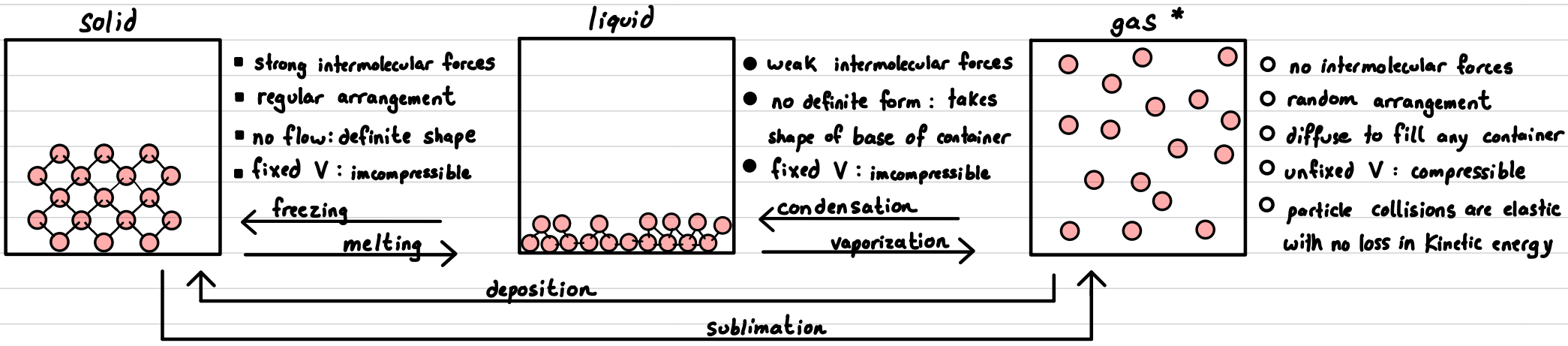
Ideal Gases

Matter exists in different **phases** depending on the amount of kinetic energy (temperature) particles have

Particle model of matter: describes how particles (can be individual atoms, molecules, compounds) move and interact in different phases

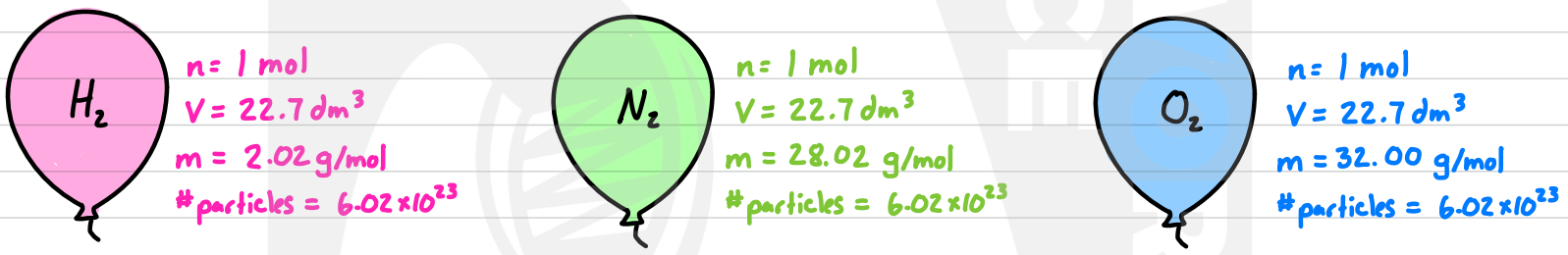


* these properties are true for 'ideal' gases but this is not true for all gases

Avogadro's Law: under Standard Temperature and Pressure (STP) equal volumes of different gases contain equal number of particles.

- 273 K or 0°C
- 100 kPa or 1 atm

} 1 mol of gas occupies **22.7 dm^3**



$$n_{gas} = \frac{V}{V_m}$$

n_{gas}: amount of ideal gas (mol); V: Volume of gas (dm^3 or L); V_m: gas molar volume ($22.7\ dm^3 mol^{-1}$)

Example problems

(i) ~ Calculate volume of gas ~

Calculate the volume occupied by 16.00 g of O_2 at STP.

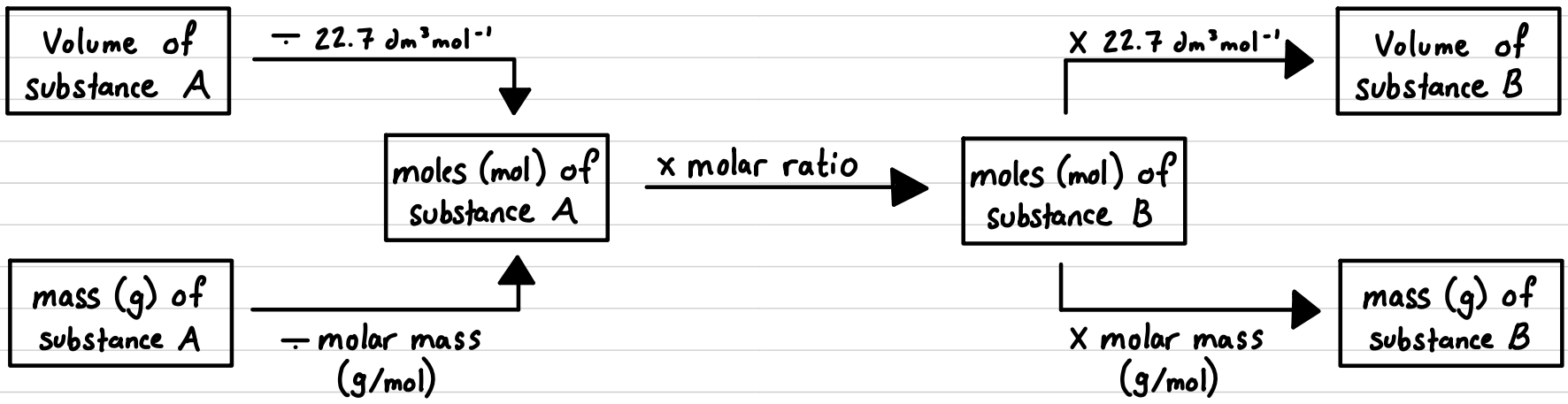
(ii) ~ Calculate mass of gas ~

Calculate the amount of grams of 5.43×10^4 mL of CH_4 at STP.

(iii) ~ Calculate number of atoms of gas ~

A sample of Cl_2 gas at STP occupies 17.1 L. Calculate the mass of Cl_2 and number of Cl atoms present in sample.

Gas Stoichiometry



Example problems

(i) ~ Calculate volume of product from known mass of limiting reactant ~
3.54g of magnesium is reacted with excess hydrochloric acid. Calculate volume of hydrogen gas produced at STP.

(ii) ~ Calculate volume of product from known volume of reactants ~
$5dm^3$ of carbon monoxide and $2dm^3$ of oxygen gas react at STP.
What is the maximum volume of CO_2 that can be produced? What volume of excess reactant that remains?

(iii) ~ Calculate volume of reactant from known mass of product ~
What volume in cm^3 of oxygen gas is required in the complete combustion of C_3H_8 if 5.0g of water is produced?