ARJUNA NEET BATCH

Structure of Atom

LECTURE - 1

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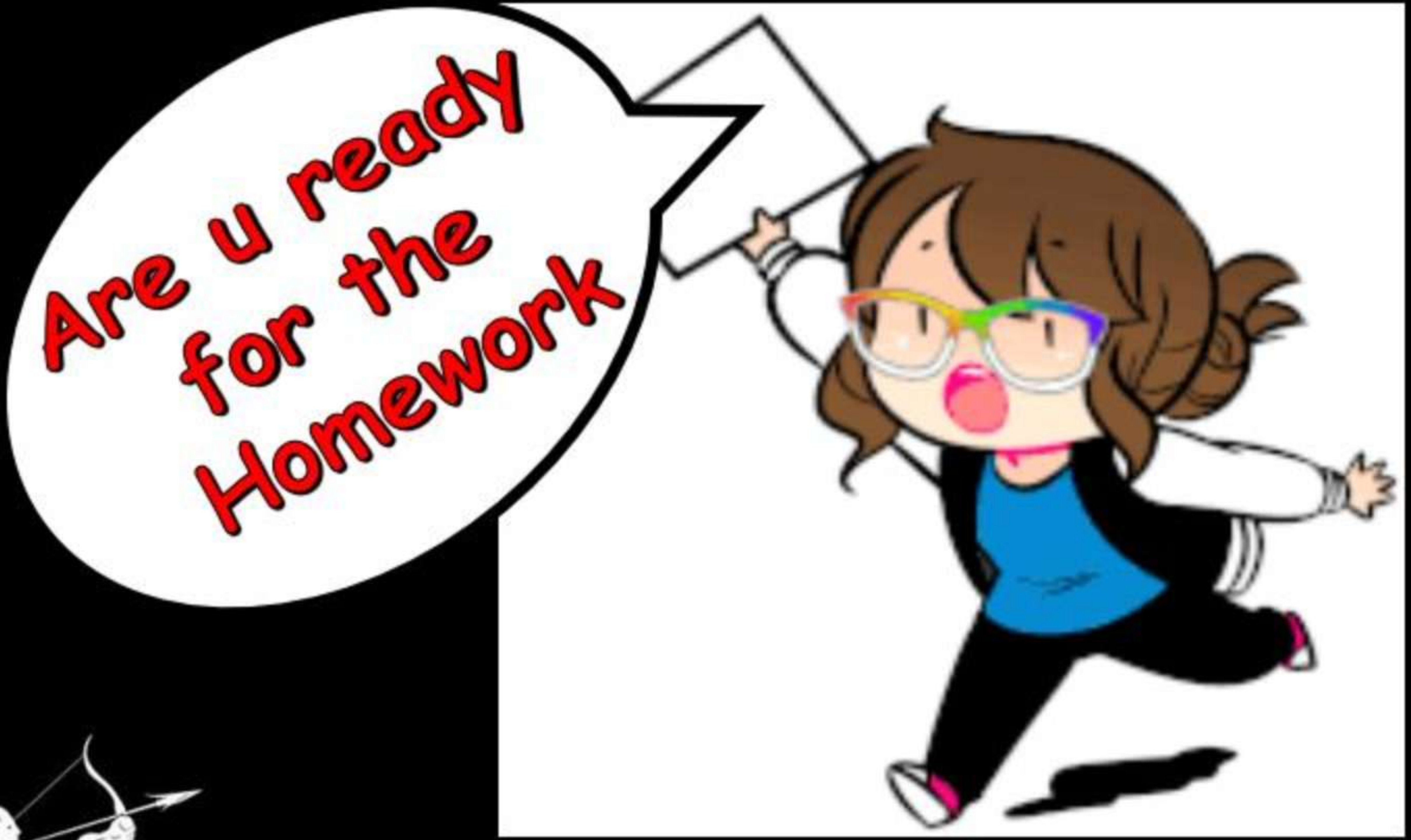
DISCOVERY OF FUNDAMENTAL PARTICLES


Are u ready
for the
Homework

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

$T = 350 K$ $\quad P = 15$ bar

$V < 20\%$

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

$Z < 1$

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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

$a \rightarrow$ magnitude of attraction force.

