N5

Activity

The **activity** or a radioactive source is a measure of how many radioactive particles are released every second.

It is calculated by $$\mathbf{A = \frac{N}{t}}$$

where **A** is the activity in becquerels (Bq)

N is the number of nuclei that decay

and **t** is the time in seconds (s)

The activity of a source decreases over time. Whilst the decay of an individual atom is completely random and unpredictable, the time taken for half the atoms in a sample of a particular material to decay can be predicted as it will always be the same. This is known as the **half-life**. The half-life is the time taken for the activity of a radioactive source to fall to half of its original value.
Different materials have different half lives:

Material	**Half-life**	**Material**	**Half-life**
hydrogen-7	1×10^{-22} s	californium-254	60.5 days
carbon-15	2.5 s	plutonium-238	87.7 years
nobelium-259	58 minutes	uranium-238	4.5 billion years

Half-life calculations

Example 1

If a source of activity 8 000 Bq has a half-life of 6 days, what activity will it have after 18 days?

1 half-life = 6 days

18 days = 18 ÷ 6 = 3 half-lives.

8 000 → 4 000 → 2 000 → 1 000

The activity is 1 000 Bq.

Example 2

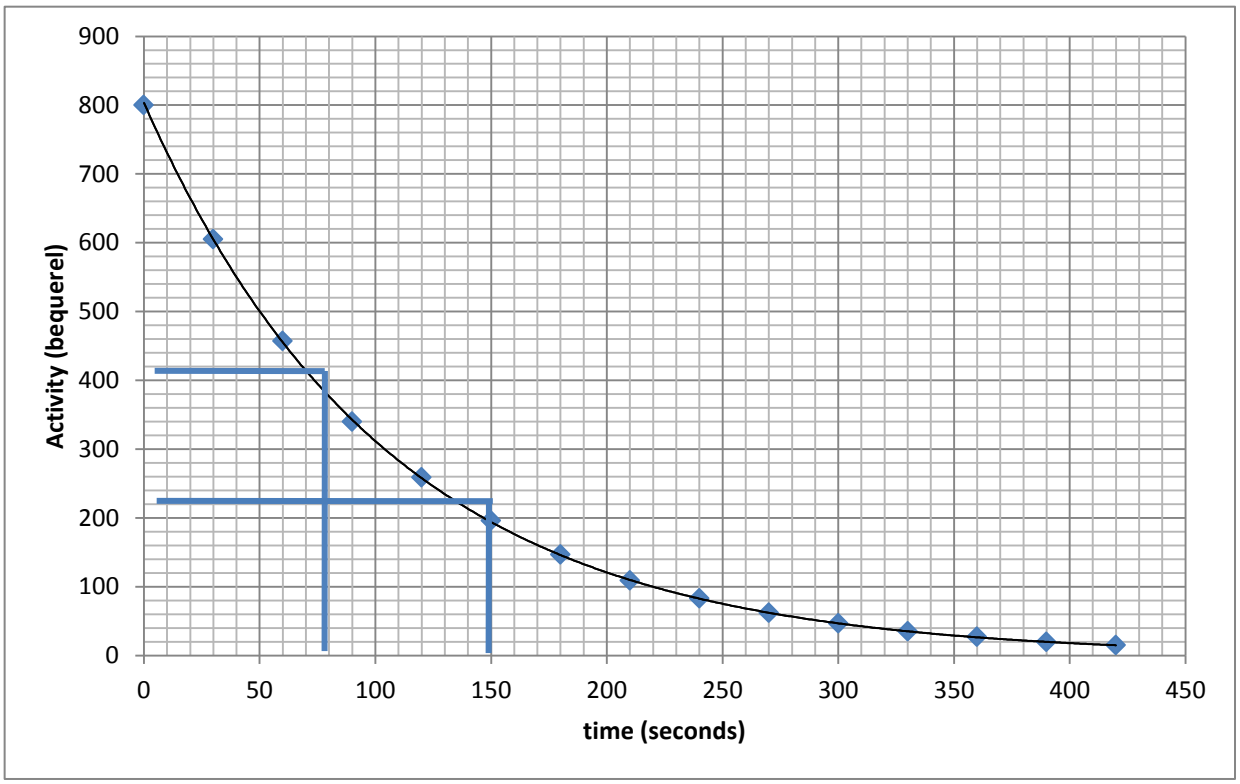
Calculate the half-life of a source that decreases in activity from 32 kBq to 8 kBq in 24 days.

32 → 16 → 8

2 half-lives = 24 days
1 half-life = 12 days

Half-life calculations continued

Half-life can be calculated by graphical methods. A graph of activity against time can be plotted and half-life worked out from it.



- Choose any value of activity on the y-axis (say 400 Bq) and draw a line in to meet the curve.
- From this point on the curve draw a line to meet the time on the x-axis.
- Do this again for a value of activity that is half of the first (200 Bq in this case).
- The **difference** between the values on the time axis is the half-life of the source.

For the above example this is 145 – 75 = 70 seconds.

Selecting a radioactive source with the correct half-life is important when choosing it for an application, for example:

- It would not be wise to choose a radioactive tracer with a long half-life as this would remain active within the body for too long a time.
- It may be be necessary to choose a source with a long half-life to examine an oil pipeline for cracks.

Do some research of your own to find out about the importance of half-life in the application of radioactive substances.