1. \(1.5 \text{ g/L} [\text{SO}_4^{2-}]\)

a. \(1.5 \frac{\text{g SO}_4^{2-}}{\text{L}} \cdot \frac{32.1 \text{ g/mol}}{96.1 \text{ g/mol}} = \frac{0.50 \text{ g-S/L}}{\text{La}} \approx \text{should be only to two significant digits}\)

b. \(\frac{1.5 \frac{\text{g SO}_4^{2-}}{\text{L}}}{96.1 \frac{\text{g-S/mol}}{\text{mol}}} = \frac{0.016 \text{ mmol/L}}{16 \text{ mmol}} \approx \text{ans}\)

c. \(\text{SO}_4^{2-}\) has a charge of 2, hence there are 2 equivalents per mole

\[0.016 \text{ mmol/L} \times 2 = 0.032 \text{ eq/L} = 0.032 \text{ N} = 32 \text{ mL}\]

2. \(\text{%}\) Flux densities: (units like \(\text{g/m}^2\cdot\text{h}\))

a. \(C_0 = 10 \text{ mg/L} = 10 \text{ g/m}^3\)

\(V = 2 \text{ cm/h} = 0.02 \text{ m/h}\)

\(J = CV = \left(10 \text{ g/m}^3 \times 0.02 \text{ m/h}\right)\)

\(= 0.2 \text{ g/m}^2\cdot\text{h}\)

\(= 200 \text{ mg/m}^2\cdot\text{h}\)

\(= 0.2 \text{ mg/cm}^2\cdot\text{h}\)

b. \(\text{Sea}\) to \(\text{Fresh}\)

\(C_0 = 30 \text{ g/L}\)

\(C_f = 0.9 \text{ g/L}\)

\(J = -\frac{dC}{dx} = -\frac{AC}{Ax} = \left[4 \times 10^{-5} \text{ cm}^2\right] \left[-30 \text{ g/L} \left(10 \text{ cm}\right)\left(1000 \text{ cm}^2/\text{L}\right)\right]\)

\(J_f = 3 \times 10^{-4} \frac{\text{g}}{\text{cm}^2\cdot\text{s}} \approx \text{ans}\)

\(= 3 \times 10^{-4} \frac{\text{g}}{\text{m}^2\cdot\text{s}}\)

\(= 2.6 \times 10^{-3} \frac{\text{g}}{\text{cm}^2\cdot\text{day}} = 26 \text{ g/m}^2\cdot\text{day}\)}
3. \(J = -D (dc/dx)\)

\[D = 10^{-5} \text{ cm}^2/\text{s}\]

\[\text{t1:}\]
\[
x = 1.5 \text{ cm} \quad \sim 0.7 \text{ g/l/cm} \quad J = 0.7e-05 \text{ g/l/cm}
\]
\[
x = 2.0 \text{ cm} \quad \sim 2.5 \text{ g/l/cm} \quad J = 2.5e-05 \text{ g/l/cm}
\]

\[\text{t2:}\]
\[
x = 1.5 \text{ cm} \quad \sim 0.3 \text{ g/l/cm} \quad J = 0.3e-05 \text{ g/l/cm}
\]
\[
x = 2.0 \text{ cm} \quad \sim 0.3 \text{ g/l/cm} \quad J = 0.3e-05 \text{ g/l/cm}
\]

If we define a control volume in the portion of the tube between 1.5 and 2 cm, clearly the above shows that at \(t1\), about 3 times as much dye is leaving as entering. Therefore, the dye cone must decrease, which it does by \(t2\), where the difference in fluxes is almost negligible.