	Marks
• What mass of isotope would be initially required if a medical procedure needs 2.0 mg of ^{99m}Tc exactly 50. hours later? The half life of ^{99m}Tc is 6.0 hours.	**2**

The activity coefficient, λ, is related to the half life, $t_{1/2}$ through:

$$\lambda = \ln 2 / t_{1/2} = \ln 2 / (6.0 \text{ hours}) = 0.115 \text{ hours}^{-1}$$

The number of nuclei, N, decays with time according to:

$$\ln(N_t / N_0) = \lambda t$$

As the mass is proportional to the number of nuclei, this can be rewritten as:

$$\ln(m_0 / m_t) = \lambda t$$

If the mass after t = 50. hours is m_t = 2.0 mg, then

$$\ln(m_0 / 2.0) = (0.115) \times (50)$$

so:

$$m_0 = 650 \text{ mg}$$

Answer: **650 mg**

• Comment on the stability of the following nuclides, and the type of radioactive decay (if any) that they undergo.	**3**

$^{18}_{10}$Ne

For this nuclide, Z = 10 and N = (18 – 10) = 8. With an N:Z ratio of 0.8, it has too few neutrons. It would undergo positron (β^+) emission or electron capture to increase this ratio.

$^{32}_{16}$S

For this nuclide, Z = 16 and N = (32 – 16) = 16. With an N:Z ratio of 1.0, it is probably stable.

$^{236}_{90}$Th

As Z > 83, it is beyond the zone of stability and is unstable. It will indergoes α decay to reduce its mass.