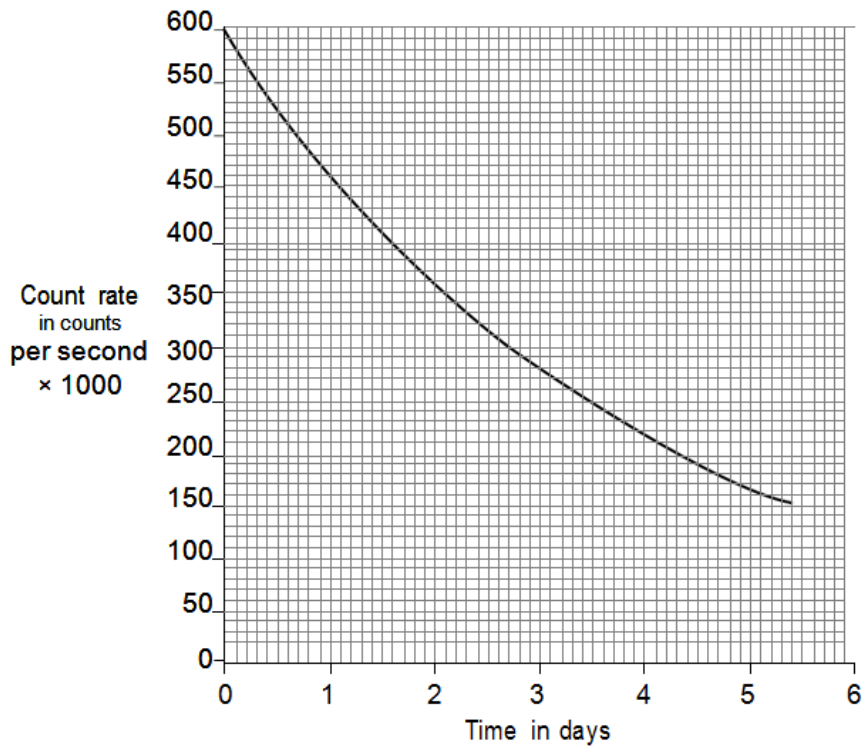# Half Life 2

Q:1   The graph shows how the count rate from a sample of gold-198 changes with time.

Use the graph to calculate the half-life of gold-198.
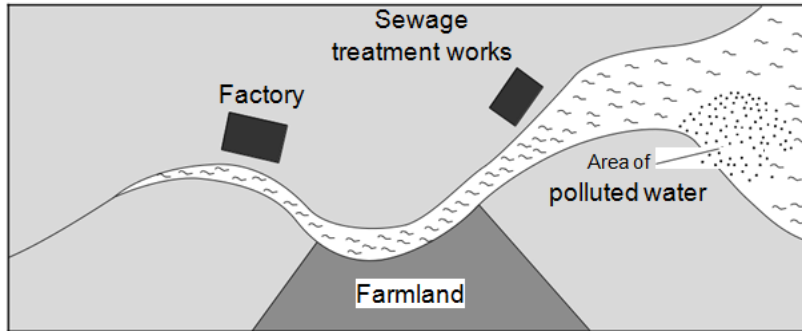
Show clearly on the graph how you obtain your answer.

_____

_____

Half-life = _____ days

(2 marks)

(b) The diagram shows a map of a river and the river estuary.

Environmental scientists have found that water flowing into one part of the river estuary is polluted. To find where the pollution is coming from, the scientists use a radioactive isotope, gold-198.

The gold-198 is used to find where the pollution is coming from.

Explain how.

_____

_____

_____

_____

(2 marks)

Q:2 In 1986, a nuclear reactor exploded in a power station at Chernobyl in the Ukraine.

(a) The table gives information about some of the radioactive substances released into the air by the explosion.

Radioactive substance	Half-life	Type of radiation emitted
Iodine-131	8 days	beta and gamma
Caesium-134	2 years	beta
Caesium-137	30 years	beta

(a)(i) How is the structure of a caesium-134 atom different from the structure of a caesium-137 atom?

_____

(1 mark)

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

_____

_____

(1 mark)

(a)(iii) Once a radioactive substance is dissolved in rainwater, it can enter the food chain.

Following the Chernobyl explosion, some milk supplies were found to be radioactive.

