Marks

- Scholars think that a parchment scroll recently found in the Middle East could have originated from the same group responsible for the Dead Sea Scrolls. If a modern piece of parchment has an activity of 4.0×10^{-4} Ci g^{-1}, calculate the expected activity of the recently discovered scroll if it originated 2100 years ago. **2**

The ^{14}C age of a sample is given by:

$$^{14}\text{C age} = 8033 \ln\left(\frac{A_0}{A_t}\right) \text{ years}$$

If the ^{14}C age is 2100 years and its initial activity, $A_0 = 4.0 \times 10^{-4}$ Ci g^{-1},

$$2100 \text{ years} = 8033 \ln\left(\frac{4.0 \times 10^{-4} \text{ Ci g}^{-1}}{A_t}\right)$$

$$A_t = 3.1 \times 10^{-4} \text{ Ci g}^{-1}$$

Answer: $A_t = 3.1 \times 10^{-4}$ Ci g^{-1}

- ^{11}C is an unstable isotope of carbon. Which force within the ^{11}C nucleus is responsible for its instability? Explain. **2**

^{11}C has 6 protons but only 5 neutrons. Stable nuclei for the lighter elements have approximately equal numbers of neutrons and protons. ^{11}C has too many protons relative to neutrons within the nucleus.

Electrostatic repulsion between protons destabilises the nucleus.

Which force is responsible for the greater stability of the ^{12}C isotope compared to the ^{11}C isotope? Explain.

^{12}C has 6 protons and 6 neutrons. The one extra neutron compared to ^{11}C increases the strength of the *strong nuclear force* between all nucleons (protons and neutrons). This overcomes the electrostatic repulsion of the protons and results in a stable nucleus.