AlAYEN IRAQI UNIVERSITY
Health and Medical Technologies
Anesthesia Department

Physical Chemistry
General Chemistry
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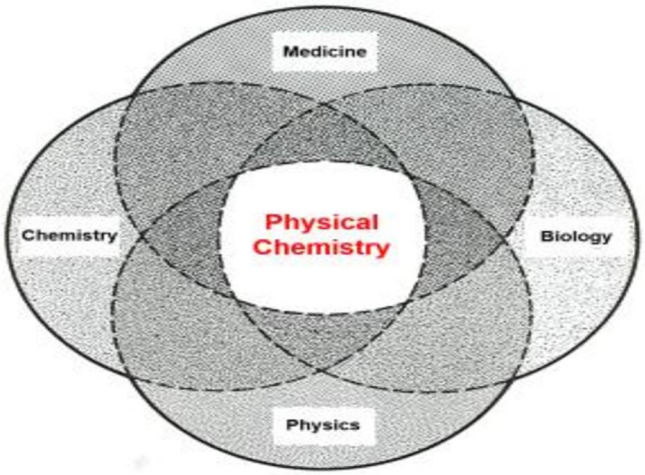
Physical Chemistry

Is the branch of chemistry concerned with the way in which the physical properties of substances depend on and influence their chemical structure, properties, and reactions.



Physical chemistry is quantitative chemistry.
It is active at the overlap of physics, biology, medicine and chemistry. It is one of the traditional sub-disciplines of chemistry and is concerned with the application of the concepts and theories of physics to the analysis of the chemical properties and the reactive behaviour of matter.

❖ The International System of Units (SI)

Commonly known as the metric system, is the international standard for measurement. The International Treaty of the Meter was signed in Paris on May 20, 1875 by seventeen countries, including the United States and is now celebrated around the globe as World Metrology Day.

The seven SI base units, which are comprised of:

Length - meter (m)
Time - second (s)
Amount of substance - mole (mole)
Electric current - ampere (A)
Temperature - kelvin (K)
Luminous intensity - candela (cd)
Mass - kilogram (kg)

SI Base Units			
Base quantity		**Base unit**	
Name	**Typical symbol**	**Name**	**Symbol**
time	t	second	s
length	l, x, r, etc.	meter	m
mass	m	kilogram	kg
electric current	I, i	ampere	A
thermodynamic temperature	T	kelvin	K
amount of substance	n	mole	mol
luminous intensity	I_v	candela	cd

Source: NIST Special Publication 330:2019, Table 2.

Describing a Gas

*Gases are composed of tiny particles

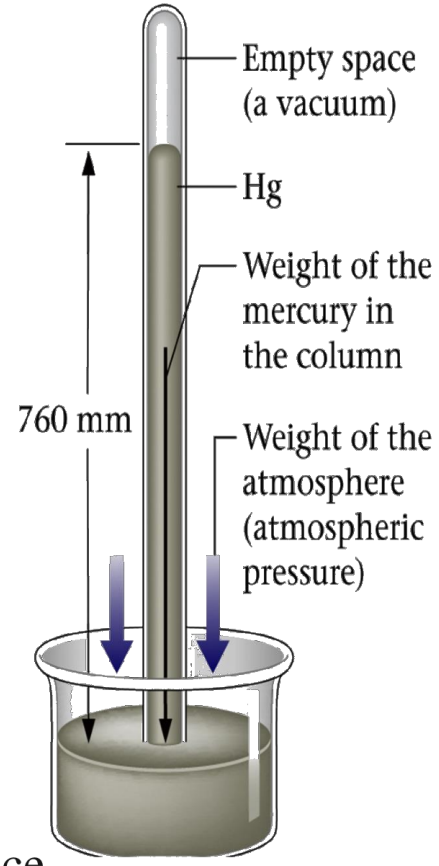
*The particles are small compared to the average space between them
-Assume the molecules do not have volume
*Molecules constantly and rapidly moving in a straight line until they bump into each other or the wall

-Average kinetic energy proportional to the temperature Results in gas pressure

-Assumed that the gas molecules attraction for each other is negligible

Properties of Gases

* **Expand to completely fill their container**
* **Take the Shape of their container**
* **Low Density**
* **much less than solid or liquid state**
* **Compressible**
* **Mixtures of gases are always homogeneous**
* **Fluid**



Pressure = total force applied to a certain area
larger force = larger pressure
smaller area = larger pressure

Gas pressure caused by gas molecules colliding with container or surface
More forceful collisions or more frequent collisions mean higher gas pressure

