

Radioactivity

Question Paper

Level	GCSE
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1P)
Topic	Radioactivity & Particles
Sub-Topic	Radioactivity
Booklet	Question Paper

Time Allowed: 106 minutes

Score: /88

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

1. A teacher shows his class how to investigate the half-life of a radioactive source.



(a) The readings from the counter need to be corrected for background radiation.

(i) State **one** source of background radiation.

(1)

(ii) Describe the method the teacher should use to correct for background radiation.

(3)

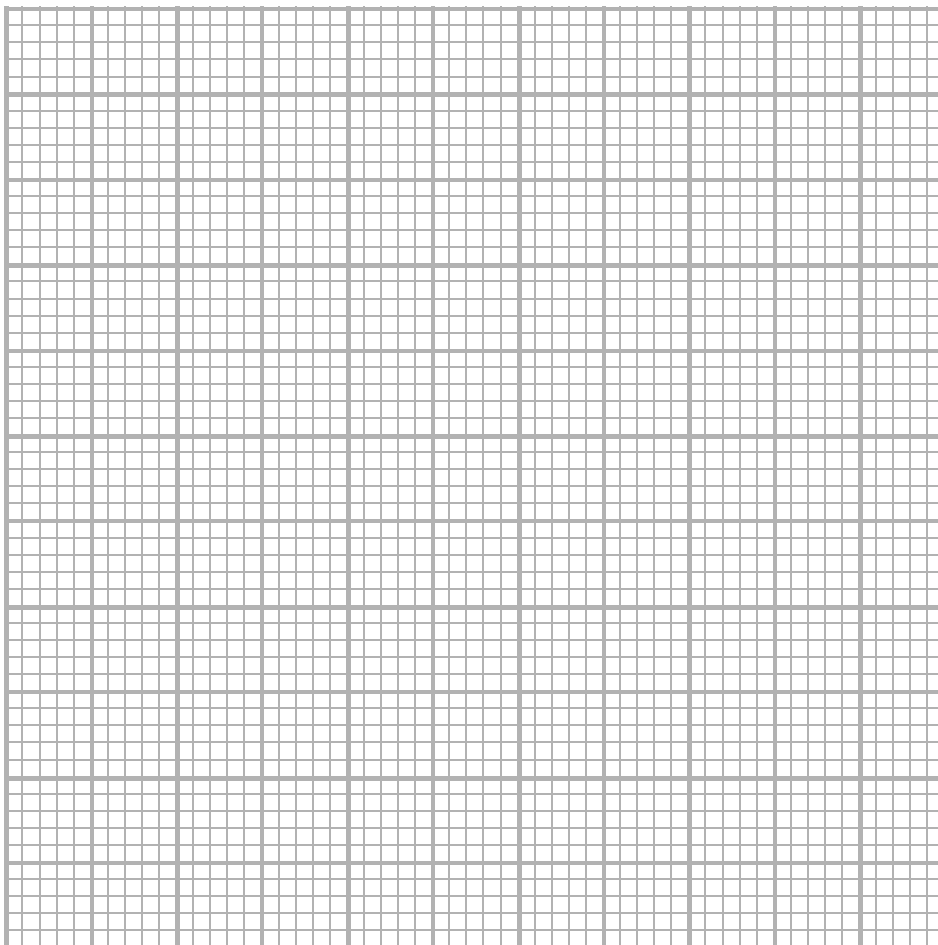
(b) Every half a minute, the teacher records the count rate.

He corrects for background radiation and produces this results table.

Time in minutes	Corrected count rate in Bq
0	49
0.5	30
1.0	24
1.5	18
2.0	15
2.5	11
3.0	10
3.5	9
4.0	5
4.5	6

(i) Draw a graph of corrected count rate against time for these results.

(5)



(ii) Use your graph to estimate the half-life for this material.

(1)

Half-life = minutes

(c) The isotope technetium-99 is a gamma emitter with a half-life of 6 hours. It is used as a radioactive tracer in medicine.

The technetium-99 is injected into a patient's bloodstream and carried around the body by the blood. The radiation it emits is detected outside the body.

Explain why technetium-99 is suitable for use as a tracer in this way.

(3)

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(Total for Question 1 = 13 marks)

2. Radon is a gas produced by some types of rocks.

(a) Radon is a natural source of radioactivity.

