ARJUNA NEET BATCH

States of Matter

LECTURE - 4

BY : DOLLY SHARMA

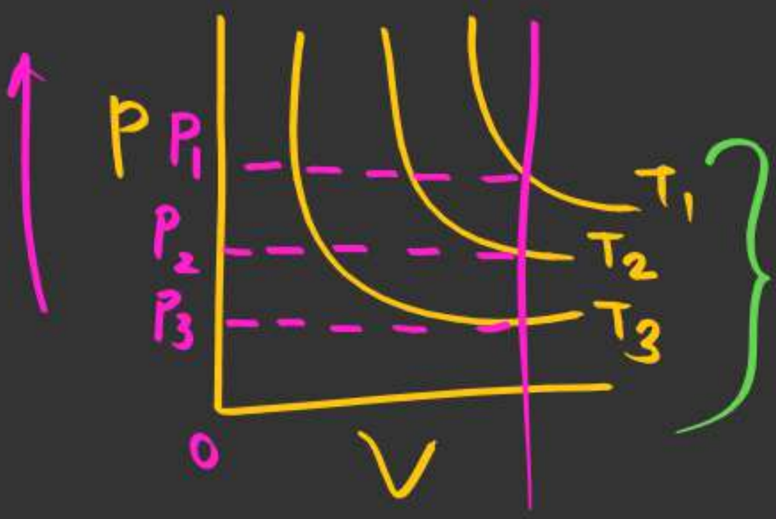
$\boxed{PV = nRT}$

Quick Recap

① Boyle's Law

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

$n, T = \text{Const}$

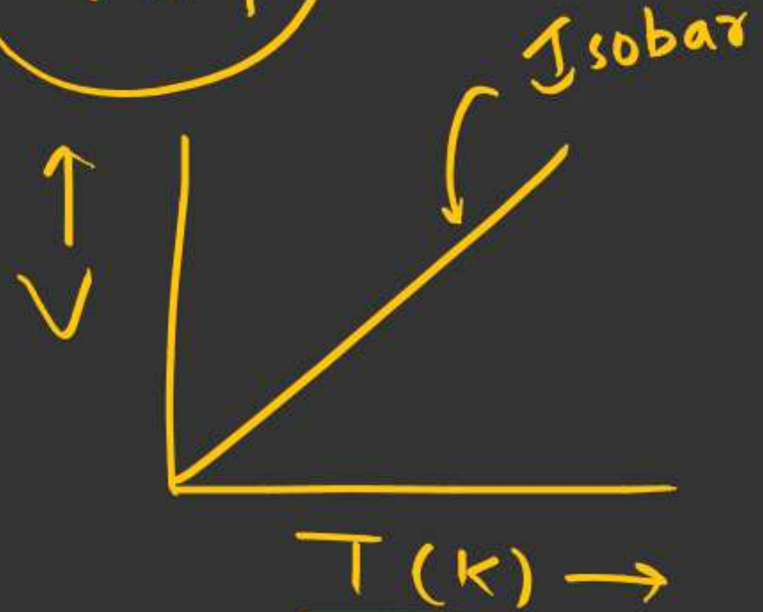


$P_1 > P_2 > P_3 \rightarrow \boxed{T_1 > T_2 > T_3}$

② Charle's Law

$V \propto T$

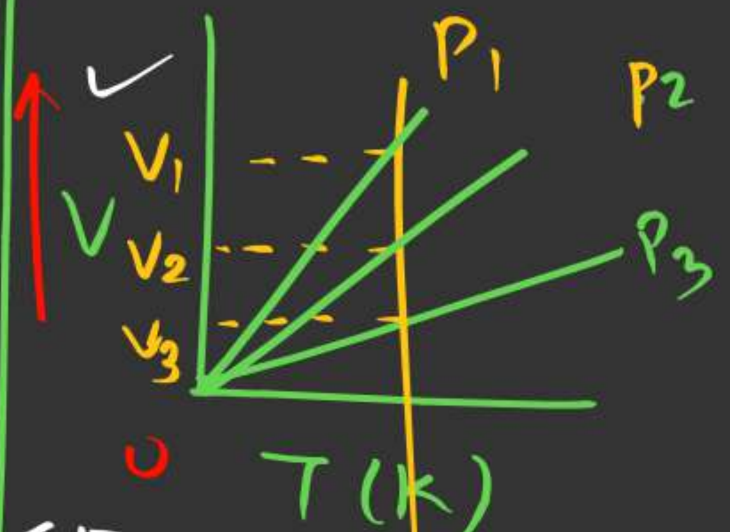
$P, n = \text{constant}$



Absolute Temp → 0K

$\boxed{-273^\circ C}$

?



