Homework for Lecture 4

The diagram below shows the pipeline used for emitting the exhaust gas of an engine into air. The total length of the horizontal pipe is l, and the CO_2 gas produced from the engine flows into the pipe through a "T" joint, which is located $l/5$ from left. Suppose the concentration of CO_2 remains constant as C_0 at the joint "T" position. After CO_2 enters the pipe, it can either go left or right by taking a random walk (diffusion). Considering the small diameter of the pipe, the diffusion of CO_2 can be treated as one-dimensional. When CO_2 comes out of either the left or right opening, it diffuses rapidly into air, immediately reaching equilibrium with air, where the concentration of CO_2 is $0.1 C_0$. Therefore, the flowing of CO_2 in the pipe can be considered as a steady state system.

1). What's the concentration distribution of CO_2 inside the left and right side of pipe?

2). What is the ratio of total amount of CO_2 in the left side to that in the right side?

3). What is the flowing flux of CO_2 inside the left and right side of pipe?