PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



EXAM QUESTION PACK

TOPIC 6: RADIOACTIVITY (PACK 2)

SCORE	PERCENTAGE
/88	%

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Q1.

Carbon-14 is radioactive and has a half-life of 5 700 years.

The number of radioactive carbon-14 atoms in a very old piece of wood is found to have decreased from 1 000 000 to 125 000.

Determine the age of the piece of wood.

(2)

age of wood = ... years

(Total for question = 2 marks)

Q2.

This question is about radioactivity.

Fluorine-19 is a stable isotope of the element fluorine.

The element fluorine also has several radioactive isotopes.

Describe **one** similarity and **one** difference between the numbers of particles in one nucleus of fluorine-19 and one nucleus of a radioactive isotope of fluorine.

(2)

similarity

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difference

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(Total for question = 2 marks)

Q3.

*The global demand for electricity is increasing.

There is a debate about whether nuclear power generation should or should not contribute to meeting this increasing demand.

Discuss the arguments for and against using nuclear power to meet the increasing global demand for electricity.

(6)

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(Total for question = 6 marks)

Q4.

The nucleus of americium-238 can absorb an electron.

When this happens, one of the protons in the nucleus becomes a neutron, as shown in Figure 8.

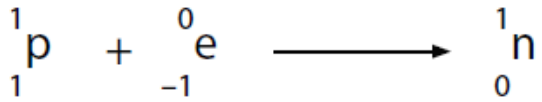


Figure 8

(i) Describe how absorbing an electron affects the proton number and the nucleon number of a nucleus.

(2)

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(ii) Deduce which nucleus is formed when americium-238 absorbs an electron.

(1)

☒ **A** uranium-234

☒ **B** uranium-235

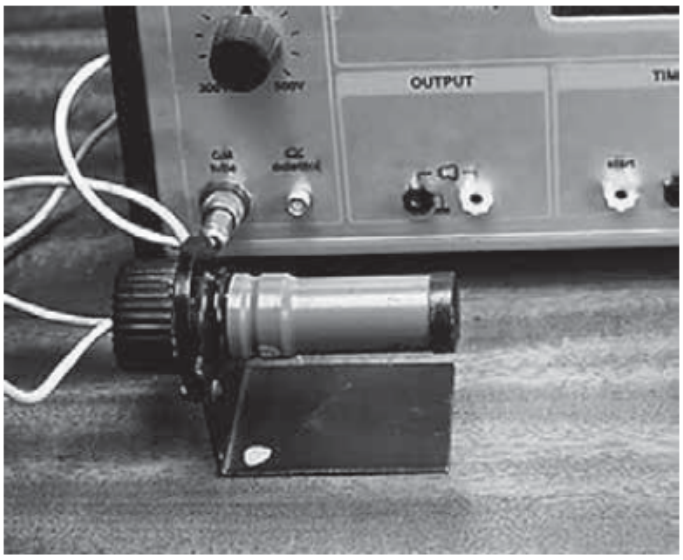
☒ **C** plutonium-238

☒ **D** americium-238

(Total for question = 3 marks)

Q5.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

One radioactive source used in hospitals is technetium (Tc).

Technetium is produced from the radioactive decay of molybdenum (Mo).

Complete the following nuclear equation.

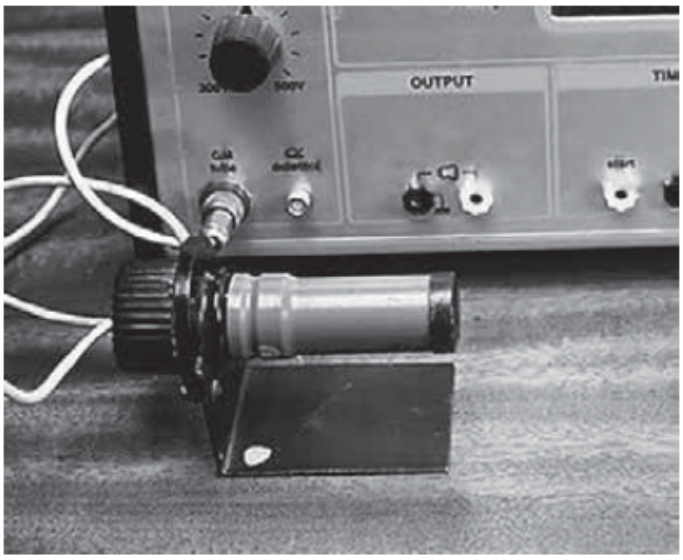
(1)

$$^{99}_{42}\text{Mo} \rightarrow \text{_____} + {}^{0}_{-1}\beta$$

(Total for question = 1 mark)

