ARJUNA NEET BATCH

States of Matter

LECTURE - 10

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Objective of today's class

PREVIOUS YEARS QUESTIONS

ARJUNA

States of Matter (One shot)

⇒ Intermolecular Forces   Thermal Energy

Solid → I.F. >>> T.E.

Liquid → I.F. ≈ T.E.

**

$\boxed{\text{Gas} \rightarrow \text{T.E.} >>> \text{I.F.}}$

FOA

Intramolecular | Intermolecular

⇒ Covalent Bond

→ -   Bond

$- \propto \frac{1}{r^6}$

① Dipole-Dipole FOA

② Dipole-Induced Dipole

Induced-Indu

④ H-Bonding

GAS

1. **Pressure** $\Rightarrow \dfrac{\text{Force}}{\text{Area}}$

S.I. Unit → N/m^2
or
Pascal

⇒ 1 atm ≃ bar
⇒ 1 atm = 760 mm of Hg
⇒ 1 atm = 760

2. **Volume**

S.I. Unit → m^3

$1\ m^3 = 1000\ L$
$= 1000\ dm^3$

$\boxed{1L = 1\ dm^3}$

$1\ L = 1000\ ml$
$= 1000\ cc$
$= 1000\ cm^3$

3. **Temperature**

S.I Unit → Kelvin

$\boxed{T(K) = T(°C) + 273.15}$

