

# Chemistry Chapters 12-15 Study Guide

## Equations (provided on test)

### Comparing Rates of Diffusion

$$\frac{\text{Rate A}}{\text{Rate B}} = \text{square root of } \frac{\text{molar mass B}}{\text{molar mass A}}$$

### Dalton's Law of Partial Pressures

$$P_{\text{total}} = P_1 + P_2 + P_3 \dots$$

### Boyle's Law

$$P_1 V_1 = P_2 V_2$$

(for a given amount of gas held at constant temperature)

### Charles's Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

(for a given amount of gas at constant pressure)

(T is in Kelvin)

### Gay-Lussac's Law

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

(for a given amount of gas at constant volume)

(T is in Kelvin)

### Combined Gas Law

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

(for a given amount of gas)

(T is in Kelvin)

Avogadro's Principle: 1 mol of any gas occupies 22.4 L

### Ideal Gas Law

$$PV = nRT$$

(Temperature in Kelvin)

### Values of R

Units	Numerical Value
L-atm/mol-K	0.08206
J/mol-K*	8.314

Concentration Description	Ratio
Percent by mass	Mass of solute/mass of solution x 100
Percent by volume	Volume of solute/volume of solution x 100
Molarity	Moles of solute/liter of solution
Molality	Moles of solute/kilogram of solvent
Mole fraction	Moles of solute/(moles of solute + moles of solvent)

### Dilution Equation

$$M_1 V_1 = M_2 V_2$$

(where M is molarity, and V is volume)

### Henry's Law

$$\frac{S_1}{P_1} = \frac{S_2}{P_2}$$

(where S is solubility and P is pressure)

### Equation for Calculating Heat

$$q = c \times m \times \text{change in } T$$

(q is heat absorbed or released, c is specific heat of the substance, m is mass of sample)

change in T is change in temp

$$(T_{\text{final}} - T_{\text{initial}})$$

### Enthalpy (heat) of reaction

$$H_{\text{rxn}} = H_{\text{final}} - H_{\text{initial}}$$

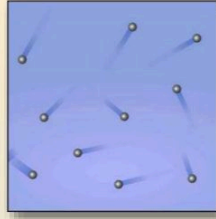
#### Measuring heat

- Metric system: calorie (cal)
  - Heat required to raise the temperature of 1 gram of pure water 1°C
- Food Calories differ from heat calories
  - 1 Calorie = 1000 cal
- SI unit: joule (J)
  - 1 J = 0.2390 cal
  - 1 cal = 4.184 J

# Concepts

## Kinetic Molecular Theory

- Particles of matter are **ALWAYS** in motion
- Volume of individual particles is  $\approx$  zero.
- Collisions of particles with container walls cause the pressure exerted by gas.
- Particles exert no forces on each other.
- Average kinetic energy is proportional to Kelvin temperature of a gas.



