

Problem 3.3

A drop of red and a drop of blue dye, each 1 mg, are released 10 cm apart into a layer of stagnant fluid between two plates. The plates are 1 m x 1 m in area and are 5 mm apart. The dye drops are released at the center of the plate area and mix rapidly across the fluid layer, i.e. between the plates. The molecular diffusion of each dye is; $D_{\text{red}} = 10^{-5} \text{ cm}^2\text{s}^{-1}$ and $D_{\text{blue}} = 4 \times 10^{-5} \text{ cm}^2\text{s}^{-1}$. The human eye can detect the color of the dye at concentrations of 10-g l^{-1} . No reactions occur between the two dyes, but at locations where the two dyes co-exist and are both above the visible threshold, the mixture will appear purple.

- a. While both clouds are fully visible ($C > 10\text{-g l}^{-1}$), which cloud **will appear larger**, and by how much?

[Hint 1](#)

- b. At what time and at what location will the two dye clouds first appear to touch?

[Hint 2](#)

[Hint 3](#)

[Solution](#)

Make a rough estimate of the **location** using your result from part a?

- c. At what time will the line connecting the release points be completely purple?

[Hint 4](#)

[Solution](#)