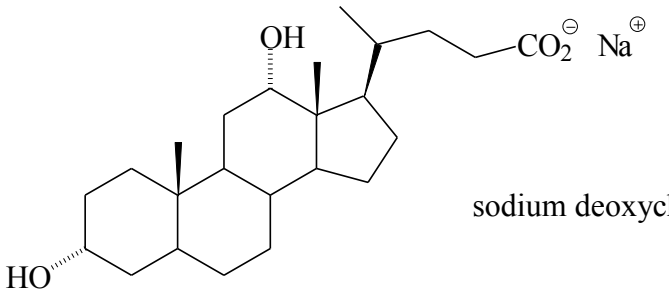
- Give three examples of colloids in biological systems, and complete the following table. Paint is given as an example of a synthetic (non-biological) system.

Marks 3

Name of colloid	Discrete phase	Continuous phase
paint	*synthetic polymer*	*water*
blood	**red blood cells**	**water/plasma**
milk	**casein**	**water**
cell	**nucleus, ribosomes etc**	**cell fluid/ctyoplasm**

3

- One of the components of bile acid is sodium deoxycholate, whose structure is given below.



sodium deoxycholate

Which one of the following terms: *electrostatic*, *electrosteric* or *steric*, best describes the way sodium deoxycholate functions to solubilise fats. Give a brief explanation.

Sodium deoxycholate is an electrostatic stabiliser.

The organic rings are hydrophobic. This part of the molecule is adsorbed onto the surface of the fat whilst the hydrophilic carboxylate group is in contact with the surrounding water. The solublised fat is stabilised in the water by the double layer of repulsion charges that prevents coagulation.

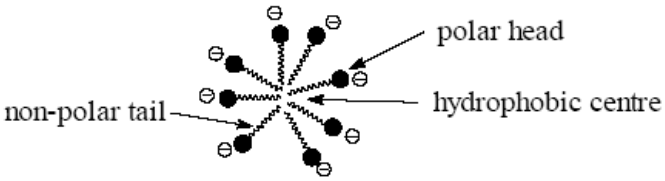
- Describe how hydrophilic and hydrophobic colloids are stabilised in water.

3

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.



	Marks
• Describe how the addition of an electrolyte can alter the state of a colloidal dispersion.	**2**

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.

- 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.

• Explain how soap acts to remove oil.	**Marks 2**

- Describe two alternative methods by which a colloidal suspension could be stabilised, and one by which a stable suspension could be destabilised. **3**

Colloidal suspensions can be stabilised either electrostatically or sterically. Electrostatic repulsions between particles with the same charge can stabilise a suspension. The presence of an adsorbed polymer layer on the particles, can also stabilise the suspension because an entropic repulsion sets in between the polymer layers.

A suspension stabilised electrostatically can be destabilised by adding an electrolyte (e.g. NaCl), which decreases the repulsion between particles, causing the suspension to aggregate and precipitate. Heating or stirring vigorously can also destabilise a suspension by increasing the number of collisions between particles.