h is a constant known as Planck's constant which has a value of 6.62×10^{-34} Js. Electromagnetic radiation is categorised in terms of its wavelength and frequency and this is expressed in the form of a chart called the electromagnetic spectrum. Spectra for plural. When radiation is separated in its component wavelengths, e.g. by using a prism or a diffraction grating, the analysed results are displayed as a spectrum. Emission spectra are produced when radiation emitted from a source is analysed. Absorption spectra are produced when radiations from a source are passed through an adsorbing medium and then analysed, it is often found that certain wavelengths have been absorbed by the medium and do not appear in the spectrum. These missing wavelengths give important information in chemical structure determination, as the energy of the radiation is directly linked to the energy level differences of atoms and molecules.

The dual nature of electromagnetic radiation

Wave behaviour

Refraction – when a narrow band of white light is passed through a prism onto a screen, the light is refracted as it passes through the prism which splits it into the separate components of the wave and a continuous spectrum of colours.

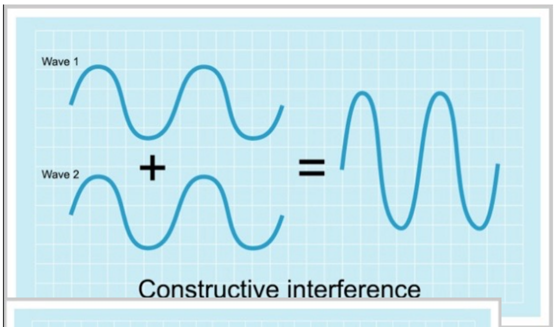
The visible spectrum forms a small narrow band between infra red and UV regions of the electromagnetic spectrum.

Red light has the lowest frequency, largest wavelength, and violet light has the highest frequency and the shortest wavelength.

In a traffic signal the frequency changes from 5.7×10^{14} Hz to 5.2×10^{14} Hz and then to 4.3×10^{14} Hz as it changes green to yellow to red.

Light waves can interfere with each other

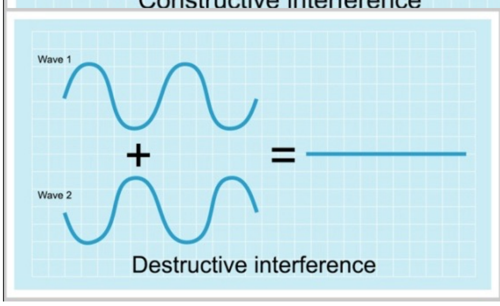
Constructive interference is when two crests meet



Double the amplitude, but the same wavelength, giving the result of a higher intensity and a brighter light.

The can also have a destructive interference, where a crest of one meets a trough of the other.

Waves cancel each other out with each other producing darkness and shadows.



Particle Behaviour

The photoelectric effect

When radiation of a particular frequency is incident on certain metal surfaces free electrons are released from metal atoms e.g. solar cells. This behaviour is

Molar conductivity:

Solutions which can carry current are referred to as electrolyte or electrolytic solutions. The conductivity of an electrolytic solution increases with increasing ion concentration due to the presence of more current carrying species.

The conductance of an ion in solution is related to the size, change and viscocity of the solvent.

Generally for ions of similar size and concentration, conductance is greater with ions of higher charge.

Mobility of an ion tends to increase with decreasing size and lower viscocity of the solvent. Conductivity is often expressed in terms of the molar conductivity Λ,

$$\text{Where } \Lambda = \frac{X}{C}$$

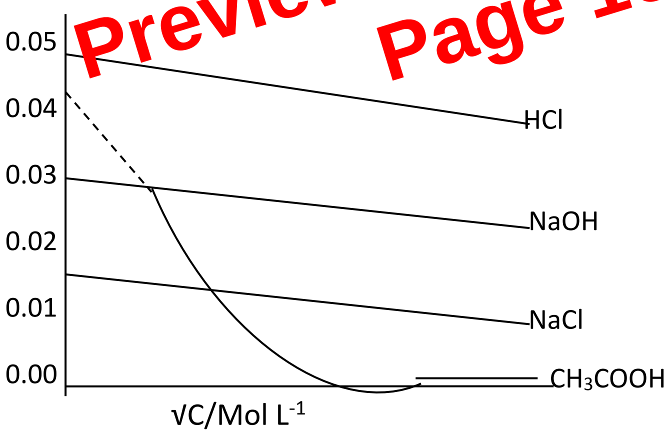
Where if C is the concentration in mol m^{-3}, X is in SM^{-1} seimens

Λ has units of SM^{-2} mol^{-1}

Studies have been shown that the relationship between molar conductance and concentration follows 2 distinct types of behaviour. For strong electrolytes, a plot of Λ ư √C is linear.

