The dissolution of lead (Pb) from soldered joints in pipes carrying drinking water is of concern. Drinking water regulations require that Pb not exceed 15 ppb (µg/L) in drinking water. Pb dissolution can be considered a mass transfer process, in which Pb is dissolved in a corrosive (low alkalinity) water and released through the diffusion boundary layer at the pipe surface. The water velocity = 20 cm/s, pipe diameter = 2.5 cm, the molecular diffusion coefficient for Pb = 10^{-5} cm^2/s, dynamic viscosity = 0.01 g/cm.s, and water density = 1 g/cm^3. Assuming a Pb concentration immediately at the surface of joint (C_s) = 10 mg/L, find the steady-state Pb concentration in µg/L in water if the length of the Pb-soldered joint = 5 cm and if [Pb] = 0 upstream. Assume negligible hydrodynamic dispersion (D_H). **Note**: start by writing your overall ADR with appropriate simplifications and think about whether the rate term in your expression represents a loss or a gain with respect to the problem framework. Don't be shy about asking if this note doesn't make sense!

- The mass transfer correlation for flow in pipes is: $Sh = 0.023\mathrm{Re}^{0.83}\,Sc^{0.33}$
- The characteristic length is the pipe diameter, d_p
- For a pipe: a_s = ratio of pipe circumference : area