ASSIGNMENT 7

CHEMISTRY 300

Due: 4:30 pm Monday 3 November 2008

1. Fick's laws describes diffusion from at point source of N_0 molecules:

$$n(r,t) = \frac{N_0 e^{-r^2/4Dt}}{(4\pi Dt)^{3/2}}$$

Bombykol (C₁₆H₂₉OH) is a silkworm moth attractant pheromone. As few as 200 bombykol molecules in a cubic centimeter causes the male silkworm to flutter his wings in a characteristic frenzy. If 1.0 mg of bombykol is placed in a small spot 1.0 m from a male moth, when will the male moth go into a frenzy? The diffusion coefficient is $D = 4.1 \times 10^{-7} \text{ m}^2 \text{ s}^{-1}$.

- 2. If a 1.00 cm² × 10.0 cm bar of Cu (k=400 W m⁻¹ K⁻¹) has one end in contact with a 1.0 g sample of ice at 0°C and the other in contact with a hot plate at 140°C, how long does it take to melt the ice? The enthalpy of fusion for water is $\Delta \overline{H}_{fus}^{\circ} = 6.008$ kJ mol⁻¹.
- 3. The Poiseuille equation for an incompressible fluid is related to viscosity:

$$\frac{dV}{dt} = \frac{\pi R^4}{8L\eta} \Delta p$$

where R is the diameter and L is the length of a cylindrical pipe, and p is pressure.

Consider two copper pipes, each 3 m long, the first having 2.6 cm and the second having 1.3 cm inner diameter, are connected in series. A pressure of 5 atm is supplied at the opening of the wider pipe and oil ($\eta = 0.114$ Pa s) exits from the narrow end at a pressure of 1 atm.

- (a) Calculate the pressure at the point where the two pipes are joined.
- (b) How many litres per minute of oil can be delivered by the combination.
- 4. Consider problem 2 in assignment 6. Derive an expression for $(\kappa/d)_{eff}$ such that:

$$\Gamma_q = -\left(\frac{\kappa}{d}\right)_{eff} \left(T_{indoor} - T_{outdoor}\right)$$