What is the name for this radioactivity?

(1)

- A** background radiation
- B** chain reaction
- C** radioactive dating
- D** radiotherapy

(b) There are two sources of alpha radiation in some houses:

- radon gas in the air
- solid americium in a smoke alarm

The alpha particles from radon are a greater risk to health than the alpha particles from americium.

Explain why.

(2)

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(c) Radon-222 and radon-220 are both isotopes of radon.

(i) A nucleus of radon-222 has 86 protons.

How many protons are there in a nucleus of radon-220?

(1)

A 86

B less than 86

C more than 86

D none

(ii) A nucleus of radon-222 has 136 neutrons.

How many neutrons are there in a nucleus of radon-220?

(1)

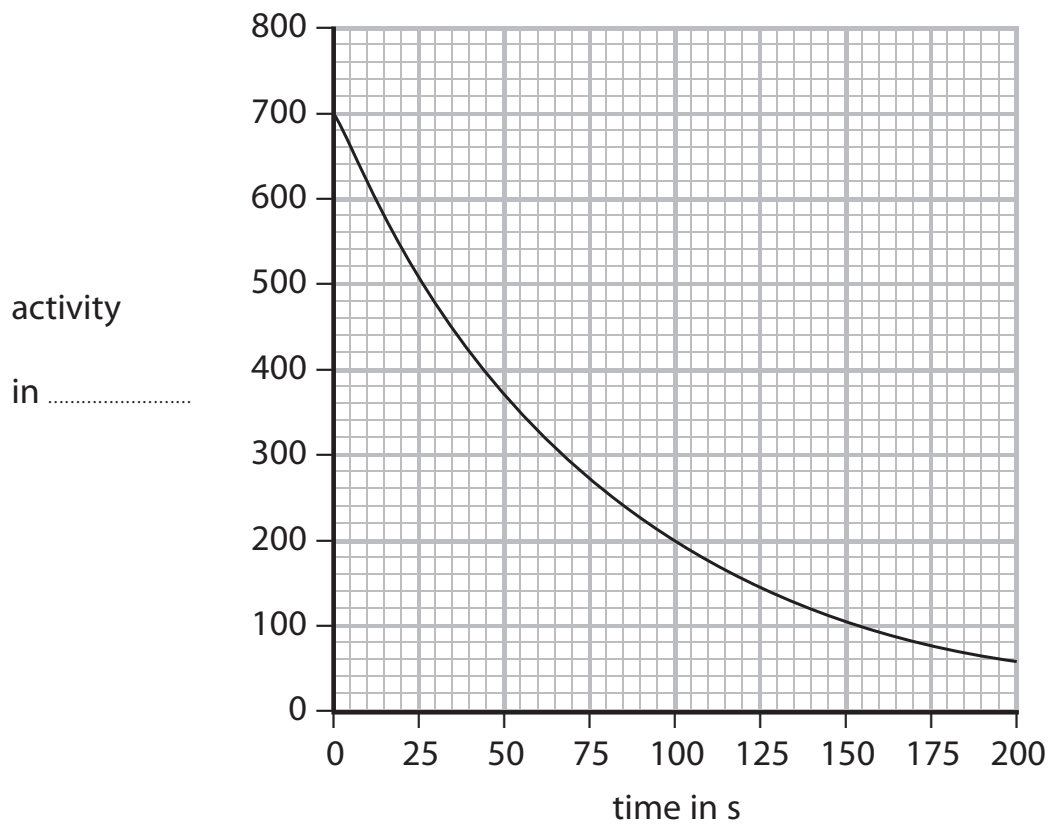
A 86

B 134

C 136

D 220

(d) The graph shows how the activity of a sample of radon-220 changes with time.



(i) Complete the graph by adding the missing unit for activity.

(1)

(ii) Explain what is meant by the term **half-life**.

(2)

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(iii) Use the graph to find a value for the half-life of radon-220.

(2)

Half-life = s

(Total for Question 2 = 10 marks)

3. Carbon-14 is a radioactive isotope of carbon.

It has the symbol



(a) (i) The number of **nucleons** in a carbon-14 nucleus is

(1)

- A 6
- B 8
- C 14
- D 20

(ii) The number of **neutrons** in a carbon-14 nucleus is

(1)

- A 6
- B 8
- C 14
- D 20

(iii) The number of **electrons** in a neutral carbon-14 atom is

(1)

- A 6
- B 8
- C 14
- D 20

(b) When carbon-14 decays it emits a beta particle.