$\boxed{T(°C) = \frac{5}{9}(F - 32)}$

4. **Amount of Substance**

$\boxed{n = \frac{w}{MM} = \frac{N_0}{N_A} = \frac{V_L}{22.4}}$

$\boxed{V.D = MM/2}$

GAS LAWS

$PV = nRT$

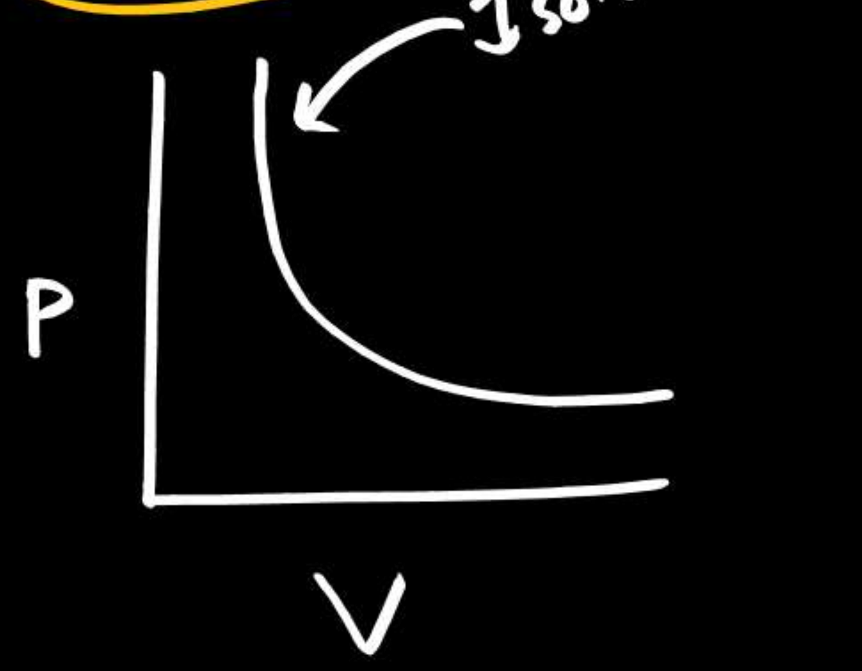
① Boyle's Law

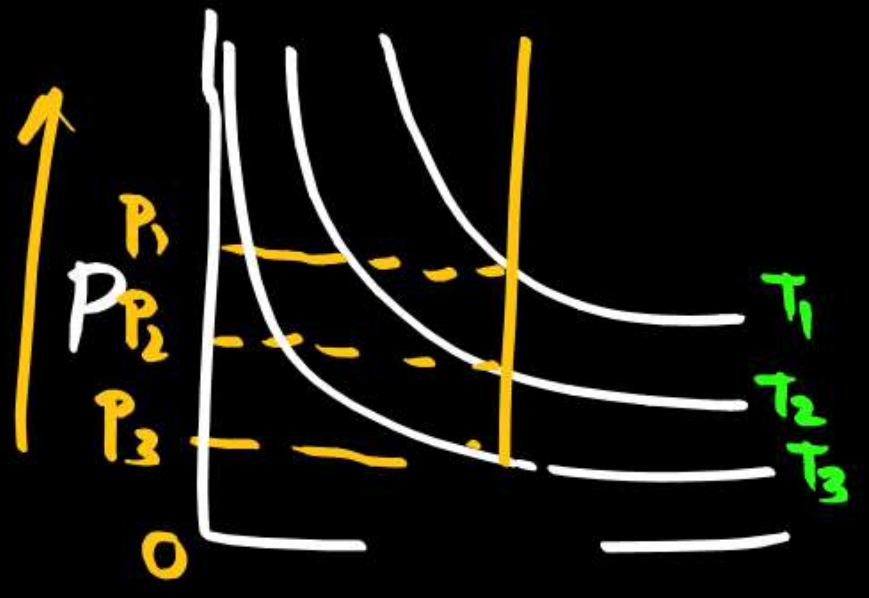
$n, T = \text{Constant}$

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

$\Rightarrow \boxed{PV = \text{Constant}}$

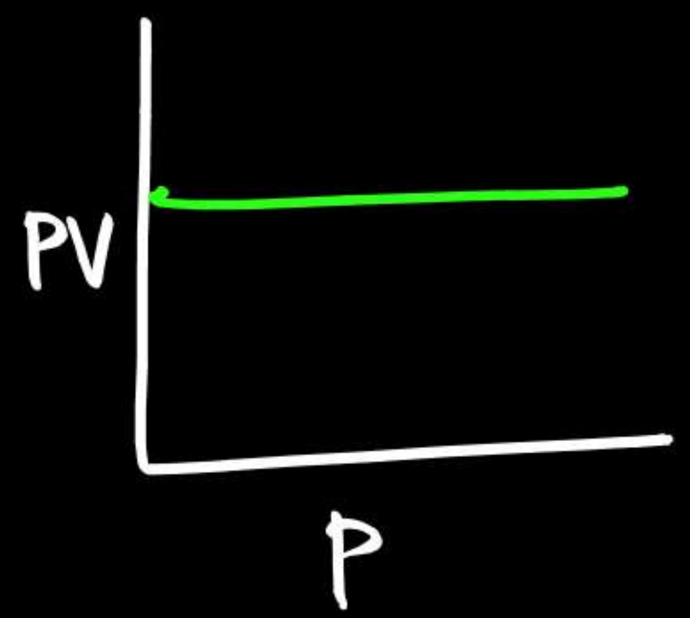
$\Rightarrow \boxed{P_1V_1 = P_2V_2}$

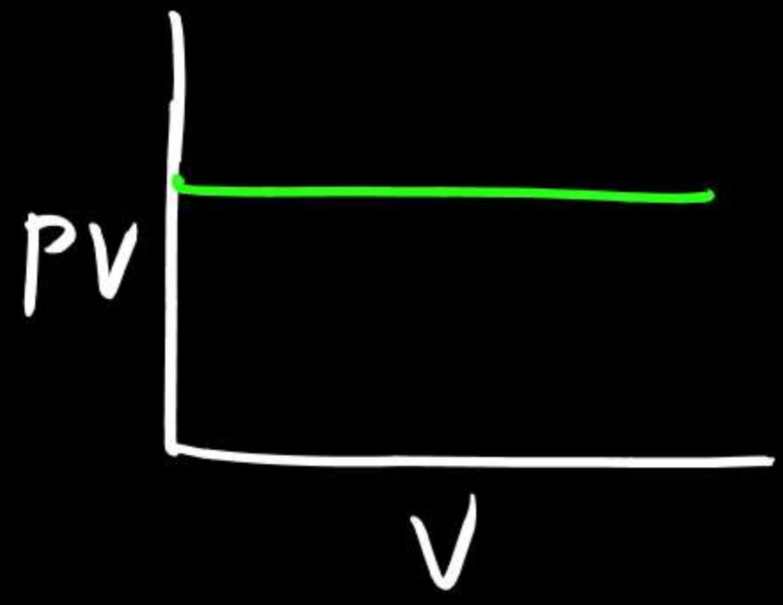




$\boxed{P_1 > P_2 > P_2}$

$\boxed{> T_2 > T_3}$



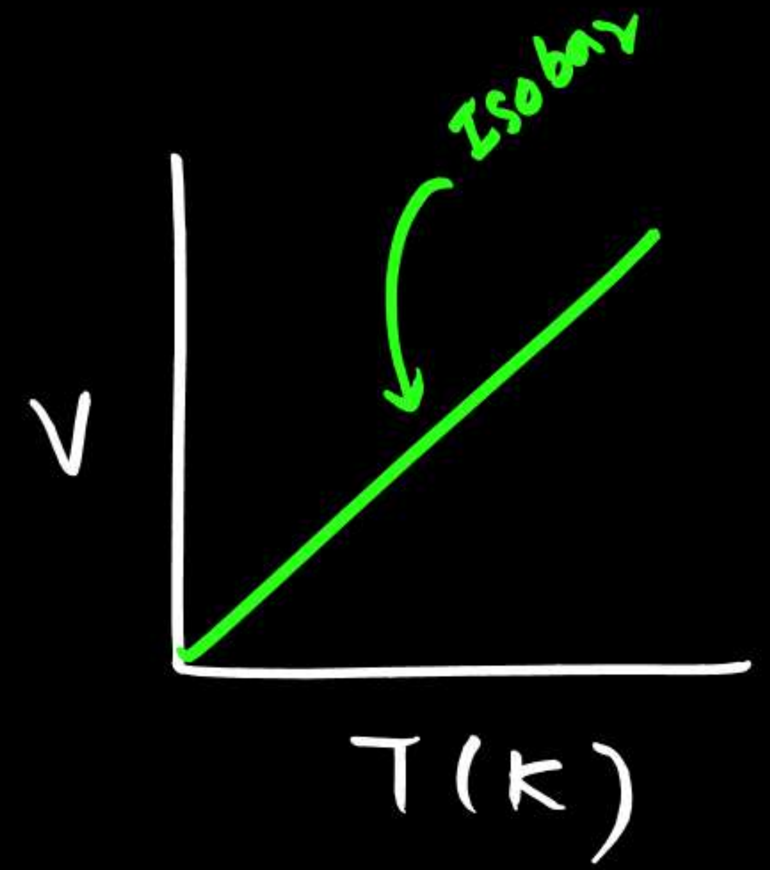


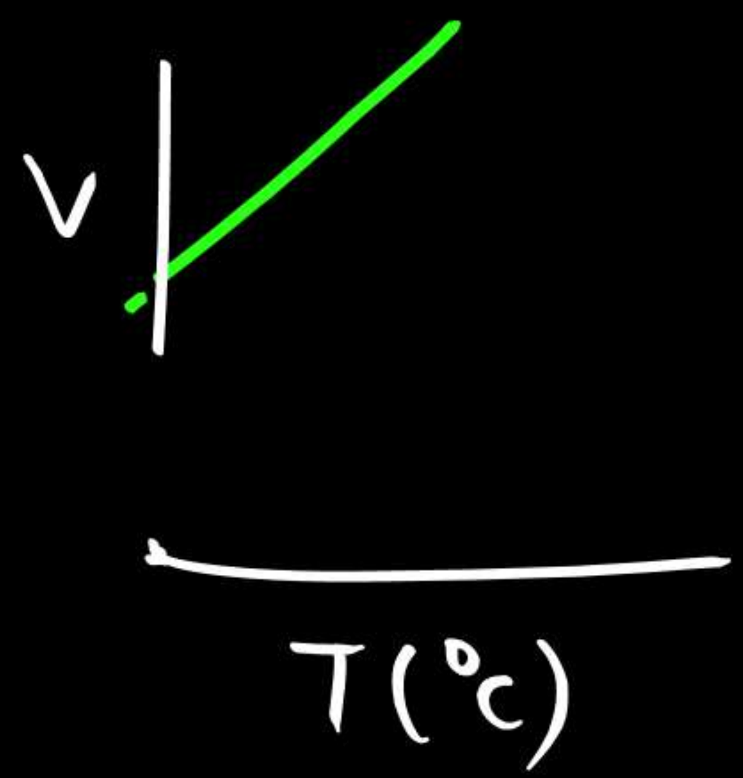
② Charle's Law

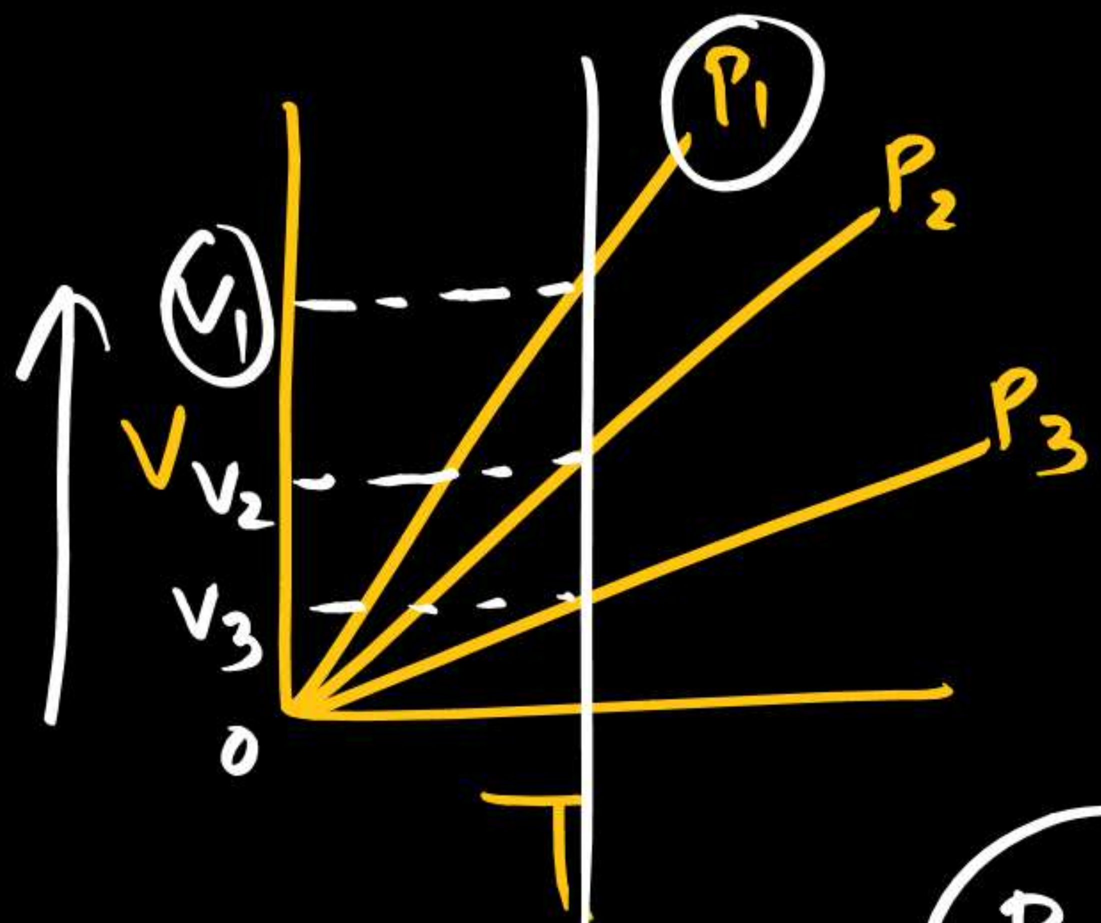
$$V \propto T(K)$$

$$\frac{V}{T} = const.$$

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







$$V_1 > V_2 > V_3$$

