Combined science - Physics

Key stage 4 - Atomic Structure

Activity and Half-life (HT)

Mr van Hoek

Basic questions

1. If a radioactive sample has an initial count rate of 600 Bq. What is its count rate after:
    i)   1 half-life?   ii) 2 half-lives   iii) 3 half-lives   iv) 4 half-lives?

2. The half-life of iodine-131 is 13 hours. If a sample of radium-226 has an original activity of 400 Bq, what will its activity be after:

i) 26 hours?   ii) 39 hours?   iii) 52 hours?

Basic questions

3. Sodium-24 has a half-life of 15 hours. If a sample of sodium-24 has an original activity of 800 Bq, what will

its activity be after:

i)   15 hours?

ii)   30 hours?

iii)   45 hours?

iv)   60 hours?

Medium questions

4. Initially, the activity of a sample of phosphorus-32 was 400Bq. After 84 days the activity of a sample of phosphorus-32 has decreased to 25 Bq.

What is the half-life of phosphorus-32?

Medium questions

5. The half-life of radon-222 is 3.8 days.

What was the original activity if it has an activity of 12 Bq after 15.2 days?

Medium questions

6. Thorium-227 has a half-life of 19 days. How many days are required for 25% of a sample to remain following radioactive decay?

Hard questions

7. The half-life of protactinium-234 is 75 seconds. What percentage of a sample will remain after 5 minutes?
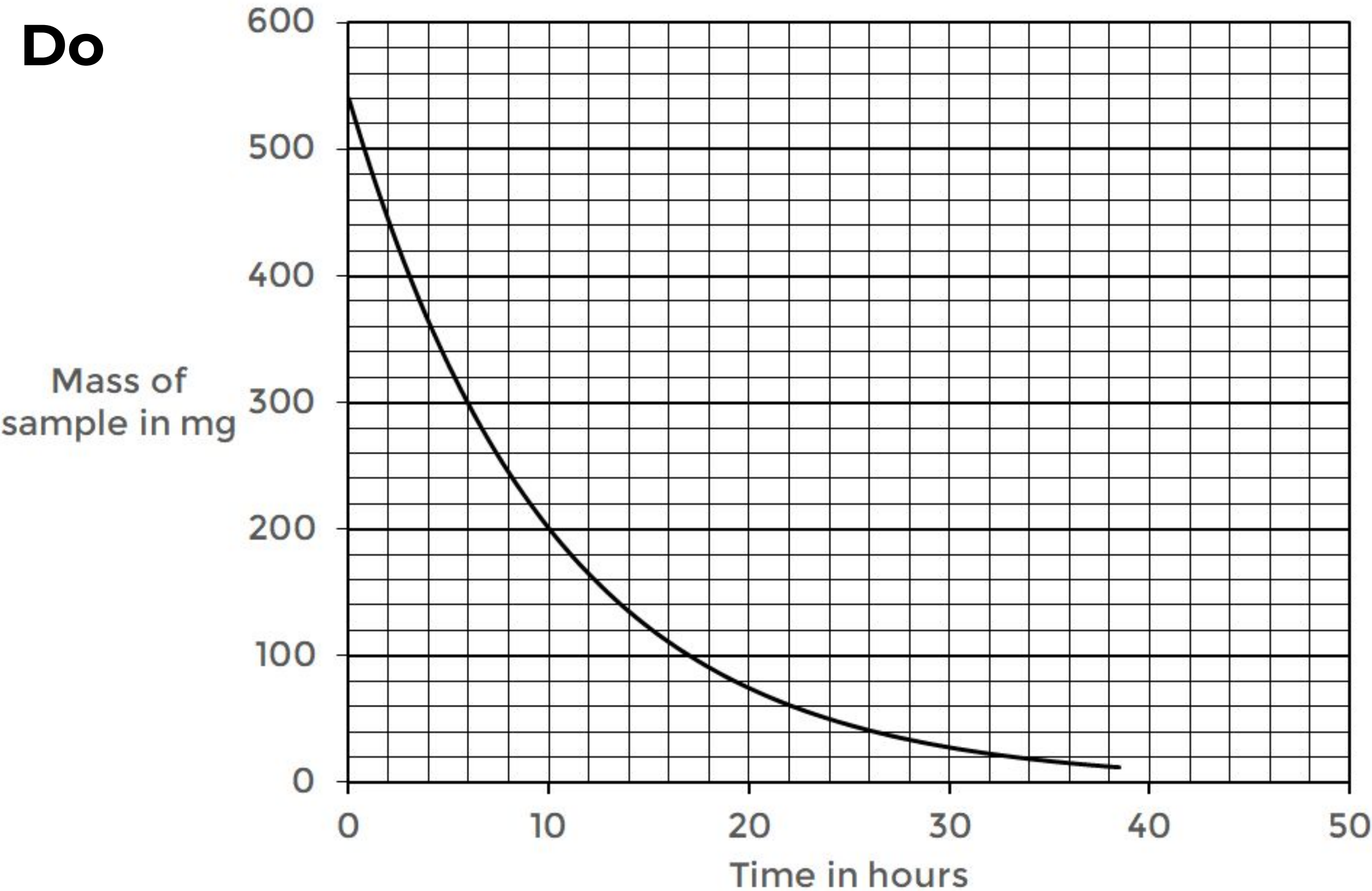
Hard questions

