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 1m x 1m 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; $D_{red} = 10^{-5}$ cm^2s^{-1} and $D_{blue} = 4 \times 10^{-5}$ cm^2s^{-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-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