$\boxed{V_1 > V_2 > V_3}$

$P_3 > P_2 > P_1$

$P_1 > P_2 > P_3$

$\boxed{P_3 > P_2 > P_1}$

CH-1

NCERT — Part-1 Q.1 → Q.20

Part-2 Q.21 → Q.36

Practice Test - 1 → 45 Question

2 Years

50

Galat

DPP

S → 1 Lecture Recording

↓

Topic

S-2 → Practice

S-3 → Silly Mistake

Objective of today's class

Gas Laws

Q. 5L of a gas is compressed from 2 atm to 5 atm. Find decrease in volume and % decrease in volume.

$V_1 = 5L$ $\quad P_1 = 2\ atm$ $\quad P_2 = 5\ atm$

$P_1V_1 = P_2V_2$

$2 \times \cancel{5} = \cancel{5} \times V_2$

$\boxed{V_2 = 2L}$

$\Rightarrow$ Decrease in Volume $= V_1 - V_2$

$= 5 - 2$

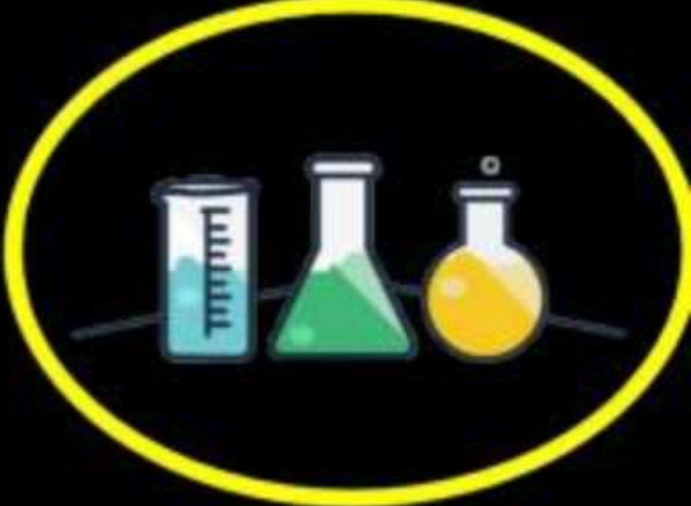
$\Rightarrow 3L$

% decrease in Volume $\Rightarrow$

$\Rightarrow \dfrac{\text{Change in Volume}}{\text{Initial Volume}} \times 100$

$\Rightarrow \dfrac{3}{5} \times 100$

$\Rightarrow 60\%$



Q. The pressure of gas A (P_A) is 3.0 atm when is occupies 5 L of the volume. Calculate the final pressure when it is compressed to 3L volume at constant temperature.

(a) 5 atm
(b) 2 atm
(c) 4 atm
(d) 3 atm

$P_1 = 3.0$ atm $\quad P_2 = ?$

$V_1 = 5.0$ L $\quad V_2 = 3$ L

$P_1V_1 = P_2V_2$

$\cancel{3} \times 5 = \cancel{3} \times P_2$

$\boxed{P_2 = 5 \text{ atm}}$

or

$$\boxed{\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}}$$

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Q. At what temperature 25 dm^3 of oxygen at 283 K is heated to make its volume 30 dm^3 ?

(a) 339.6 K (b) 448 K

(c) 298 K (d) 473 K

$T = ?$

$V_1 = 25\,dm^3$ $V_2 = 30\,dm^3$

$T_1 = 283\,K$ $T_2 = ?$

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

$$\frac{25}{283} = \frac{30}{T_2}$$

$$T_2 = \frac{\overset{6}{\cancel{30}} \times 283}{\underset{5}{\cancel{25}}}$$

$\Rightarrow$ 339.6K

Gay Lussac's Law
(Pressure – Temperature Relationship)

- Joseph Gay Lussac
- "At constant volume pressure of a fixed amount of a gas is directly proportional to the temperature.

n, V = Constant

$$\boxed{P \propto T(K)}$$

$$\frac{P}{T} = K \text{ (Constant)}$$

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

$P_1 \rightarrow$ Initial Pressure

$P_2 \rightarrow$ final pressure

T_1 = Initial Temp.

$T_2 \rightarrow$ final temp.