8. The half-life of tritium (hydrogen-3) is 12.3 years. If 96.0 mg of tritium is released from a nuclear power plant during the course of an accident, what mass of the sample will remain after 61.5 years?
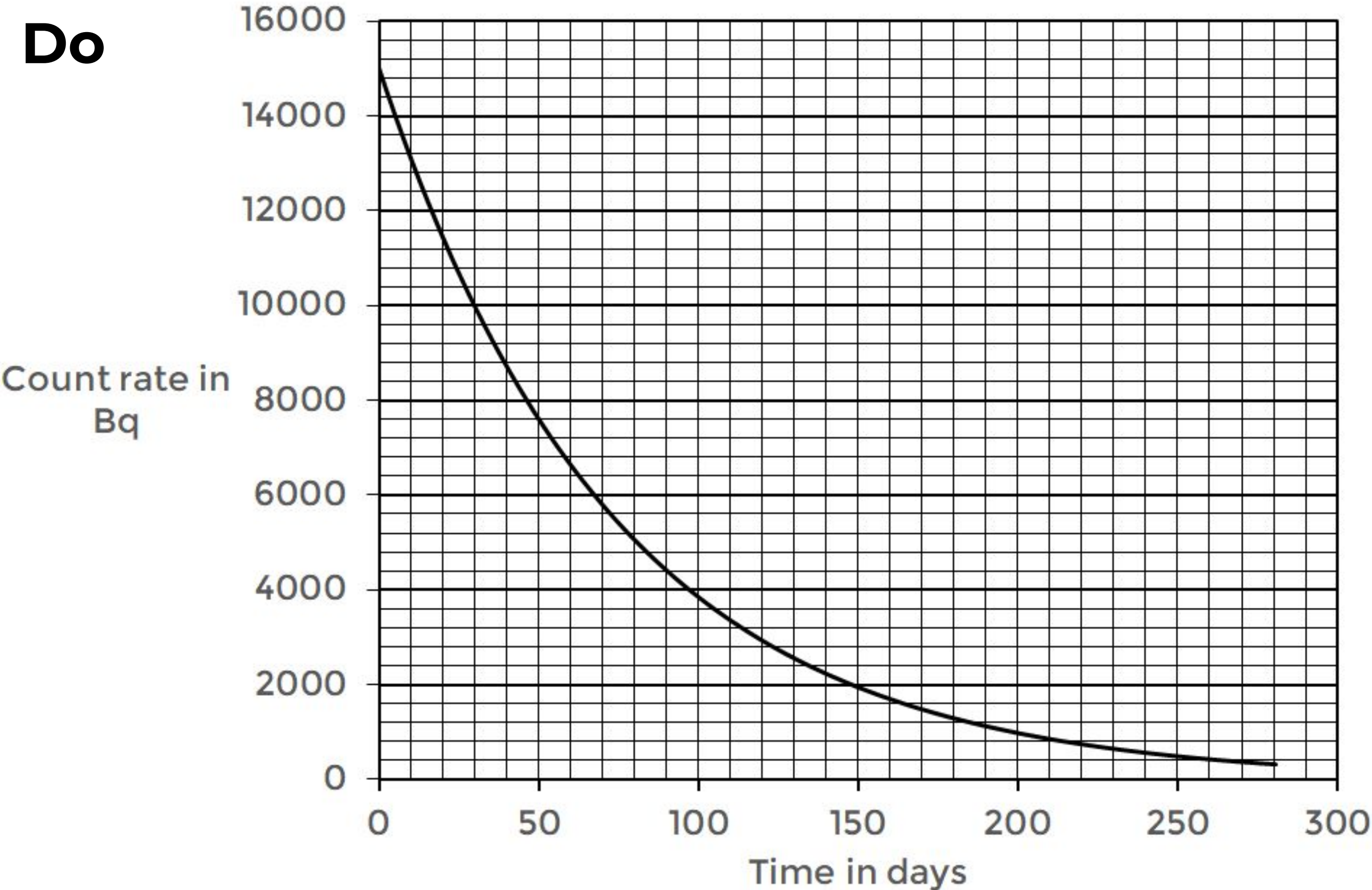
I Do