For weak electrolytes, Λ is small in dilute solutions, but at very low concentration, it rises rapidly.

$\Lambda/SM^2\ Mol^{-1}$



The equation of the straight line takes the term:

$\Lambda^{y} = \Lambda^{c}_{o} - K\sqrt{C}^{\,MX}$ (M = gradient of the line)

For strong electrolytes, K can be found from the gradient of the line and Λ_o, the molar conductivity at infinite dilution, (the limiting molar conductivity) can be found by extrapolating the line to the intercept.

For weak acids, Λ_o is found by calculation. Generally, the limiting molar conductivity is the sum of the contributions from the anions and cations.

This can be expressed as:

$\Lambda_o = \lambda + + \lambda -$
Where λ+ and λ- are the limiting molar conductances of the positive and negative ions respectively.

E.g for HCl $\Lambda_o = \lambda H^+ + \lambda Cl^-$

$CuCL_2$ $\Lambda_o = \lambda Cu^{2+} + 2\lambda Cl^-$

Calculation:

Given Λ_o HCl = 0.04267 SM^2 Mol^{-1}
Λ_o NaCl = 0.01265 SM^2 Mol^{-1}
Λ_o CH_3 COONa = 0.00931 SM^2 Mol^{-1}

Calculate Λ_o CH_3 COOH

Solution:

1. Λ_o HCl = $\lambda H^+ + \lambda Cl^-$ = 0.04267 SM^2 Mol^{-1}
2. Λ_o NaCl = $\lambda Na^+ + \lambda Cl^-$ = 0.01265 SM^2 Mol^{-1}
3. Λ_o CH_3COOHN = $\lambda Na^+ + \lambda CH_3COO^-$ = 0.000931 SM^2 Mol^{-1}
4. Λ_o CH_3COOH = $\lambda H^+ + \lambda CH_3COO^-$ = ?
   1 + 3 – 2 = ?   ? = 0.03933
   Λ_o CH_3COOH = λHCl + Λ_o CH_3COONa - Λ_o NaCl

Lecture 10

Finding the concentration

Finding from pH

If pH = -log

Then – pH = log

10^{-pH} =

Type inverse log (– pH value)

Buffer Solutions

Adding a small amount of acid and base can significantly alter the pH of a solution. Most living organisms can only survive in a narrow pH range.

For humans this is:

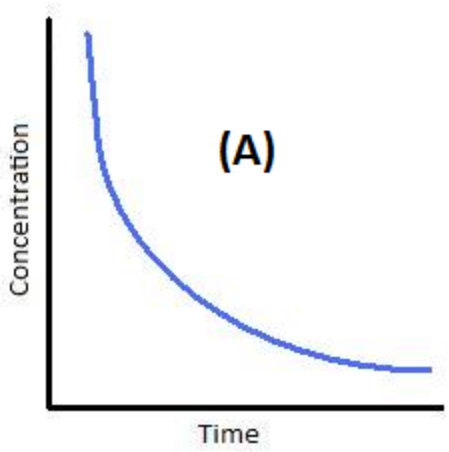
form of a concentration vs time graph. The gradient of the graph, determines the rate of the reaction. Generally the stronger the gradient, the faster the reaction, is occurring.

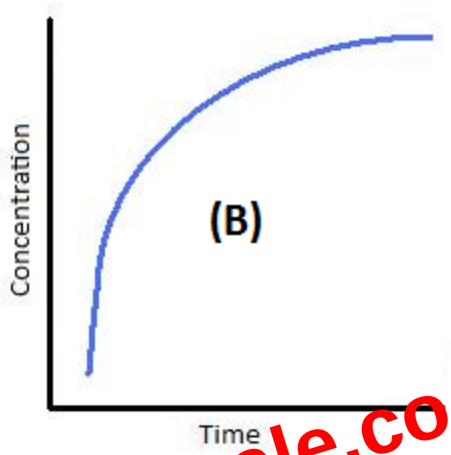
Consider the reaction

A → B

The rate of the reaction can be expressed as either

or





Consider the reaction

A → products

If rate is measured in terms of

then the rate law can be expressed as

If x = 1 the reaction is first order

So i.e rate α

Rearranging gives

Integrating between the limits

T = 0 to t = t gives

Ln = ln

Where is the initial concentration of