$$\boxed{P_3 > P_2 > P_1}$$

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

$V \uparrow$ $\quad d = \frac{w}{V}$ $\quad d \downarrow$

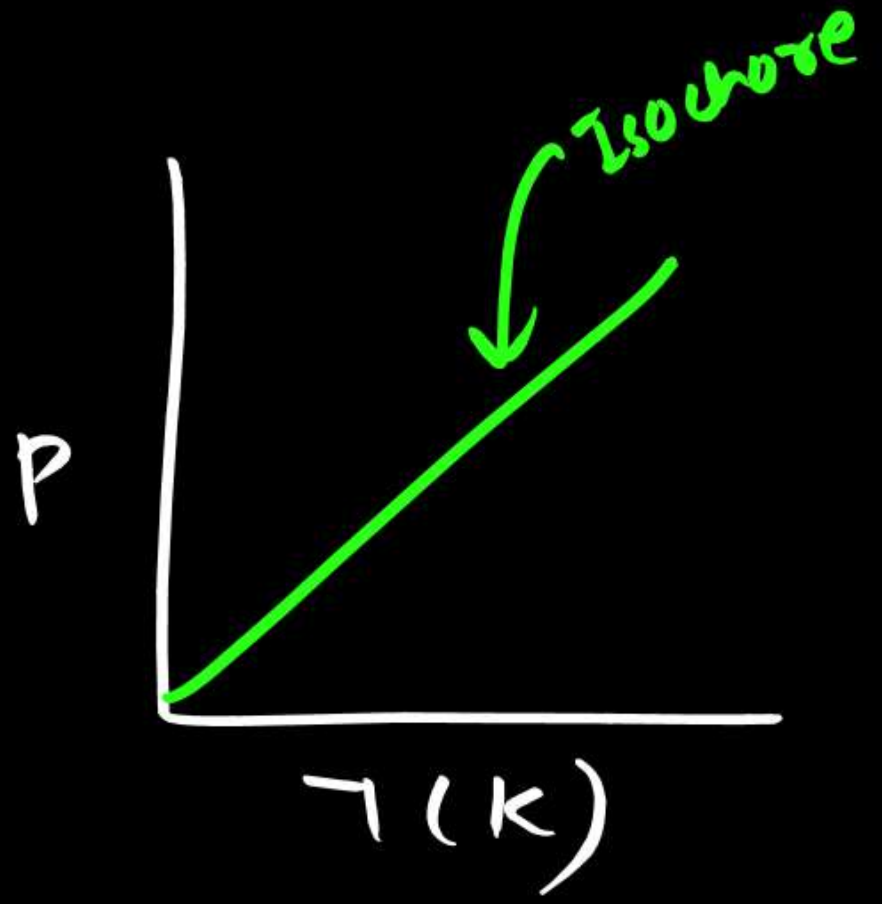
③ Gay Lussac's Law

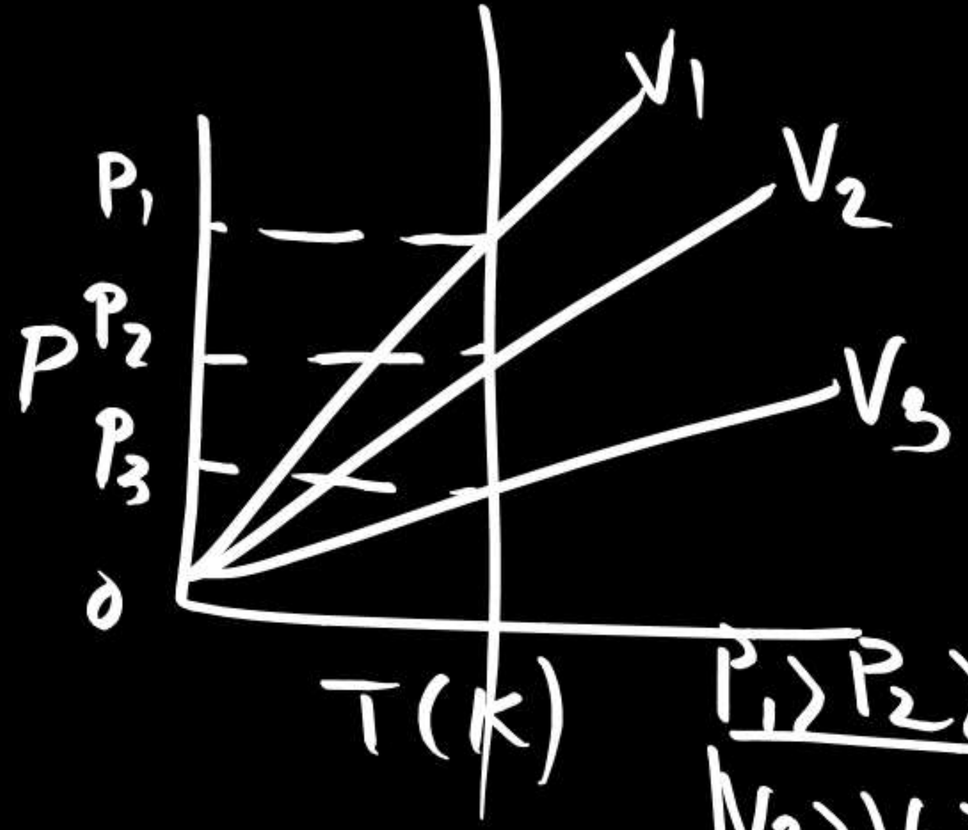
$n, V = \text{const}$

$P \propto T$

$\frac{P}{T} = \text{constant}$

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





$P_1 > P_2 > P_3$

$V_3 > V_2 > V_1$

④ Avogadro Law

$P, T = \text{const.}$

$V \propto n$

$$\boxed{PV = nRT}$$ → Ideal gas Equation

R → Universal gas constant

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

$R = 8.314$ Joule K^{-1} mol^{-1}

$R = 1.9 \approx 2$ Calorie K^{-1} mol^{-1}

Combined gas law.

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

$$PM = dRT$$

$$\boxed{d = \frac{PM}{RT}}$$

$$\boxed{\frac{d_1T_1}{P_1M_1} = \frac{d_2T_2}{P_2M_2}}$$

d → density