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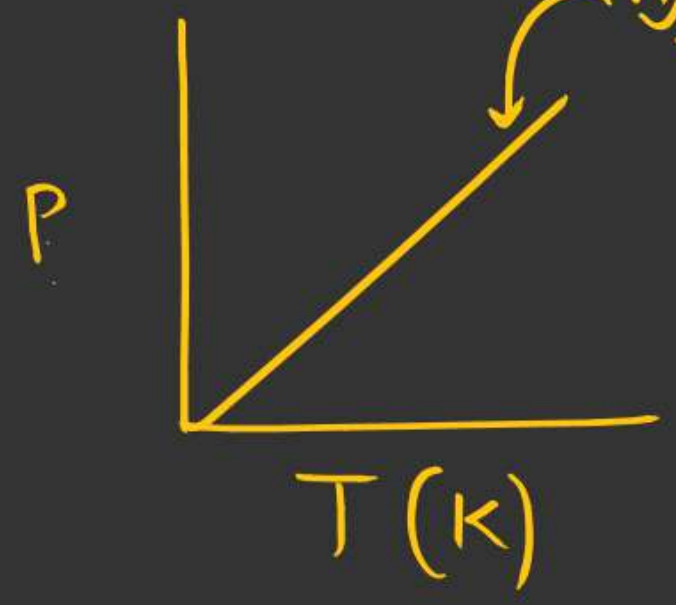
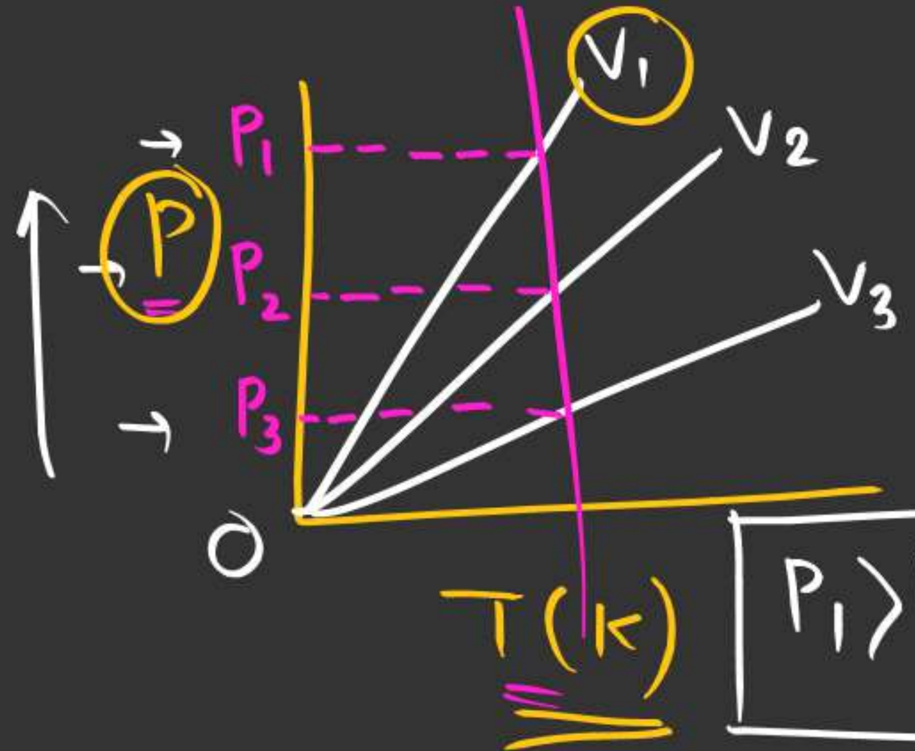
Isochore → The line (curve) represents the pressure-temperature Relation at fixed volume.