What is the time taken for the mass of the sample to decrease by half?
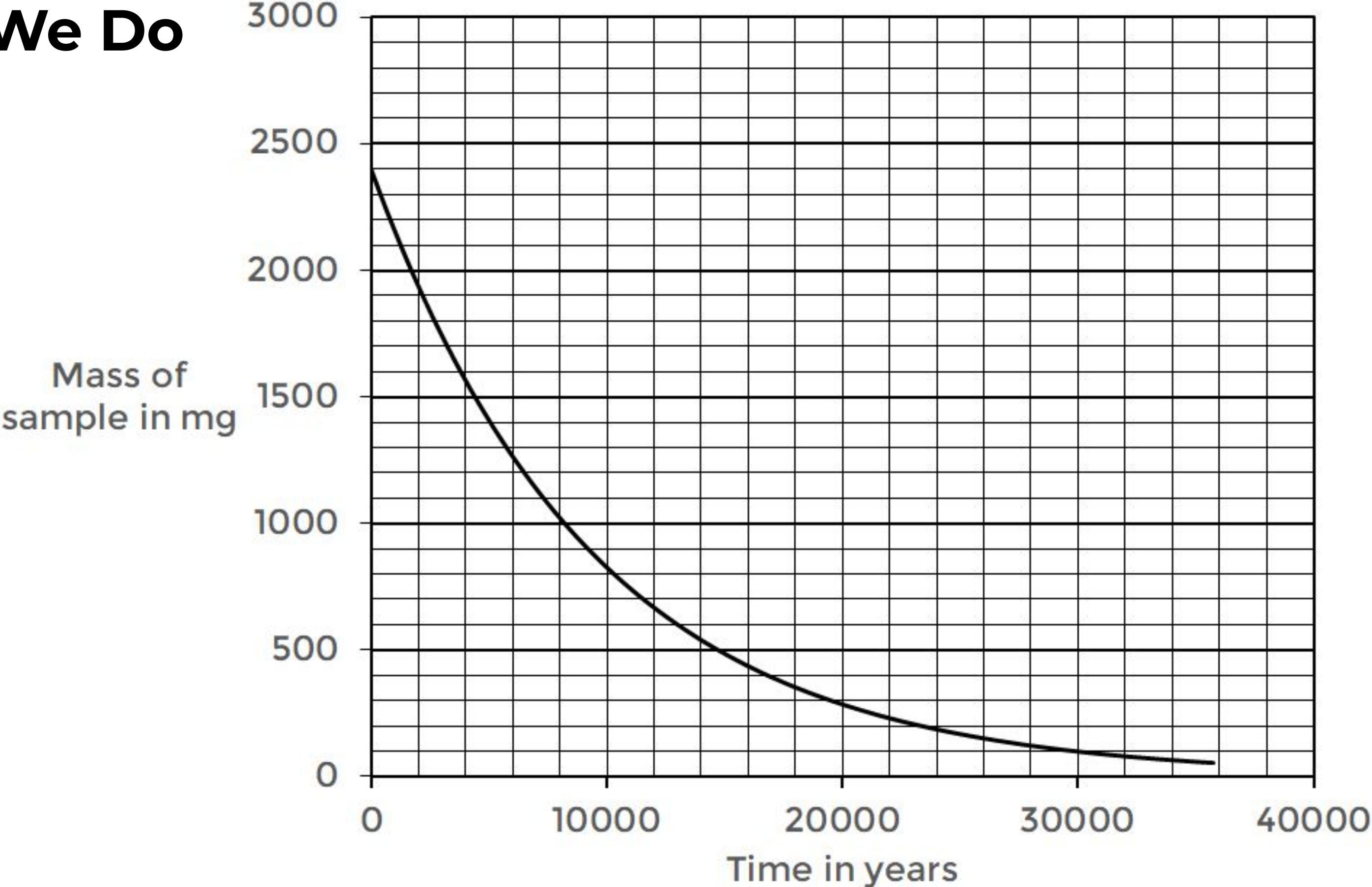
What is the half-life?

