11:31 AM

CHM 101 ADESINA...

SUNNYWISE

Other types of forces holding solids together:

ionic: "charged ions stuck together by their charges"

(a) CsCl (b) ZnS (c) CaF_2

There are no individual molecules here.

1:00:40

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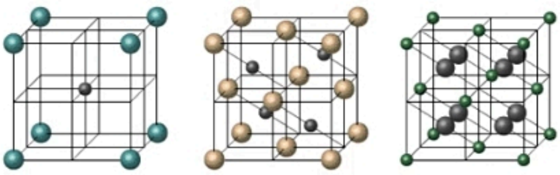

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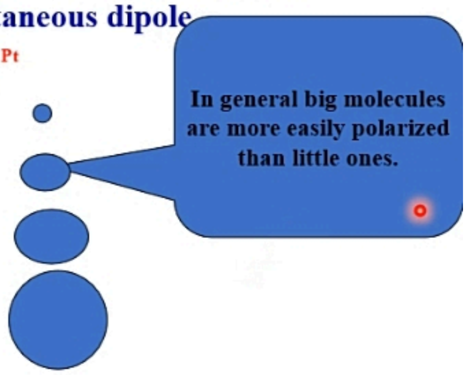
polarizability: the ease with which an atom or molecule can be distorted to have an instantaneous dipole

Halogen	Boiling Pt (K)	Noble Gas	Boiling Pt (K)
F_2	85.1	He	4.6
Cl_2	238.6	Ne	27.3
Br_2	332.0	Ar	87.5
I_2	457.6	Kr	120.9



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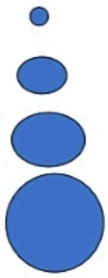

Types of intermolecular forces (between neutral molecules):

London dispersion forces: (instantaneous dipole moment)
(also referred to as van der Waal's forces)

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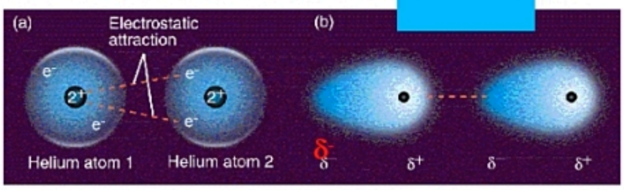
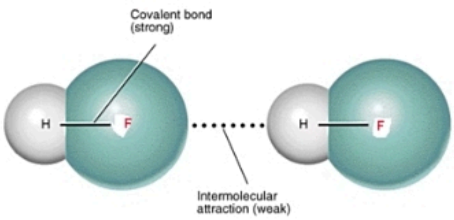


Types of intermolecular forces (between neutral molecules):

Hydrogen bonding: cases of very strong dipole-dipole interaction (bonds involving H-F, H-O, and H-N are most important cases).

$^{\delta+}$H-F$^{\delta-}$ --- $^{\delta+}$H-F$^{\delta-}$



Hydrogen bonding is a weak to moderate attractive force that exists between a hydrogen atom covalently bonded to a very small and highly electronegative atom and a lone pair of electrons on another small, electronegative atom (F, O, or N).

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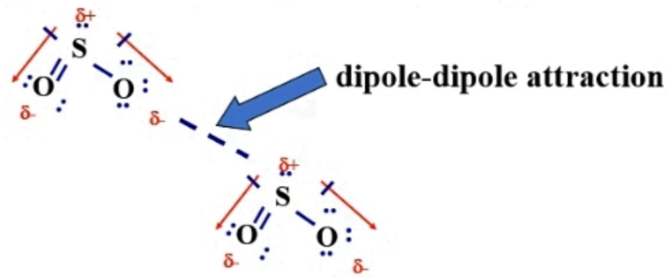

