

- Technetium-99 is used in imaging internal organs in the body, and is often used to assess heart damage. The rate constant for decay of $^{99m}_{43}\text{Tc}$ is 0.116 hour^{-1} . What is the half life of this nuclide?

Marks
2

The half life is related to the decay constant, λ :

$$t_{1/2} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{0.116 \text{ hours}^{-1}} = 5.98 \text{ hours}$$

Answer: **5.98 hours**

What fraction is left after 30 minutes?

The number of radioactive nuclei present reduces with time according to:

$$\ln\left(\frac{N_0}{N_t}\right) = \lambda t = 0.116 \times \frac{30}{60} \text{ so } \frac{N_0}{N_t} = 1.06$$

Hence, 6% has decay and the fraction remaining is 94%

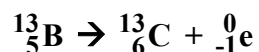
Answer: **94%**

- Boron-13 is a synthetic (not naturally occurring) isotope of boron. Using the N/Z ratio, predict a possible mode of decay for the isotope boron-13. Give a reason for your choice and write the nuclear equation for this decay.

2

The most stable nuclei tend to have $N \sim Z$.

^{13}B has 8 neutrons and 5 protons. As $N > Z$, the nucleus has too many neutrons and will decay by beta decay: conversion of a neutron into a proton and an electron:



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