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

$\boxed{NH_3 \rightarrow 4.17}$

$H_2 \rightarrow 0.244$

$O_2 \rightarrow 1.36$

$CO_2 \rightarrow 3.59$

Z

Z = 1 — ideal gas

Z < 1

Z > 1

⇒ -ive dev

→ Easy to liquify

$\underline{a} \uparrow$

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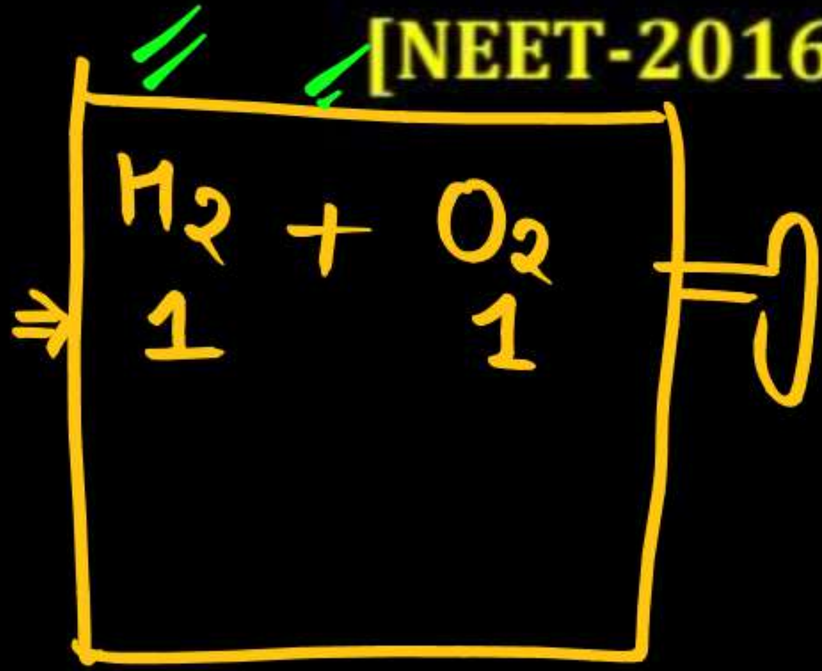
Q4. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?

[NEET-2016]

A. 1/2 B. 1/8

C. 1/4 D. 3/8



Graham's law of diffusion

$$\frac{R_{H_2}}{R_{O_2}} = \sqrt{\frac{MM_{O_2}}{MM_{H_2}}}$$

$$\frac{\frac{1}{2}}{R_{O_2}} = \sqrt{\frac{\cancel{32}\,16}{\cancel{2}}}$$

$$\frac{1}{2\times 4} = R_{O_2}$$

$$R_{O_2} = \frac{1}{8}$$

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

CO

Low press. & high temp

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

H_2 , O_2 , CH_4

P, T = const.

$V \propto n$

$n_{H_2} : n_{O_2} : n_{CH_4}$

$\Rightarrow \frac{\cancel{w}}{2} : \frac{\cancel{w}}{32} : \frac{\cancel{w}}{16}$

$\rightarrow \boxed{16 : 1 : 2}$

32

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

Polar

non polar

C. SiF, and He atoms

D. H_2O and alcohol

Dipole

↓

Polar Bond

↓

A — B ← EN diff.

Q8. Maximum deviation from ideal gas is expected from

[NEET-2013]

A. $N_2(g)$

B. $CH_4(g)$

C. $NH_3(g)$

D. $H_2(g)$

a ↑

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

$x \rightarrow gas$

$He \rightarrow gas$

$$r \propto \frac{1}{t} \propto \frac{1}{\sqrt{M}}$$

$$\frac{t_x}{t_{He}} = \frac{\sqrt{M_x}}{\sqrt{M_{He}}} \Rightarrow \frac{3}{1} = \frac{\sqrt{M_x}}{\sqrt{4}} \Rightarrow 9 = \frac{M_x}{4}$$

$M_x = 36\,u$

$b \rightarrow H_2 < He < O_2 < CO_2$

Q10. For real gases van der Waals equation is written as

$a \rightarrow CH_4 > O_2 > H_2$

$\left(p+\frac{an^2}{V^2}\right)(V-nb)=nRT$, where 'a' and 'b' are van der waals constants.

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

Two sets of gases are:

(I) O_2, CO_2, H_2 and He

(II) CH_4, O_2, and H_2

$CO_2 > O_2 > He > H_2$

The gases given in set-I in increasing order of b and 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) $O_2 > CH_4 > H_2$

b → magnitude of Molecular size

↳ Molecular mass

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

$$V_{average} = \sqrt{\frac{8RT}{\pi M}} \Rightarrow \sqrt{2} \rightarrow 1.414 \approx 1.4$$

2

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

$n_{N_2} = 1$

$n_{CO} = 1$

$\boxed{CO + N_2}$

$P_T = 1$ atm

Dalton's Law of P.P.