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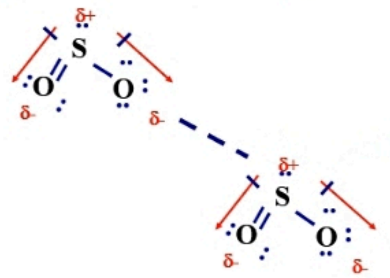
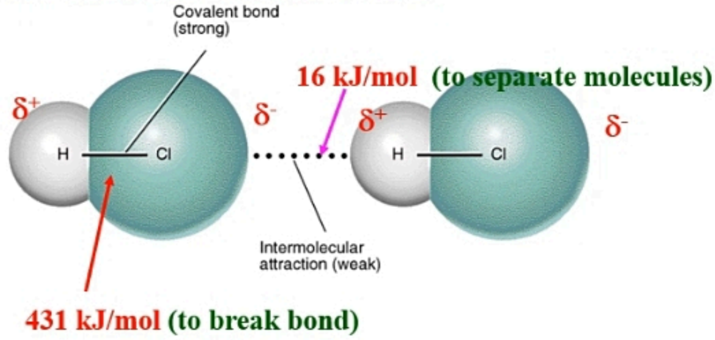


SUNNYWISE

The strengths of intermolecular forces are generally weaker than either ionic or covalent bonds.



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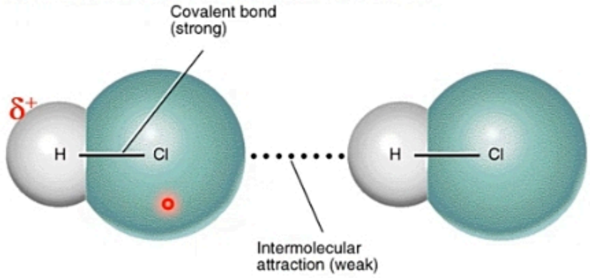
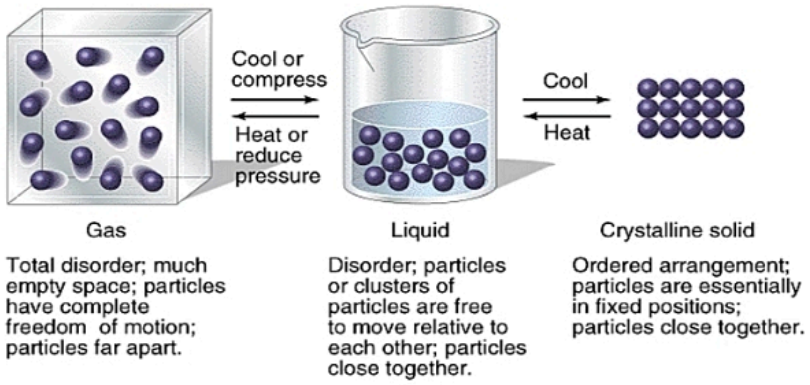


Gases: The average kinetic energy of the gas molecules is much larger than the average energy of the attractions between them.

Liquids: the intermolecular attractive forces are strong enough to hold the molecules close together, but without much order.

Solids: the intermolecular attractive forces are strong enough to lock molecules in place (high order).


Cool or
compress
Heat or
reduce
pressure
Cool
Heat
Gas
Total disorder; much empty space; particles have complete freedom of motion; particles far apart.
Liquid
Disorder; particles or clusters of particles are free to move relative to each other; particles close together.
Crystalline solid
Ordered arrangement; particles are essentially in fixed positions; particles close together.

SUNNYWISE

Write a complete balanced equation, including states, for this reaction.

How many moles of hydrogen form when 4 moles of methane react completely?

How many moles of water va[illegible]eact to yield 174.82 moles of hydrogen?

