

Puu-0.3110 Surface and Colloid Chemistry–Exam questions

23.10.2014, 09-13. Close book, close notes exam. No calculator necessary.

Each correct answer to questions 1 to 20 is 1 point maximum.

Total maximum grade achievable = 20 points

COLLOIDS and SURFACE ENERGY

1. What is a colloid?
2. What is the relevance of Laplace (also known as Young-Laplace) equation? You can use an example in your explanation, highlighting why it is important or what implication Laplace Eqn. has in a given phenomenon. Feel free to use examples discussed in class or from your own experience or work.
3. What is the difference between adhesion and cohesion? What do you need to know in order to predict the work of adhesion and cohesion?
4. Name two techniques to measure the surface tension of a liquid. Explain briefly the principle of measurement in each case.
5. Could you indicate (and explain briefly) one use of the Kelvin equation?

CONTACT ANGLE, WETTING & SURFACTANTS

6. What is the most important variable that gives rise (and is factored in) in the contact angle equation corresponding to the Wenzel or Cassie-Baxter regimes?
7. What are the two most important properties of surfactants? Explain them briefly.
8. Why do nonionic surfactants in general have lower CMC values compared to ionic ones?
9. What is the effect of surfactant's hydrophobic group on its CMC. You can indicate, for example, how the CMC would change if the size of the hydrophobic group in a surfactant is increased (by using longer tail groups)
10. What is the utility of the Gibbs adsorption isotherm?

EMULSIONS and SURFACE FORCES

11. Based on the Winsor-R theory, can you predict the change in phase behaviour in a Surfactant-Oil-Water system that is subjected to a formulation scan? More specifically, imagine that test tubes are prepared with 50% of a given oil and 50% water. The surfactant consists of an alkyl sulphate. The salinity is the scanned variable. What can you say about the evolution of the phase behaviour (WI, WII and WIII) as the salinity is increased?
12. What do we mean with "catastrophic" emulsion inversion? In what conditions does this inversion occur?

13. What did we discuss in relation to the use of conductivity measurements in emulsion systems? What it is useful for? Explain.

14. Name two techniques that can be used to measure surface interaction forces. Explain briefly the main principle of measurement.

15. What is meant with the "double layer" to describe electrostatic interaction forces?

DLVO and COLLOID STABILITY

16. A dispersion of silica nanoparticles is reasonable stable at low electrolyte concentration. What are the forces contributing to the stability of the dispersion? Adding salt to the dispersion induces flocculation. Why?

17. Explain briefly the DLVO theory. There are situations where the DLVO theory is not enough to explain the interactions. Give examples of at least 2 forces not accounted for by the DLVO theory.

18. What two techniques did we discuss can be useful to measure polymer adsorption on solid surfaces? Explain briefly the main principle of operation for each one.

19. You have a dispersed phase A in medium B (aqueous solvent). You want to keep the system stabilized. Please mention anything you potentially could do to help the system to be stabilized or to avoid agglomeration/flocculation.

20. Adsorption of cationic polyelectrolytes to negative surfaces such as cellulose, silica etc. is an essential phenomenon in flocculation, etc. How does the polymer charge density, the surface charge density and the ionic strength influence the maximum amount of polymer adsorbed on negatively charged surface?