$3\,Mg(OH)_2 + 2\,H_3PO_4 \rightarrow 6\,H_2O + Mg_3(PO_4)_2$

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atomic mass unit (u) = $\frac{1}{12}$ mass of a ^{12}C atom

1 mole of amus = 1 g

If the average mass of one atom of carbon is 12.011 u, the average mass of one mole of carbon is 12.011 g.

$4\,NH_3(g) + 3\,O_2(g) \rightarrow 2\,N_2(g) + 6\,H_2O(g)$

Given 20.0 g of ammonia, how much oxygen (in grams) would be necessary to completely react with NH_3?

molar mass NH_3 = 1 x N + 3 x H = 14.01 + 3 x (1.01) = 17.04 g

$$\frac{20.0\text{ g } NH_3}{1} \times \frac{1\text{ mol } NH_3}{17.04\text{ g } NH_3} \times \frac{3\text{ mol } O_2}{4\text{ mol } NH_3} \times \frac{32.00\text{ g } O_2}{1\text{ mol } O_2} = 28.17\text{ g } O_2$$

mass → mole mole → mole mole → mass

molar mass O_2 = 2 x O = 2 x 16.00 = 32.00 g

Solution – a homogeneous mixture (usually refers to a liquid)

solvent – the major component of a homogeneous mixture

solute – the minor component of a homogeneous mixture

dissolve – to form a homogeneous mixture

soluble – able to form a homogeneous mixture

concentration – the ratio of solute to solvent

$$\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$

mass % of sugar in a solution of sugar in water

$$= \frac{\text{mass sugar}}{\text{mass sugar + mass water}} \times 100\%$$

Parts per million (ppm)

$$\text{ppm} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 1{,}000{,}000$$

$$\text{\% volume} = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100\%$$

$$\text{Molarity} \equiv (M) \equiv \frac{\text{moles of solute } (n)}{\text{liters of solution}}$$

"molar"

$$M = \frac{n}{L} \hookrightarrow n = M \cdot L$$

Given a 0.25 M aqueous solution of $NaNO_3$,

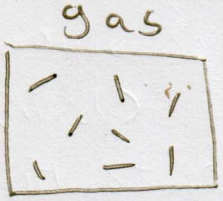
water is the solvent

how many moles of $NaNO_3$ are present in 4.0 L of solution?

$$n = M \cdot V = 0.25\,M \times 4.0\,L = 1.0 \text{ moles}$$

fixed volume
fixed shape
condensed
low motion
(normally)
geometric order

fixed volume
variable shape
condensed
moderate motion
no geometric order

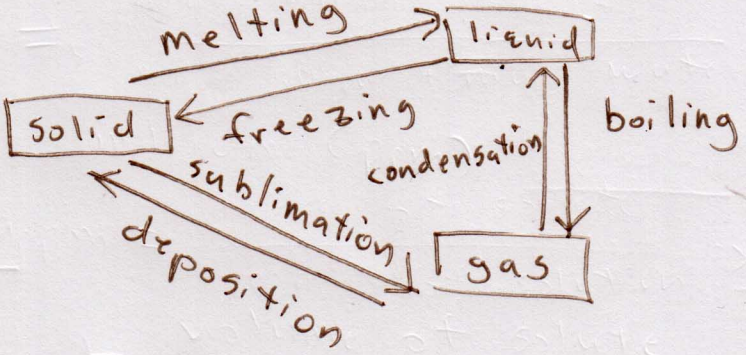


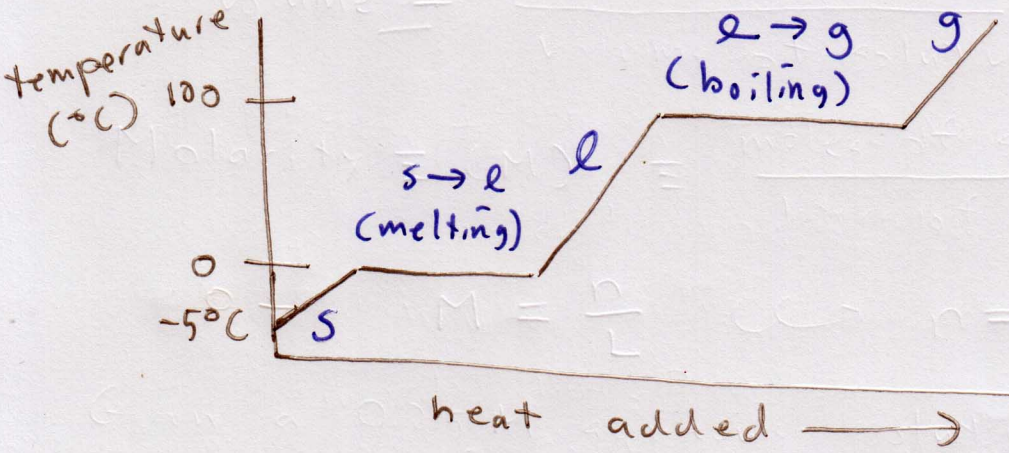
variable volume
variable shape
high motion
no geometric order

← phases of matter

crystalline – a solid that has some form of geometric order to the way atoms or molecules are arranged.

amorphous – "without shape" – a solid without internal geometric order — glass, sulfur





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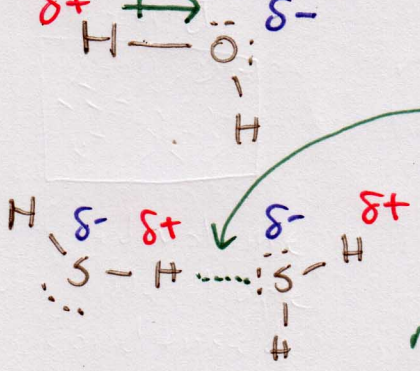
intramolecular forces – forces inside a molecule that hold a molecule together

→ ions attracting ions, bonds

intermolecular forces – forces between molecules

dipole-dipole interaction

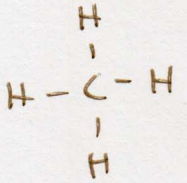
dipole – charge separation across space



Two molecules of H_2S can be attracted to each other due to the fact that a portion of each molecule is positively charged and negatively charged.

→ dipole-dipole force

methane	water	ethane
CH_4	H_2O	CH_3-CH_3
16 g/mol	18 g/mol	30 g/mol
gas at room temp. (RT)	liquid @ RT	gas @ RT

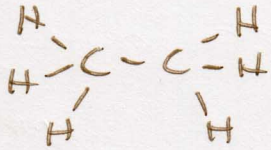


tetrahedral

non-polar

bent

polar



Methane has no permanent dipole because its structure is symmetric, therefore, it has very little intermolecular forces (IMF), so it doesn't take much energy to pull molecules of methane apart, Water has a strong permanent dipole because its structure is not symmetric. Therefore, it has high IMF so it takes a lot of energy to pull molecules of water apart.