Q6.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

One radioactive source used in hospitals is technetium (Tc).

Technetium is produced from the radioactive decay of molybdenum (Mo).

Complete the following nuclear equation.

(1)

$$^{99}_{42}\text{Mo} \rightarrow \text{____}\text{Tc} + {}^{0}_{-1}\beta$$

(Total for question = 1 mark)

Q7.

Rutherford devised an experiment to fire alpha particles at thin gold foil.

The apparatus that was used in the experiment is shown in Figure 6.

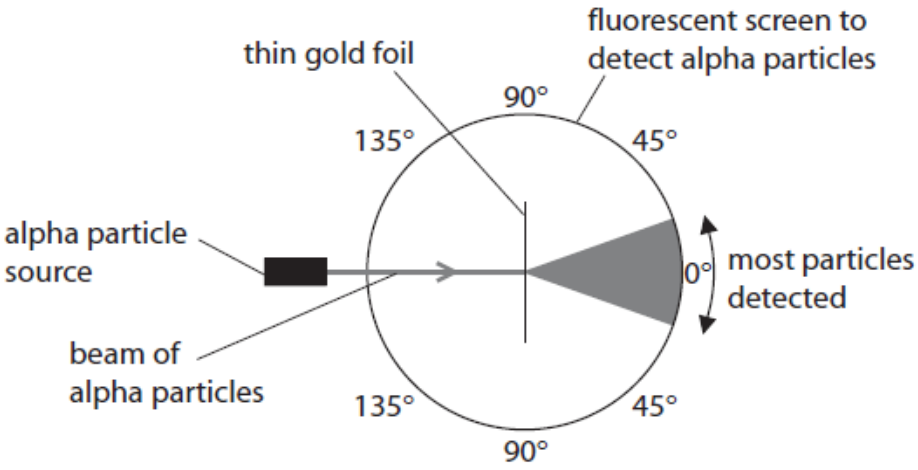


Figure 6

(i) The number of particles detected at each angle in a given time is shown on the graph in Figure 7.

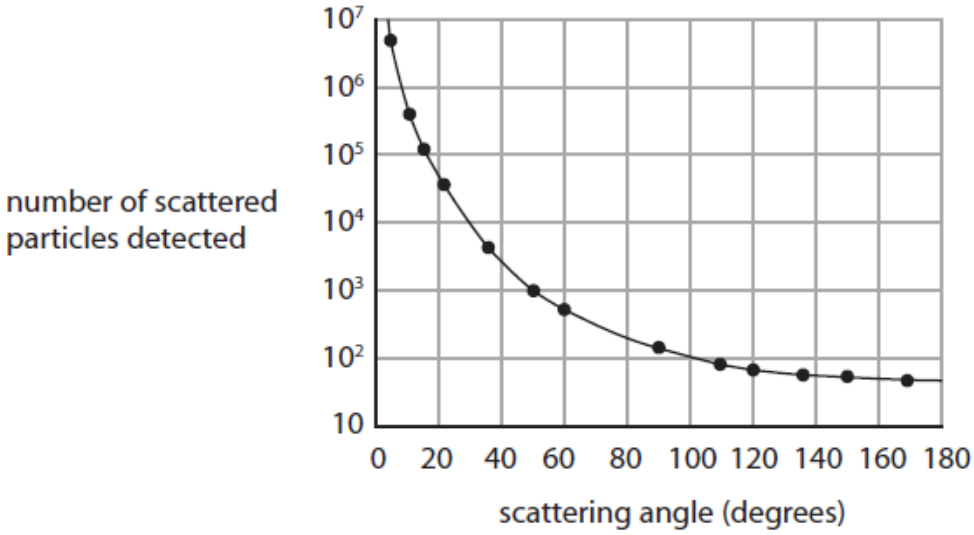


Figure 7

Use information from the graph.