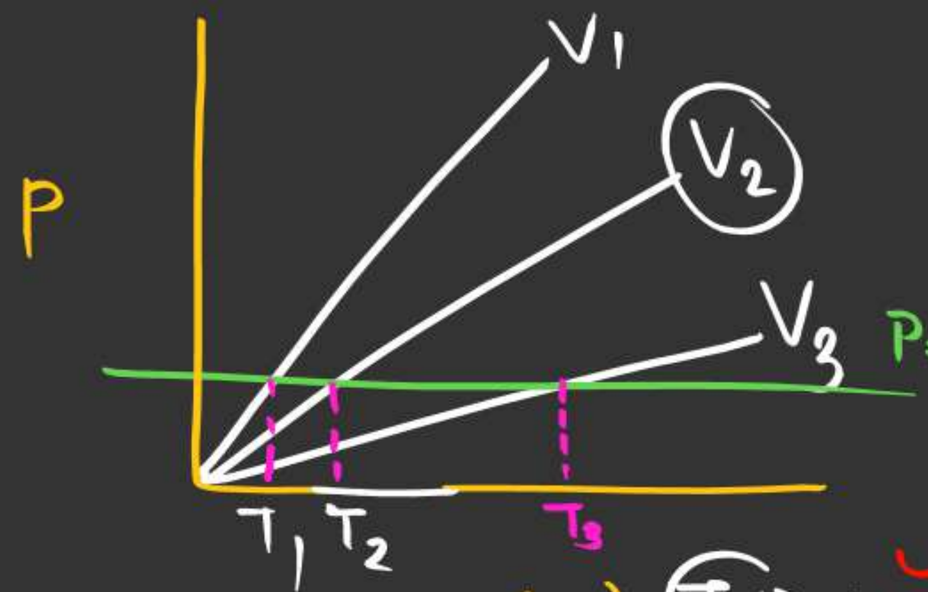
$P \propto T(K)$



$\boxed{P_1 > P_2 > P_3}$

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

$\boxed{V_3 > V_2 > V_1}$



(K) $T_3 > T_2 > T_1$

$\boxed{V_3 > V_2 > V_1}$

Application

→

Physical significant of Gay Lussac's Law

- Pressure of the inflated tyres of automobiles is constant but in summers on a hot sunny day when the temperature is high, then the pressure inside the tyres increases, and they may burst.
- In winters, on a cold morning, when the temperature is low, then the pressure inside the tyres decreases considerably.

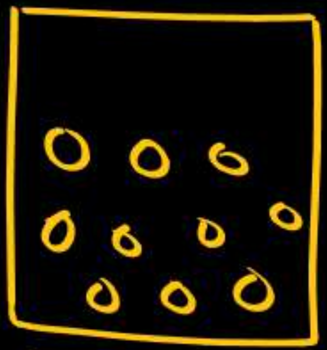
Avogadro's Law
(Volume – ~~Temperature~~ Relationship)

no. of moles

❖ Avogadro's Law states that the $\boxed{\text{equal volume}}$ of all gases under the same conditions of temperature and pressure contain equal number of moles or molecules.

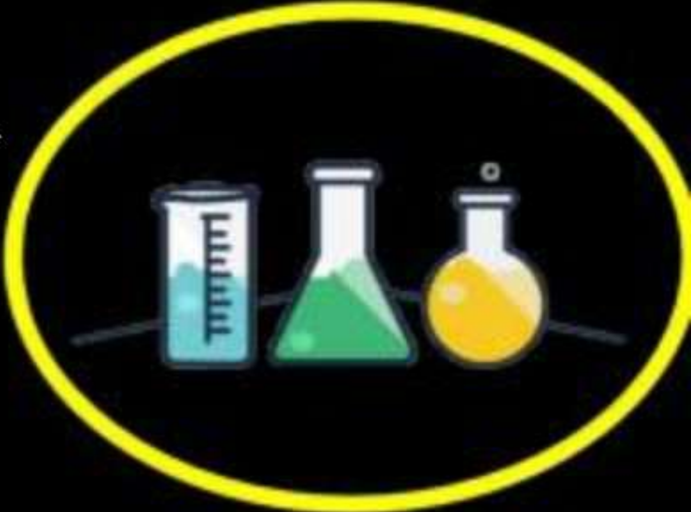
P, T = Constant

$\boxed{V \propto n}$



$\boxed{V \propto n}$ → no. of moles or no. of molecule

$\boxed{P, V, T, n}$



IDEAL GAS EQUATION

Acc to Boyle's Law $P \propto \frac{1}{V}$

Charle's Law → $V \propto T$

Gaylussac's Law → $P \propto T$

Avogadro Law → $V \propto n$

⇒ $PV \propto nT$

$$\boxed{PV = nRT}$$ *

Ideal gas Equation

R → gas constant

↓

Same for all types of gases

Universal gas Constant

⇒ $R = \frac{P \times V}{n \times T}$

⇒ P → SI Unit → Pa.

