

'Shrinking Species'

$$\begin{aligned} \text{a) } -\frac{dN}{dt} &\propto N \\ \frac{dN}{dt} &= -kN \\ \int_{N_0}^N \frac{1}{N} dN &= \int_0^t -k dt \\ \ln \frac{N}{N_0} &= -kt \\ N &= N_0 e^{-kt} \end{aligned}$$

[4 marks]

$$\begin{aligned} \text{b) } 0.90 &= e^{-200k} \\ \ln 0.90 &= -200k \\ k &= -\frac{\ln 0.90}{200} \end{aligned}$$

[3 marks]

$$\begin{aligned} \text{c) } 0.8 &= e^{\frac{\ln 0.90}{200}t} \\ \ln 0.8 &= \frac{\ln 0.90}{200}t \\ t &= 423 \text{ therefore the year is } 2223 \end{aligned}$$

[3 marks]