If one litre of milk contaminated with iodine-131 gives a count rate of 400 counts/second, how long will it take for the count rate to fall to 25 counts/second? Show clearly how you work out your answer.
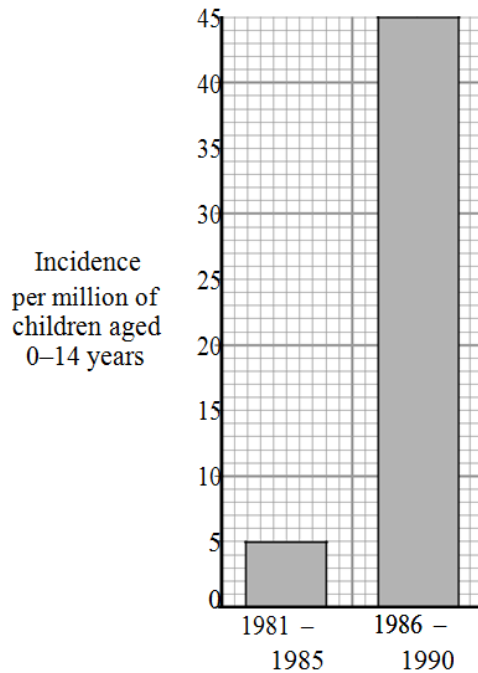
_____

_____

_____

_____

Time taken = _____ days

(2 marks)

 (a) (iv) After 20 years, the caesium-137 emitted into the atmosphere is a more serious problem than the iodine-131.Explain why.

_____

_____

_____

_____

_____

(2 marks)

(b) The bar chart compares the incidence of thyroid cancer in Ukrainian children, aged 0–14 years, before and after the Chernobyl explosion.

Of the children that developed thyroid cancer, 64% lived in the areas most contaminated by the radiation.

Considering this data, can you be certain that a child who developed thyroid cancer between 1986 and 1990 did so because of the Chernobyl explosion?

Explain the reason for your answer.

_____

_____

_____

_____

_____

(2 marks)

(c) In 1991, some scientists compared the health of two groups of people: a control group and a group that had been exposed to the radiation from Chernobyl.

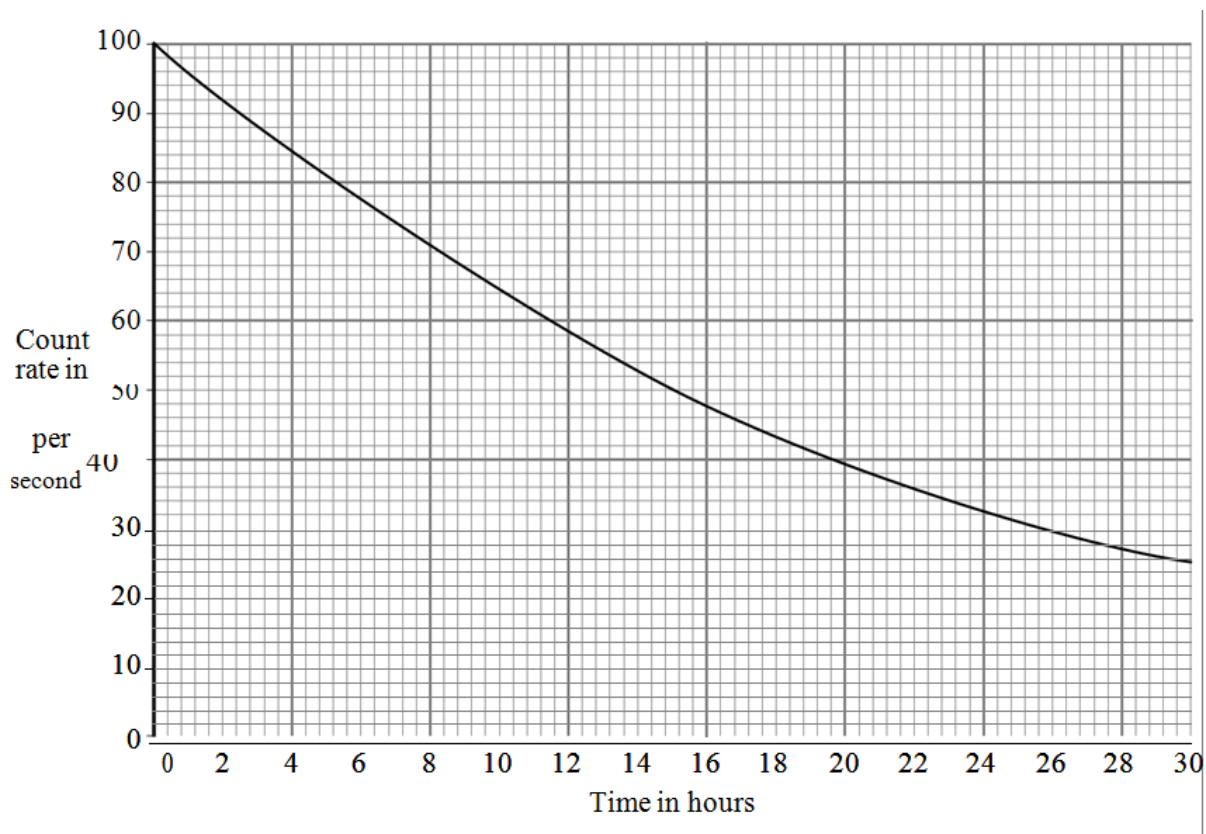What people would have been in the control group?

