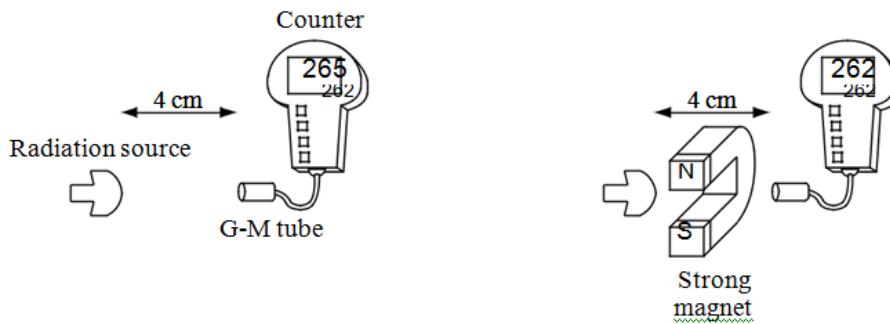# Half Life 1

Q:1 The diagrams show a G-M tube and counter used to measure the radiation emitted from a source. Both diagrams show the reading on the counter one minute after it was switched on.

Explain why the counter readings show that the source is giving out only gamma radiation.

_____

_____

_____

_____

(2 marks)

(b) The box gives information about the radioactive isotope technetium-99.

Type of radiation emitted: gamma

Half-life: 6 hours

Used as a medical tracer

What is meant by the term half-life?

_____

_____

(1 mark)

(c) To study the blood flow in a patient's lungs, a doctor injects a small quantity of a technetium-99 compound into the patient. The radiation emitted by the technetium-99 atoms is detected outside the patient's body.
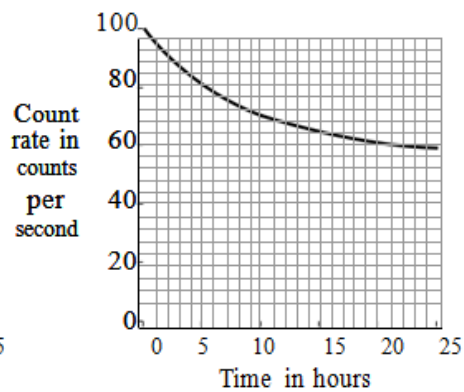
Explain why a doctor would not use a radioactive isotope with a very short half-life, such as 2 seconds, as a medical tracer.
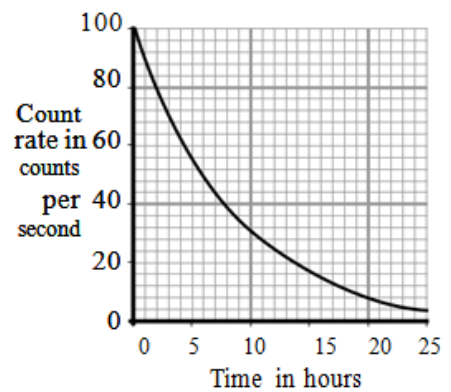
_____

_____

_____

(2 marks)

Q:2 The graphs show how the count rates from three different radioactive sources, J, K, and L, change with time.
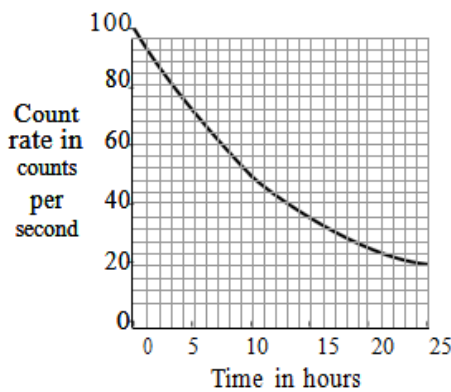
(a) Which source, J, K, or L, has the highest count rate after 24 hours? _____

(1 mark)

(b) For source L, what is the count rate after 5 hours? _____ counts per second

(1 mark)

(c) Which source, J, K, or L, has the longest half-life? _____

(1 mark)

(d) A radioactive source has a half-life of 6 hours. What might this source be used for?

Put a tick ( ) in the box next to your choice.

