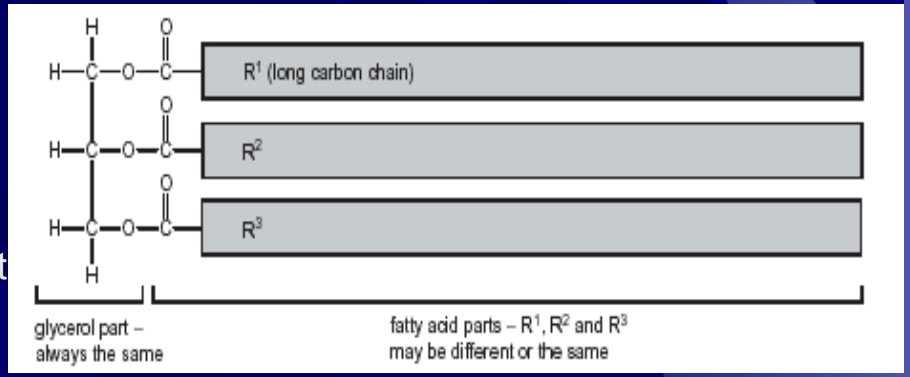
Paint Media

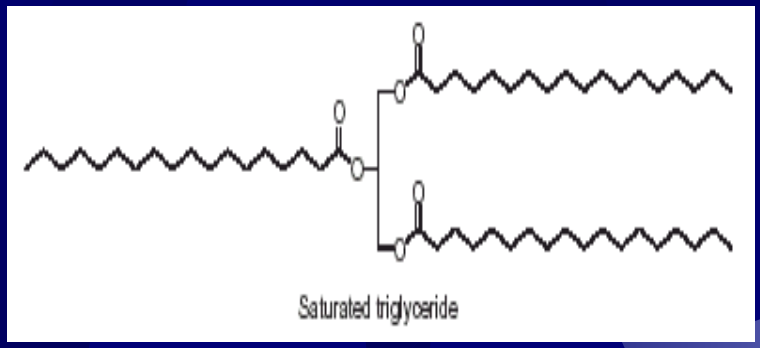
Fats and Oils

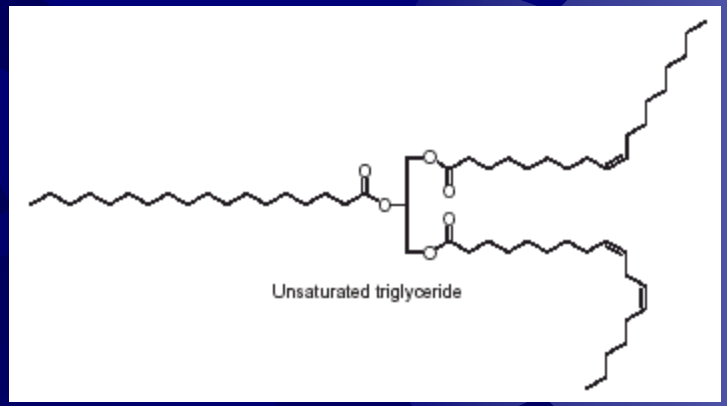
- Most oils and fats are triesters of propane-1,2,3-triol and long chain carboxylic acids.
- These carboxylic acids (commonly fatty acids) have an even number of carbon atoms ranging from 4 to 24.
- Palmitic and stearic acid are saturated (no carbon-carbon double bonds).
- Linoleic and oleic acid are unsaturated (have carbon-carbon double bonds)
- Any natural oil or fat contains a mix of triesters. The proportions in which the acid groups occur more or less constant for a particular oil or fat.
- Like all esters,fats and oils can be hydrolysed. This can be performed by heating under reflux with NaOH to form propane-1,2,3-triol and sodium salts of the carboxylic acids. This is how soap is made.

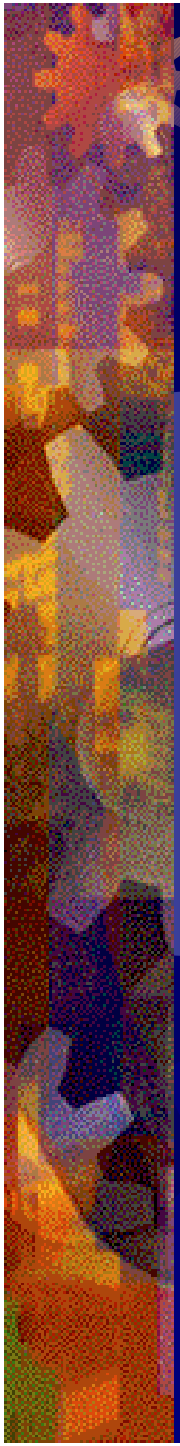


Solid or liquid?

- Saturated oils and fats tend to have higher melting points than unsaturated ones as they have more linear fatty acid chains. Intermolecular forces only occur when molecules/parts of molecules are close together so these forces are stronger when the chains are linear.
- Unsaturated fats and oils have double carbon-carbon bonds which mean that the fatty acid chains cannot pack so closely together as cis double bonds cause the fatty acid chains to kink. These gives weaker intermolecular forces so the melting point is lower.

