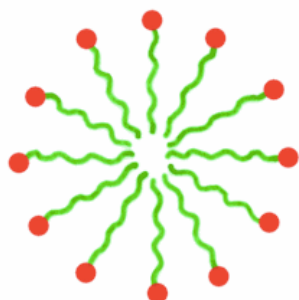
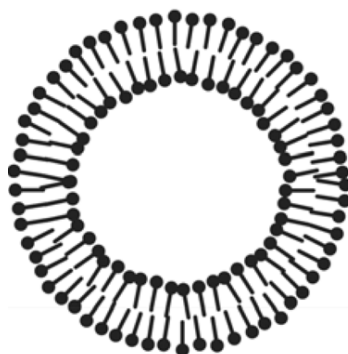


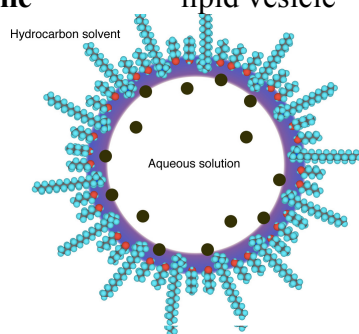
- Draw sketches of a detergent micelle, a lipid vesicle and a water-in-oil microemulsion.



detergent micelle



lipid vesicle



water-in-oil microemulsion

• Give a brief definition or explanation of the following concepts in colloid science.	Marks 6
double layer The layers of ions on a colloidal particle. The inner (Stern) layer consists of ions that are electrostatically attracted to the charged particle. The outer (diffuse) layer consists of counter ions.	
counter ion An ion of opposite charge to another chemical species.	
isoelectric point The pH value at which an amino acid or peptide has zero net charge.	
zeta potential The zeta potential is a measure of repulsion between adjacent, similarly charged particles in a colloid (<i>i.e.</i> the stability of a colloid). Colloids with high zeta potentials are electrically stabilized, whilst those with low potentials tend to coagulate.	
flocculation The process in which colloidal particles clump together to form larger particles causing separation of the colloid.	
electrokinetic mobility The movement of colloidal particles in response to the application of an electric field.	

- Why do phospholipids self-assemble in solution, what structures do they form, and why are they relevant to cell biology?

Phospholipids contain a hydrophilic head and 2 hydrophobic tails.

They self assemble in bilayers with the hydrophobic tails in the centre and the hydrophilic heads at the interface with the solution.

Lipid bilayers (intercalated with proteins) make up over 50 % of cell membranes in biology, as the bilayer arrangement makes an effective barrier against the free passage of water and ions into and out of cells.

Marks
4

- Give 2 examples of changes of conditions that might cause a colloidal dispersion to coagulate. In each case, explain why coagulation occurs.

Heating and stirring: increase the frequency and velocity of collisions that are necessary for coagulation to occur.

Addition of an electrolyte: neutralises the surface charges, thus removing the electrostatic repulsion between colloidal particles.

Changing the pH: can flatten / desorb electrosteric stabilisers

• Explain how the self-assembly of phospholipids can be utilised in a drug delivery system.	Marks 2
A lipid bilayer will self assemble to form vesicles, which contain solvent that is physically separated from the outer solvent. If the drug is present in the trapped solvent it must stay contained there until the vesicle is broken up where the drug is required.	

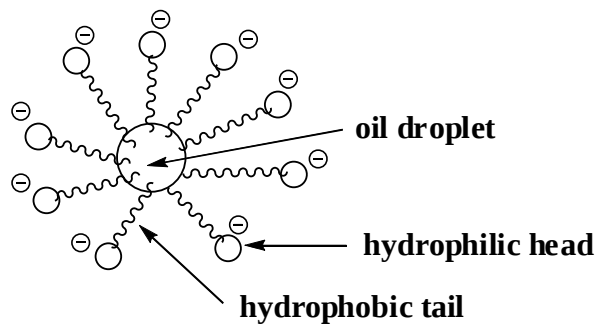
- Explain how soap acts to remove oil.

Marks
2

Soap molecules consist of a long hydrophobic tail and a charged hydrophilic head.