I Do

What is the time taken for the count rate to decrease by half?
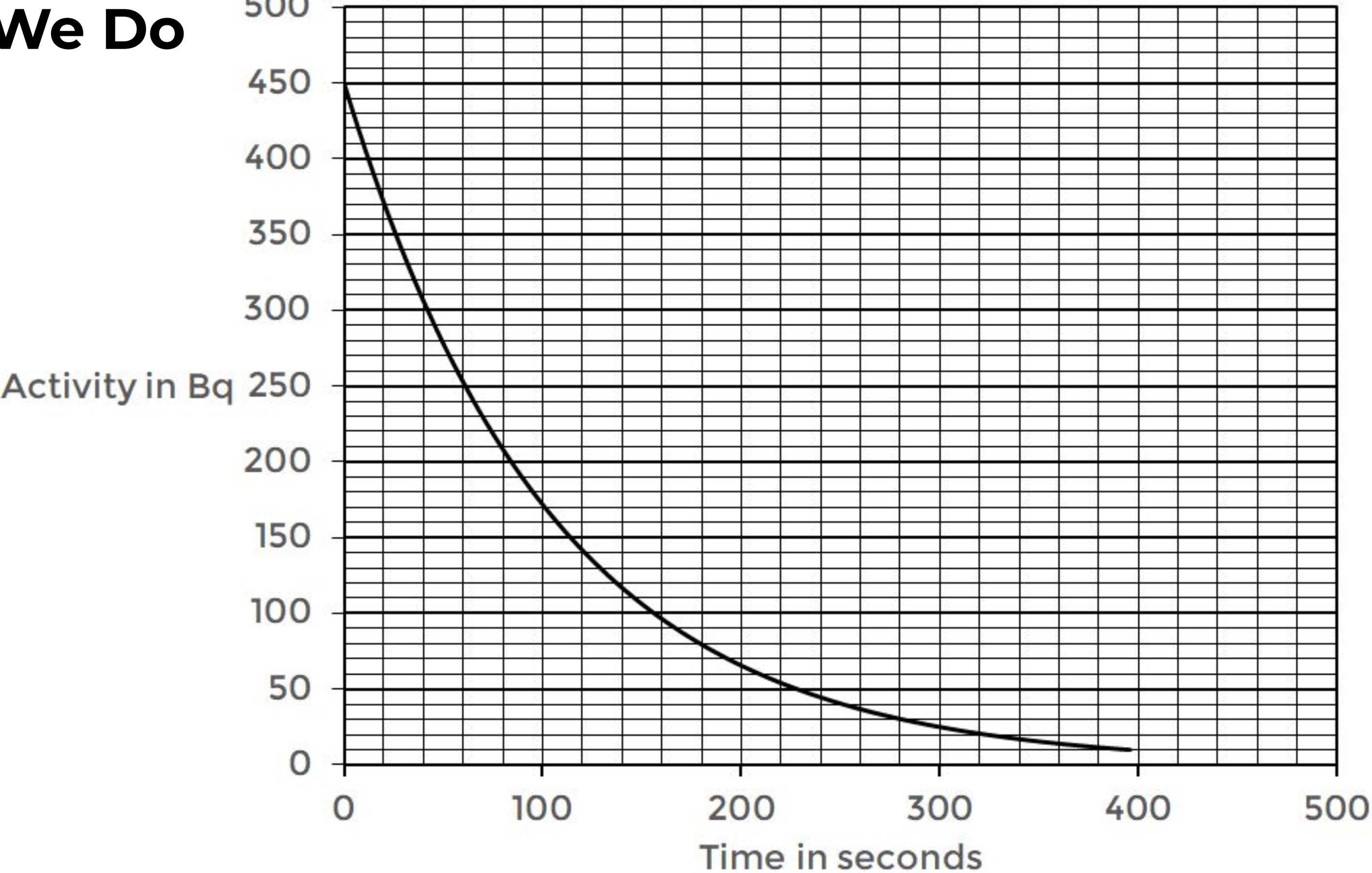
What is the half-life?