Estimate the ratio of the number of particles scattered through 5° to the number of particles scattered through 100°.

(2)

ratio = ...

(ii) Explain how the difference in the number of particles scattered at different angles gives evidence for the current model of the structure of the atom.

(4)

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(Total for question = 6 marks)

Q8.

Rutherford devised an experiment to fire alpha particles at thin gold foil.

It was found that alpha particles were scattered by the gold foil.

The gold foil was about 4.0×10^{-7}m thick.

A gold atom has a diameter of about 0.15 nm.

Estimate how many gold atoms would fit across this thickness of gold foil.

(2)

number of atoms = ...

(Total for question = 2 marks)

Q9.

Rutherford devised an experiment to fire alpha particles at thin gold foil.

It was found that alpha particles were scattered by the gold foil.

The gold foil was about 4.0×10^{-7} m thick.

A gold atom has a diameter of about 0.15 nm.

Estimate how many gold atoms would fit across this thickness of gold foil.

(2)

number of atoms = ...

(Total for question = 2 marks)

Q10.

The half-life of cobalt-60 is 5 years.

A school cobalt source had an activity of 38.5 kBq in the year 2000.

Estimate the activity of this source in the year 2020.

(3)

activity = ... kBq

(Total for question = 3 marks)

Q11.

The half-life of cobalt-60 is 5 years.

A school cobalt source had an activity of 38.5 kBq in the year 2000.

Estimate the activity of this source in the year 2020.

(3)

activity = ... kBq

(Total for question = 3 marks)

Q12.

The apparatus that was used in the experiment is shown in Figure 10.

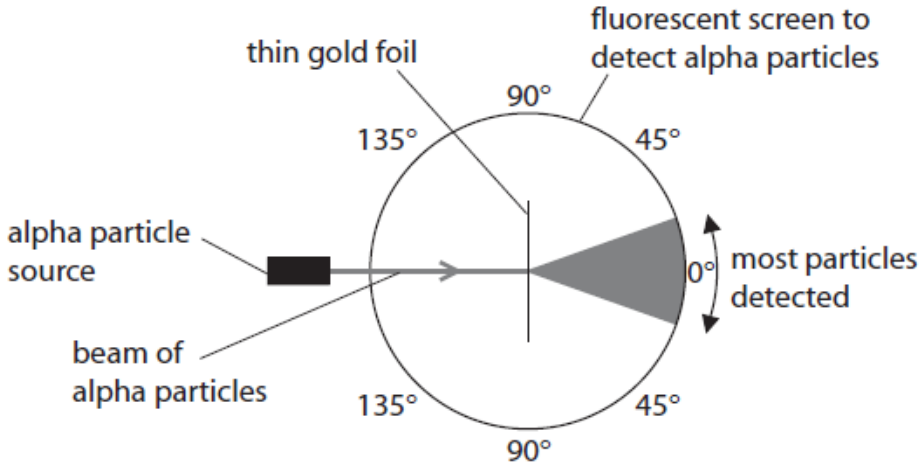


Figure 10

(i) The number of particles detected at each angle in a given time is shown on the graph in Figure 11.