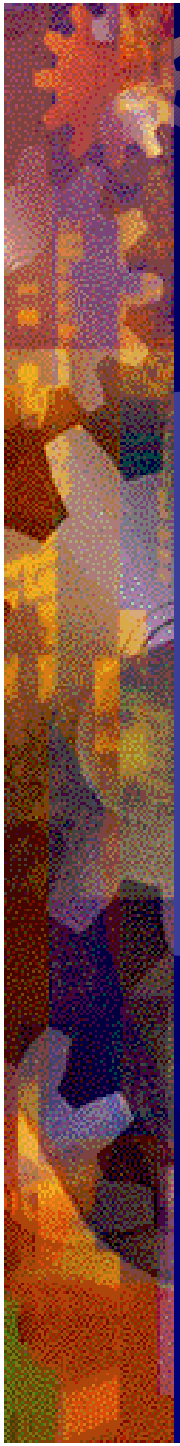






Drying oils

- Oils used in oil paints must be drying oils.
- Unlike water-based paints, oil based paints do not dry through the evaporation of water, but through **oxidative crosslinking.**
- This process involves a radical chain reaction initiated by the action of light on oxygen molcules.
- The oxygen radicals then react with double carbon-carbon bonds to form covalents crosslinks
- Therefore drying oils have carbon-carbon double bonds.



Identifying paints

When a painting is being restored different analytical techniques are used to identify the paints and pigments used:

- → Absorption/Transmission spectrum.
- → Atomic emission spectrum
- → glc
- → Nmr spectrum
- → Ir spectrum
- → Mass spectrum

Absorption and Transmission Spectra

- If you make a solution of the paint and measure the quantity of UV and visible light absorbed by it using a spectrometer you can obtain an absorption spectrum (radiation is also passes through a sample solution of the solvent so the two spectra are compared to exclude absorptions caused by the solvent).
- The absorptions of specific frequencies can be compared with known spectra of paint to find out which it is.
- Reflectance spectrum is used when a solution of the paint cannot be made (e.g. when it is on the surface of a painting) and it measures the specific frequencies reflected.

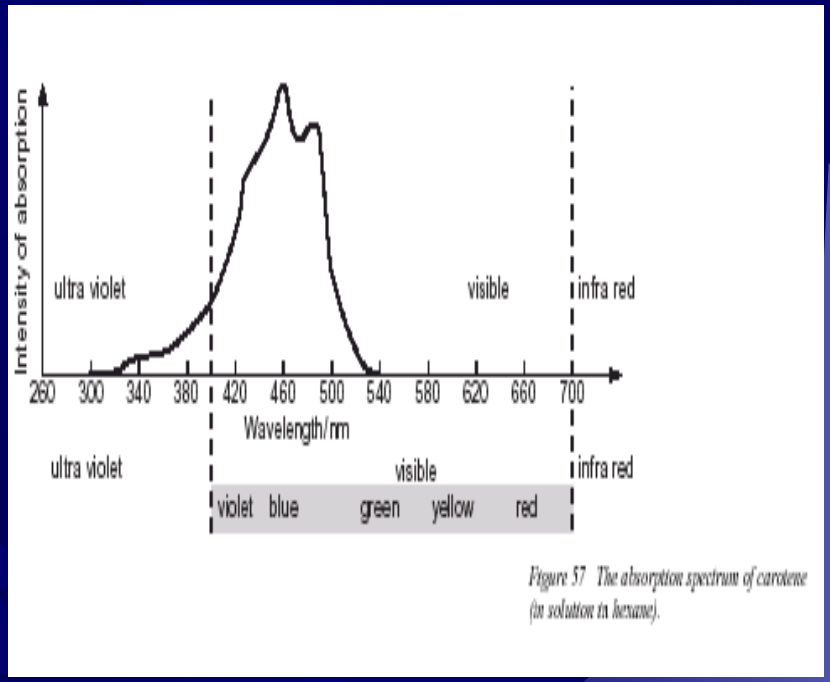
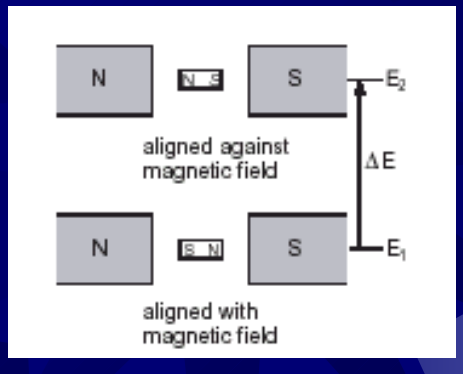
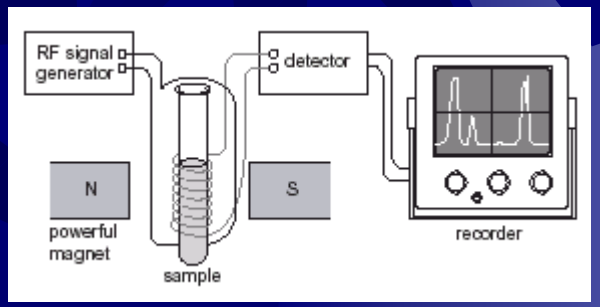


