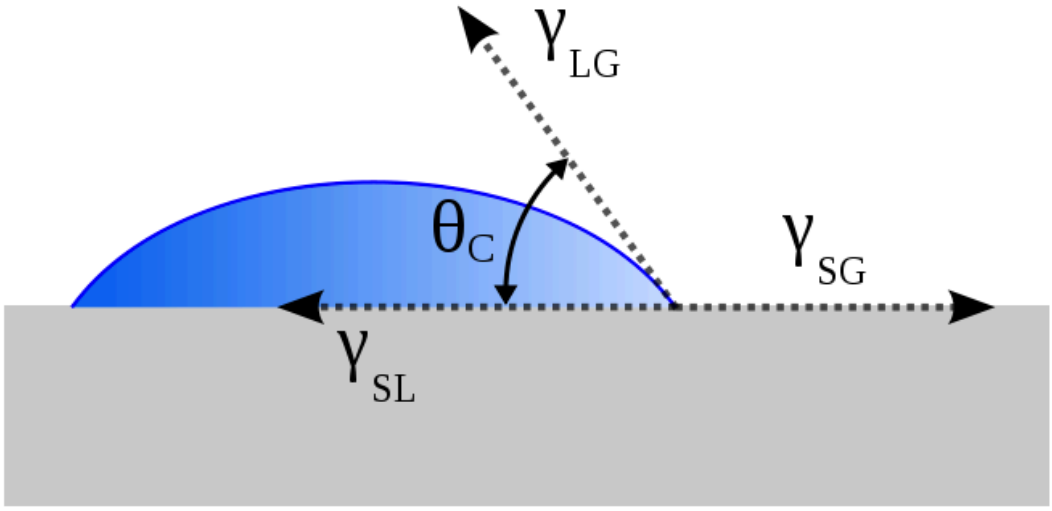
Exercices- surface tension-high surface area Thu 5/09

1) Let's consider a drop of water on Teflon. The surface tension of Teflon-water is 92 mM/m, the surface tension of water-air is 72 mN/m and the surface tension of Teflon-air is 20 mN/m. Calculate the contact angle of the drop on the Teflon surface. Draw the drop.

Answer:



Young equation:

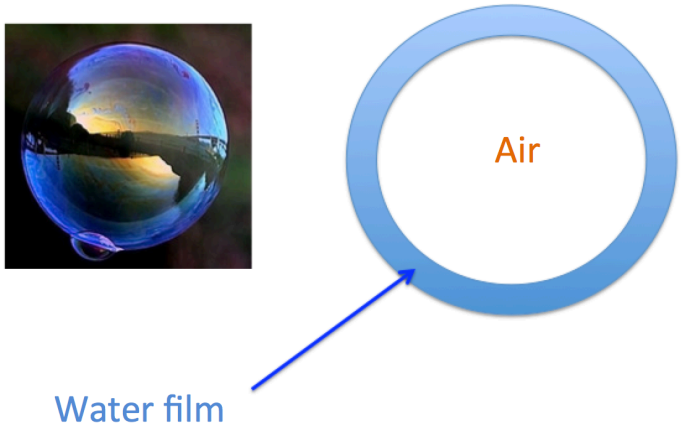
$$\gamma_{SL} + \gamma_{LG} cos\theta_C = \gamma_{SG}$$

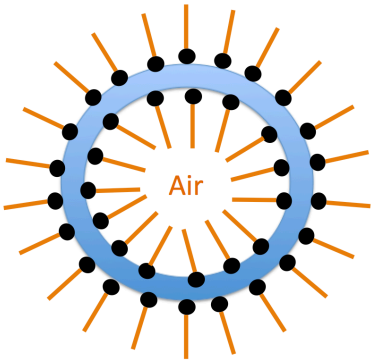
$$cos\theta_C = \frac{\gamma_{SG} - \gamma_{SL}}{\gamma_{LG}} = -1$$

$$\theta_C = 180°$$

2) How are surfactants positioned in a soap bubble? Make a drawing.

Answer:





4) Let's consider an oil-in-water emulsion. The volume of water is 1 l and the volume of oil is 0.1 l. The oil dropplets are 1μm in radius and the interfacial tension between oil and water is 50 mN/m.
Calculate the oil-water total interfacial energy of this emulsion.

Answer: $V_{oil} = 0.1\ V_{water}$

$$V_{droplet} = \frac{4}{3}\pi r^3$$

Number of droplets: $N_{droplet} = \frac{V_{oil}}{V_{droplet}} = \frac{0.3\ V_{water}}{4\pi r^3}$

Total oil water area:

$$A_{oil-water} = N_{droplet} \times A_{droplet} = \frac{0.3\ V_{water}}{4\pi r^3} \times 4\pi r^2 = \frac{0.3\ V_{water}}{r}$$

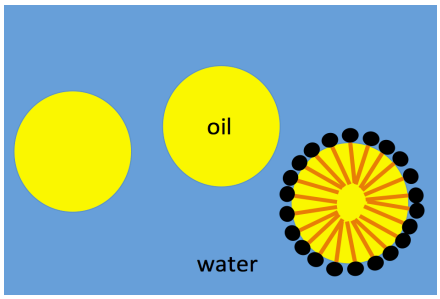
Total interfacial energy:

$$E_{oil-water} = A_{oil-water} \times \gamma_{oil-water} = \frac{0.3\ V_{water}}{r}\gamma$$

$$E_{oil-water} = \frac{0.3\times10^{-3}}{10^{-6}} 50\times10^{-3}\ N.m\ = 15\ N.m = 15\ J$$

5) Now surfactant is added to stabilize the emulsion (the interfacial tension between oil and water in the presence of surfactant is 10 mN/m).

- Draw the surfactants in the emulsion



- What is the total interfacial energy of this emulsion now?

Answer: 3J