P.3 Problem statement

Compound A deffuses through 4m tube and reacts as diffuses. as equation given below, one end has large (0.1M) concentration of A and other absorbent that absorbs all A.. (0 M).

Given,

$D = 1.5 \times 10^{-6}$; $C_a(x=0) = 0.1\ M$

$k = 5 \times 10^{-6}$; $C_a(x=4) = 0\ M$

concentration of A as fuction of dist in tube = ?

$L = 4m$

equation,

$$D\frac{d^2A}{dx^2} - kA = 0$$

$$\frac{d^2A}{dx^2} = \frac{d}{dx}\left(\frac{dA}{dx}\right) = \frac{\left.\frac{dT}{dx}\right|_{i+1} - \left.\frac{dT}{dx}\right|_{i}}{\Delta x}$$

$\Delta x = x_{i+1} - x_i = L/N \longrightarrow$ N is step size

$\frac{d^2A}{dx^2} = \frac{A_{i+1} - 2A_i + A_{i-1}}{\Delta x^2} \longrightarrow$ by Finite diff. Method

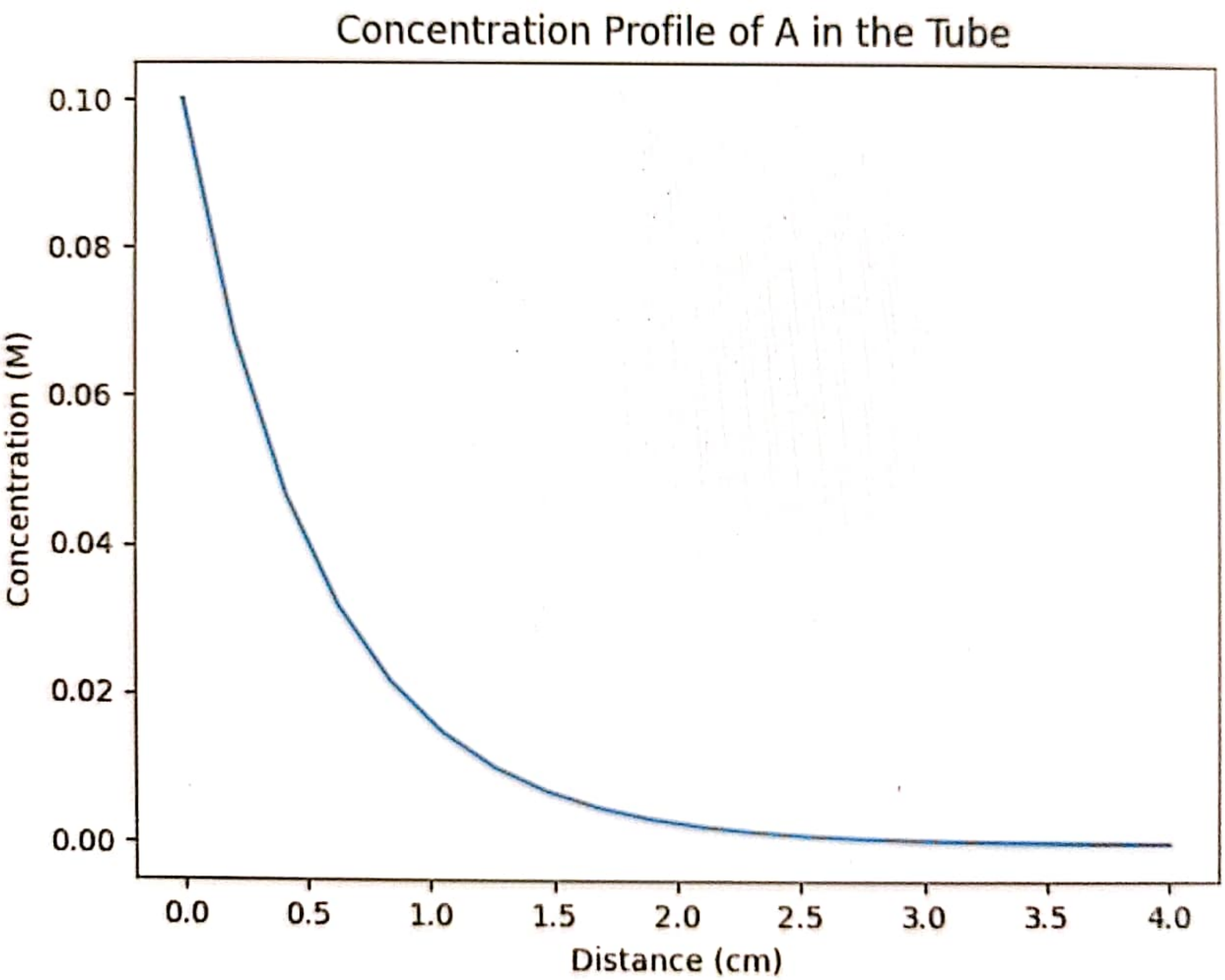
$$D(A_{i+1} - 2A_i + A_{i-1}) = (kA)(\Delta x^2)$$

$i=1$ $D(A_2 - A_1 + A_0) = (kA_1)(\Delta x^2)$

$i=2$ $D(A_3 - A_2 + A_1) = (kA_2)(\Delta x^2)$

$i=3$ $D(A_4 - A_3 + A_2) = (kA_3)(\Delta x^2)$

$i=20$ $D(A_{21} - 2A_{20} + A_{19}) = (kA_{20})(\Delta x^2)$


Concentration Profile of A in the Tube
Concentration (M)
0.10
0.08
0.06
0.04
0.02
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Distance (cm)