20   Gases

20.1   The Experimental Gas Laws

The **pressure** of a gas is the force per unit area that the gas exerts normally on a surface.

The unit of pressure is the **pascal**, $1\text{Pa} = 1\text{N m}^{-2}$.

The pressure of gas depends on

- Its **temperature**.
- The **volume** of the gas container.
- The **mass** of gas in the container.

Boyle's Law

Boyle's law states that for a **fixed mass** of gas at **constant temperature**.

$$pV = \text{constant}$$

For a constant temperature, the measurements plotted on a graph of **pressure against** $\dfrac{1}{\textbf{volume}}$ is a straight line through the origin.

Any change at constant temperature is called an **isothermal change**.

Charles' Law

For a **fixed mass** of gas at **constant pressure**. Charles' law states the relation between volume and temperature in kelvins can be written as

$$\frac{V}{T} = \text{constant}$$

For a constant pressure, the measurements plotted on a graph of **volume against temperature** is a straight line through the origin - no matter how much gas is used, the volume of an ideal gas is zero at **absolute zero**.

Any change at constant pressure is called an **isobaric change**.

- When work is done to change the volume of gas, energy must be **transferred by heating** to keep the pressure constant.

$$\text{Work done} = p\Delta V$$

The Pressure Law

For a **fixed mass** of gas at **constant volume**, the pressure law states the relation between pressure and temperature can be written as

$$\frac{p}{T} = \text{constant}$$