Problem 9.7
Between midnight and 2 am, illegal dumpers empty two five-gallon drums containing 2 kg of Toluene into a shallow abandoned well. Within 24 hours the Toluene is distributed vertically over the shallow (5 m thick), sandy aquifer. Evidence of the dumping is discovered two days later, and you are asked to assess the risk to a drinking well located 1 km directly downstream, if no remediation is done. Previous tests on this aquifer indicate the following:

Mean pore velocity, u = 1 m /day
Isotropic, Homogeneous Dispersivity, K = 0.1 m^2/day.
Porosity, n = 0.3
Solids density, ρ_S = 2.6 g/mL.

Toluene partitions rapidly to aquifer solids and has a solid-water partitioning coefficient of

$$K_d = 0.5 \ \frac{g_{toluene} / kg_{solid}}{g_{toluene} / L_{water}}.$$

Assume that the partitioning of Toluene is everywhere in equilibrium.

a) Write an appropriate transport equation.
b) Estimate the total concentration, C(t), at the drinking well.
c) Estimate the peak concentration in the pore water at the well and the duration of exposure.