7. Carbon-14, the radioactive element of carbon, decays according to the formula $P = 100(0.99988)^n$, where P is the percentage of the original mass of Carbon-14 that remains after n years.

(a) Find the percentage of Carbon-14 that remains after (i) 200 years (ii) 500 years.

(b) Estimate (using trial and error) how long it will take the Carbon-14 sample to decay to half its original mass. Give your answer correct to the nearest 10 years.

(c) A bone containing 79% of its original Carbon-14 was discovered in a bog in County Offaly. Estimate its age.

$P = 100(0.99988)^n$

(a)

$n = 200$ years
$n = 500$ years

$P = 100(0.99988)^{200} = 97.6\%$
$P = 100(0.99988)^{500} = 94.2\%$

(b)

$n = ?$
$P = 50$

$x^n = y \Leftrightarrow n = \log_x y$

$100(0.99988)^n = 50$

$(0.99988)^n = 0.5$

$n = \log_{0.99988} 0.5 = 5776$ years

≈ 5780 years

(c)

$n = ?$
$P = 79$

$100(0.99988)^n = 79$

$n = \log_{0.99988} 0.79 \approx 1964$ years