What is a **beta particle**?

(1)

- A an electron
- B a neutron
- C a nucleus
- D a proton

(c) Carbon-14 has a half-life of 5700 years.

A sample of cloth contains 6.0 g of carbon-14.

What mass of carbon-14 will remain in the cloth after 11 400 years?

(1)

- A 1.5 g
- B 2.0 g
- C 2.5 g
- D 3.0 g

(d) The carbon atoms in the cloth are mainly atoms of carbon-12, a different isotope of carbon.

What are **isotopes**?

(2)

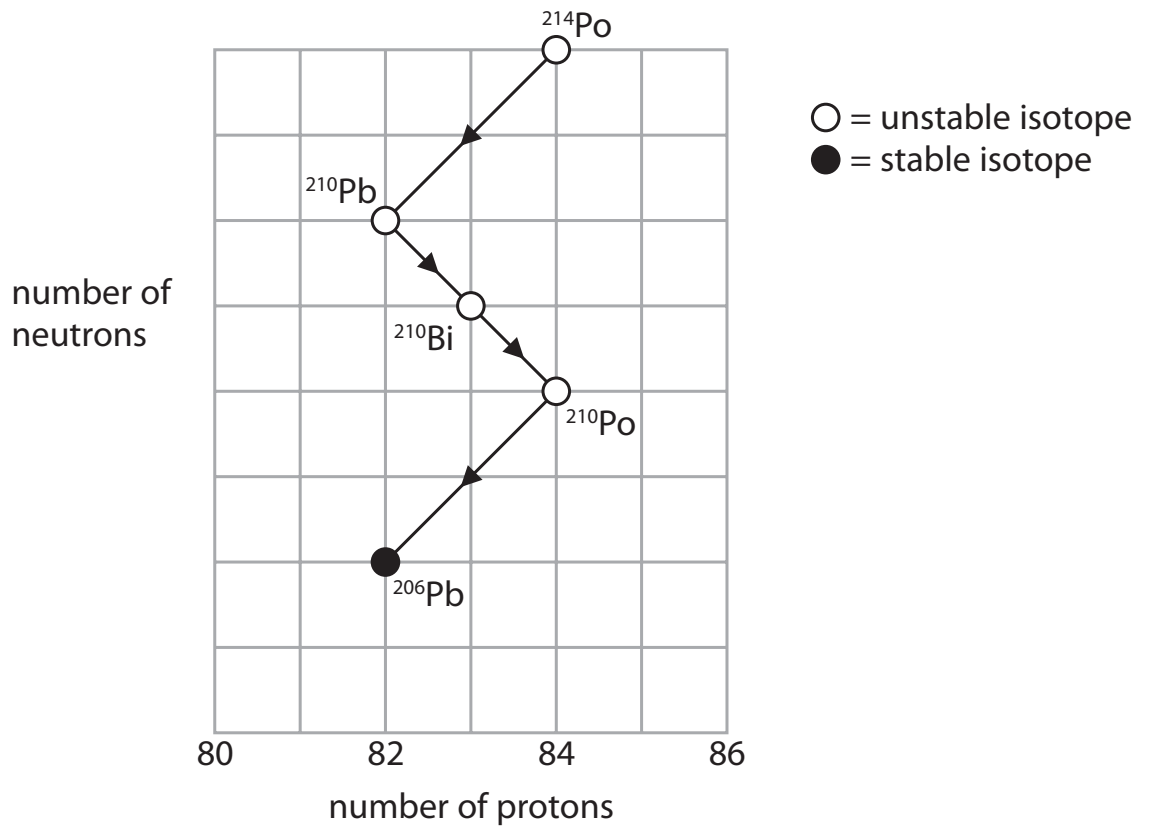
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(Total for Question 3 = 7 marks)

4. The grid shows the number of neutrons and the number of protons in some isotopes formed during successive radioactive decays.



(a) (i) What are **isotopes**?

(2)

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(ii) Why are some isotopes described as **stable**?

