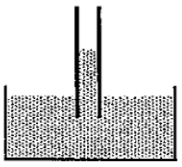
Puu-0.3110 Surface and Colloid Chemistry. Exam 24.10.2013

NAME: STUDENT NUMBER:

1. A glass capillary with an inside diameter of 1 mm is dipped vertically in water at 20 °C.



a) Assuming that water wets the glass wall perfectly (contact angle 0°), calculate the water rise inside the capillary. The surface tension of water at 20 °C is 72.8 mN/m.

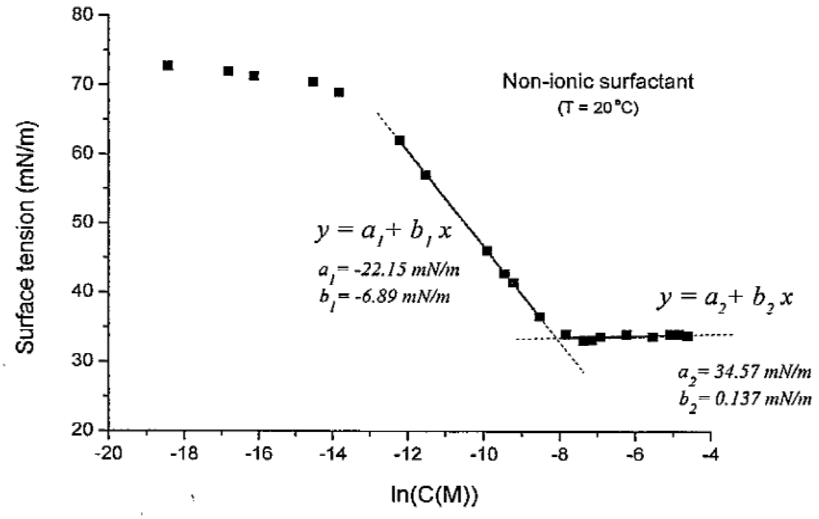
b) Is the capillary rise affected if some surfactant is added to the water? If so, how and why?

2. The adsorption of cationic polymers to negatively charged surfaces such as cellulose is an essential phenomenon in the use of such polymers as retention and flocculation aids. Explain how the amount and conformation of a cationic polymer adsorbed on a negatively charged surface is affected by: a) the polymer concentration in solution; b) the molecular weight of the polymer; c) the polymer charge density; d) the salt concentration in solution.

3. The surface tensions of different aqueous solutions of a non-ionic surfactant were measured at 20 °C. The experimental data are plotted in the figure (C = surfactant concentration).

a) Calculate the critical micelle concentration (*cmc*) of the surfactant.

b) Calculate the concentration of surfactant adsorbed at the air/liquid interface and the cross-sectional area per surfactant molecule at the *cmc* ($R = 8.31$ J mol^{-1} K^{-1} ; $N_A = 6.022\times10^{23}$ molecules/mol).

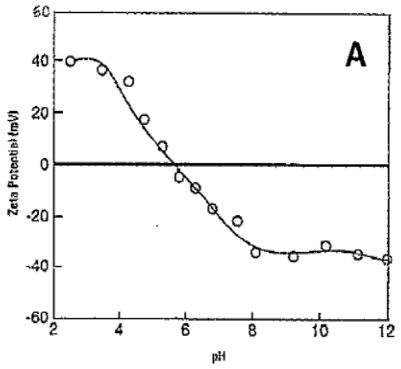


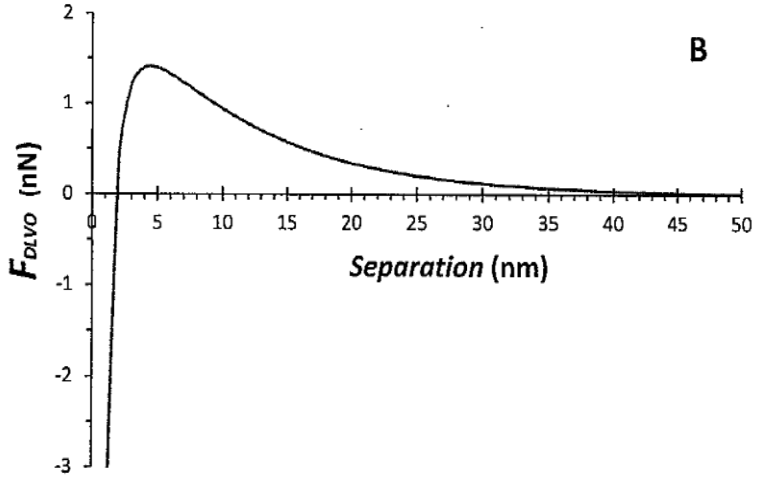
4. a) Enumerate the factors that can affect the final characteristics of an emulsion.
   b) What is the role played by the emulsifier in emulsion formation?
   c) Draw schematically the distribution of surfactant emulsifier molecules in O/W and W/O emulsions.
   d) Enumerate different mechanisms that can stabilize or destabilize liquid foams.

5. Figure A presents the zeta potential of certain colloidal particles as a function of pH. The interaction force between two of such colloidal particles in a solution at pH 9 and 1 mM NaCl is shown in figure B.

   a) Describe the interaction between two colloidal particles in a solution at pH 9 and 1 mM NaCl when they approach each other from a separation of 50 nm to 1 nm.

   b) Suggest two methods to provoke the fast aggregation of the particles in the colloidal solution. Explain how the suggested methods affect the DLVO force curve.





Points per exercise: 5 ;	*Maximum number of points: 25 ;*	*Minimum number of points to pass: 10*
Grade system: grade 0 (0–9.9 points); grade 1 (10–12.9 points); grade 2 (13–15.9 points); grade 3 (16–18.9 points); grade 4 (19–21.9 points); grade 5 (22–25 points).		