

Question 3

(25 marks)

Scientists can estimate the age of certain ancient items by measuring the proportion of carbon-14, relative to the total carbon content in the item. The formula used is $Q = e^{-\frac{0.693t}{5730}}$, where Q is the proportion of carbon-14 remaining and t is the age, in years, of the item.

- (a) An item is 2000 years old. Use the formula to find the proportion of carbon-14 in the item.

$$\begin{aligned}
 Q &= e^{-\frac{0.693(2000)}{5730}} \\
 &= 0.785 \\
 &= 78\frac{1}{2}\%
 \end{aligned}$$

- (b) The proportion of carbon-14 in an item found at Lough Boora, County Offaly, was 0.3402. Estimate, correct to two significant figures, the age of the item.

$$Q = e^{-\frac{0.693t}{5730}} = 0.3402$$

$b^n = a$
 $\log_b a = n$

$$\frac{-0.693t}{5730} = \log_e 0.3402$$

$$t = (\ln 0.3402) \left(\frac{5730}{-0.693} \right)$$

$$= 8915.17$$

$$\log_e = \ln$$

$$\approx 8900 \text{ years old}$$