Chemistry 20

Unit B: Gases and the gas laws

The gas laws

Syringe compression and heating

- Pushing a sealed syringe in at one temperature makes the trapped air push back harder.
- Warming that same air while the plunger is free to move makes the volume grow instead.

Three equations, each with a fixed quantity

- Boyle’s law is P1V1 = P2V2 when temperature and amount stay constant.
- Charles’s law is $V_1/T_1 = V_2/T_2$ in kelvin, and the combined law is $P1V1/T_1 = P2V2/T_2$.

Key terms

Boyle's law

At constant temperature and amount of gas, the product of pressure and volume stays the same. (P1V1 = P2V2)

Charles's law

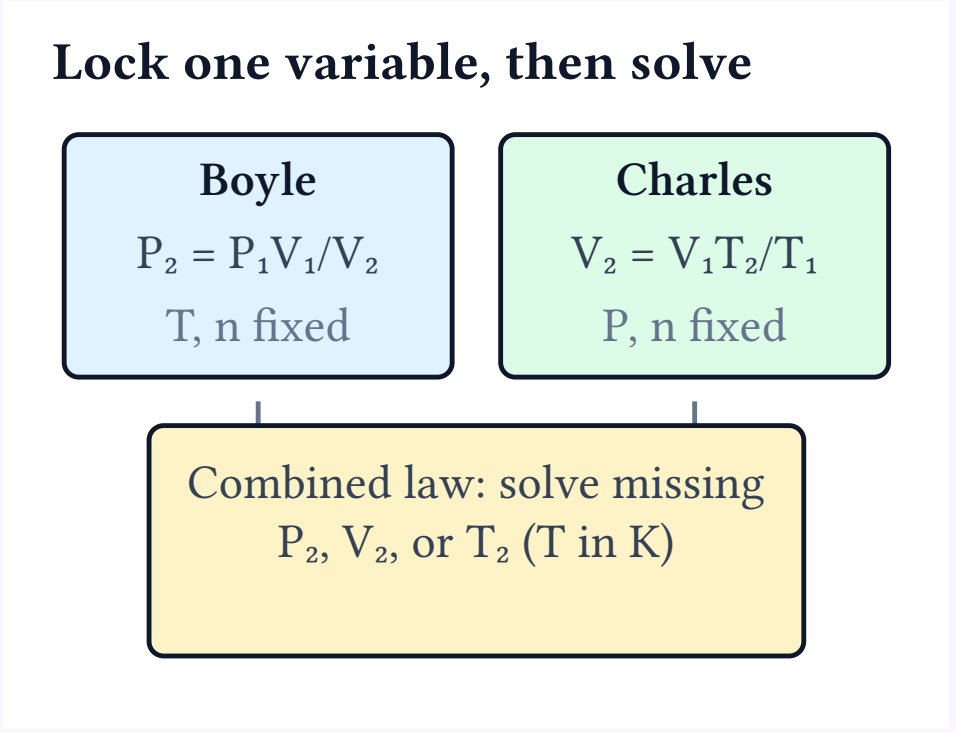
At constant pressure and amount of gas, volume divided by kelvin temperature stays the same. ($V_1/T_1 = V_2/T_2$)

combined gas law

For a fixed amount of gas, $P1V1/T_1$ equals $P2V2/T_2$ when pressure and temperature both change. ($P1V1/T_1 = P2V2/T_2$)

Lock one variable, then solve

- Boyle's law solves $P_2 = P1V1/V_2$, and Charles's law solves $V_2 = V1T2/T_1$.
- The combined law solves whichever of P_2, V_2, or T_2 is missing, with T in kelvin.



Compress 2.40 L at 100 kPa to 0.800 L

- Temperature and amount stay constant, so Boyle’s law applies.
- The new pressure is the original pressure scaled by 2.40/0.800.

Heat 1.50 L from 300 K to 450 K

- Pressure and amount stay constant, so Charles’s law applies.
- Both temperatures are already kelvin, so no 273.15 shift is still waiting.

Pressure and temperature both change

- A fixed amount of gas starts at 100 kPa, 3.00 L, and 300 K.
- Find the volume at 200 kPa and 400 K with the combined law.