P → Pressure

M → Molar mass

T → Temp. (K)

V → volume

n → mole

Dalton's Law of Partial Pressure

$$\boxed{P_T = P_1 + P_2 + P_3 \ldots}$$

Reacting gas

$\left.\begin{array}{l} NH_3 + HCl \\ SO_2 + Cl_2 \end{array}\right\}$ These gases reacts at Room temp. that's y Dalton's Law is 'ot Applic ...as

Acid + Base } Room temp. react

O.A. + R.A

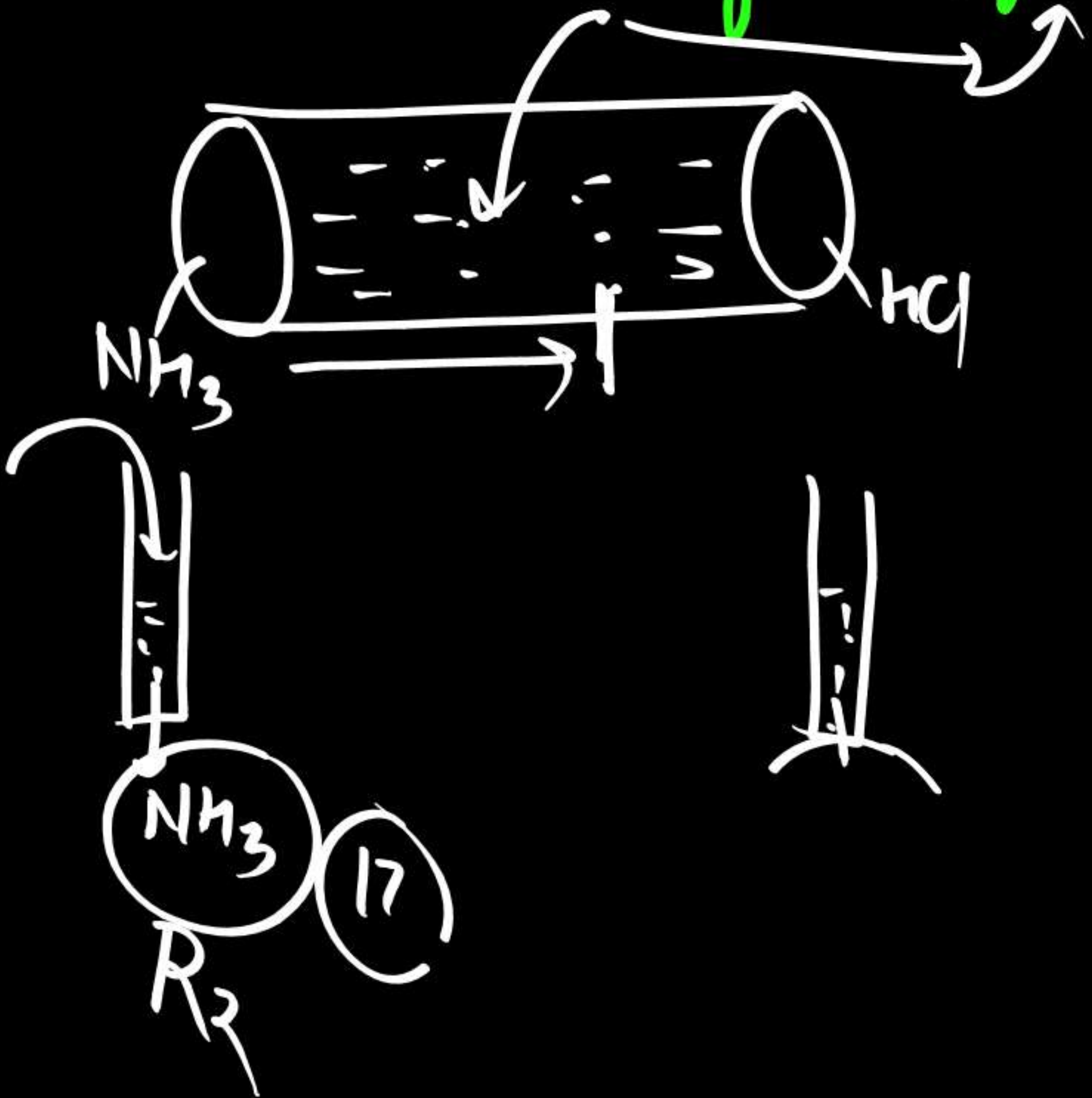
Oxidising agent

Reducing agent

$P_{moist\ gas} = P_{dry\ gas} + Aq.\ tension$

P_{H_2O} or

Graham's Law of Diffusion or Effusion



$$\frac{R_2}{R_1} = \sqrt{\frac{M_1}{M_2}} = \sqrt{\frac{d_1}{d_2}} = \sqrt{\frac{T_2}{T_1}}$$

$$\frac{R_2}{R_1} = \frac{V_2}{V_1} = \frac{t_1}{t_2} = \frac{P_2}{P_1} = \frac{n_2}{n_1}$$

KTG

$\boxed{K.E \propto Temp.}$

Average

Absolute Temp. → 0K

$$\boxed{K.E = \frac{3}{2} nRT}$$

$$\boxed{K.E. = \frac{3}{2} KT}$$

T → Temp.

