

Ideal gases

Cambridge International AS & A Level Physics

Unlike IGCSE, 9702 gives you a data sheet: it is page 2 of Papers 1, 2 and 4, with more formulae on page 3 of Paper 4. Everything marked GIVEN is printed for you; everything else you must recall. Compiled by GioPhysics from the published syllabus. This is an independent study aid, not a Cambridge document; the official syllabus is the authority.

15.2 Equation of state

A LEVEL Ideal gas equation, by moles

$$pV = nRT$$

- p — pressure (Pa)
- V — volume (m³)
- n — amount of substance (mol)
- R — molar gas constant (J K⁻¹ mol⁻¹)
- T — thermodynamic temperature (K)

A LEVEL Ideal gas equation, by molecules

$$pV = NkT$$

- N — number of molecules
- k — Boltzmann constant (J K⁻¹)

A LEVEL Boltzmann constant

$$k = R / N_A$$

- k — Boltzmann constant (J K⁻¹)
- R — molar gas constant (J K⁻¹ mol⁻¹)
- N_A — Avogadro constant (mol⁻¹)

15.3 Kinetic theory of gases

A LEVEL Pressure of an ideal gas

$$p = \frac{1}{3} (Nm/V) \langle c^2 \rangle$$

- N — number of molecules
- m — mass of one molecule (kg)
- V — volume (m³)
- $\langle c^2 \rangle$ — mean-square speed (m² s⁻²)

A LEVEL Average translational kinetic energy of a molecule

$$\frac{1}{2}m\langle c^2 \rangle = (3/2)kT$$

- k — Boltzmann constant (J K⁻¹)
- T — thermodynamic temperature (K)

Deduced by comparing $pV = \frac{1}{3}Nm\langle c^2 \rangle$ with $pV = NkT$.