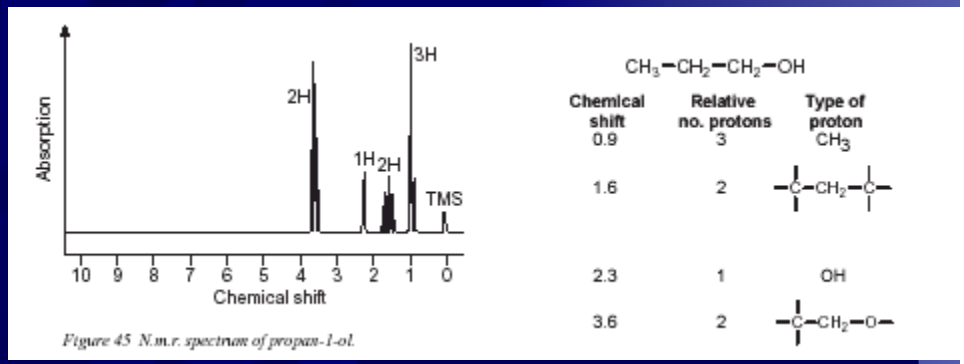
Figure 57 The absorption spectrum of carotene (in solution in hexane).

nmr

- Nmr allow us to distinguish between different types of protons as protons behave differently in different environments.
- H nuclei behave like tiny magnets and when they are placed in a strong magnetic fields some align themselves with the field and others against. Those aligned against have a higher energy level. In nmr spectrum radiation is fired at the sample so H atoms move from lower energy levels to higher energy levels and fall back down. The frequencies emitted are then measured to give a nmr spectrum.

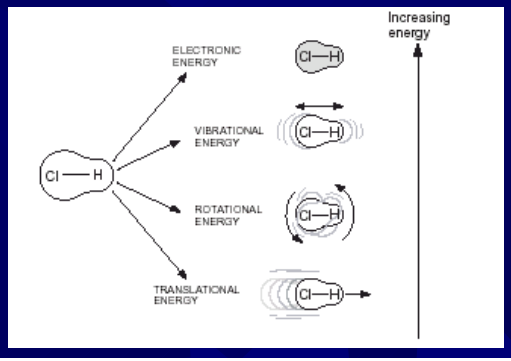






Ir spectrum

- When particles absorb ir radiation changes occur in their vibrational energy levels so their bonds stretch and bend. Different bonds have different bond enthalpies so they absorb specific ir frequencies.
- In ir spectrum one beam of ir radiation passes through a sample solution and another through a reference cell containing the solution (eliminating absorptions caused by the solution).
- A NaCl prism (transparent to ir radiation) is rotated so that different single frequencies can be measured by the detector to produce a ir spectrum.
- This can be used to identify the presence of bonds.



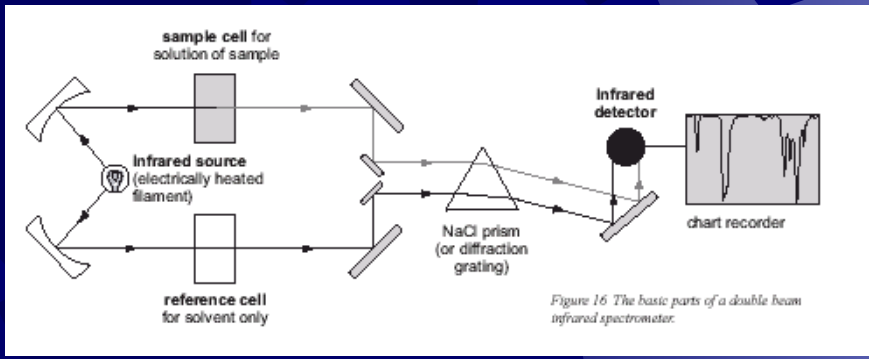
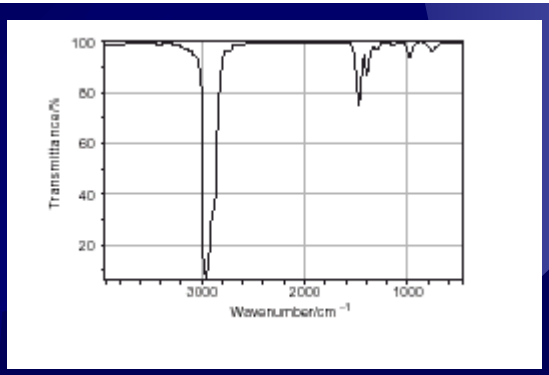


Figure 16 The basic parts of a double beam infrared spectrometer.



Mass spectrum

- A mass spectrometer can be used to investigate the structure of molecules.
- The heaviest ion (molecular ion) corresponds to the whole molecule.
- However, fragmentation of the molecule occurs so that ions of different masses reach the detector.
- Using the masses of the fragments we can identify functional groups in the molecule so we can elucidate its structure(e.g. 17=OH).