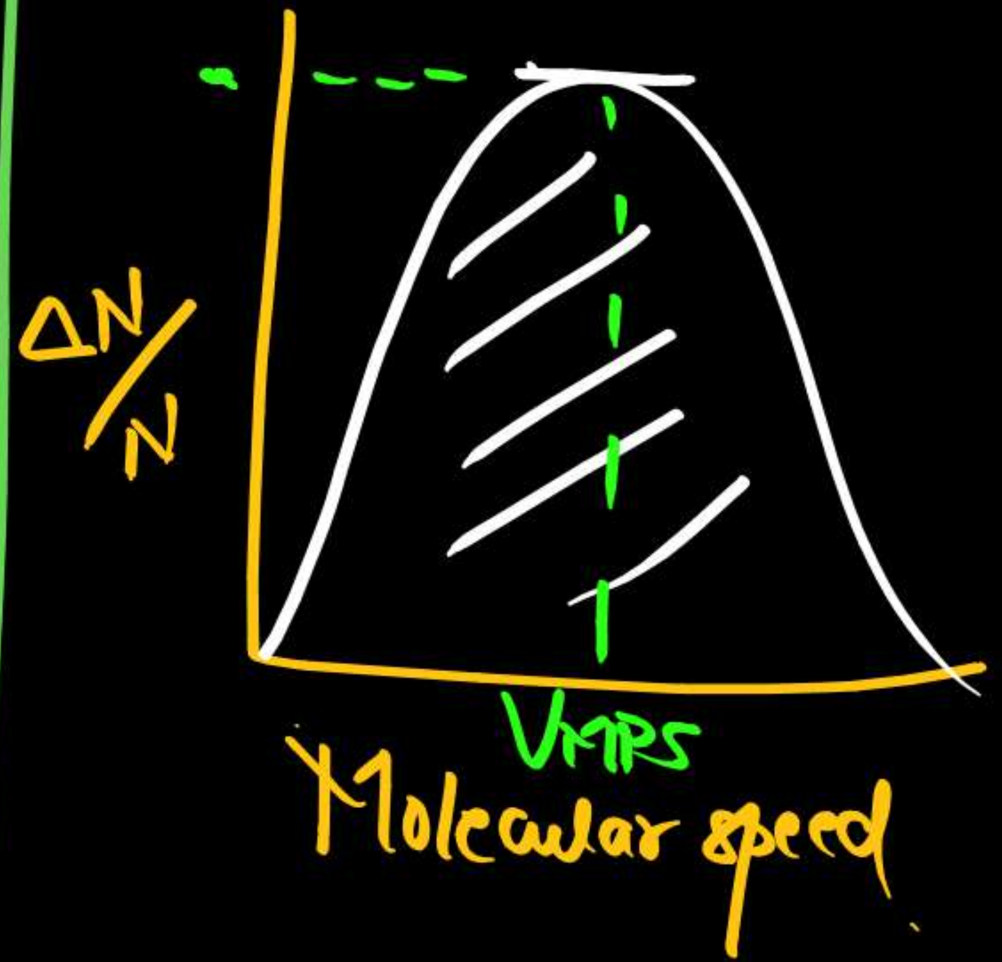
n → mole.

R → gas const

K → Boltzmann constant.

$$\boxed{K = 1.38 \times 10^{-23}\ J/K}$$

Maxwell Boltzmann Distribution



Molecular speed

V_{MPS}

$$= \sqrt{\frac{2RT}{M}}$$

or

$$\sqrt{\frac{2PV}{M}}$$

or

$$= \sqrt{\frac{2P}{d}}$$

$V_{Average}$

$$= \sqrt{\frac{8RT}{\pi M}}$$

or

$$= \sqrt{\frac{8PV}{\pi M}}$$

or

$$= \sqrt{\frac{8P}{\pi d}}$$

V_{rms}

$$= \sqrt{\frac{3RT}{M}}$$

or

$$= \sqrt{\frac{3PV}{M}}$$

or

$$= \sqrt{\frac{3P}{d}}$$

$R \rightarrow$ gas const

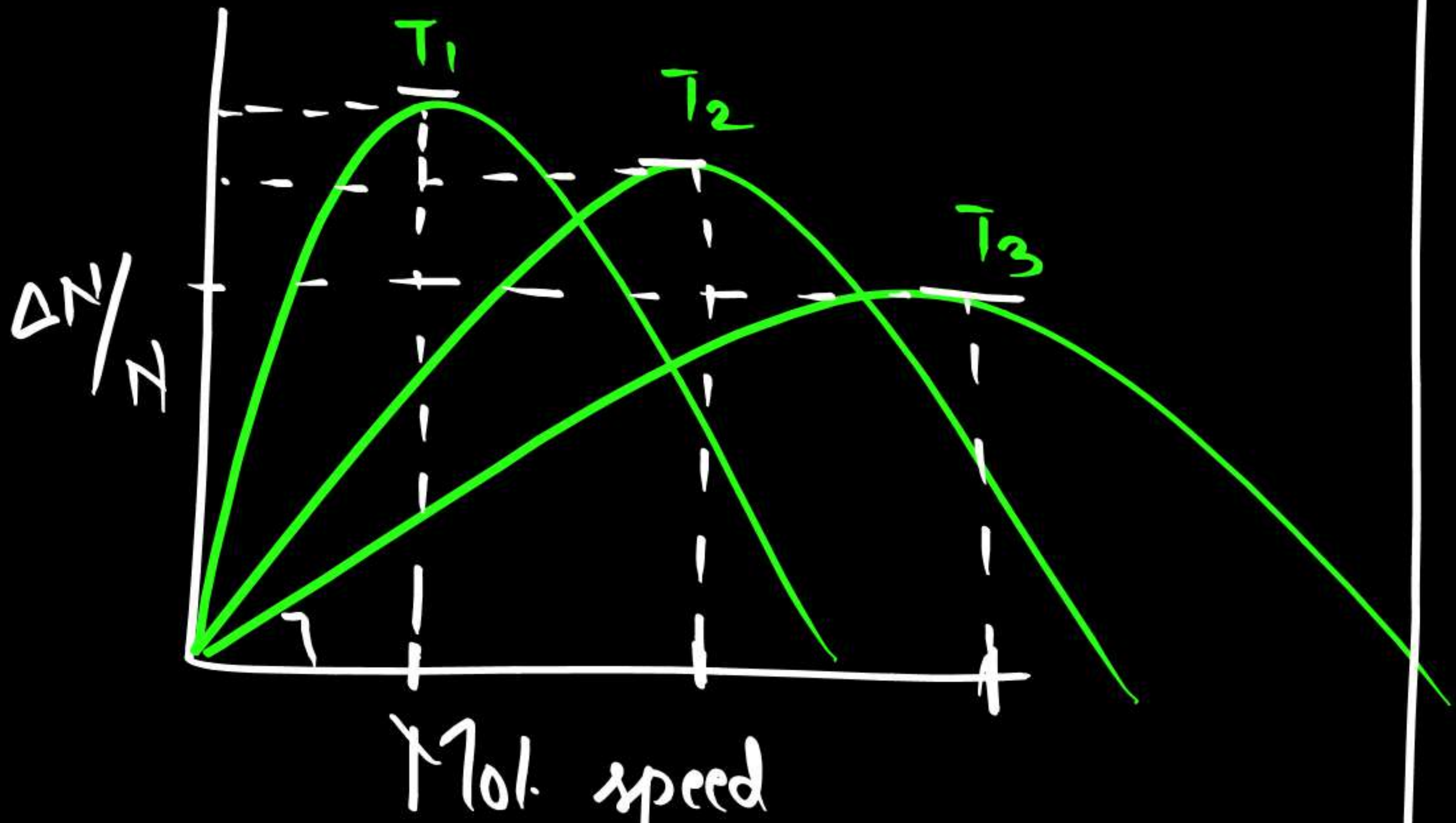
$T \rightarrow$ Temp.