To monitor the thickness of paper as it is made in a factory ☐

To inject into a person as a medical tracer ☐

To make a smoke alarm work ☐

(1 mark)

Q:3 Most elements have some isotopes which are radioactive.
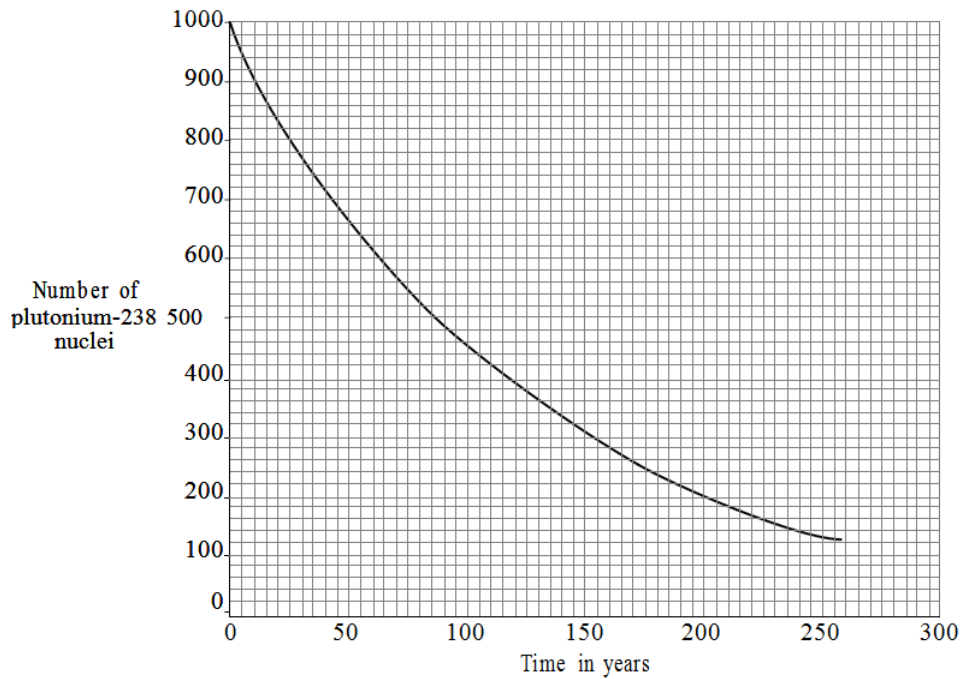
(a) What is meant by the terms:

(a)(i) isotopes

_____

_____

(1 mark)

(a)(ii) radioactive?

_____

_____

(1 mark)

(b) The graph shows how the number of nuclei in a sample of the radioactive isotope plutonium-238 changes with time.

Use the graph to find the half-life of plutonium-238. Show clearly on the graph how you obtain your answer.

Half-life = _____ years

(2 marks)

(c) The Cassini spacecraft launched in 1997 took seven years to reach Saturn.

The electricity to power the instruments on board the spacecraft is generated using the heat produced from the decay of plutonium-238.

(c)(i) Plutonium-238 decays by emitting alpha particles.

What is an alpha particle?

_____

(1 mark)

(c) (ii) During the 11 years that Cassini will orbit Saturn, the output from the generators will decrease.

Explain why.

_____

_____

_____

(2 marks)

(d) Plutonium-238 is highly dangerous. A tiny amount taken into the body is enough to kill a human.

(d)(i) Plutonium-238 is unlikely to cause any harm if it is outside the body but is likely to kill if it is inside the body.Explain why.

_____

_____

_____

(2 marks)

(d)(ii) In 1964, a satellite powered by plutonium-238 was destroyed, causing the release

of radioactive material into the atmosphere.Suggest why some environmental groups protested about the launch of Cassini.

_____

_____

(1 mark)

Q:4 Some rocks inside the Earth contain a radioactive element, uranium-238. When an atom of uranium-238 decays, it gives out an alpha particle.
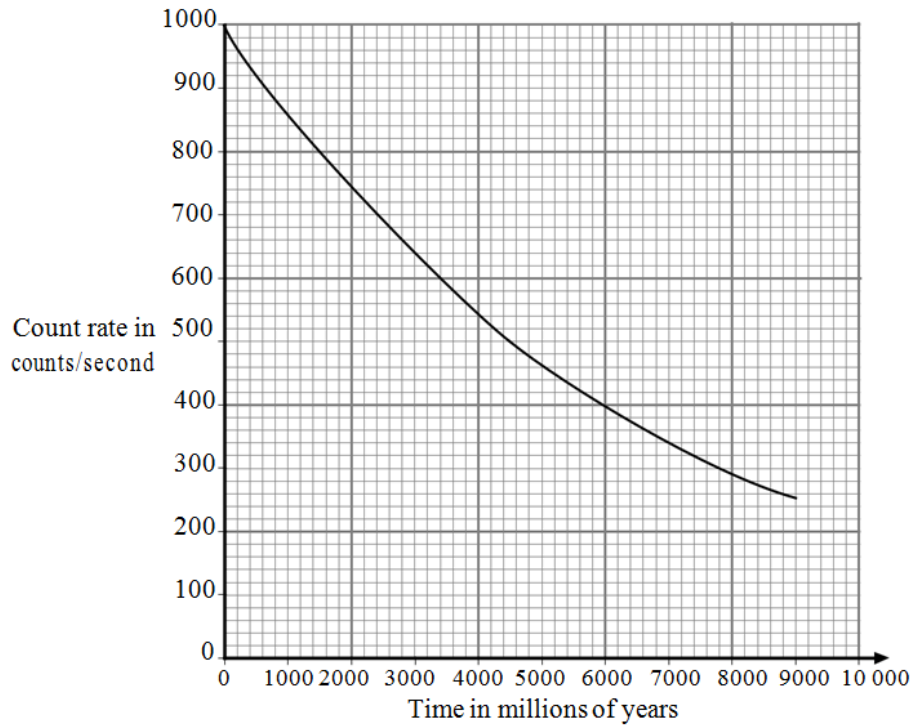
(a) The following statement about alpha particles was written by a student. The statement is not correct.

