Cheatography

# Gaseous State Cheat Sheet

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## Conversions

**Volume**

1 Litre= $10^3$ mL= $10^3$ $cm^3$= $10^{-3}$ $m^3$= 1 $dm^3$

**Pressure**

1 atm= 76 cm of Hg= 760 mm of Hg= 760 torr

1 atm= 1.01*$10^5$ $Nm^2$

1 atm= 1.01*$10^5$ Pa

1 bar= 0.9862 atm≈ 1 atm

mL= milli-litre

cm= centimeter

m= meter

dm= decimeter

atm= atmosphere

N= Newton

Pa= Pascals

## Boyle's Law

Boyle's Law $PV = K$ $P_1V_1 = P_2V_2$

If the temperature is constant, as pressure of a gas increases the volume decreases.

According to Boyle's law,

$V \propto P^{-1}$

or, PV = constant @particular temperature.

or, $P_1V_1=P_2V_2$

## Charles' Law

Charles's Law $\frac{V}{T} = K$ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

If the pressure is constant, as temperature of a gas increases the volume increases.

***Temperature must be in Kelvin for all gas laws***

According to Charles' Law,

$V \propto T$ @constant Pressure

therefore, $V_1/T_1 = V_2/T_2$

or, $V_1T_2 = V_2T_1$

## Gay-Lussac's Law

Gay-Lussac's Law $\frac{P}{T} = K$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

As the temperature of an enclosed gas increases, the pressure increases at constant volume.

According to Lussac's law,

$P \propto T$

or, $PT^{-1}$ = constant @constant volume

$P_1T_2 = P_2T_1$

## Ideal Gas Equation

PV=nRT

or, $PVT^{-1}$ = constant = nR

R= Universal Gas Constant

## Universal Gas Constant

[R] = Lit atm $K^{-1}$ $mol^{-1}$ = work done per Kelvin per mole

R= 0.0821 Lit atm $K^{-1}$ $mol^{-1}$

R= 8.314 J $K^{-1}$ $mol^{-1}$ = 8.314 Pa $cm^3$ $K^{-1}$ $mol^{-1}$

R= 1.987 cal $K^{-1}$ $mol^{-1}$

R= 5.189* $10^{19}$ eV $K^{-1}$ $mol^{-1}$

## Dalton's Law of Partial Pressure

According to Dalton's Law of Partial Pressure,

$P = P_1+P_2+P_3+.....+P_n = \Sigma P_n$

Where P is the total pressure and $P_1$, $P_2$, $P_3$... are the partial pressures of gases 1, 2, 3 and so on.

$P_1$= P*$x_1$

where $x_1$ is the mole fraction of gas 1.

## Graham's Law of Diffusion

$$r \propto \sqrt{\frac{1}{M}} \propto \sqrt{\frac{1}{d}}$$
$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{d_2}{d_1}} = \frac{n_1}{n_2}$$
$$\frac{r_1}{r_2} = \frac{P_1}{P_2}\sqrt{\frac{M_2}{M_1}}$$

r= rate of diffusion

M= molar mass of given gas

d= density of given gas

n= number of moles of given gas

## Velocity of Gas Particles

**Most Probable Velocity**
$$\alpha = \sqrt{\frac{2Rt}{M}} = \sqrt{\frac{2PV}{M}}$$
**Average Velocity**
$$v = \sqrt{\frac{8RT}{\Pi M}} = \sqrt{\frac{8RPV}{\Pi M}}$$
**Root Mean Square Velocity**
$$u = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3PV}{M}}$$

α:v:u = 1 : 1.128 : 1.224

## Kinetic Energy

$$PV = \frac{1}{3}mNu^2$$
$$PV = \frac{1}{3}Mu^2$$
**Molar Kinetic Energy**
$$K.E. = \frac{1}{2}Mu^2 = \frac{3}{2}PV = \frac{3}{2}RT$$
**Molecular Kinetic Energy**
$$K.E. = \frac{3RT}{2N_a} = \frac{3}{2}k_bT$$

k = Boltzmann Constant = 1.380649 × $10^{-23}$ joule per kelvin

## Van der waal's Equation

**Van der waal's Equation**
$$(P + \frac{an^2}{V^2})(V - nb) = nRT$$
**Dimensions of a & b**
$$[a] = atm * L^2 * mol^{-2} = N m^4 mol^{-2}$$
$$[b] = L * mol^{-1} = m^3 mol^{-1}$$

## Molecular Collision

**Critical Temperature**
$$t_c = \frac{8a}{27Rb}$$
**Critical Pressure**
$$P_c = \frac{a}{27b^2}$$
**Critical Volume**
$$V_c = 3b$$
**Relation between T, V & P**
$$\frac{PV_c}{RT_c} = \frac{3}{8}$$

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