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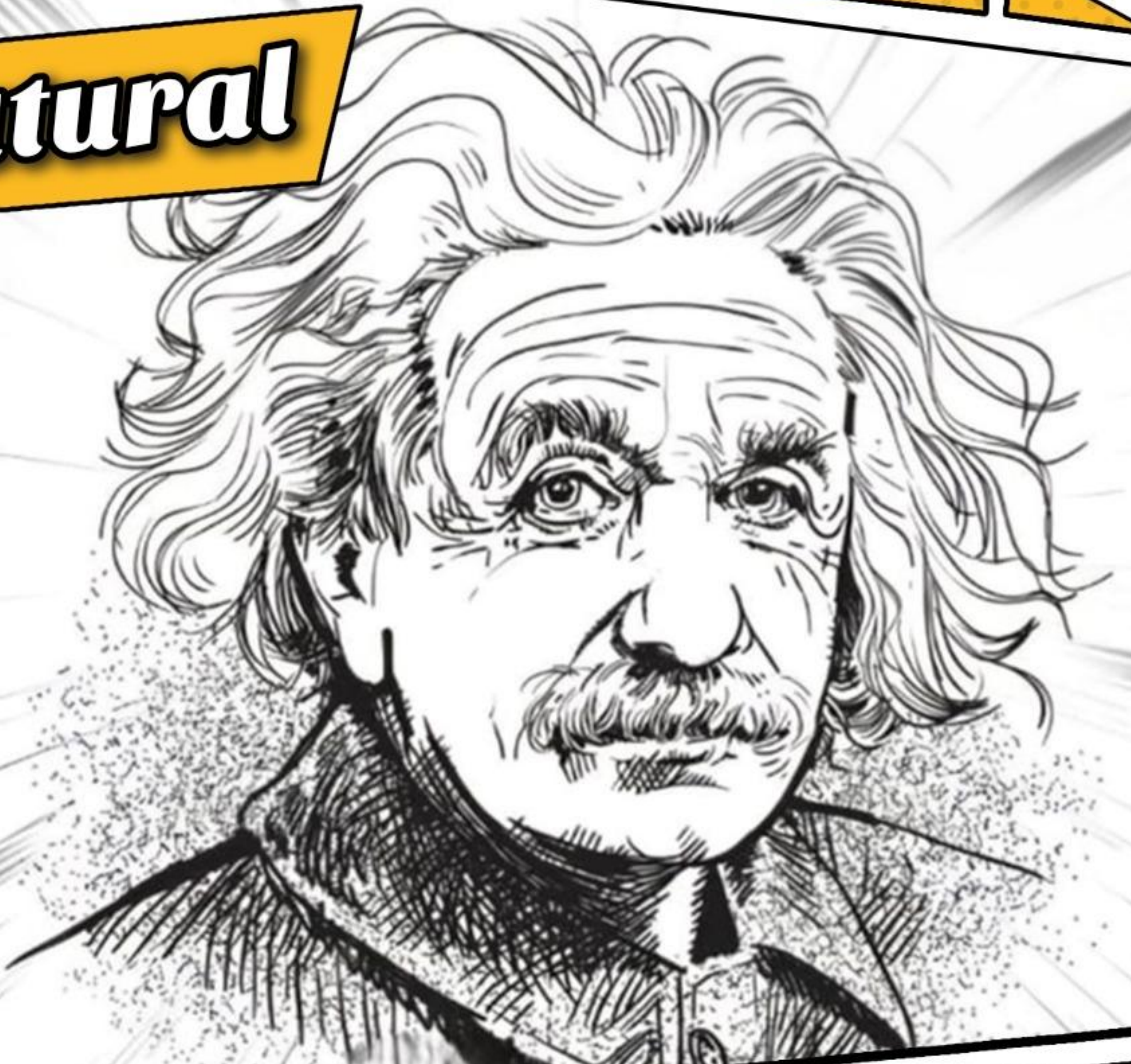
Natural



Heat (Kinetic Theory of gas)

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Kinetic theory of gases

The basic assumptions of the kinetic theory of ideal

① The total mass of the particles be $m\ N$, If M is the mass in grams molecule, They are identical.

$$n = \frac{m}{M} N$$

② here is not a strong force from attraction or repulsion between the gas molecules but there is a collision between each other molecules, and between the particles and the wall of the vessel containing the gas.

③ The collisions between the molecules are full flexibility elastic collisions.

④ no preferred direction to the speed of any part and thus at any given moment there are many molecules moving in the direction as in the other.

⑤ The speed of the particles covers the range from zero to the speed of light.

⑥ The average kinetic energy of the molecule is directly proportional to the degree of absolute temperature of the gas.

