

Half-lives & Random Decay

Half-life

[3 marks]

Define the **half-life** of a radioactive isotope. (3)

use these key words

☐ time ☐ activity / number of nuclei ☐ halve

Random decay

[2 marks]

Explain what is meant by radioactive decay being **random**. (2)

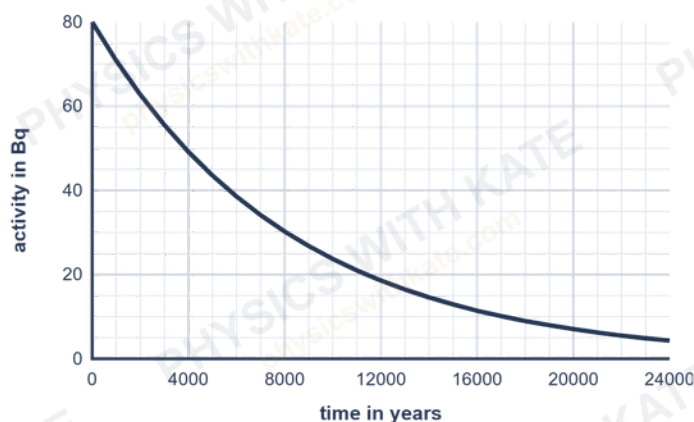
use these key words

☐ predict ☐ decay ☐ nuclei

Half-life graphs

[6 marks]

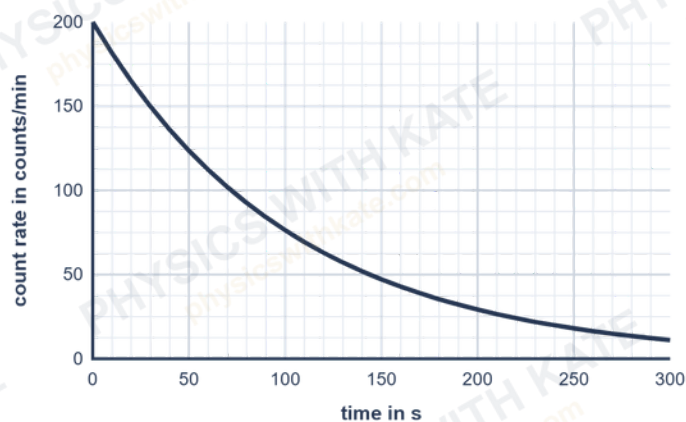
Carbon-14



half-life = _____ years

time for 80% of the sample to decay = _____ years

Protactinium-234

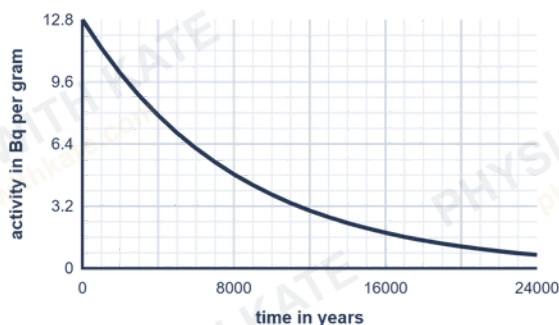


half-life = _____ s

time until a quarter remains = _____ s

Exam-style question

[6 marks]



A piece of **cloth** is found at an archaeological site. A historian claims it was made in **1066** and was worn at the Battle of Hastings.

Living material takes in carbon-14. When it dies, no more is taken in and the carbon-14 already in it decays.

activity of the cloth = **3.2 Bq** per gram of carbonactivity of living material = **12.8 Bq** per gram of carbonUse the graph and the data to **evaluate** the historian's claim. (6)

160 Bq $\xrightarrow{\text{half-life}}$ 80 Bq $\xrightarrow{\text{half-life}}$ 40 Bq $\xrightarrow{\text{half-life}}$ 20 Bq $\xrightarrow{\text{half-life}}$ 10 Bq

$$\text{time} = \text{number of half-lives} \times \text{half-life}$$

Going from **160 Bq** down to **10 Bq** takes _____ half-lives.

If the half-life is **20 s**, then $\text{time} = \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ s}$

Your turn — make up an example

use the isotope given



Protactinium-234

half-life = 72 s

Choose a **starting activity** and a **final activity** that halves a whole number of times. Work out how long it takes.

Question 1

[4 marks]

A sample of **iodine-131** has an initial activity of **145 000 Bq**. The half-life of iodine-131 is **8.0 days**.

Calculate the time taken for the activity to fall to **6.25%** of its initial value.

time = _____ days

Question 2

[4 marks]

A hospital receives a sample of **technetium-99m** with an activity of 3.2×10^9 Bq. It cannot be disposed of until the activity has fallen to 1.0×10^8 Bq. The half-life of technetium-99m is **6.0 hours**.

Calculate the time the hospital must wait. Give your answer in **days**.

time = _____ days