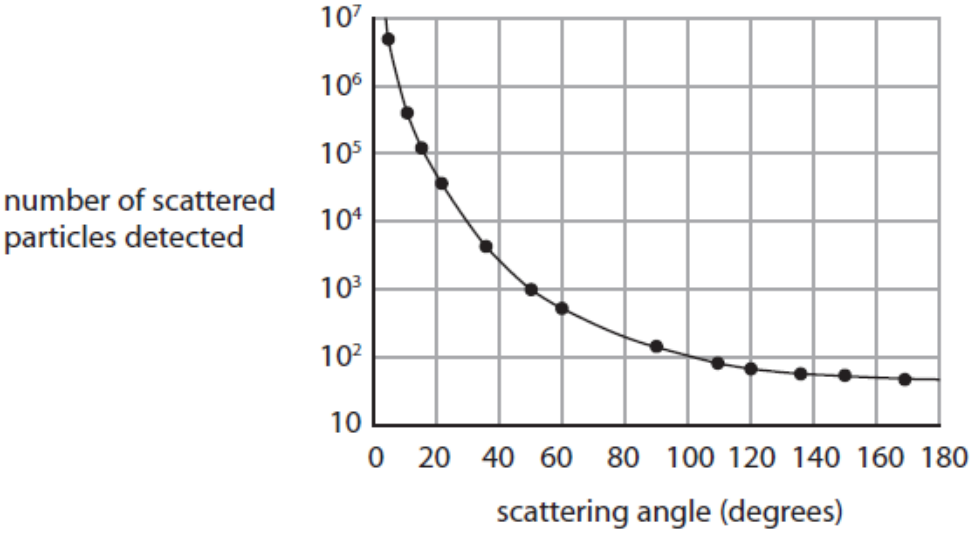


Figure 11

Use information from the graph.

Estimate the ratio of the number of particles scattered through 5° to the number of particles scattered through 100°.

(2)

ratio = ...

(ii) Explain how the difference in the number of particles scattered at different angles gives evidence for the current model of the structure of the atom.

(4)

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(Total for question = 6 marks)

Q13.

Figure 6 is a diagram of a nuclear reactor.

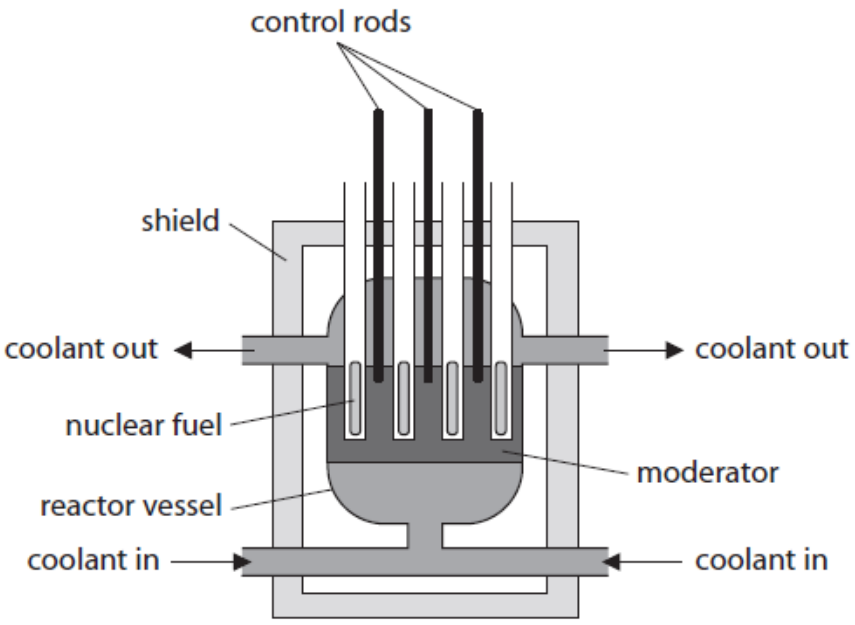


Figure 6

(i) Explain how pushing the control rods further into the reactor slows down the nuclear chain reaction.

(2)

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(ii) The moderator in a nuclear reactor slows down the neutrons so that the neutrons are more likely to start other fission reactions.

In a nuclear reactor,

- the average speed of the fast neutrons is 3.0 × 107 m/s
- the average speed of the slow neutrons is 4.0 × 103 m/s

Calculate the average speed of the slow neutrons as a percentage of the average speed of the fast neutrons.

(2)

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(iii) The nuclear reaction is the first stage in the process of generating electricity.

Describe how energy is transferred from the nuclear reaction to the next stage in the process.

(2)

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(Total for question = 6 marks)

Q14.

Some isotopes are unstable.
They emit β^- particles when they decay.

Explain how a nucleus changes when a β^- particle is emitted.

