1. Answer briefly to the following:
   a) Why do not common salts dissolve in organic solvents in significant extent?
   b) What is Donnan potential? How does it arise?
   c) How high waterfall an osmotic pressure of a 0.6 M NaCl solution corresponds to?
   d) What is the Henderson-Hasselbalch equation?

2. Propranolol has $\log P_{oct/w} = 3.4$ and $pK_a = 9,5$. 100 mg propranolol hydrochloride (DHCl, MW = 295.80) is dissolved in 10 mL of water. The solution is equilibrated with 1 mL of n-octanol. What are the concentrations of propranolol species at equilibrium at the aqueous pH of a) 10.0 and b) 7.4? Assume that partitioning of the protonated species DH^+ into n-octanol is insignificant.

3. Permeability of an oligonucleotide (24-mer) across bovine sclera (a membrane in an eye) was measured. The permeated amount was the following:

| t (min)	0	20	40	60	80	100	120	180	240	300
permeated ($\mu g/cm^2$)	0	0	0.9	17.6	31.4	48.7	64.8	103.9	146.7	185.2
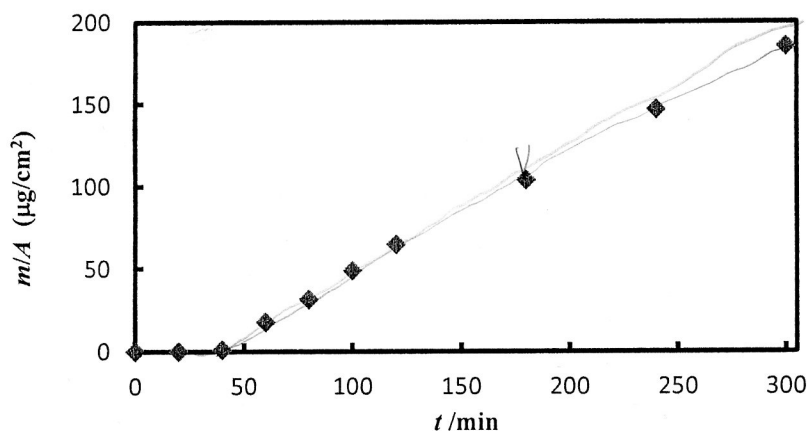
A Franz cell was used. The donor chamber volume was 0.7 mL and the receiving chamber volume 3.9 mL. Donor concentration c^0 was 1.0 mg/mL. Based on this experiment, what is the permeability of the oligonucleotide $K_p = D/h$ in bovine sclera? Equation you need is

$$\frac{m(t)}{A} = c^0 h \left[\frac{Dt}{h^2} - \frac{1}{6} - \frac{2}{\pi} \sum_{k=1}^{\infty} \frac{(-1)^k}{k^2} \exp\left(-\frac{k^2 \pi^2 Dt}{h^2} \right) \right] \approx c^0 h \left[\frac{Dt}{h^2} - \frac{1}{6} \right] \quad \text{when } t > \tau_{lag}$$

where h is the sclera thickness and D the diffusion coefficient of the oligonucleotide in sclera. How thick sclera is?

Turn around!

The solubility of a drug (D) is very low, only $S_0 = 0.0012$ M, but can be increased by complexing the drug with cyclodextrane, C. The value of the equilibrium constant of the reaction

$$D + C \leftrightarrows DC$$
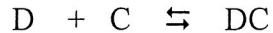
is 2×10^4 M^{-1}. If the cyclodextrane concentration is 0.5 M, how much does the solubility of the drug increase? What are the concentrations of DC and C at equilibrium.

Binding of an oligonucleotide to the single stranded binding protein of *E. coli* is described with the model where the protein has four binding sites. The sites reside in the corners of a square, and interaction takes place between adjacent corners only. Write the grand canonical partition function with the variables $s = Kc$ and $\sigma = e^{-\beta w}$; K is the binding constant, c is oligonucleotide concentration and w the interaction energy. Derive the binding isotherm and study the case $w = 0$.