

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Q1.

Most elements have some *isotopes* which are *radioactive*.

(a) What is meant by the terms:

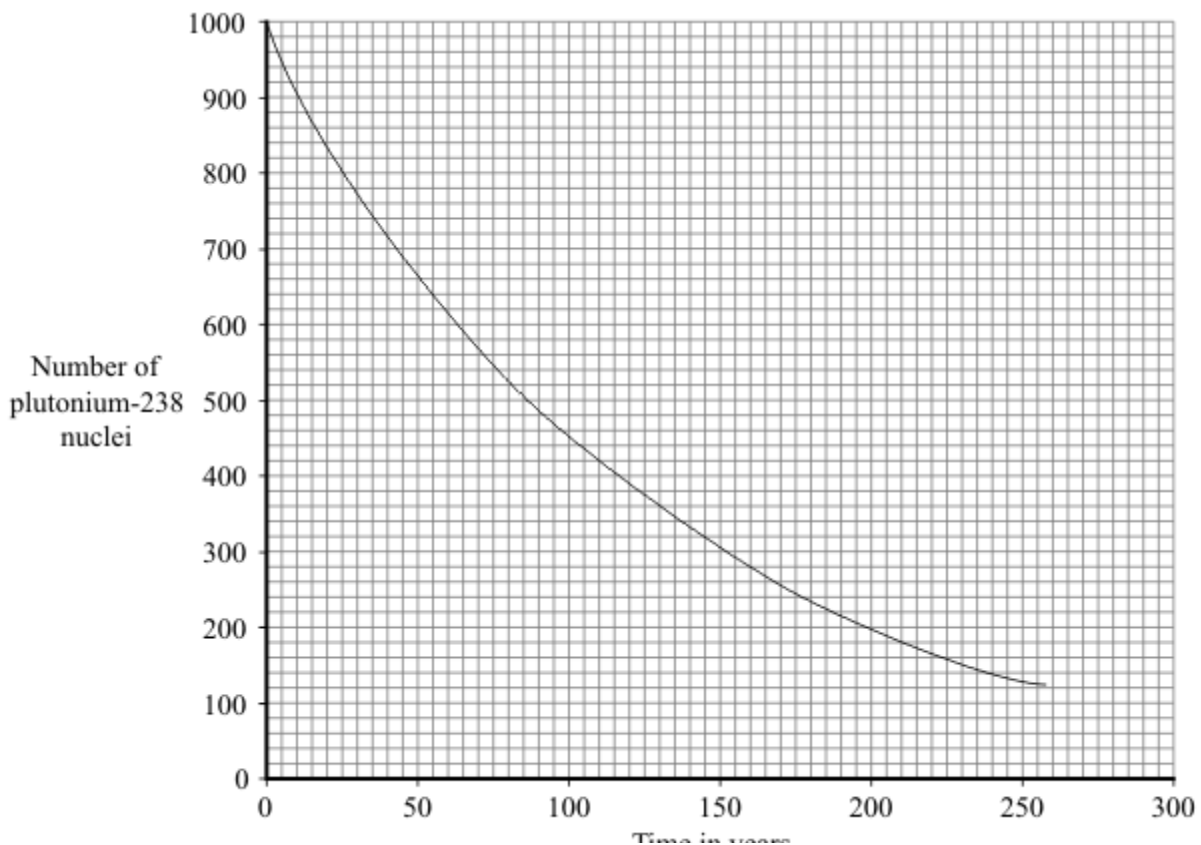
(i) *isotopes*

(1)

(ii) *radioactive?*

(1)

(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)

- (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.

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

What is an alpha particle?

(1)

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

Explain why.

(2)

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

- (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)

(Total 10 marks)

Q2.

- (a) Complete the following table for an atom of uranium-238 ($^{238}_{92}\text{U}$)

mass number	238
number of protons	92
number of neutrons	

(1)

- (b) Complete the following sentence.

The name given to the number of protons in an atom is the proton number or the

_____.

(1)

- (c) An atom of uranium-238 ($^{238}_{92}\text{U}$) decays to form an atom of thorium-234 ($^{234}_{90}\text{Th}$).

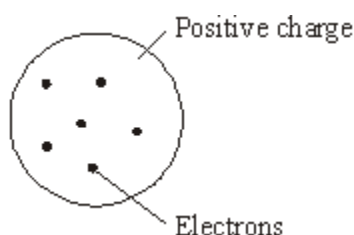
- (i) What type of radiation, alpha, beta or gamma, is emitted by uranium-238?

(1)

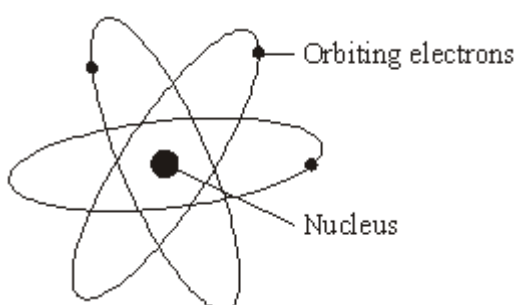
- (ii) Why does an atom that decays by emitting alpha or beta radiation become an atom of a different element?

Q3.

In the early part of the 20th century, scientists used the 'plum pudding' model to explain the structure of the atom.



Following work by Rutherford and Marsden, a new model of the atom, called the 'nuclear' model, was suggested.



- (a) Describe the differences between the two models of the atom.

(4)

- (b) In their investigation, Rutherford and Marsden fired positively charged alpha particles at a very thin sheet of gold. Over a period of several months, the scientists made over 100 000 measurements. These measurements showed that:

- a very small number of alpha particles were deflected backwards from the gold foil.

Use the nuclear model to explain this experimental result.

(2)

- (c) Why did the work of Rutherford and Marsden convince many scientists that the 'plum pudding' model of the atom was incorrect?

(2)

(Total 8 marks)