(1)

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(b) (i) Use the grid to **calculate** the number of neutrons in a ^{210}Po nucleus.

(1)

number of neutrons =

(ii) Describe what happens to the number of protons and the number of neutrons when a nucleus of ^{210}Pb decays to form ^{210}Bi .

(2)

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(iii) State the type of decay that occurs when ^{210}Pb decays to form ^{210}Bi .

(1)

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(c) Explain why the mass (nucleon) number and the atomic (proton) number do not change when a gamma ray is emitted from a nucleus.

(2)

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(Total for Question 4 = 9 marks)

5. A scientist placed a radioactive source in front of a Geiger-Muller detector and measured the count rate every 20 minutes.

The table shows her data.

Time in minutes	Count rate in counts per minute	Corrected count rate in counts per minute
0	660	630
20	462	432
40	330	300
60	240	210
80	180	150
100	142	112

- (a) The scientist corrects the count rate readings to allow for background radiation.

- (i) State two sources of background radiation.

(2)

1.....

2.....

- (ii) Describe how the scientist should measure the background radiation and correct the count rate readings.

(3)

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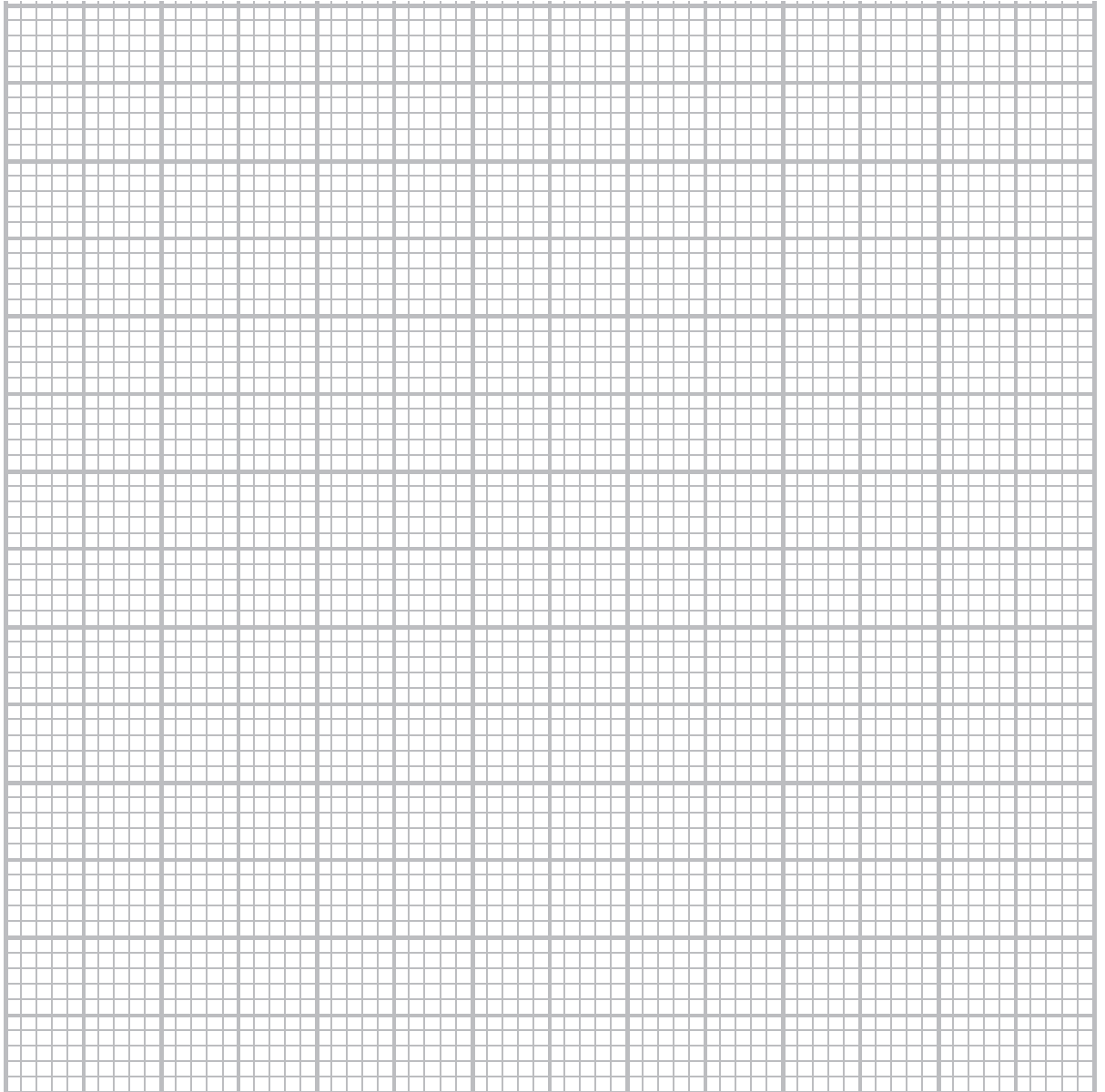
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(iii) Plot a graph of corrected count rate against time and draw the curve of best fit.