1 atm → 10^5 Pa

1 mole → 22.4 L or 22.7 L

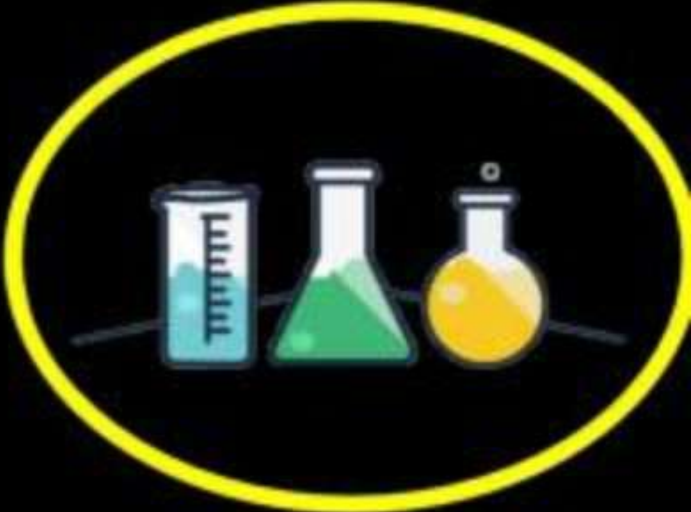
↓

Volume

⇒ $22.7 \times 10^{-3}\ m^3$

$1\ m^3 = 1000\ L$

T = 273 K



$\Rightarrow PV = nRT$

$\Rightarrow R = \frac{PV}{nT}$

$$R = \frac{(10^5 \text{ Pascal})(22.7 \times 10^{-3} m^3)}{(1 \text{ mole})(273 K)}$$

** $\boxed{R \Rightarrow 8.314 \text{ Pa } m^3 \text{ mol}^{-1} K^{-1}}$

$\Rightarrow$ when Pressure is in atm and Volume is in L

$$R = \frac{(1 \text{ atm})(22.7 L)}{1 \text{ mole} \times 273 K}$$

$\boxed{R = 0.0821 \text{ L atm mol}^{-1} K^{-1}}$

or

$\boxed{R = 0.083 \text{ bar atm mol}^{-1} K^{-1}}$

Ideal gas Equation

$\boxed{PV = nRT}$

$P \rightarrow$ Pressure

$V \rightarrow$ Volume

$T \rightarrow$ Temp. (K)

$R \rightarrow$ gas constant

$n \rightarrow$ no. of mole

Combined gas law

$PV = nRT$

$n \rightarrow$ no. of mole

$n = \frac{w}{MM}$

$PV = \frac{w}{MM} \times R \times T$

$P \times MM = \frac{w}{V} RT$

$d = \frac{w \text{ (mass)}}{V \text{ (Volume)}}$

$P \times MM = dRT$

$$\boxed{d = \frac{P \times MM}{RT}}$$

$d \rightarrow$ density of gas

$MM \rightarrow$ Molecular mass of gas.

$P_1V_1 = n_1RT_1$ — (1)

$P_2V_2 = n_2RT_2$ — (2)

(1) = (2)

$$\frac{P_1V_1}{n_1\cancel{R}T_1} = \frac{P_2V_2}{n_2\cancel{R}T_2}$$

$$\boxed{\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}}$$

Combined gas Law.

$P_1 \rightarrow$ Initial pressure of gas

$V_1 \rightarrow$ Initial Volume of gas

$n_1 \rightarrow$ Initial moles of gas

$T_1 \rightarrow$ Initial temp. of gas

$P_2 \rightarrow$ Final pressure of gas

$V_2 \rightarrow$ Final Volume of gas

$n_2 \rightarrow$ Final moles of gas

$T_2 \rightarrow$ Final temp. of gas

Q!

$$\Rightarrow \frac{P_1 V_1}{\cancel{n_1 T_1}} = \frac{P_2 V_2}{\cancel{n_2 T_2}}$$

$$\Rightarrow P_1 V_1 = P_2 V_2$$

Q. A sample of gas occupies 10 L under a pressure of 1 atm. What will be its volume if the pressure is increased to 2 atm? Assuming that temperature of the gas sample does not change?

(a) 2 L
(b) 5 L
(c) 10 L
(d) 1 L

H.W.

Q. How much should the pressure be increased in order to decrease the volume of a gas by 5% at a constant temperature?

(a) 5%
(b) 5.26%
(c) 10%
(d) 4.26%

H.W.

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Q. If the density of a certain gas at 30°C and 768 torr is 1.35 kg/m^3 its density at STP would be

(a) 1.48 kg/m^3

(b) 1.58b kg/m^3

(c) 1.25 kg/m^3

(d) 1.4 kg/m^3

H.W.

Q. The two bulbs of volume 5 litre and 10 litre containing an ideal gas at 9 atm and 6 atm respectively are connected. What is the final pressure in the two bulbs if the temperature remains constant?

(a) 15 atm

(b) 7 atm

(c) 12 atm

(d) 21 atm

H.W.:

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Q. The density of neon will be highest at

(a) STP

(b) 0°C and 2 atm

(c) 273°C and 1 atm

(d) 273°C and 2 atm

H.W

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Q. A vessel has 6 g of oxygen at a pressure P and temperature 400 K. A small hole is made in it so that O_2 leaks out. How much O_2 leaks out if the pressure is P/2 and temperature 300K?

(a) 5 g
(b) 4 g
(c) 2 g
(d) 3 g

H.W

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thanks
for watching

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