(d) Although there are some risks associated with nuclear power stations, it is likely that new ones will be built.Give two reasons to justify the use of nuclear power.

1 _____

_____

2 _____

_____

(2 marks)

Q:3 The graph shows how the count rate from a sample of radioactive sodium-24 changes with time.

(a)(i) How many hours does it take for the count rate to fall from 100 counts per second to 50 counts per second?

Time = _____ hours

(1 mark)

(a)(ii) What is the half-life of sodium-24?

Half-life = _____ hours

(1 mark)

(b) A smoke detector contains a small amount of americium-241.

Americium-241 is a radioactive substance which emits alpha particles. It has a half-life of 432 years.

(b) (i) Which one of the following statements gives a reason why the americium-241 inside the smoke detector will not need replacing?
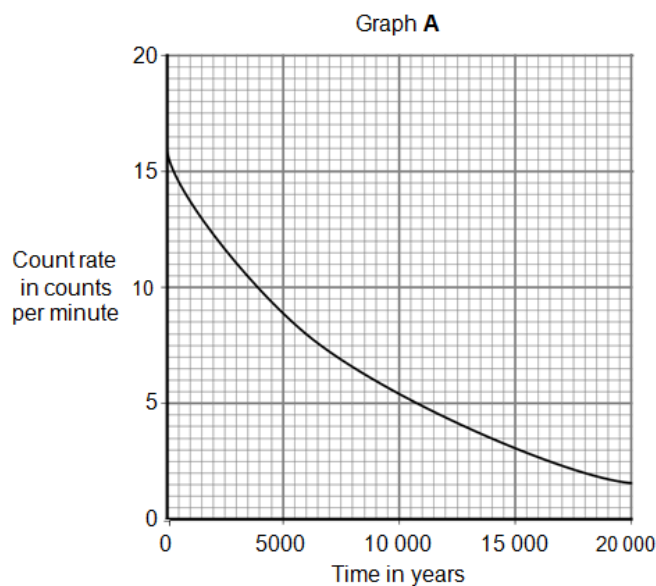
Put a tick (☑) in the box next to your answer.

The alpha particles have a low energy. ☐

People replace smoke detectors every few years. ☐

Americium-241 has a long half-life. ☐

(1 mark)

Q:4 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.

Graph **A**

(a) (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.
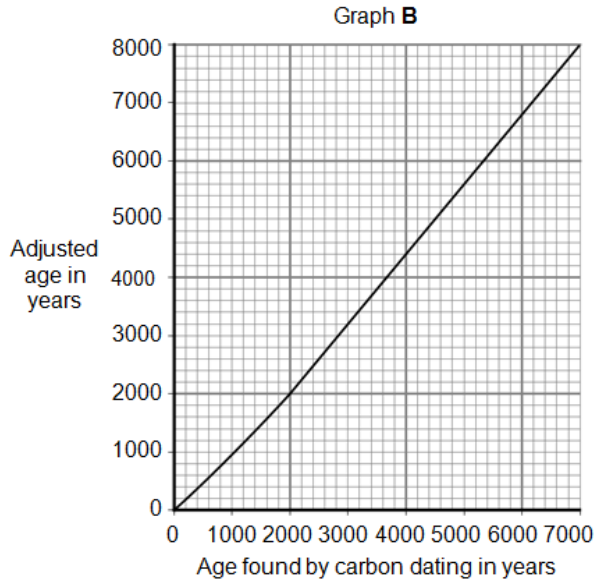
At the time of the eruption, the count rate would have been 16 counts per minute.

Use graph A to find the age of Lake Cuicocha.