Try these

1. A solution was made by dissolving 8.20 g of sodium phosphate in water and then diluting the mixture with water to achieve a total volume of 100.0 [illegible] What is the solution's molarity? (Ans = 0.50 M)

2. How many millilitres of 2.00 M sodium hydroxide are necessary to neutralize 25.00 mL of 1.50 M phosphoric acid? (Ans = 56.3 mL)

$$\text{Percent Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100\% = \frac{5.393\text{ g}}{x} \times 100\%$$

- We need to calculate the theoretical yield we would get if the 2-methyl-1-propanol, which is the limiting reactant, were converted completely to 1-br[illegible]mo-2-me[illegible]pane. (C[illegible] 12, H = 1, O = 16, Br = 80)

$$x = \frac{(3 \times 137\text{ g } C_4H_9Br)}{(3 \times 74\text{ g } C_4H_9OH)} \times 6.034\text{ g } C_4H_9OH = 11.17\text{ g } C_4H_9Br$$

$$\text{Percent Yield} = \frac{5.393\text{ g}}{11.17\text{ g}} \times 100\% = 48.28\%\text{ yield}$$

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Example

Phosphorus tribromide, PBr_3, can be used to add bromine atoms to alcohol molecules such as 2-methyl-1-propanol. In a student experiment, 5.393 g of 1-bromo-2-methylpropane form when an excess of PBr_3 reacts with 6.034 [illegible] methyl-1-propanol. What is the percent yield?

- Write a balanced equation of reaction

$$\underset{\text{2-methyl-1-propanol}}{3CH_3CH(CH_3)CH_2OH} + PBr_3 \longrightarrow \underset{\text{1-bromo-2-methylpropane}}{3CH_3CH(CH_3)CH_2Br} + H_3PO_3$$

Theoretical Yield, Actual Yield and Percent Yield

- The theoretical yield is the amount of product possible from stoichiometry.
- The actual yield is the amount one actually produces and measures.
- The percent yield is a comparison of the amount actually obtained to the amount it was possible to make.

$$\text{Percent Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100\%$$

11:22 AM

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If all of the 0.012 mol of bicarbonate were to be used up, there would need to be 0.012/3 or (0.004) mol of citric acid. There is 0.0052 mol of citric acid (which is not the smallest amount), so sodium bicarbonate is the limiting reactant.

Sodium bicarbonate which is the limiting reactant is used to calculate the amount of products in the reaction.

No of moles of CO_2 = 3 (0.004) mol = 0.012 mol

Amount of CO_2 produced = 0.012 × 44 g/mol = 0.53 g

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$3NaHCO_3(aq) + H_3C_6H_5O_7(aq) \rightarrow 3CO_2(g) + 3H_2O(l) + Na_3C_6H_5O_7(aq)$

gram	1.0 g	1.0 g	
MW	84 g/mol	192 g/mol	44 g/mol
mol	1.0/84	1.0/192	
	0.012 mol	0.0052 mol	

Limiting Reactants

- The limiting reactant is the reactant present in the smallest stoichiometric amount

If 1.0 g of sodium b[illegible]rbonat[illegible] [illegible].0 g cit[illegible] acid are reacted to make carbon dioxide, sodium [illegible], and wa[illegible]er, which is limiting? How much carbon dioxide is produced?

- When magnesium metal is ignited in oxygen, the white oxide MgO(s) is formed. What mass of magnesium reacts completely to give 1.000g of MgO(s)? (Mg = 24, O = 16)

Start by writing a balanced equation of reaction

$$2Mg + O_2 \rightarrow 2MgO$$

(2 × 24)g of Mg gives 2(24 + 16)g of MgO

48 g of Mg gives 80 g of MgO

X g of Mg will give 1.0 g of MgO

X = 1 × 48/80 = 0.6 g of Mg

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Stoichiometric Calculations

10 g of glucose ($C_6H_{12}O_6$) react in a combustion reaction. How many grams of each product are produced?

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$$

	10 g		?	?
MW	180 g/mol		44 g/mol	18 g/mol
mol	10 g/(180 g/mol)			
	0.055 mol		6(0.055) mol	6(0.055) mol
grams			6(0.055)×44	6(0.055)×18
			15 g	5.9 g