(2)

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(Total for question = 2 marks)

Q15.

Some isotopes are unstable.
They emit β^- particles when they decay.

Explain how a nucleus changes when a β^- particle is emitted.

(2)

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(Total for question = 2 marks)

Q16.

Explain how neutrons enable a nuclear chain reaction to take place.

(2)

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(Total for question = 2 marks)

Q17.

Early in the twentieth century, scientists fired a beam of alpha particles at thin gold foil.

Figure 2 shows the main parts of their experiment with some results.

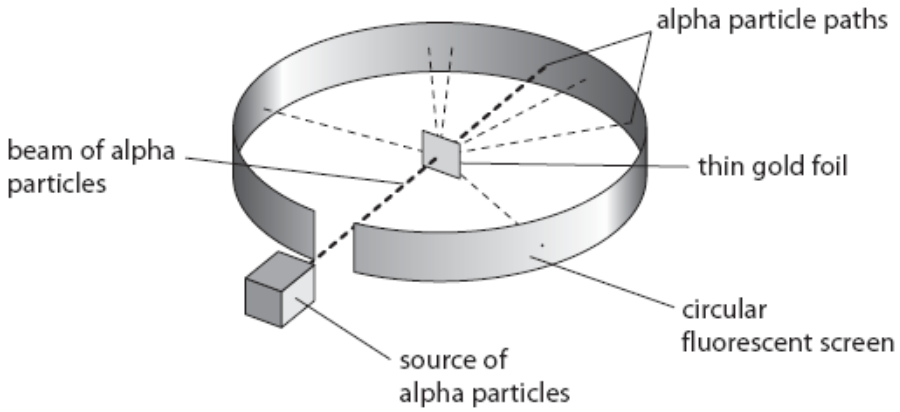


Figure 2

Explain how the results of the experiment shown in Figure 2 support the nuclear model of an atom.

(3)

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(Total for question = 3 marks)

Q18.

Early in the twentieth century, scientists fired a beam of alpha particles at thin gold foil.

Figure 2 shows the main parts of their experiment with some results.

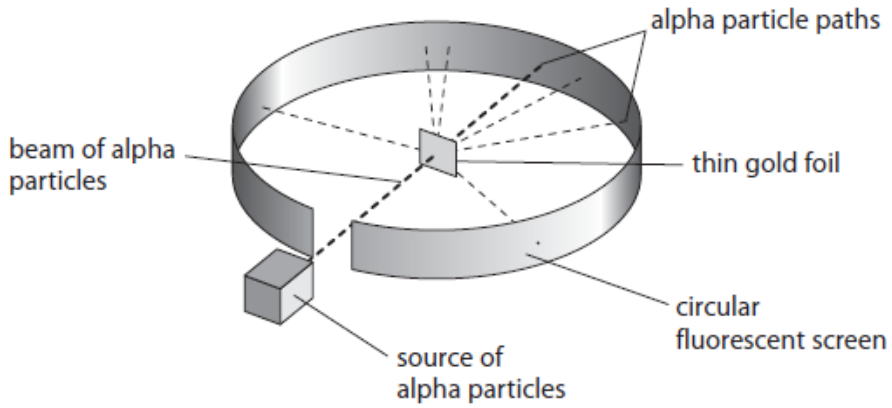


Figure 2

Explain how the results of the experiment shown in Figure 2 support the nuclear model of an atom.

(3)

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(Total for question = 3 marks)

Q19.

In a nuclear reactor, a chain reaction is produced and controlled.

Explain what happen inside a nuclear reactor if neutron speeds are not controlled.

(3)

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(Total for question = 3 marks)

Q20.

Explain the use of a moderator in a nuclear reactor.

(3)

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(Total for question = 3 marks)

Q21.

Carbon–14 decays into nitrogen–14.

The symbol for nitrogen–14 is $^{14}_{7}N$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

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(Total for question = 2 marks)

Q22.

Carbon-14 decays into nitrogen-14.

The symbol for nitrogen-14 is $^{14}_{7}N$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

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(Total for question = 2 marks)

Q23.

