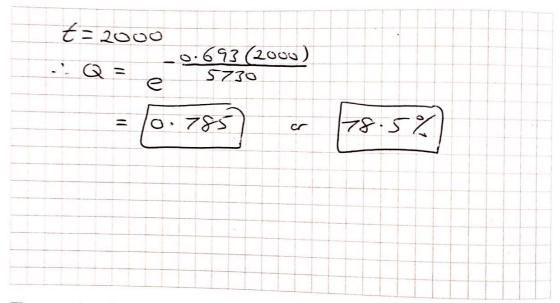**Question 3** (25 marks)

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.

$$t = 2000$$

$$\therefore Q = e^{-\frac{0.693(2000)}{5730}}$$

$$= \boxed{0.785} \quad \text{or} \quad \boxed{78.5\%}$$

(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.

$$0.3402 = Q$$

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

$$\therefore \ln 0.3402 = -\frac{0.693t}{5730}$$

$$\therefore -\frac{5730}{0.693} \ln 0.3402 = t$$

$$t = 8915$$

$$\therefore \boxed{t \approx 8900 \text{ years}}$$

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