$M \rightarrow$ Molar mass

$d \rightarrow$ density

$V \rightarrow$ Volume

Effect of Temp.



$T_3 > T_2 > T_1$

VANDERWAAL Gas Equation (Real gas)

$$\left(P + \frac{a}{V^2}\right)\left(V - b\right) = RT$$

or

$$\boxed{\left(P + \frac{an^2}{V^2}\right)\left(V - nb\right) = nRT}$$

Ideal gas

Favourable Condition for ideal behaviour

→ Low Pressure, Hight temp.

Conditions for deviation from ideal behaviour

→ High Pressure, Low temp.

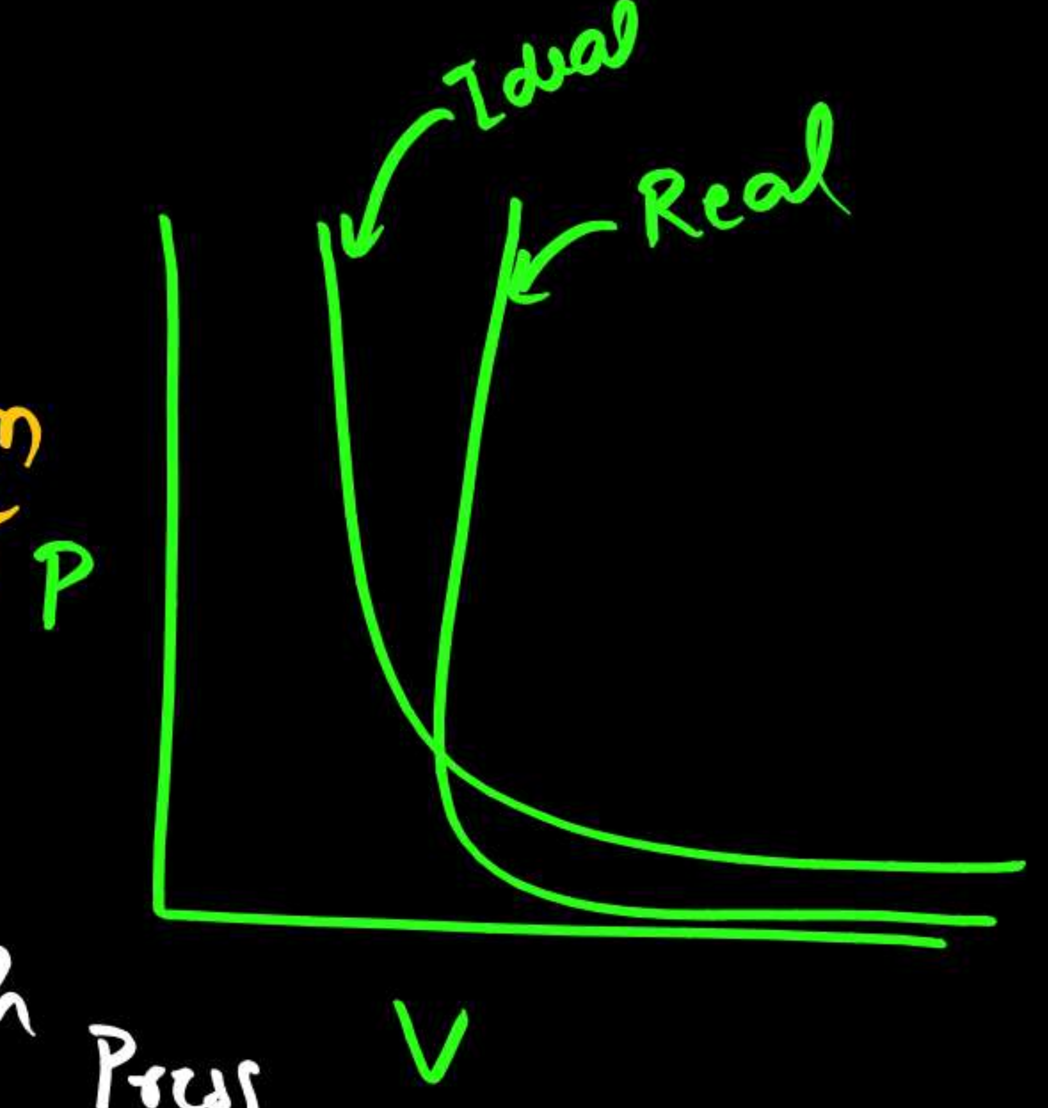
Real gas

Favourable condt^{n} for Real gas

→ low temp. High Press

Condition for deviation from Real gas behaviour.

→ Low Pressure High temp.