Alpha particles can pass through a very thin sheet of lead .

Change one word in the statement to make it correct. Write down your new statement.

_____

_____

(1 mark)

(b) The graph shows how the count rate from a sample of uranium-238 changes with time.

The graph can be used to find the half-life of uranium-238. The half-life is 4500 million years.

(b) (i) Draw on the graph to show how it can be used to find the half-life of uranium-238.

(1 mark)

(b) (ii) There is now half as much uranium-238 in the rocks as there was when the Earth was formed.

How old is the Earth?

Draw a ring around your answer.

    2250 million years   4500 million years   9000 million years

(1 mark)

(b) (iii) If a sample of uranium-238 were available, it would not be possible to measure the half-life in a school experiment. Explain why.

_____

_____

_____

(2 marks)

Q:5 Uranium-238 has a half-life of 4500 million years.

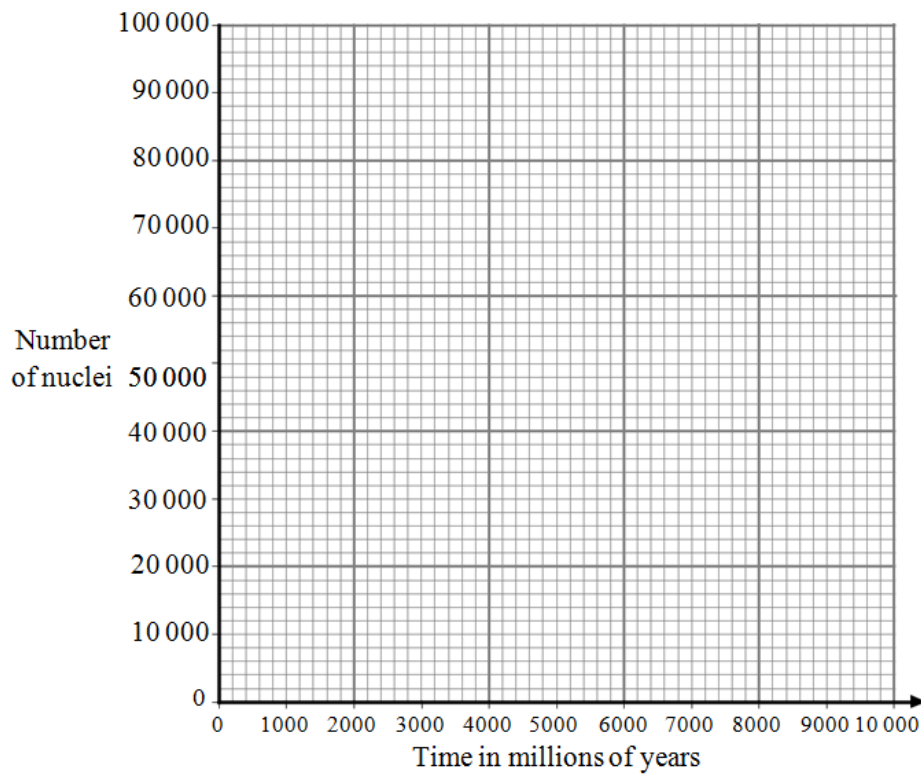**(a)** When the Earth was formed, there was twice as much uranium-238 in the rocks as there is now.

What is the age of the Earth?

....

(1 mark)

(b) Complete the graph to show how the number of nuclei in a sample of uranium-238 will change with time.

Initially, there were 100 000 nuclei in the sample.

(2 marks)

TOTAL MARKS=27