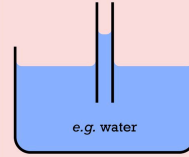
## capillary action

occurs due to interaction between

**adhesion** and **cohesion**

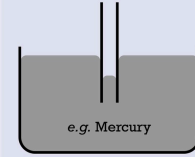


**capillary attraction**






**adhesion** > cohesion

**capillary repulsion**



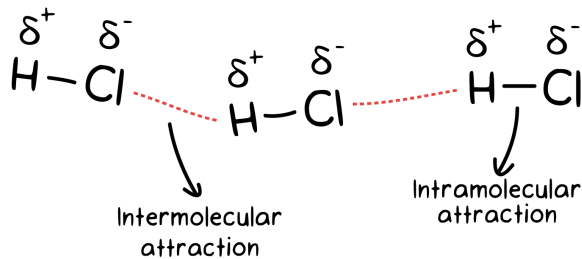
**adhesion** < **cohesion**

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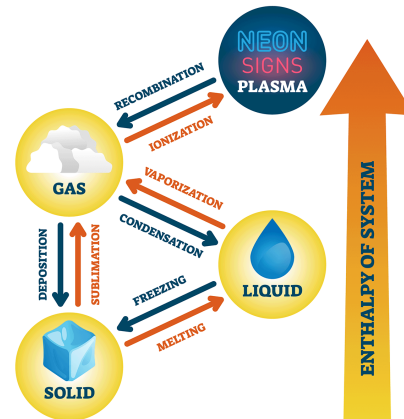
PROPERTIES	SOLID	LIQUID	GAS
Mass	Definite	Definite	Definite
Shape	Definite	Acquires the shape of the container	Acquires the shape of the container
Volume	Definite	Definite	Indefinite
Compressibility	Not Possible	Almost Negligible	Highly Negligible
Fluidity	Not Possible	Can flow	Can flow
Rigidity	Highly Rigid	Less Rigid	Not Rigid
Diffusion	Slow	Fast	Very Fast
Space between particles	Most Closely packed 	Less Closely packed 	Least Closely packed 
Interparticle force	Definite	Slightly weaker than in solid	Negligible

Type of Force	Applied to	Strength
Dispersion Forces	All molecules	0.1 – 5 kJ/mol
Dipolar Forces	Polar molecules	5 – 20 kJ/mol
Hydrogen Bonding	Polar molecules with N – H, O – H or F – H bond	5 – 50 kJ/mol

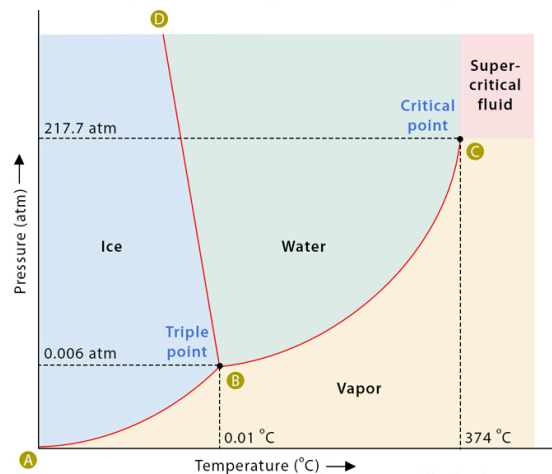
Table 2.6 Summary of the Three Major Intermolecular Forces



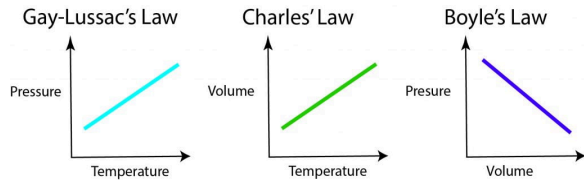
## PHASE CHANGES



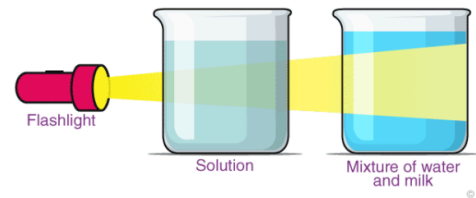
## Phase Diagram of Water



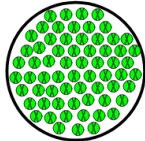
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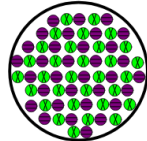
**TYNDALL EFFECT**



**Pure Substances**

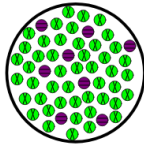


Element

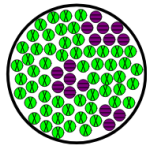


Compound

**Mixtures**

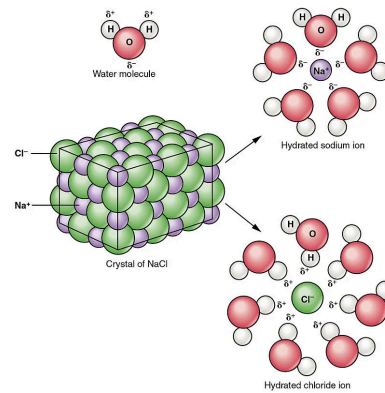


Homogeneous



Heterogeneous

**“Like dissolves like”**



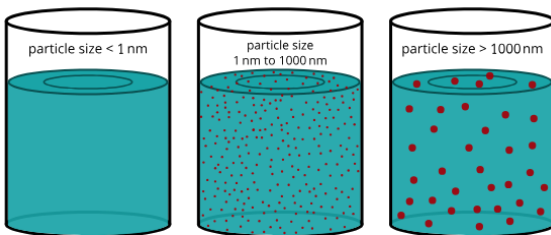
**Factors that affect Solvation**

Agitation

Surface Area

Temperature

Solubility of gas **DECREASES** as temperature **INCREASES**

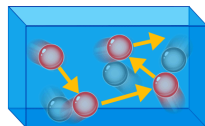


Solution

Colloid

Suspension

The random movement of particles in a colloid caused by collisions between the particles



**Brownian motion**

**Colligative Properties**

Colligative properties are characteristics of a solution that depend on the ratio of the number of solute particle to solvent particles.

