

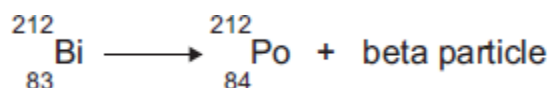
Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

- (a) Atoms of the isotope bismuth-212 decay by emitting either an alpha particle or a beta particle. The equation represents what happens when an atom of bismuth-212 decays by beta emission into an atom of polonium-212.



- (i) The bismuth atom and the polonium atom have the same mass number (212).

What is the *mass number* of an atom?

(1)

- (ii) Beta decay does **not** cause the mass number of an atom to change.

Explain why not.

(2)

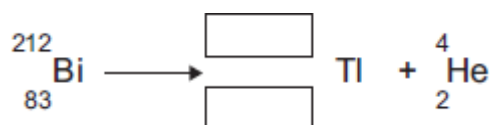
- (b) When an atom of bismuth-212 emits an alpha particle, the atom decays into an atom of thallium.

An alpha particle is the same as a helium nucleus.
 The symbol below represents an alpha particle.



- (i) The equation below represents the alpha decay of bismuth-212.

Complete the equation by writing the correct number in each of the two boxes.



(2)

- (ii) It is impossible for the alpha decay of bismuth-212 to produce the same element as the beta decay of bismuth-212.

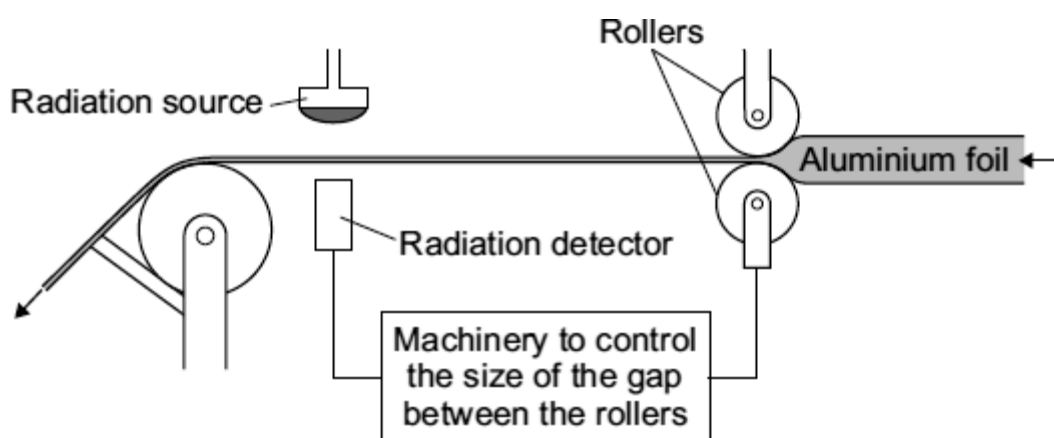
Explain why.

(2)

(Total 7 marks)

Q2.

The diagram shows a system used to control the thickness of aluminium foil as it is being rolled. A radiation source and detector are used to monitor the thickness of the foil.

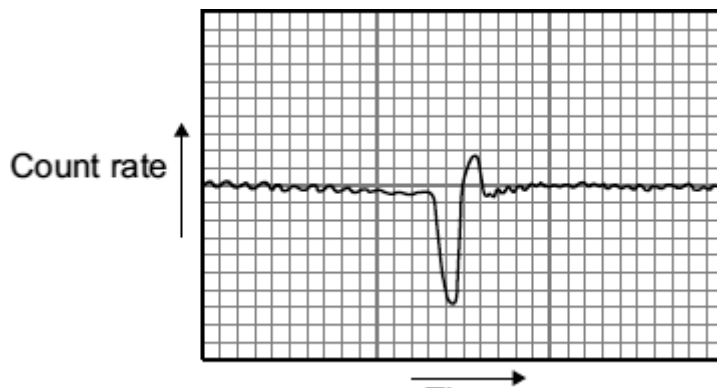


- (a) Which type of source, alpha, beta or gamma, should be used in this control system?

Explain why each of the other two types of source would **not** be suitable.

