Marks
2

- The radioactive isotope ^{99m}Tc has a half life of 6.0 hours. How much time after production of the ^{99m}Tc isotope do radiologists have to examine a patient if at least 25 % of the original activity is required to get useful exposures?

As the half life is 6.0 hours, the activity will be reduced to 50 % of its original value after 6.0 hours.

After a further 6.0 hours, it will be reduced by another 50 % and so will be 25% of its original value. Therefore 2 half lives are required: 12 hours.

Alternatively, the activity decreases with time according to the equation:

$$\ln\left(\frac{A_0}{A_t}\right) = kt.$$

If the activity has decreased to 25 %, $\dfrac{A_0}{A_t} = \dfrac{100}{25} = 4$. As $t_{1/2} = 6.0$ hours, the activity coefficient $= \ln 2\,/\,t_{1/2}$. Therefore:

$$\ln 4 = \left(\frac{\ln 2}{6.0 \text{ hours}}\right) \times t \text{ so } t = 12 \text{ hours}$$

Answer: **12 hours**