Age of Lake Cuicocha = _____ years

(1 mark)

(a) (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**

Adjusted age in years (y-axis): 0, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000

Age found by carbon dating in years (x-axis): 0, 1000, 2000, 3000, 4000, 5000, 6000, 7000

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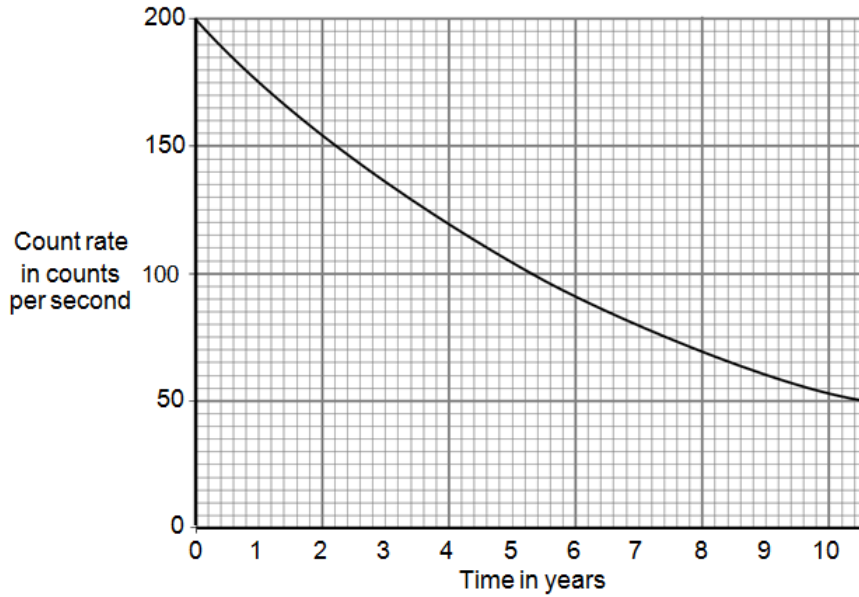
Use graph B and the information above to find the maximum age that Lake Cuicocha could be.

Show clearly how you obtain your answer.

_____

_____

Maximum age of Lake Cuicocha = _____ years

(2 marks)

Q:5 (a) The graph shows how the count rate from a sample containing the radioactive substance cobalt-60 changes with time.

(a) (i) What is the range of the count rate shown on the graph?

From_____ counts per second to _____ counts per second.

(1 mark)

(a) (ii) How many years does it take for the count rate to fall from 200 counts per second to 100 counts per second?
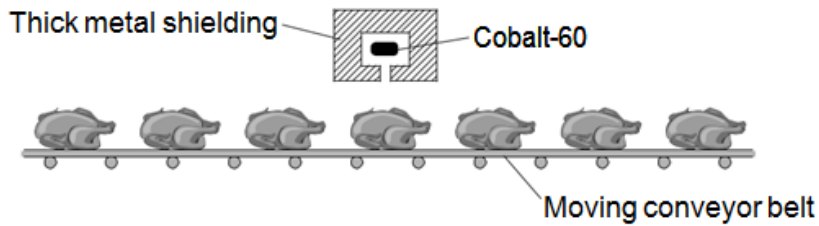
Time = _____ years

(1 mark)

(a) (iii) What is the half-life of cobalt-60?

Half-life = _____ years

(1 mark)

(b)   The gamma radiation emitted from a source of cobalt-60 can be used to kill the bacteria on fresh, cooked and frozen foods. Killing the bacteria reduces the risk of food poisoning.

The diagram shows how a conveyor belt can be used to move food past a cobalt-60 source.

(b) (i)   Which one of the following gives a way of increasing the amount of gamma radiation the food receives?

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

Increase the temperature of the cobalt-60 source.   ☐

Make the conveyor belt move more slowly.   ☐

Move the cobalt-60 source away from the conveyor belt.   ☐

(1 mark)

(b) (ii)   To protect people from the harmful effects of the gamma radiation, the cobalt-60 source has thick metal shielding.

Which one of the following metals should be used?

Draw a ring around your answer.

        aluminium   copper   lead

(1 mark)

(c)   A scientist has compared the vitamin content of food exposed to gamma radiation with food that has not been exposed.

The table gives the data the scientist obtained when she tested 1 kg of cooked chicken.

Vitamin	Food not exposed to gamma radiation	Food exposed to gamma radiation
	Mass in milligrams	Mass in milligrams
B6	1.22	1.35
B12	21.00	28.00
E	3.30	2.15
Niacin	58.00	55.50
Riboflavin	2.10	2.25

Considering only this data, which one of the following is a correct conclusion?

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

Vitamin content is not affected by gamma radiation. ☐

Gamma radiation completely destroys some types of vitamin. ☐

Exposure increased the content of some types of vitamin. ☐

(1 mark)

TOTAL MARKS=27