Principle of Conservation of Amount of Pollutant

$(\Delta \text{ of pollutant}) = \text{Pollutant}_{in} - \text{Pollutant}_{out}$

$V \cdot c(t+\Delta t) - V \cdot c(t) = C_{in} \cdot [Q \cdot \Delta t] - c(t) \cdot [Q \cdot \Delta t]$

Divide by Δt, take limit as $\Delta t \to 0$

derivative

$$V \frac{c(t+\Delta t) - c(t)}{\Delta t} = [C_{in} - C(t)] \cdot Q$$

$$V \frac{d c(t)}{dt} = [C_{in} - C(t)] \cdot Q$$

Variable Separable or Linear 1st order

$$\frac{dC}{dt} + \underbrace{\frac{Q}{V}}_{P(t)} \cdot C = \underbrace{C_{in} \cdot \frac{Q}{V}}_{Q(t)}$$

, call $\frac{Q}{V}$ a new term α

From integration

$c(t) = e^{-\alpha t}[C_{in} e^{\alpha t} + A] = C_{in} + Ae^{-\alpha t}$ GS

, when $t=0$, $C(0) = 0.1 = C_0$

$C_0 = C_{in} + Ae^0$, $A = C_0 - C_{in}$

$c(t) = C_{in} + (C_0 - C_{in})e^{-\alpha t}$, @ time $= T$, $c(T) = 0.05$

$0.05 = 0.02 + (0.1 - 0.02)e^{-\alpha T}$

$e^{-\alpha T} = \frac{3}{8} =$

$-\alpha T = \ln\left(\frac{3}{8}\right)$, $T = \frac{-1}{\alpha} \ln\left(\frac{3}{8}\right)$

$= \frac{-V}{Q} \ln\left(\frac{3}{8}\right) = \frac{-1600}{500} \ln\left(\frac{3}{8}\right)$, $t = 3.14$ years