The molecules are able to form micelles (see diagram below) in which the tails interact with the oil particles and the heads interact with the water.

In this way, the oil is dissolved in the water and can be removed.



- Explain why surface effects are important in colloidal systems.

2

The small size of the colloidal particles means that they have a very large total surface area.

The colloid can be stabilised by steric and/or electrostatic effects.

If surface interactions are unfavourable, they are minimised by flocculation and coagulation.

- Describe how the addition of an electrolyte can alter the state of a colloidal dispersion.

If the colloidal particle has a charge, a layer of oppositely charged ions will form on the surface (the Stern layer). In the region around the outside of the colloid, there is therefore a build-up of counter ions creating a double charge layer. The charge surrounding one colloid will repel the charge surrounding other particles and so coagulation is prevented.

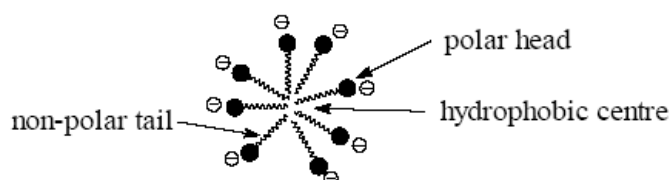
Addition of an electrolyte leads to reduction in the net charge surrounding each colloid and prevents this electrostatic stabilization. As a result, the colloid particles tend to coagulate and the colloidal dispersion is lost.

- Describe how hydrophilic and hydrophobic colloids are stabilised in water.

They can be stabilised via electrostatic and steric stabilisation.

Hydrophilic colloids may have a charge on their surface that attracts oppositely charged ions (H^+ or OH^- present in water) to form a tightly bound layer known as the Stern Layer. The Stern layer is surrounded by a diffuse layer which contains an excess of counter-ions (opposite in charge to the Stern layer) and a deficit of co-ions. The Stern layer and diffuse layer are collectively known as a double layer. Coagulation of a hydrophilic colloid is prevented by mutual repulsion of the double layers.

Hydrophobic colloids may be stabilised by the use of a surfactant, e.g. a long chain fatty acid with a polar head and a non-polar tail. When dispersed in water these molecules arrange themselves spherically so that the polar (hydrophilic) heads are interacting with the polar water molecules and the non-polar (hydrophobic) tails are interacting with each other. This arrangement is called a micelle. The hydrophobic colloid can be stabilized by dissolving in the non-polar interior of the micelle.



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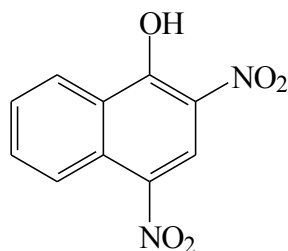
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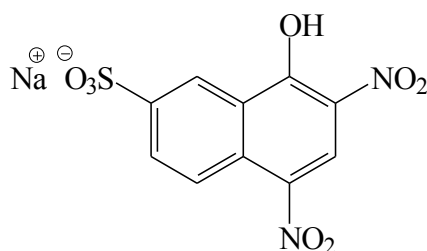


Marks
3

- Consider the following two compounds.



(I) Martius Yellow



(II) Naphthol Yellow S

On ingestion of compound (I), death from liver failure occurs very quickly. In contrast, compound (II) is completely non-toxic and is used as an artificial colouring agent. Explain, using the model of biological membranes, why (I) is highly toxic.

Naphthol Yellow S is water soluble, so does not pass through the cell membrane. The hydrophilic region of the lipid bilayer acts as an impermeable barrier.

Martius Yellow is non-polar so may pass through the cell membrane. It can either disrupt the function of the cell membrane itself, or pass into the cell and damage the various parts of the liver cells.

3

- Give three examples of colloids in biological systems, and complete the following table. Paint is given as an example of a synthetic (non-biological) system.

Name of colloid	Discrete phase	Continuous phase
<i>paint</i>	<i>synthetic polymer</i>	<i>water</i>
blood	red blood cells	water/plasma
milk	casein	water
cell	nucleus, ribosomes etc	cell fluid/cytoplasm