Q6 Describe the structure of surfactant (25% of marks). Explain the effects of surfactant upon surface tension and lung mechanics (75% of marks) (Sept 2012)

Surfactant:

- Produced by type II alveolar cells
- 80% DPPC (dipalmitoyl phosphotidylcholine), a phospholipid, 10% other lipid, 2% carbohydrate, 4% surfactant proteins and 4% other proteins. There are four surfactant proteins, A to D. Proteins A and D are believed to be important in production and secretion of surfactant, with B and C important in the orientation of the surfactant within the alveolus.
- Surfactant is an amphipathic molecule. It aligns itself in a monolayer within the alveolus with the hydrophilic head facing the liquid lining the alveolus and the hydrophobic tail facing the air.

Surface tension:

- Refers to the forces acting across an imaginary line drawn in the surface of a body of water, due to the forces of attraction between water molecules being much greater than those between the water and gas molecules.
- The result is that the liquid surface area becomes as small as possible
- Within the fluid-lined alveolus, pressure exists due to surface tension. The pressure is determined by Laplace's Law $P = 2T/R$. Hence smaller alveoli (with smaller radii) will have greater pressure and will therefore tend redistribute their contents to larger bubbles (ie, they collapse).

Roles of surfactant:

- Reduce surface tension → The exact mechanism of postulated to be that the intermolecular repulsive forces between DPPC molecules oppose the normal attracting forces between the liquid surface molecules that are responsible for surface tension
- By reducing surface tension, reduces alveolar collapse
- Prevents alveolar oedema → Reducing the surface tension of the curved alveolar surface reduces the hydrostatic pressure outside the capillary and prevent alveolar transudation (remembering that fluid movement will depend on the net starling forces across the membrane)
- Improves compliance and reduces work of breathing (because alveoli are not collapsed, so at a more favourable place on the compliance curve)
- Important in lung elastic recoil and hysteresis