(5)



(iv) Use your graph to find the half-life of the radioactive source.

(2)

half-life = minutes

(b) The radioactive nuclei in the source emit beta radiation.

What effect does the emission of a beta particle have on a nucleus?

(2)

(c) The scientist needs to reduce the risks when working with radioactive sources.

(i) Explain why radioactive sources can be dangerous.

(2)

(ii) Describe how the risks of working with radioactive sources can be reduced.

(3)

(Total for Question 5 = 19 marks)

6. Sodium-24 is a radioactive isotope.

(a) What are isotopes?

(2)

(b) Sodium-24 decays by emitting beta particles.

(i) Describe the nature of a beta particle.

(1)

(ii) Name a piece of equipment that can be used to detect beta particles.

(1)

(iii) Describe how a detector can be used with sheets of lead, aluminium and paper to show that a sample of sodium-24 emits beta particles.

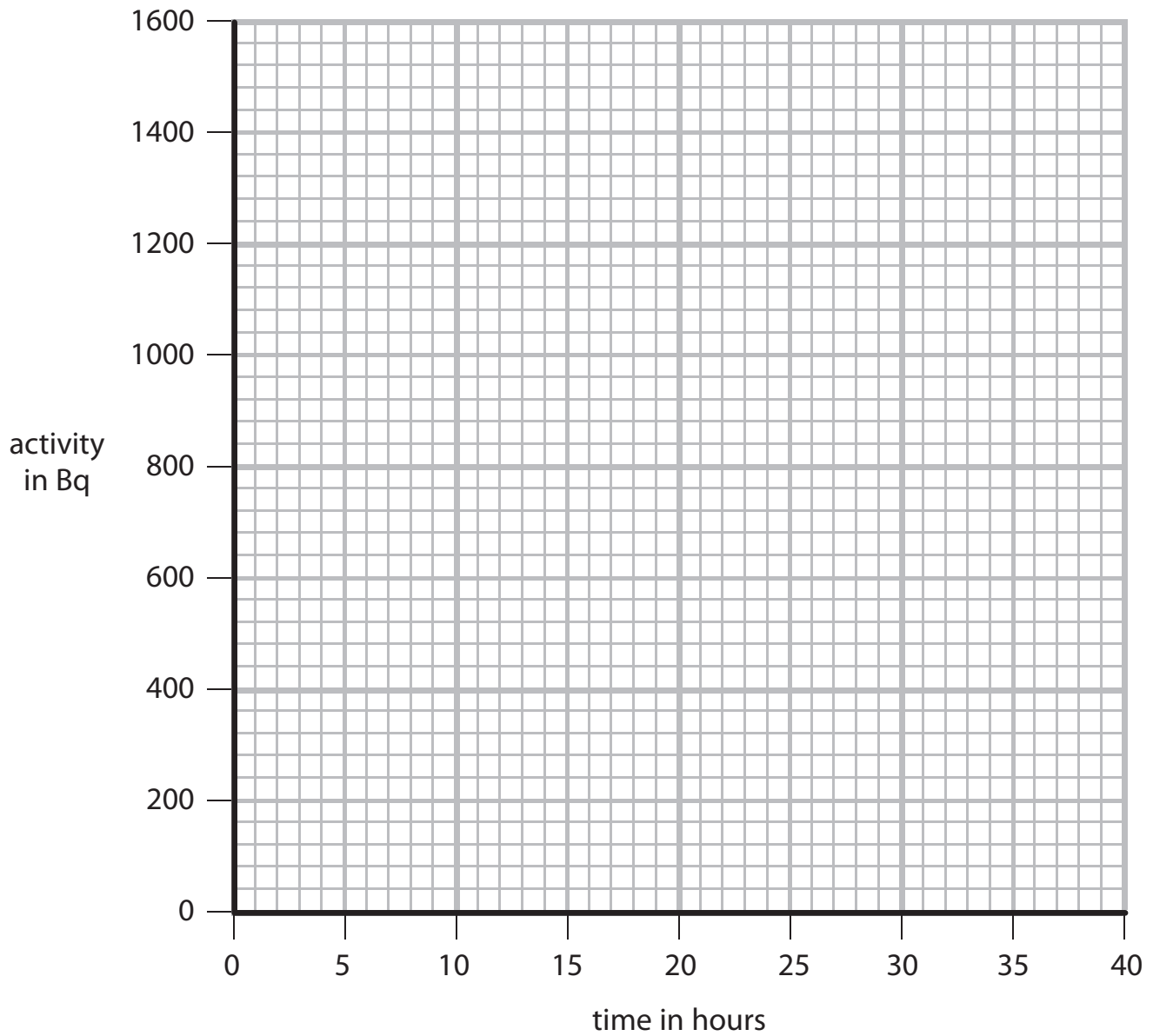
(2)

