Exercises for Introduction to Colloids and Surfaces – Lista 3

1. Only one of the following is true. The Hamaker constants of polystyrene (PS) and silver particles are 6.6 and 40 (both in $\times 10^{-20}$ J). These values imply that:
   a. The vdW forces between two PS particles are stronger than between two silver particles
   b. The vdW forces between two silver particles are stronger than between two PS particles
   c. The vdW forces cannot be assessed based on this information
   d. The vdW forces are not important for such values of the Hamaker constant

2. Only one of the following statements about the vdW forces between particles is wrong. Which one?
   a. They are always attractive in air or vacuum
   b. They are always attractive between two identical particles
   c. They increase because of an intervening medium
   d. They can be repulsive between different particles in a medium

3. The Hamaker constant of pentane in air is 3.8×10^{-20} J, while the Hamaker constant of pentane in water is 0.28×10^{-20} J. These results mean (Yes or No to each) that:
   a. There is small difference in the vdW forces of pentane in air and in water;
   b. The vdW forces of pentane are stronger in water than in air;
   c. The information is insufficient to conclude anything about the vdW forces between pentane molecules;
   d. The vdW forces are stronger in air than in water.

4. Which of the following statements is wrong about the CMC (critical micelle concentration)?
   a. It decreases with increasing hydrophobic chain length.
   b. It decreases with adding salt (for ionics).
   c. It increases with increasing hydrophilic length.
   d. It decreases with temperature for all known surfactant families.

5. Describe briefly the various mechanisms for the stabilization of colloidal dispersions. How does DLVO treat the stability of ionic colloidal dispersions? What are the limitations of DLVO theory for explaining colloid stability in general?

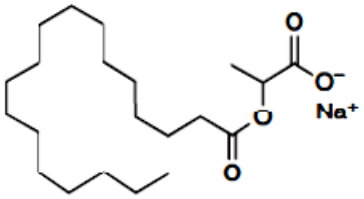
6. The volume and extended length of an SDS monomer are given below.

   Assuming that SDS micelles are spherical, estimate the micellar aggregation number at the CMC, the area per molecule of SDS in the micelle and the critical packing parameter (CPP).

   $V_{surf} = 0.274 + 0.0269 \times 12 = 0.350$ nm^3 for a 12 carbon chain.

   $l_{chain} = 0.154 + 0.1265 \times 12 = 1.67$ nm for a C12 chain

7. A company is asked by a customer to make a 1 m^3 batch of mayonnaise using the following emulsifier instead of egg yolk:



The optimum HLB (hydrophilic–lipophilic balance) value required for making mayonnaise is 12.

a. Estimate the HLB value of this emulsifier and comment on its suitability for making mayonnaise.

b. Two other emulsifiers, which have HLB values of 6 and 15, respectively, are considered as an alternative. What should be the concentration ratio of these two emulsifiers, on an emulsifier weight fraction basis, if they are used for the mayonnaise?

8. The Table below gives the group-contribution values for estimating the Hydrophilic-Lipophilic Balance (HLB) according to the method of Davies and Rideal using the relationship:

$$\mathrm{HLB} = 7 + \sum_i n_i \mathrm{HLB}_i$$

Group	HLB	Group	HLB
$-SO_4Na$	38.7	-OH (free)	1.9
-COOK	21.1	-OH (sorbitan)	0.5
-COONa	19.1	Sulfonate	11
-N (tertiary amine)	9.4	CH, CH_2, CH_3	–0.475
Ester (sorbitan)	6.8	$-CH_2CH_2O$	0.33
Ester (free)	2.4	$-CH_2CH_2CH_2O$	–0.15
-COOH	2.1	$-CF_2, -CF_3$	–0.87
-O-	1.3		

As noted above, the optimum HLB (hydrophilic–lipophilic balance) value for making mayonnaise is 12. Design a non-ionic surfactant with a 16 carbon alkyl chain and “n” oxyethylene units with the structure: $CH_3(CH_2)_{15}$-$(OCH_2CH_2)_n$-OH that should be suitable for making mayonnaise (even though it may not be recommended for human consumption).