Problem 5.3.
You are the safety officer for a new factory with a permit to discharge a treated waste stream into the center of a river at a flow rate of 2 m^3s^{-1}. The river has a square cross-section with an area of $20m^2$. Under standard operating procedures the discharge is fully treated before release. The discharge is monitored, and if the chemical concentration in the waste stream becomes elevated above a safety threshold of 100 mgl^{-1} the factory will shut-down. However, the response time for the shut down is 100 seconds. You are asked to prepare an environmental impact report for a fish hatchery located 1-km downstream of the plant. The hatchery draws water from the river to flush the hatchery tanks. Based on studies of chronic exposure to juvenile fish the safety standard at the hatchery is set at $C = 0.5\ mgl^{-1}$

Write an expression describing the concentration experienced at the hatchery. Then, for each scenario below find the peak concentration and the duration of exposure at the intake to the fish hatchery. Then describe the exposure threat - considering duration and level - for each flow regime and state whether you would issue a water quality warning.

Case 1: High Discharge. $U = 50\ cms^{-1}$, $D_x = 10\ m^2s^{-1}$, $D_Y = D_Z = 0.1\ m^2s^{-1}$
Case 2: Low Discharge. $U = 2\ cms^{-1}$, $D_x = 1\ m^2s^{-1}$, $D_Y = D_Z = 0.01\ m^2s^{-1}$

Hint 1 - Start by defining the system dynamics using time scales