(c) A sample of sodium-24 has an activity of 1400 Bq.

On the axes, sketch a graph to show how the activity of this sample changes over the next 40 hours.

(the half-life of sodium-24 is 15 hours)

(3)



7. The table describes the nuclei of four atoms.

uranium-234	uranium-235	plutonium-238	americium-238
$^{234}_{92}\text{U}$	$^{235}_{92}\text{U}$	$^{238}_{94}\text{Pu}$	$^{238}_{95}\text{Am}$

(a) Atoms contain electrons.

Which nucleus needs the largest number of electrons to form a neutral atom?

(1)

- A** uranium-234
- B** uranium-235
- C** plutonium-238
- D** americium-238

(b) (i) Which two nuclei have the same number of protons?

(1)

..... and

(ii) Which two nuclei have the same number of nucleons?

(1)

..... and

(iii) Which two nuclei have the same number of neutrons?

(1)

..... and

(c) All of the nuclei are unstable and have a different half-life.

(i) Explain what is meant by the term **unstable**.

(1)

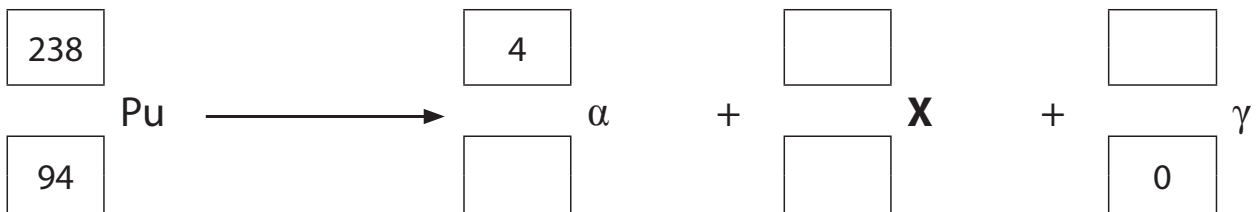
(ii) Explain what is meant by the term **half-life**.

(2)

(d) When plutonium decays, it emits an alpha particle and a gamma ray.

(i) Complete the decay equation for plutonium-238.

(4)



(ii) Use information from the table to identify element X.

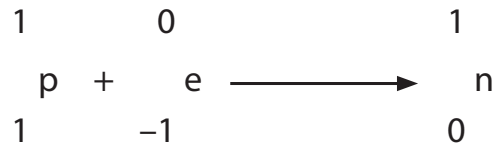
(1)

element X =

(e) The nucleus of americium-238 can absorb an electron.

When this happens, one of the protons in the nucleus becomes a neutron.

This equation describes the process.



(i) Describe how this process affects the proton number and the nucleon number of the nucleus that absorbs the electron.

(2)

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(ii) Identify the new nucleus formed by this process.

(1)

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(Total for Question 7 = 15 marks)
