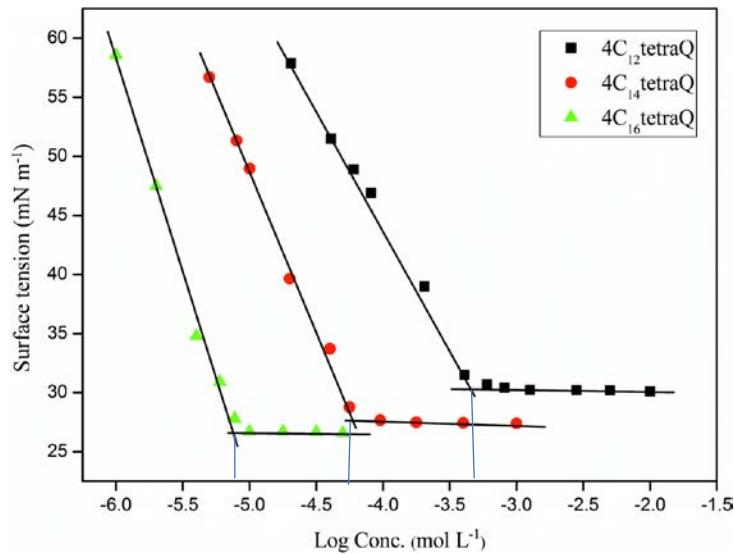**Answers**

Q1

Lines show cmc which by inspection are 9x10⁻⁶ , 7.5x10⁻⁵ and 4x10⁻⁴ mol/l   6 marks

b) basically at long hydrocarbon chain length the surfactant is more hydrophobic, HLB number would be lower so the surfactant would associate more readily as it would be expelled from the water

c) Surface XS given by Gibbs eqn

$$\Gamma = -1/R(d\gamma/d\ln c) = -2.303/RT(d\gamma/d\log_{10}c)$$

$$= -2.303/(8.314\times300)\,(d\gamma/d\log_{10}c) = 9.2 \times 10^{-4}(d\gamma/d\log_{10}c)$$

$$= 7\times10^{-5} \text{ mol/l for C16; } 6.2 \times 10^{-5} \text{ mol/l for C14 and } 2.5 \times 10^{-5} \text{ mol/l for C12}$$

d) you need to change the packing parameter P so that the head group is smaller than the tail easiest way is to add a multivalent ion eg Ca Fe

e) here again need to change P by reducing size of the headgroup, so that the number of EO groups is reduced would form W/O emulsions whilst high EO numbers would for O?W emulsions.

Q2

i) mechanical energy; some stabilising mechanism, slow drainage also low ST would be a possibility in most cases

ii) Something like picture below

i.e bubbles followed by drainage followed by films of polyhedra

iii) it would be more stable to reduce surface area since the surface energy is always positive this would be achieved by the foam breaking since the SA is reduced.

iv) slow down drainage by inc viscosity of the liquid in the foam

making the surfactant film more viscoelastic to be able to accept deformations

having strong repulsion between the headgroups of the surfactant in film layers

bi) Something like
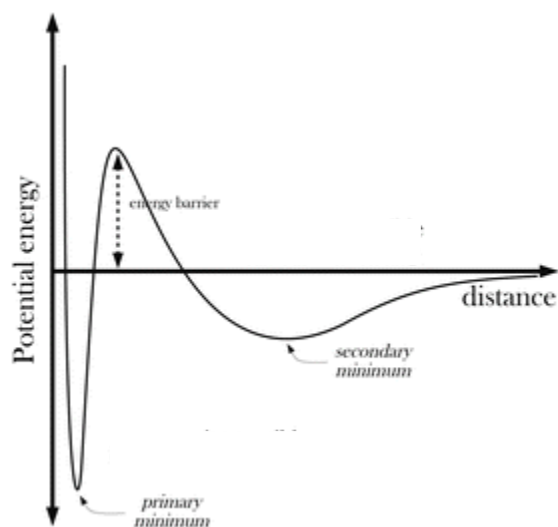
ii) various possibilities here, including adding a potentially determining ion, generally a multivalent anion in this case.

Also can simply add electrolyte such that the zeta potential is reduced as usually some ions will ads on the surface at high concentrations

Add an anionic polyelectrolyte

Add an anionic surfactant

Add a polymer to shift the plane of shear further out. Here Surface potential is constant but zeta is reduced.

Q3 for creaming and sedimentation the force is gravity the density difference between the droplets causes the droplets to rise or fall

For flocculation the interparticle forces becomes attractive giving rise to aggregation, eg for charged droplets high salt would bring this about

For coalescence the film of liquid between two droplets needs to break, so the film would need to be brittle in nature and have a low elasticity and viscosity

In polydisperse emulsions Ostwald ripening would occur, where the pressure inside a small droplet is larger than a large one so molecules would slowly diffuse out of the small droplets into the large ones. Note that this effect would be larger if the liquid in the droplet has some solubility in the continuous phase

Q4

i) Volume of 1 g of sodium montorillonite V is

$V = \dfrac{10\text{-}3}{2800}$ m3

Now Surface are x thickness, t will also be the volume so assume 1 plate of 0.97 nm
So SA = V/t $= 10^{-3}/ (2800 \times 9.7 \times 10^{-10})= 368$ m^2 so amount of surfactant required per gram = 368 x 0.5 mg = 184 mg.

0.5 mg/m2 = 0.5 x 10^{-3} x 6 10^{23} / 300 molecules per m2 = 1 x10^{18} molecules or one molecule occupying 1nm2 of surface. So assuming a simple square arrangement each molecule would be 1 nm from the other. Or slightly further in an hexagonal array.