Q12 Explain the following laws: Dalton's, Boyles, Henry's, Graham's, Fick's Law of Diffusion (Sept 2013)

Dalton's Law → the partial pressure of a gas in a gas mixture is directly proportional to the pressure that gas would exert if it occupied the same volume at the same temperature alone.

Boyles Law → at a constant temperature, the volume of a given mass of gas varies inversely with the absolute pressure

Henry's Law → the concentration of a gas dissolved in a liquid (in mmol/L) is proportional to the partial pressure of that gas in equilibrium with the liquid (in mmHg)

Graham's Law → the rate of diffusion of a gas across a membrane is inversely proportional to the square root of its molecular weight

$$\text{Rate} \propto 1/\sqrt{MW}$$

Fick's law of diffusion → the rate of diffusion of a gas across a semipermeable membrane is proportional to the surface area of the membrane, the difference in partial pressure of the gas on either side of the membrane, and the diffusion constant, and inversely proportion to the thickness of the barrier

$$\text{Flow of gas} \propto \frac{\text{Area}}{\text{Thickness}} \times \text{Diffusion constant} \times (P_1 - P_2)$$

The diffusion constant is proportional to the solubility of the gas divided by the square root of the molecular weight (an application of Graham's law)

$$\text{Diffusion constant} \propto \text{Solubility}/\sqrt{MW}$$