Freezing Point Depression



Boiling Point Elevation



Osmotic Pressure



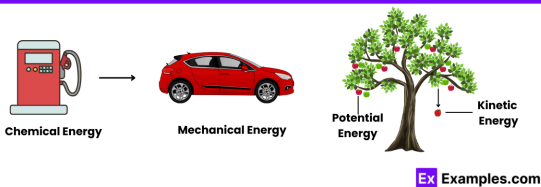
Vapor Pressure Lowering



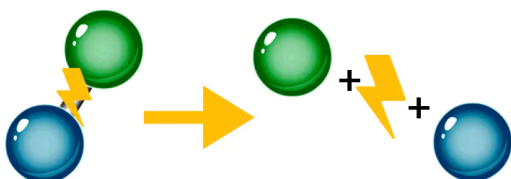
## Law of Conservation of Energy

### Definition:

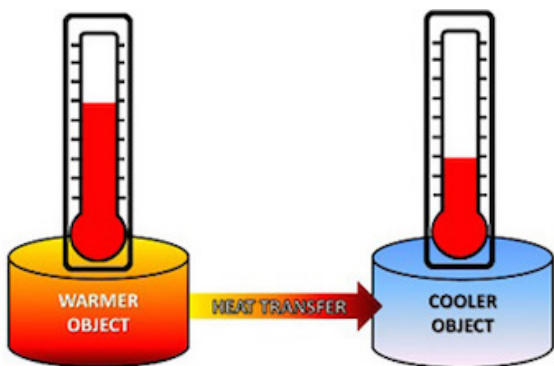
The Law of Conservation of Energy states that energy cannot be created or destroyed in an isolated system; it can only be transformed from one form to another.



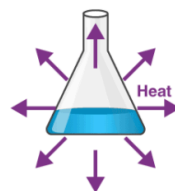
The energy stored in the chemical bonds of a substance



## chemical potential energy



The specific heat of any substance is the amount of heat required to raise the temperature of one gram of that substance by one degree Celsius.



### Exothermic Reactions

A reaction that releases energy from the system in the form of heat.

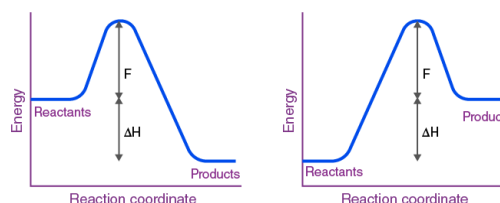


### Endothermic Reaction

A reaction that the system absorbs energy from its surrounding in the form of heat.

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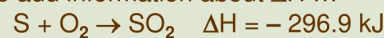
## WHAT IS ENTHALPY ?



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## Thermochemical equations

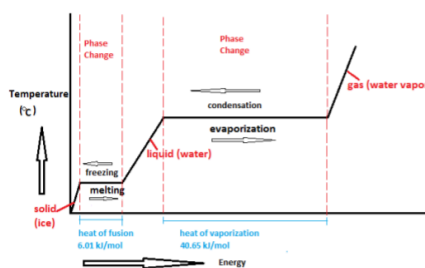
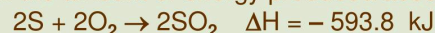
- A typical chemical equation is  $S + O_2 \rightarrow SO_2$
- It is called a "thermochemical equation" when we add information about  $\Delta H$  ...



- If we change the equation, then the  $\Delta H$  also changes ...



- If the reaction is reversed the sign is reversed
- Also, if numbers in the equation change, so will the amount of energy produced/absorbed:



Molar heat of vaporization: heat required to vaporize one mole of a liquid (- heat of condensation)

Molar heat of fusion: heat required to melt one mole of a solid substance (- heat of solid)