Significance of a am b

a → magnitude of attraction forces

a

Unit → atm L^2 mol^{-2}

a ↑ Compressibility

b → molecular size ↓ Molecular mass ↑

b ↑ → Excluded volume

Compressibility ↓

or Covolume

$4 \times \frac{4}{3}\pi r^3$

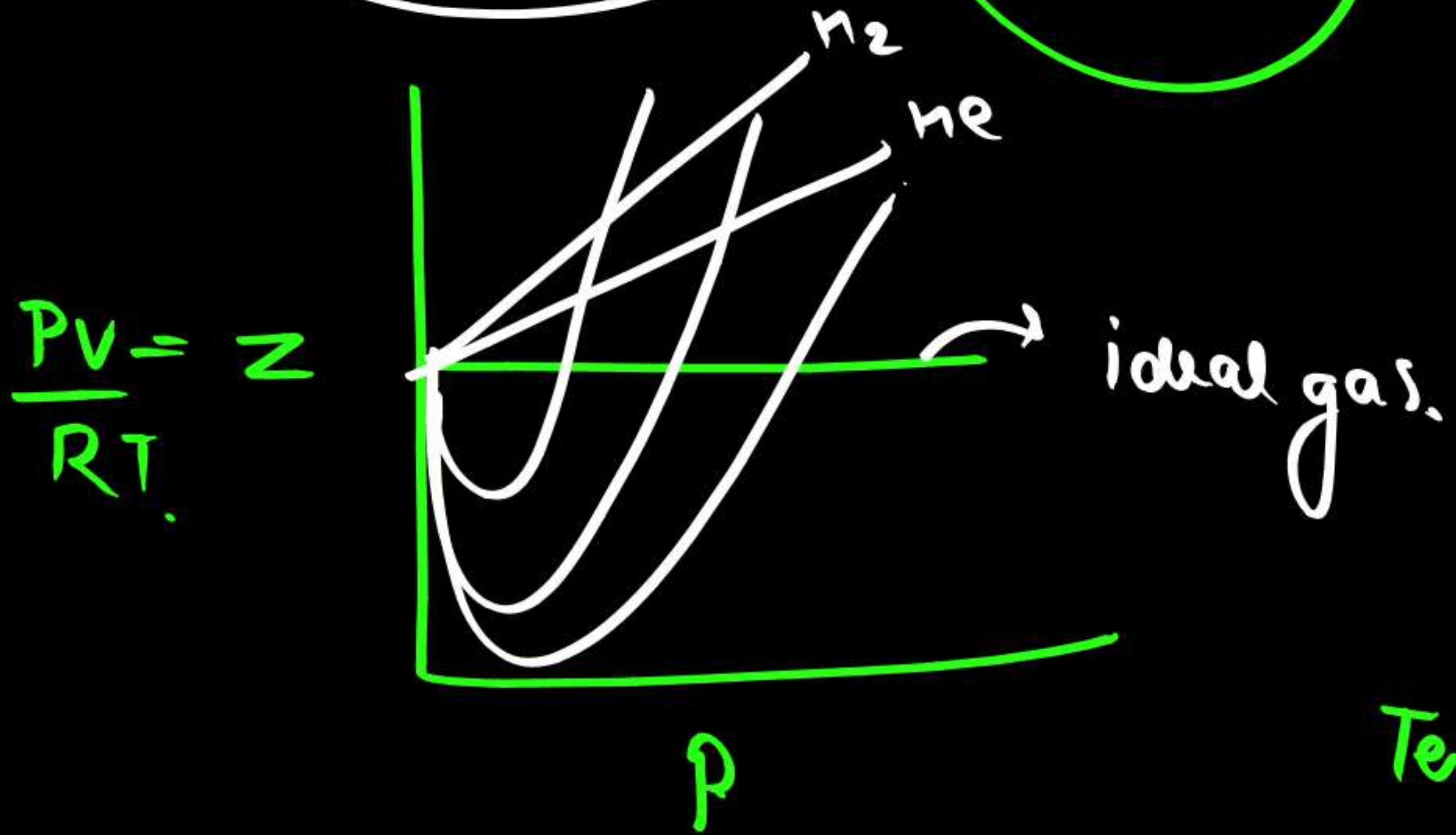
Unit b → $L\ mol^{-1}$

7b

Compressibility Factor (Z)

$$Z = \frac{V_{Real}}{V_{ideal}}$$

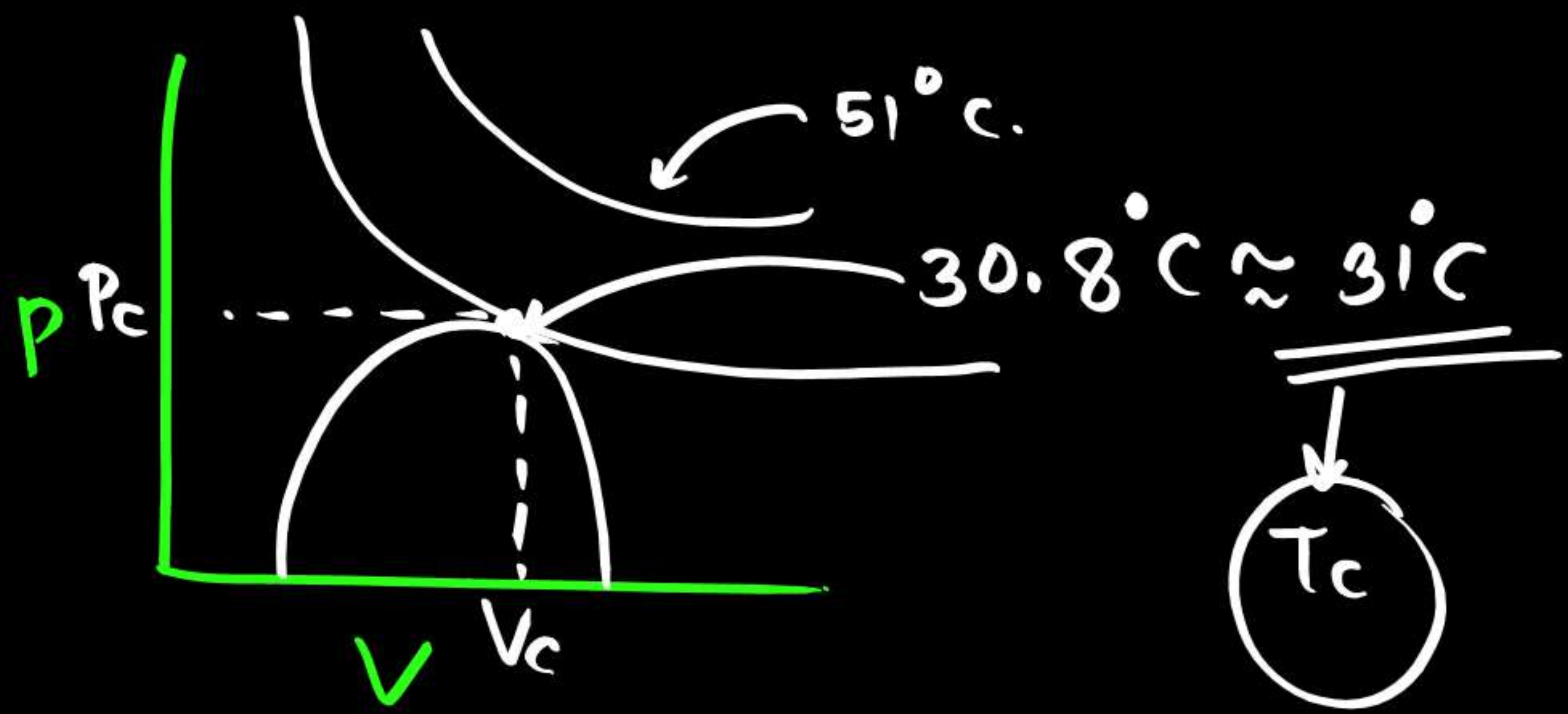
$$Z = \frac{PV}{RT}$$



Z

- Z = 1
  - ideal gas
- Z ≠ 1
  - Z < 1
    - -ive deviation from ideal gas beh.
    - → greater FOA
    - → Easy to Compress
    - → Easy to liquify ∴ a ↑
    - Temporary → gases
  - Z > 1
    - H_2, He
    - +ive deviation
    - → lesser FOA
    - → Hard to Compress
    - → Hard to liquify
    - Permanent gases

Andrews (CO_2 → isotherm)



$$\boxed{T_c = \frac{8a}{27Rb}}$$

$$\boxed{P_c = \frac{a}{27b^2}}$$

$$\boxed{V_c = 3b}$$

$$\boxed{T_b = \frac{a}{Rb}}$$

$$\boxed{T_i = \frac{2a}{Rb}}$$

$$\boxed{T_i > T_b > T_c}$$

Liquid State

I.F. $\simeq$ T.E.