(3)

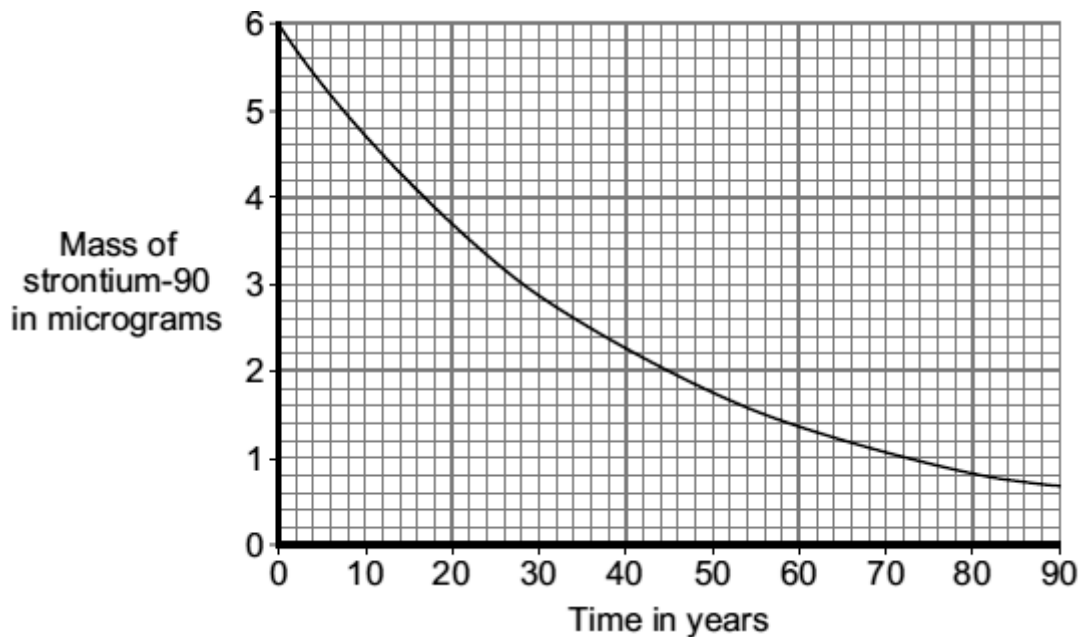
- (b) The chart shows how the count rate recorded by the detector varies over a short period of time.



Use the graph to explain how the thickness of the foil changes, and how the control system responds to this change.

(2)

- (c) When first used, the radiation source contains 6 micrograms of strontium-90. The graph shows how the mass of the strontium-90 will decrease as the nuclei decay.



The control system will continue to work with the same source until 75 % of the original strontium-90 nuclei have decayed.

After how many years will the source need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

Q3.

- (a) Carbon has three naturally occurring isotopes. The isotope, carbon-14, is radioactive. An atom of carbon-14 decays by emitting a beta particle.

- (i) Complete the following sentences.

The atoms of the three carbon isotopes are the same as each other because

The atoms of the three carbon isotopes are different from each other because

(2)

- (ii) What is a beta particle and from what part of an atom is it emitted?

(1)

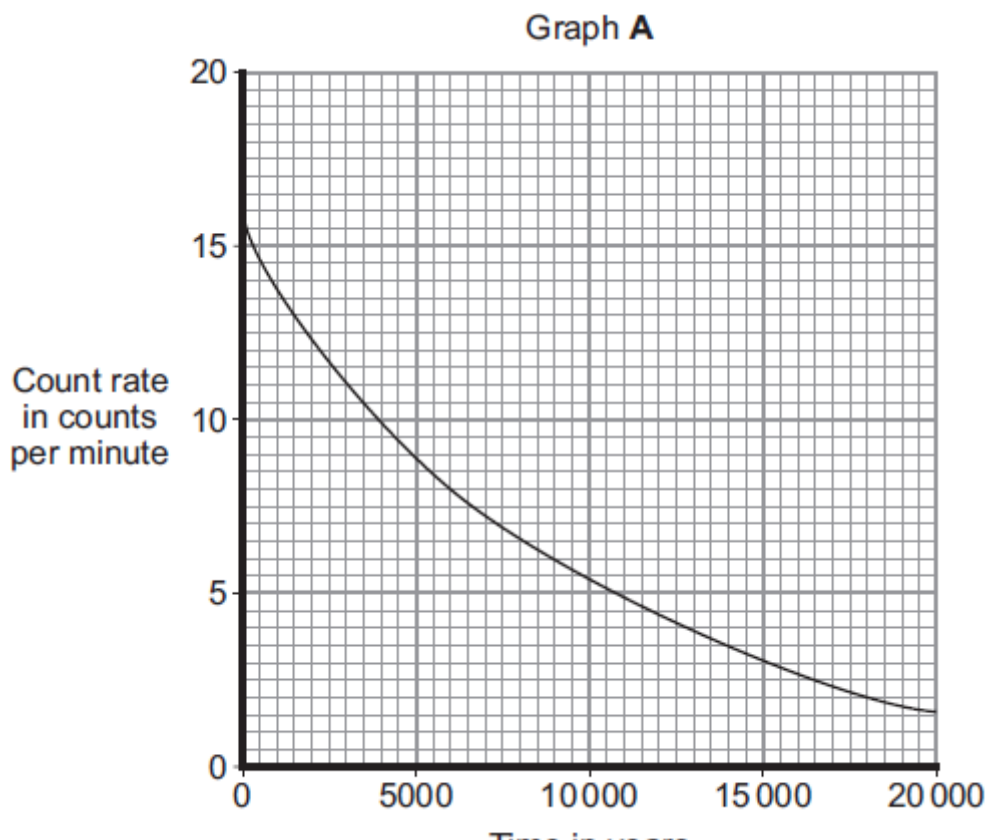
- (b) Carbon-14 is constantly being made in the atmosphere, yet for most of the last million years, the amount of carbon-14 in the atmosphere has not changed.