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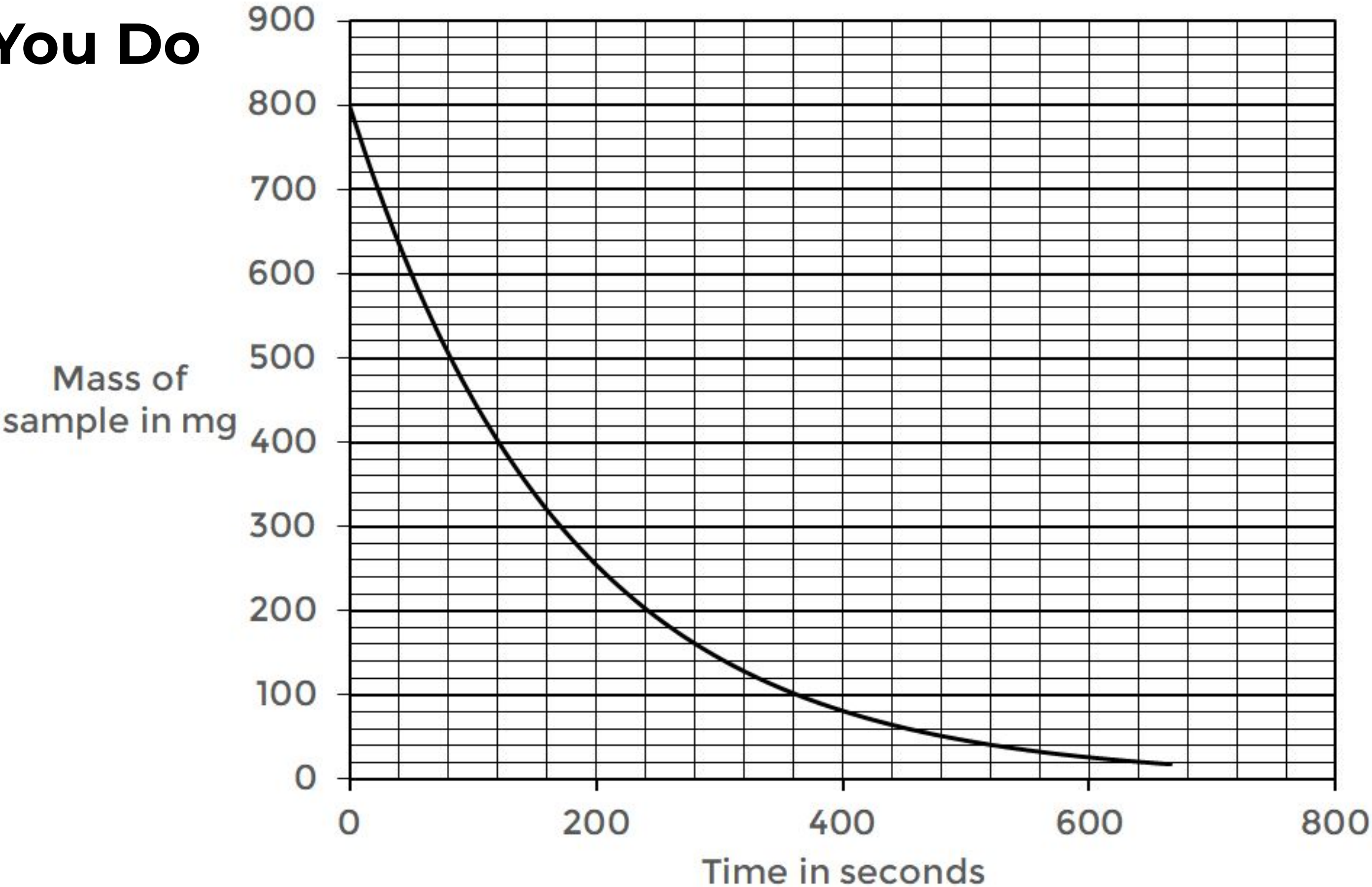
What is the half-life?

