Chemistry 20

Unit B: Gases and the gas laws

Calculations with the ideal gas law

Four measurements, one equation

- A sealed sample has a pressure, a volume, a temperature, and an amount of gas, and any three determine the fourth.
- The link among those four is the ideal gas law, once the temperature is in kelvin and the units match R.

PV = nRT and molar volumes

- Rearrange PV = nRT to isolate the measurement the problem asks for.
- At STP one mole occupies 22.4 L, and at SATP one mole occupies 24.8 L.

Key terms

ideal gas law

The equation PV = nRT connecting pressure, volume, amount of gas, and kelvin temperature. (PV = nRT)

molar volume

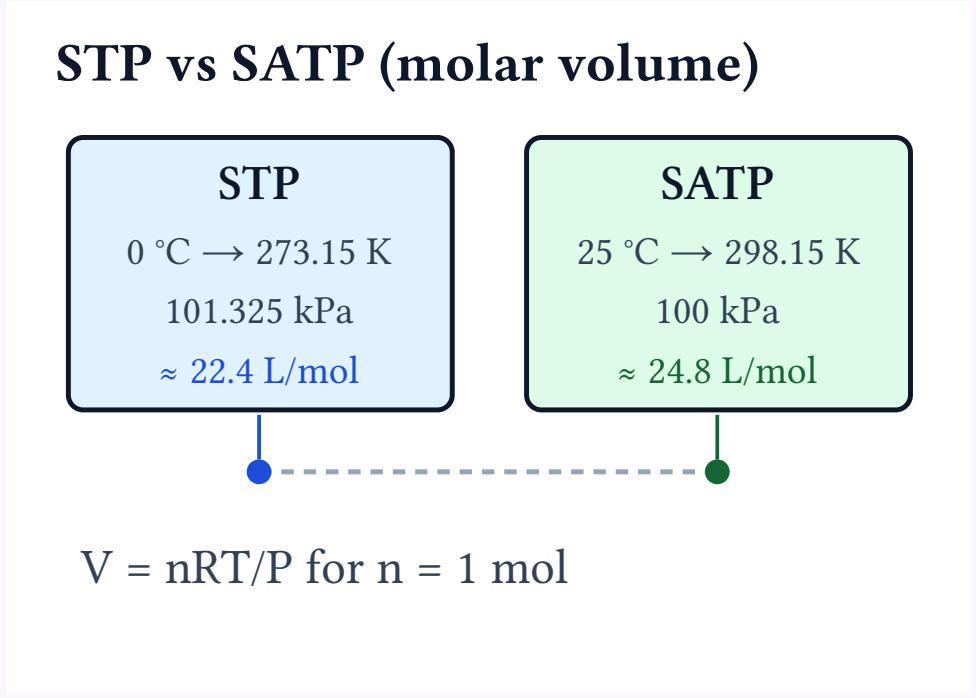
The volume of one mole of gas at a stated temperature and pressure, 22.4 $L \cdot mol^{-1}$ at STP and 24.8 $L \cdot mol^{-1}$ at SATP. ($L \cdot mol^{-1}$)

gas constant

The constant R in PV = nRT, equal to 8.314 when pressure is in kilopascals, volume in litres, amount in moles, and temperature in kelvin. (R)

Where 22.4 and 24.8 come from

- STP is 0 °C, which is 273.15 K, and 101.325 kPa.
- SATP is 25 °C, which is 298.15 K, and 100 kPa.



Pressure of 0.250 mol in 5.00 L

- The sample is 0.250 mol in 5.00 L at 298.15 K.
- Pressure is nRT/V, and the result rounds to 124 kPa.

Amount in 11.2 L at STP

- STP supplies the molar volume 22.4 $L \cdot mol^{-1}$.
- The same amount should appear from PV/RT within ordinary rounding.

SATP volume and the right conditions

- Find the volume of 0.200 mol at SATP using 24.8 L·mol^{-1}.
- Say what volume you would wrongly get if you used 22.4 L·mol^{-1} instead.