① Vapour Pressure

$V.P \propto \frac{1}{I.F.}$

$V.P. \propto Temp$

② Boiling Point

Normal B.pt

$P = 1\,atm \rightarrow 100^\circ C$

Standard B.pt

$P = 1\,bar \rightarrow T = 99.6^\circ C$

③ Surface Tension

$\propto$ I.F.

$\propto \frac{1}{K}$

F/l

N/m^{-1}

or

dyn/cm

④ Viscosity

$\propto$ I.F.

$\propto \frac{1}{K}$

$$F = \eta A \frac{dv}{dz}$$

Unit

$\rightarrow Nsm^{-2}$

or

Pas

$\rightarrow$ Poise

All PYQ's (18 Quest^n)

ARE HOME WORK!

Q1. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The correct option about the gas and its compressibility factor (Z) is:

[NEET-2019]

A. $Z > 1$ and attractive forces are dominant

B. $Z > 1$ and repulsive forces are dominant

C. $Z < 1$ and attractive forces are dominant

D. $Z < 1$ and repulsive forces are dominant

Q2. The correction factor 'a' to the ideal gas equation corresponds to [NEET-2018]

A. Density of the gas molecules
B. Volume of the gas molecules
C. Forces of attraction between the gas molecules
D. Electric field present between the gas molecules

Q3. Given van der Waals constant for NH_3,H_2,O_2 and CO_2 are respectively 4.17, 0.244, 1.36 and 3.59, which one of the following gases is most easily liquefied?

[NEET-2018]

A. NH_3

B. H_2

C. CO_2

D. O_2

Q4. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?

[NEET-2016]

A. 1/2
B. 1/8
C. 1/4
D. 3/8

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Q5. A gas such as carbon monoxide would be most likely to obey the ideal gas law at **[Re-AIPMT-2015]**

A. High temperatures and high pressures
B. Low temperatures and low pressures
C. High temperatures and low pressures
D. Low temperatures and high pressures

Q6. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27°C in identical conditions. The ratio of the volumes of gases $H_2 : O_2$: methane would be [AIPMT-2014]

A. $8 : 16 : 1$
B. $16 : 8 : 1$
C. $16 : 1 : 2$
D. $8 : 1 : 2$

Q7. Dipole-induced dipole interactions are present in which of the following pairs

[NEET-2013]

A. Cl_2 and CCl_4

B. HCl and He atom

C. SiF, and He atoms

D. H_2O and alcohol

Q8. Maximum deviation from ideal gas is expected from

[NEET-2013]

A. $N_2(g)$

B. $CH_4(g)$

C. $NH_3(g)$

D. $H_2(g)$

Q9. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be [AIPMT (Mains)-2012]

A. 27 u
B. 36 u
C. 64 u
D. 9 u

Q10. For real gases van der Waals equation is written as $\left(p+\frac{an^2}{V^2}\right)(V-nb)=n\,RT$, where 'a' and 'b' are van der waals constants. Two sets of gases are:

(I) O_2, CO_2, H_2 and He

(II) CH_4, O_2, and H_2

The gases given in set-I in increasing order of band gases given in set-II in decreasing order of an arranged below. Select the correct order from the following: [AIPMT (Mains)-2012]

A. (I) $He < H_2 < CO_2 < O_2$ (II) $CH_4 > H_2 > O_2$

B. (I) $O_2 < He < H_2 < CO_2$ (II) $H_2 > O_2 > CH_4$

C. (I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$

D. (I) $H_2 < O_2 < He < CO_2$ (II) $O_2 > CH_4 > H_2$

Q11. By what factor does the average velocity of a gaseous molecule increase when the temperature (in kelvin) is doubled?

[AIPMT (Prelims)-2011]

A. 1.4 B. 2.0

C. 2.8 D. 4.0

Q12. A gaseous mixture was prepared by taking equal mole of CO and N_2. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N_2) in the mixture is

[AIPMT (Prelims)-2011]

A. 1 atm
B. 0.5 atm
C. 0.8 atm
D. 0.98 atm

Q13. A bubble of air is underwater at temperature 15°C and the pressure 1.5 bar. if the bubble rises to the surface where the temperature is 25°C and the pressure is 1.0 bar what will happen to the volume of the bubble? [AIPMT (Mains)-2011]

A. Volume will become smaller by a factor of 0.70
B. Volume will become greater by a factor of 2.5
C. Volume will become greater by a factor of 1.6
D. Volume will become greater by a factor of 1.1

Q14. The pressure exerted by 6.0 g of methane gas in a 0.03 m^3 vessel at 129°C is (Atomic masses : C = 12.01 , H = 1.01 and R = 8.314 JK^{-1} mol^{-1}) [AIPMT (Mains)-2010]

A. 215216 Pa
B. 13409 Pa
C. 41648 Pa
D. 31684 Pa

Q15. A monatomic gas at pressure P_1 and volume V_1 is compressed adiabatically to $1/8^{th}$ its original volume. What is the final presssure of the gas ? [AIPMT (Mains)-2010]

A. $64\ P_1$

B. P_1

C. $16\ P_1$

D. $32\ P_1$

Q16. If a gas expands at constant temperature, it indicates

[AIPMT (Prelims)-2008]

A. Number of the molecules of gas increases

B. Kinetic energy of molecules decreases

C. Pressure of the gas increases

D. Kinetic energy of molecules remains the same

Q17. The surface tension of which of the following liquid is maximum?

[AIPMT (Prelims)-2005]

A. H_2O

B. C_6H_6

C. CH_3OH

D. C_2H_5OH

Q18. What is the density of N_2 gas at 227°C and 5.00 atm pressure ?
($R = 0.0821$ atm K^{-1} mol^{-1}) **[Medical Ent. Exams.-2005]**

A. 0.29 g/ml B. 1.40 g/ml

C. 2.81 g/ml D. 3.41 g/ml

thanks
for watching