We Do

What is the time taken for the activity to decrease by half?
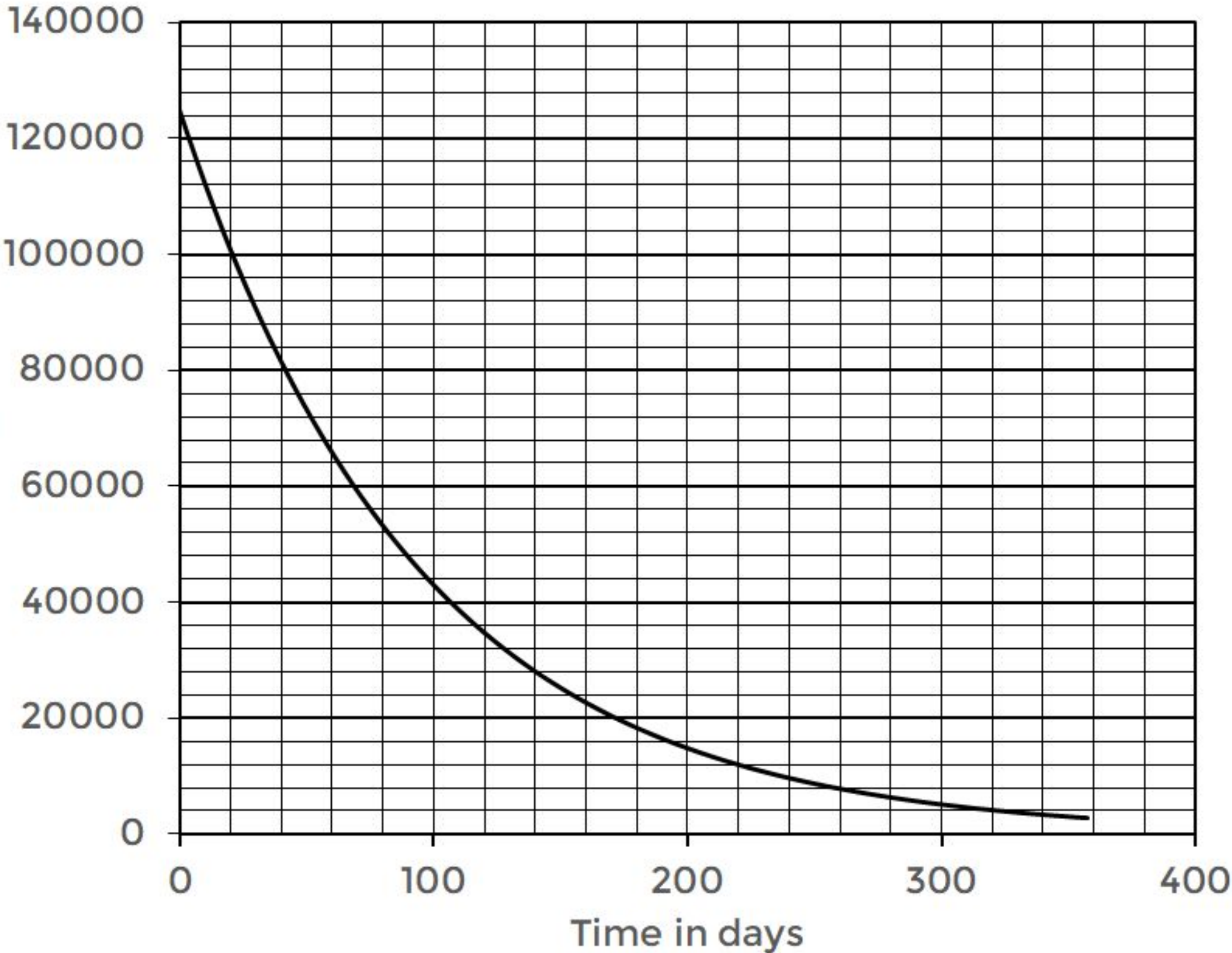
What is the half-life?

You Do

What is the time taken for the mass of the sample to decrease by half?

What is the half-life?

You Do

What is the time taken for the number of nuclei to decrease by half?

What is the half-life?

I do

When the Earth was originally formed the amount of radioactive isotopes found within the Earth's crust was much higher. Uranium-238 is an isotope is found in the Earth's crust. Uranium-238 has a half-life of 4.46 billion years.

Scientist have calculated that the amount of Uranium-238 found in uranium deposits was 7.2g per kilogram in the oldest parts of the Earth's crust. The current amount of Uranium-238 is 3.6g per kilogram.

Use this data to show that the oldest parts of the Earth's crust are about 4.5 billion years old.

I do

All living organisms take in the radioactive isotope carbon-14, either within carbon dioxide for plants, or within food for animals.
After the death of the organism, the proportion of carbon-14 in the remains of the organism can be used to tell how long it is since the organism was living.

Carbon-14 has a half-life of 5730 years.

A living piece of wood contains 800 mg of carbon-14. A piece of wood of the same mass from a buried sailing boat discovered in an ancient burial ground contains 50 mg of carbon-14. Calculate the age of the sailing boat.

We do

Carbon-14 $^{14}_{6}\text{C}$ is a radioactive isotope of carbon with a half-life of 5730 years.

A fossilised fern leaf is estimated to have died 23,920 years ago and contains Carbon-14

The original activity in the carbon-14 was 960 Bq.

Determine the current activity of the carbon-14 in the leaf.

We do

Carbon-14 $^{14}_{6}C$ is a radioactive isotope of carbon with a half-life of 5730 years.

A sample of $^{14}_{6}C$ from a fossilised human bone gives a count rate of 40 Bq.

The human is estimated to have died about 34,000 years ago.

Determine what the count rate of the $^{14}_{6}C$ isotope was then the human died.

You do:

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You Do

The radioactive isotope Carbon-14 is used for carbon dating by archaeologists to work out how hold some objects are.

