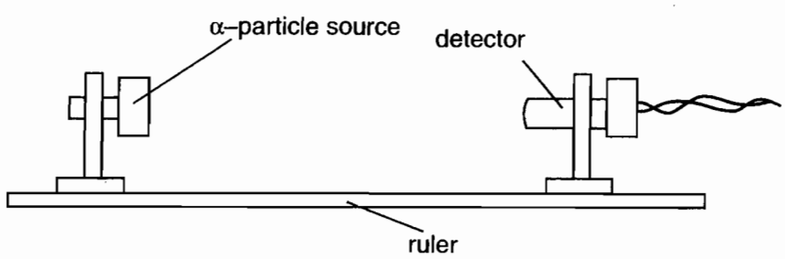

Fig. 11.1

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]

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

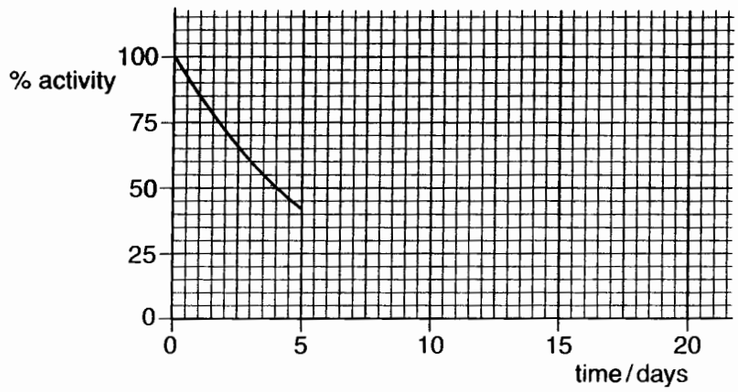

Fig. 10.1

(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]