Nuclear fusion is another type of nuclear reaction.

Explain why there are no power stations using nuclear fusion.

(3)

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(Total for question = 3 marks)

Q24.

Fusion and fission are nuclear reactions in which large amounts of energy are released.

(i) In a fusion reaction, two hydrogen nuclei are forced together to form a helium nucleus.

Explain why a very high temperature is needed for this reaction to happen.

(3)

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(ii) In a fusion reaction, the combined mass of the two small nuclei is greater than the mass of the resulting nucleus.

This decrease in mass, m, appears as energy, E, according to the equation.

$$E = mc^2$$

c is the speed of light = 3.0×10^8 m/s.

The energy released in one fusion reaction is 4.5×10^{-12} J.

Calculate the decrease in mass.

(3)

decrease in mass = ... kg

(Total for question = 6 marks)

Q25.

This question is about radioactivity.

Figure 3 shows a Geiger-Muller (G-M) tube attached to a counter.
The G-M tube is used to measure the activity of a source of beta (β) radiation.
There is an aluminium sheet between the beta source and the G-M tube.
The counter is switched on and after 1 minute shows a count of 268.

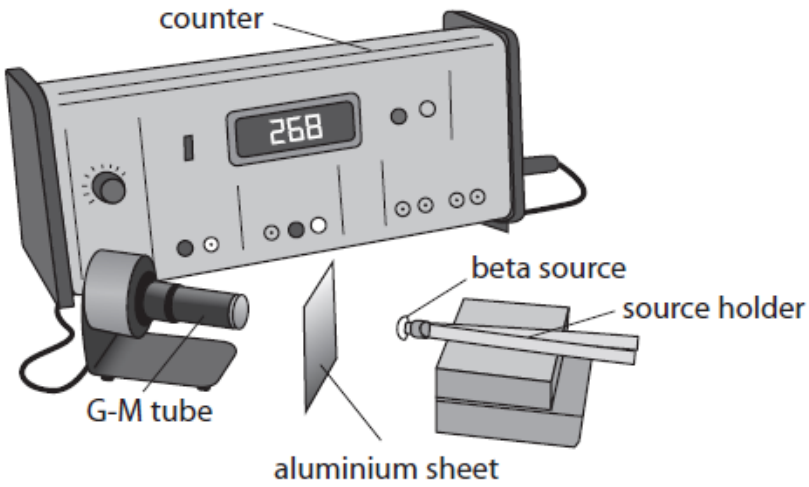


Figure 3

(i) The aluminium sheet is taken away.
The counter is reset to zero and then switched on again.
A new count is taken for 1 minute.

Explain why the new count is greater than 268.

(2)

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(ii) The beta source is then also taken away.
The counter is reset to zero and switched on again.
A new count is taken for 1 minute.

Give a reason why there would now be a reading on the counter.

(1)

.....

.....

(iii) State the SI unit for the activity of a radioactive source.

(1)

.....

(Total for question = 4 marks)

Q26.

Figure 3 shows a Geiger–Muller (G–M) tube attached to a counter.
The G–M tube is used to measure the activity of a source of beta (β) radiation.
There is an aluminium sheet between the beta source and the G–M tube.
The counter is switched on and after 1 minute shows a count of 268.

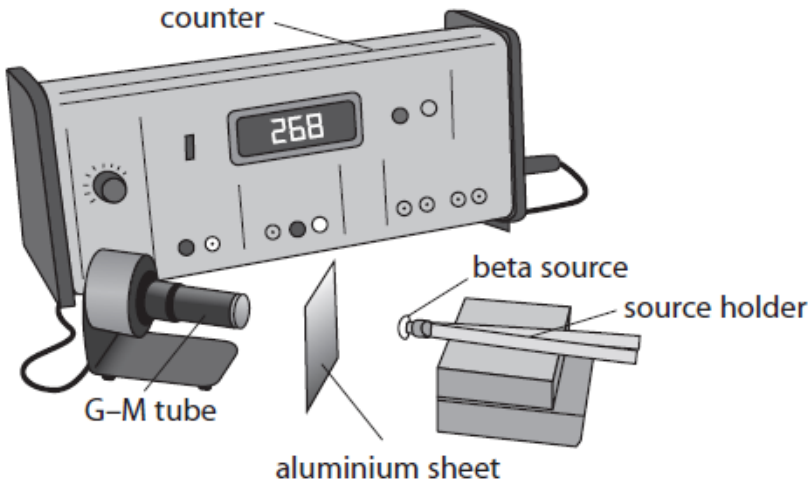


Figure 3

(i) The aluminium sheet is taken away.
The counter is reset to zero and then switched on again.
A new count is taken for 1 minute.

