



Properties of Gases
Chemistry – Leaving Cert
Quick Notes

Properties of Gases

The physical state of a substance is determined by the freedom of movement of its particles. In a solid, the particles vibrate about fixed positions, in a liquid the particles slide over each other and in a gas the particles have almost complete freedom of movement. Boyle's law states that at constant temperature, the volume of a fixed mass of gas is inversely proportional to its pressure. Charles' law states that at constant pressure the volume of a fixed mass of gas is directly proportional to its temperature measured on the Kelvin scale. To convert degree Celsius to Kelvin, add 273. Boyle's law and Charles' law may be merged to produce the Combined Gas law: $P_1 \text{ by } V_1 \text{ over } T_1 \text{ equals } P_2 \text{ by } V_2 \text{ over } T_2$. The value for standard temperature is 273 Kelvin and the value for standard pressure is 100 kilo Pascal. Gay-Lussac's law states that in a reaction between gases, the volumes of the reacting gases and the volumes of any gaseous products are in the ratio of small whole numbers, provided that the volumes are measured at the same temperature and pressure. Avogadro's law states that equal volumes of gases contain equal numbers of molecules under the same conditions of temperature and pressure. At s.t.p. (that is standard temperature and pressure), one mole of any gas has a volume of 22.4 litres. An ideal gas is one that obeys all the assumptions of the kinetic theory of gases under all conditions of temperature and pressure. There are five assumptions made in relation to the kinetic theory of gases: 1 – Gases consist of small particles in continuous motion, colliding with each other and with the side of the container. 2- There are no attractive or repulsive forces between the molecules of a gas. 3- The gas molecules are so small and widely separated that the actual volume of all the molecules is negligible with the space they occupy. 4- Collisions between the molecules of a gas are perfectly elastic. 5- The average kinetic energy of the molecules in a gas is proportional to the temperature measured on the Kelvin or absolute scale. In reality, there is no such gas as an ideal gas. However, gases become closest to ideal behaviour at low pressure and high temperature because under these conditions, the particles are well separated from each other. The ideal gas equation is $pV = nRT$. P stands for pressure in pascals, v stands for volume in m³, n stands for number of moles, R is the universal gas constant which is 8.31 J mol⁻¹K⁻¹ and T is temperature. To measure the relative molecular mass of a volatile liquid a dry conical flask is weighed, liquid is added and the flask is heated, the liquid is allowed to evaporate, the flask is reweighed and the flask is filled to the brim with water, the water is poured into a graduated cylinder to find the volume of the flask and the pressure

is read from the barometer. Alternatively, the relative molecular mass of a volatile liquid can be determined using a gas syringe.