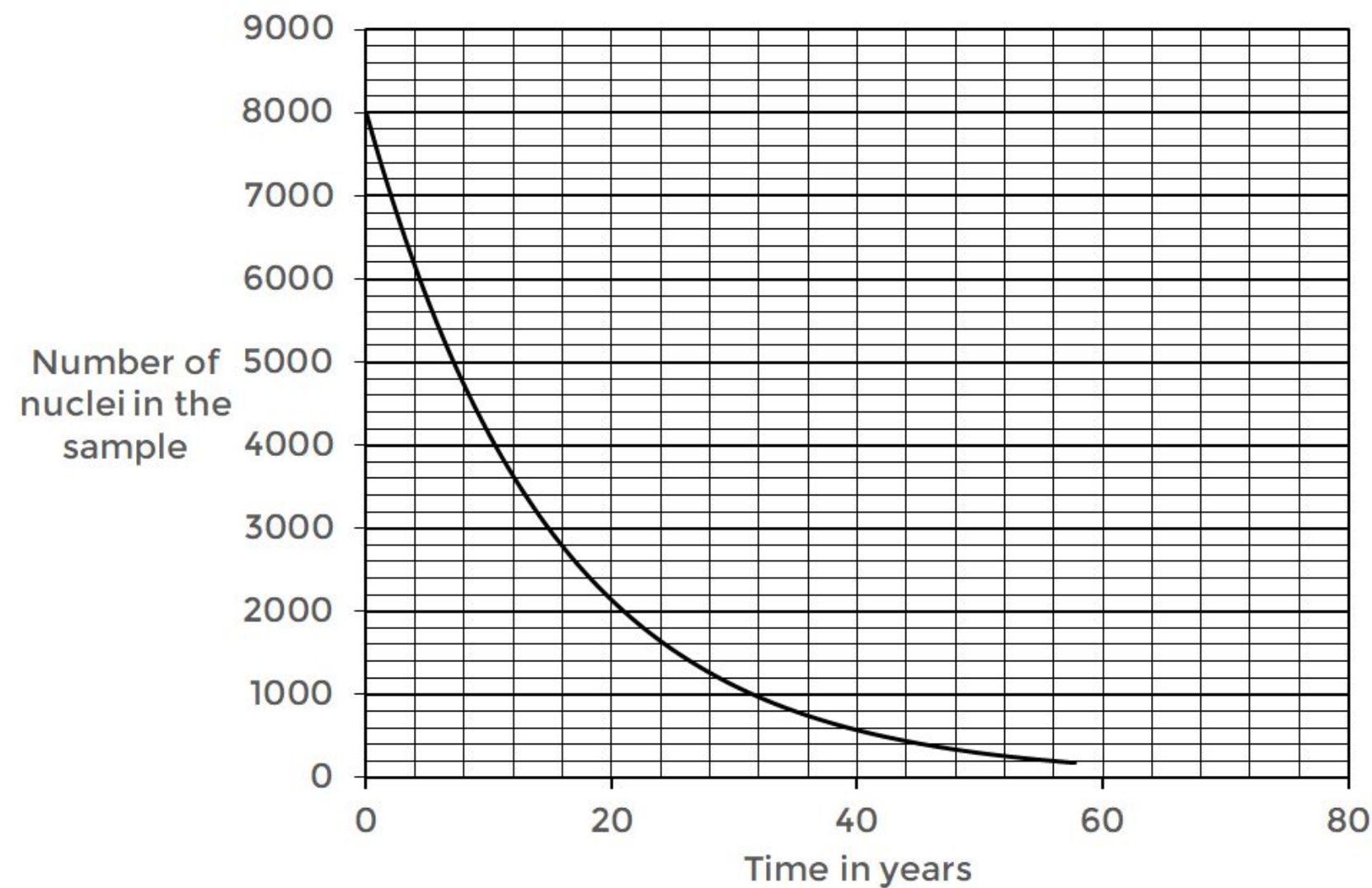The half-life of carbon-14 is 5730 years.

A tree fossil was carbon dated. The results showed that there was only 6.25% of the original amount of carbon-14 left in the wood.

Calculate the age of the tree.