Explain why the new count is greater than 268.

(2)

.....

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(ii) The beta source is then also taken away.
The counter is reset to zero and switched on again.
A new count is taken for 1 minute.

Give a reason why there would now be a reading on the counter.

(1)

.....

.....

(iii) State the SI unit for the activity of a radioactive source.

(1)

.....

(Total for question = 4 marks)

Q27.

Figure 1 is a diagram of three atoms.

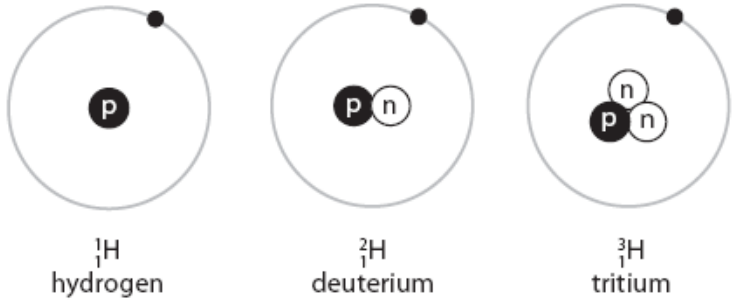


Figure 1

Give reasons why these atoms are isotopes.

(2)

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(Total for question = 2 marks)

Q28.

Figure 1 is a diagram of three atoms.

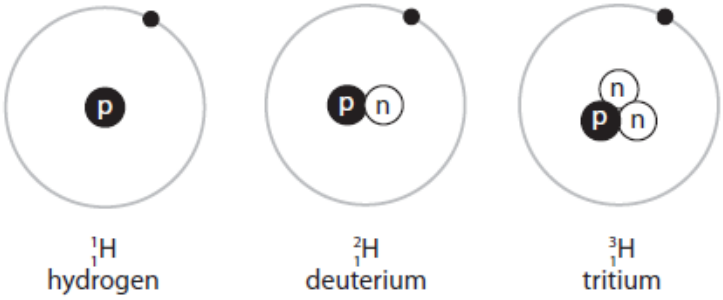


Figure 1

Give reasons why these atoms are isotopes.

(2)

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(Total for question = 2 marks)

Q29.

Other unstable isotopes emit alpha particles.

Which of these describes an alpha particle?

(1)

☒ **A** a hydrogen nucleus

☒ **B** a hydrogen atom

☒ **C** a helium nucleus

☒ **D** a helium atom

(Total for question = 1 mark)

Q30.

Figure 1 is a diagram of three atoms.

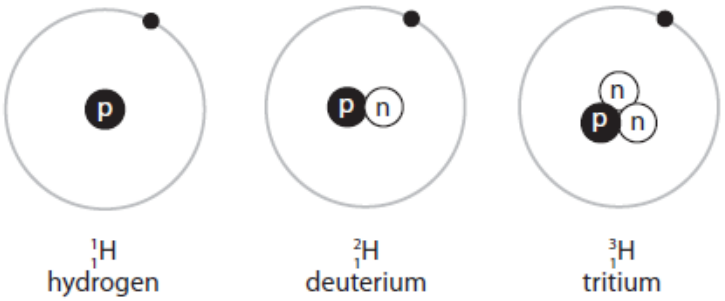


Figure 1

Some unstable isotopes emit alpha particles.

Which of these describes an alpha particle?

(1)

☒ **A** a hydrogen nucleus

☒ **B** a hydrogen atom

☒ **C** a helium nucleus

☒ **D** a helium atom

(Total for question = 1 mark)