Units of Gas Pressure

* atmosphere (atm)
* height of a column of mercury (mm Hg, in Hg)
* torr
* Pascal (Pa)
* pounds per square inch (psi, lbs./in^2)
* 1.000 atm = 760.0 mm Hg = 29.92 in Hg = 760.0 torr = 101,325 Pa = 101.325 kPa = 14.69 psi

Pressure and Temperature

As the temperature of a gas increases, the average speed of the molecules increases

the molecules hit the sides of the container with more force (on average)

the molecules hit the sides of the container more frequently

the net result is an ***increase in pressure***

Volume and Temperature

In a rigid container, raising the temperature increases the pressure

For a cylinder with a piston, the pressure outside and inside stay the same

To keep the pressure from rising, the piston moves out increasing the volume of the cylinder

as **volume increases, pressure decreases**

Absolute Zero

Theoretical ***temperature*** at which a gas would have zero volume and no pressure
calculated by extrapolation
0 K = -273.15 °C
Kelvin T = Celsius T + 273.15
Never attainable
though we've gotten real close!
All gas law problems use Kelvin temperature scale!

Boyle's Law

* Pressure is inversely proportional to Volume
 -constant T and amount of gas
 -graph P vs V is curve
 -graph P vs 1/V is straight line
* as P increases, V decreases by the same factor

P x V = constant

$P_1 \times V_1 = P_2 \times V_2$

Ex:- What is the new volume if a 1.5 L sample of freon-12 at 56 torr is compressed to 150 torr?

°Plug in the known values and calculate the unknown

°P_1 = 56 torr P_2 = 150 torr

°V_1 = 1.5 L. V_2 = ? L

$$\frac{P_1}{P_2} \times V_1 = V_2$$

$$\frac{56 \text{ torr}}{150 \text{ torr}} \times 1.5 \text{ L} = 0.56 \text{ L}$$

Charles' Law

Volume is directly proportional to Temperature

-constant P and amount of gas

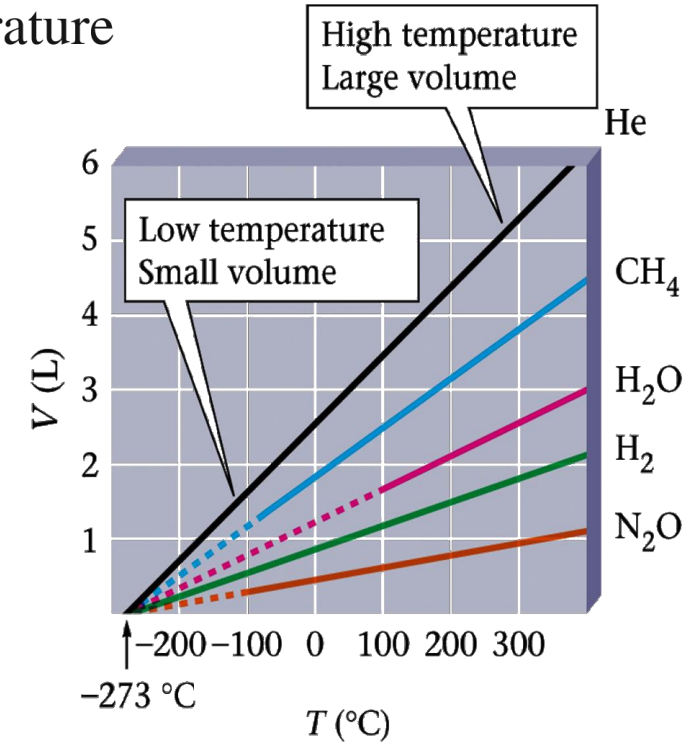
-graph of V vs T is straight line

as **T increases, V also increases**

V = constant x T

if T measured in kelvin

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



Ideal Gas Law

By combing the proportionality constants from the gas laws we can write a general equation
R is called the **gas constant**
The value of **R** depends on the units of P and V
Generally use R = 0.08206 when P in atm and V in L
Use the ideal gas law when have gas at one condition
Most gases obey this law when pressure is low (at or below 1 atm) and temperature is high (above 0°C)
If a gas changes some conditions, the unchanging conditions drop out of the equation

$$PV = nRT$$

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

Homework

Q1 :-What is the new volume of the gas when it is compressed from a pressure(P) =40 torr and volume (V) = 4 L at temperature(T) = 35 °C into new pressure (p)=90 torr at a temperature (t)=60 °C?

Q2 :- Calculate the number of moles of hydrogen present in (2000 mL) of gas at a pressure of (70 atm) and a temperature of (30 °C) ?

THANK YOU!

؟؟ ANY QUESTIONS

PLEASE ASK