Exam question

The graph shows how a sample of barium-133, a radioactive isotope with a long half-life, decays with time.
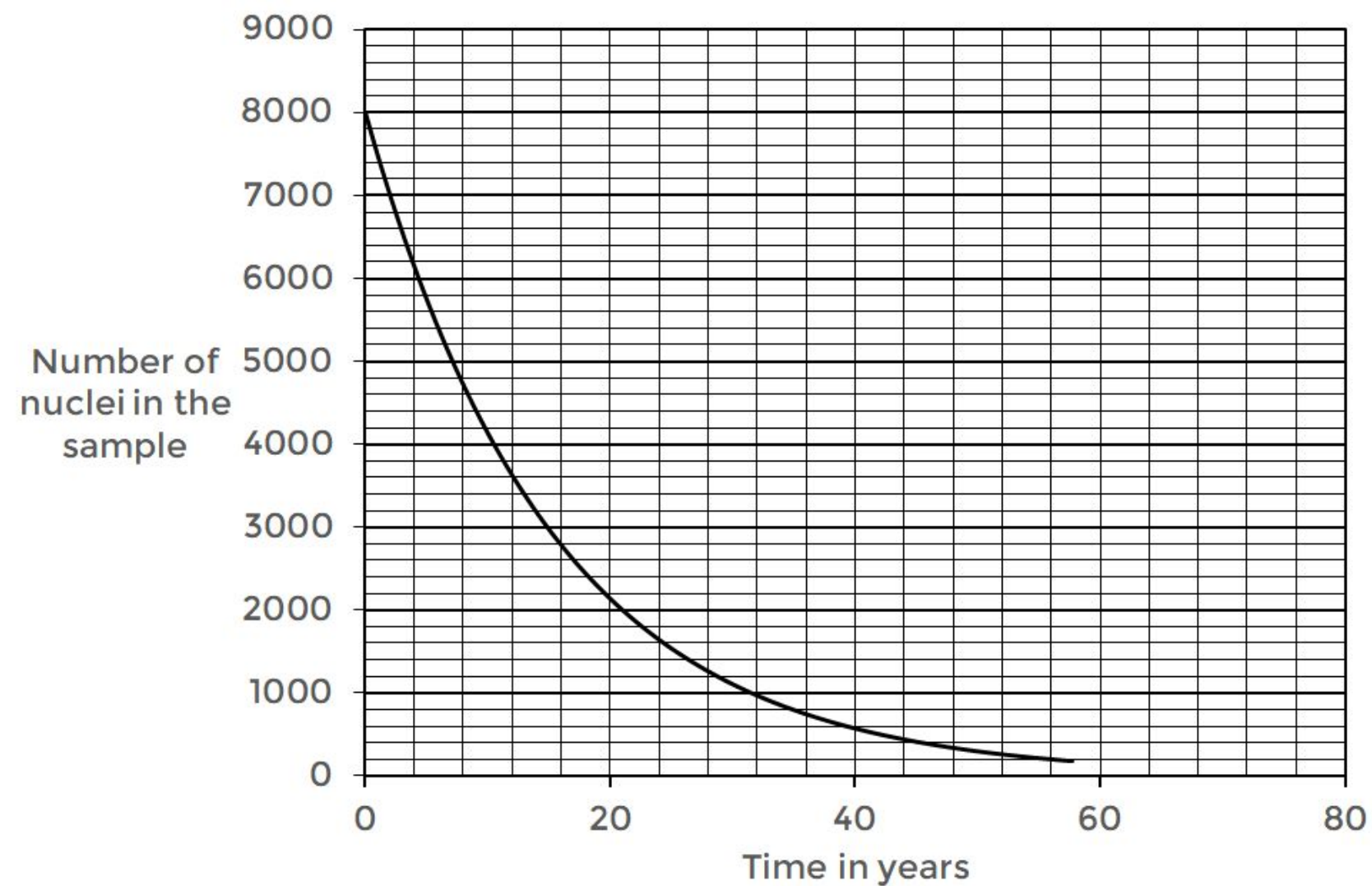

a) What is meant by the term half-life?

b) What is meant by the term isotope?

Exam question

The graph shows how a sample of barium-133, a radioactive isotope with a long half-life, decays with time.

c) Use the graph to find the half-life of barium-133.

Exam Question

A radioactive source has a half-life of 80 s.

How long will it take for $^7/_8$ of the source to decay?

1.   10 s
2.   70 s
3.   240 s
4.   640 s

OCR, GCSE Gateway Physics A,
Paper 4, Specimen.

Exam Question

Radioactive substances decay naturally.

Look at the information about two different radioactive substances.

Use the data in the table to compare the half-life of substance **X** and the half-life of substance **Y**.

time in hours	Activity of substance X in counts per second	Activity of substance Y in counts per second
0	8 070	12 810
1	6 801	6 385
2	5 697	3 221
3	4 808	1 594
4	4 027	807
5	3 390	392
6	2 861	197
7	2 410	102
8	2 008	51