How is this possible?

(1)

- (c) Trees take in carbon-12 and carbon-14 from the atmosphere. After the tree dies, the proportion of carbon-14 that the tree contains decreases.

Graph **A** shows the decay curve for carbon-14.



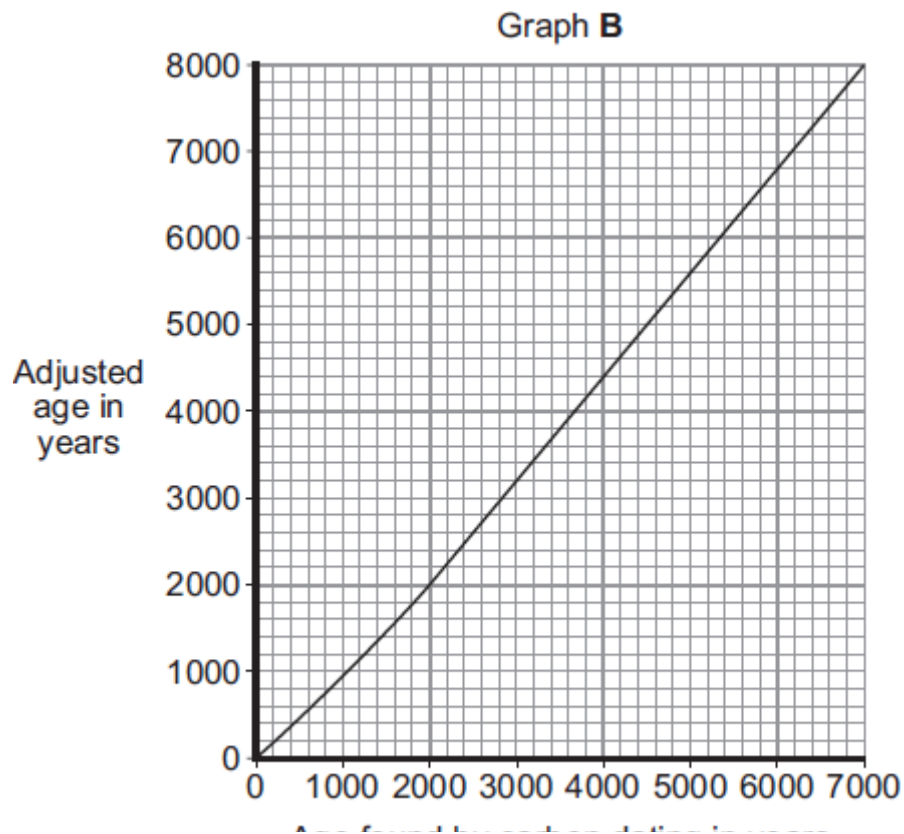
- (i) Lake Cuicocha in Ecuador was formed after a volcanic eruption. Carbon taken from a tree killed by the eruption was found to have a count rate of 10.5 counts per minute. At the time of the eruption, the count rate would have been 16 counts per minute.

Use graph A to find the age of Lake Cuicocha.

Age of Lake Cuicocha = _____ years

(1)

- (ii) Finding the age of organic matter by measuring the proportion of carbon-14 that it contains is called carbon dating. This technique relies on the ratio of carbon-14 to carbon-12 in the atmosphere remaining constant. However, this ratio is not constant so the age found by carbon dating needs to be adjusted.



Graph **B** is used to adjust the age of an object found by carbon dating.
The value obtained from graph **B** will be no more than 50 years different to the true age of the object.

Use graph **B** and the information above to find the maximum age that Lake Cuicocha could be.

Show clearly how you obtain your answer.

Maximum age of Lake Cuicocha = _____ years

(2)

(Total 7 marks)