Ideal gas

properties of the ideal gas

1) the particle is very small
2) any particle is solid and flexible
3) the collision is full flexible
4) the ideal and gas is subject to the general law of gases

Properties of natural gas are governed by three variables

1) gas pressure.
2) volume occupied by the gas.
3) gas temperature.

Boyles Law

☞ Boyle, a law states that "at constant temperature, the size of a certain amount of gas inversely proportional with the pressure to this size."

☞ This means that

$$P \propto \frac{1}{V}$$

$$\boldsymbol{P_1V_1 = P_2V_2 = const.}$$

Example

A gas occupies a volume of 4.0 liters at a pressure of 2.0 atm. If the pressure on the gas is increased to 5.0 atm, what will the new volume of the gas be, assuming the temperature remains constant?

Answer

$$P_1 V_1 = P_2 V_2$$

P_1 = initial pressure = 2.0 atm

V_1 = initial volume = 4.0 liters

P_2 = final pressure = 5.0 atm

V_2 = final volume = ?

$$(2.0\ atm) * (4.0\ L) = (5.0\ atm) * V_2$$

Solving for V_2:

$$V_2 = \frac{(2.0 * 4.0)}{5.0} = 1.6\ liters$$

Charles Law

☞ It states that "At const pressure the volume of this quantity of gas direct proportion to the degree of absolute gas temperature" This means that:

$$V \propto T$$

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

$$\boldsymbol{\frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V_3}{T_3} = const}$$

Example

A gas occupies a volume of 3.0 liters at a temperature of 300 K. If the temperature is increased to 450 K, what will be the new volume of the gas, assuming the pressure remains constant?

Answer

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

V_1 = initial volume = 3.0 liters

T_1 = initial temperature = 300 K

V_2 = final volume = ?

T_2 = final temperature = 450 K

Substitute the values into the formula:

$$\frac{3.0}{300} = \frac{V_2}{450}$$

$$V2 = \frac{(3.0 * 450)}{300} = 4.5\ liters$$

Gay-Lussac law

- ☞ It states that "when there is evidence the size of a certain amount of pressure
- ☞ the ideal gas this quantity proportional directly proportional to the degree of absolute gas temperature" This means that:

$$P \propto T \quad , \qquad \frac{P}{T} = const.$$

$$\boldsymbol{\frac{P_1}{T_1} = \frac{P_2}{T_2} = \frac{P_3}{T_3} = const}$$

Example

A gas is held at a constant volume and has an initial pressure of 1.0 atm at a temperature of 273 K. If the temperature is increased to 546 K, what will be the new pressure of the gas?

Answer

$$\frac{1.0}{273} = \frac{P_2}{546}$$

Solving for P_2:

$$P_2 = \frac{1.0 \times 546}{273} = 2.0\ atm$$

General equation for gas

☞ We discussed above the gas laws that give the relationship between two variables is recognized when the third variable, but if there is a change in pressure, volume and temperature at the same time can be a gas equation in this case as follows:

❶ From Boyle's law

$$P \propto \frac{1}{V} \quad , \quad V \propto \frac{1}{P} \quad \rightarrow \quad \boxed{1}$$

❷ Charles Law

$$V \propto T \quad \rightarrow \quad \boxed{2}$$

From equations (1), (2)

$$V \propto T \quad \times \frac{1}{P}$$

$$V \propto \frac{T}{P} \quad ,$$

$$\therefore PV \propto T$$

$$PV = CT \quad \rightarrow \quad \boxed{3}$$

$$\boldsymbol{\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} = \frac{P_3 V_3}{T_3} = const.}$$

$$\boldsymbol{P\,V = n\,R\,T}$$

Where → R: universal gas const & n: Nummer of moles

Example

Gas holds size of $0.105\ m^3$ at a temperature of 20 ℃ and a pressure of $1.5\ Kg/Cm^2$ calculate degree final gas temperature when the pressure becomes equal to $7.5\ Kg/Cm^2$ and size of $0.04\ m^3$

Answer

$V_1 = 0.105\, m^3 \;\; , V_2 = 0.04\, m^3$

$P_1 = 1.5 \;\; Kg/Cm^2 \;\;\; , = 1.5 \; \times 10^4 \;\; Kg/m^2$

$P_2 = 7.5 \;\; Kg/Cm^2 = 7.5 \times 10^4 \;\; Kg/m^2$

$T_1 = 20 + 273 = 293\, K \;\;\; , \;\; T_2 = ??$

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

$$\frac{(1.5 \; \times 10^4)(0.105)}{293} = \frac{(7.5 \times 10^4)(0.04)}{T_2}$$

$$T_2 = 558\, K$$

Example

Gas at 333 K temperature and a pressure of 20 Kg/cm^2 operating size of $0.06\, m^3$ If this amount is stretched until he became its size $0.54\, m^3$ fined final pressure of the gas if the temperature after expansion is 30 C^0

Answer