$$p_{N_2} = X_{N_2} P_T$$

$$= \frac{1}{2} \times 1$$

$$\Rightarrow \frac{1}{2} = 0.5$$

$$X_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{CO}}$$

$$\Rightarrow \frac{1}{1+1} = \frac{1}{2}$$

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

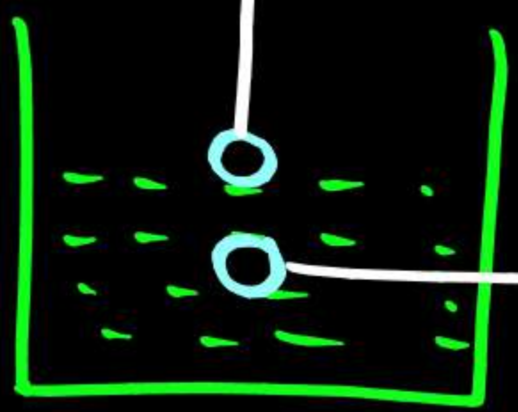
D. Volume will become greater by a factor of 1.1

273

$T_2 = 25°C$

$P_2 = 1.0$ bar

$V_2 = ?$



$T_1 = 15°C$

273

$P_1 = 1.5$ bar

$V_1 = V_i$

$$\Rightarrow \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \frac{1.5 \times V_1}{288} = \frac{1.0 \times V_2}{298}$$

$V_2 = ?$

$$\boxed{V_2 = 1.6 V_1}$$

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 mol^{-1}) [AIPMT (Mains)-2010]

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

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

$V = 0.03\ m^3$

$w_1 = 6.0\ g$

$T = 129°C$
$\ \ \ \ \ 273$
$\ \ \ \ \ 402$

$PV = nRT$

$P = \frac{\overset{2}{\cancel{6.0}}}{16} \times \frac{8.314 \times 402 \times 100}{0.0\cancel{3} \times \cancel{10}}$

$\Rightarrow$

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. $32\,P_1$

$q = 0$

Thermodynamics

$P_1 = P_1 \qquad P_2 = ?$

$V_1 = V_1 \qquad V_2 = \frac{1}{8} V_1$

$$\Rightarrow \boxed{P_1 V_1^{\gamma} = P_2 V_2^{\gamma}}$$

$\gamma \rightarrow C_P/C_V \rightarrow$ Monoatomic gas $\rightarrow 5/3$

$$P_1 V_1^{5/3} = P_2 \left(\frac{1}{8} V_1\right)^{5/3}$$

$$\frac{P_1 \times \cancel{V_1^{5/3}}}{\left(\frac{1}{8}\right)^{5/3} \times \cancel{V_1^{5/3}}} = P_2$$

$$\frac{P_1}{\left(\frac{1}{2^{\cancel{3}}}\right)^{5/\cancel{3}}} = P_2$$

$$P_2 = 2^5 P_1$$

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

K.E. $\propto$ Temp.

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

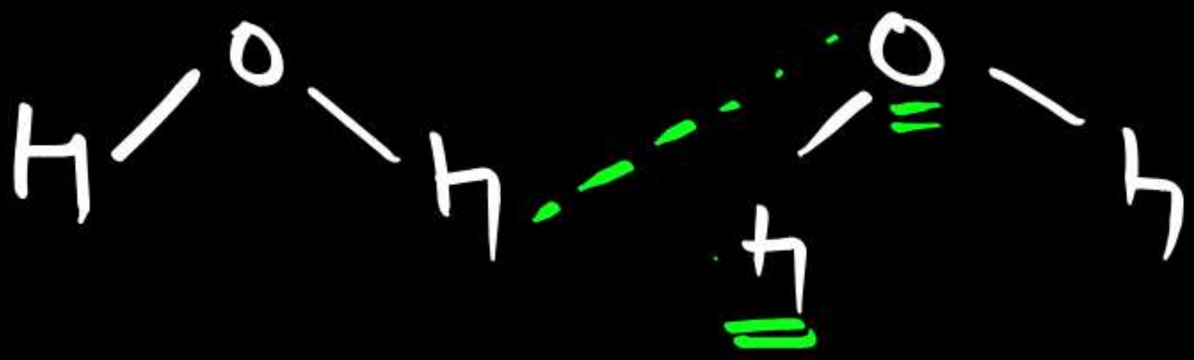
[AIPMT (Prelims)-2005]

A. H_2O B. C_6H_6

C. CH_3OH D. C_2H_5OH

intermolecular H- Bonding

Surface Tension $\propto$ Intermolecular force of attra.



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

$d_{N_2} = ?$

$T = 227^\circ C$
$\underline{\quad 273}$
500

$P = 5$ atm

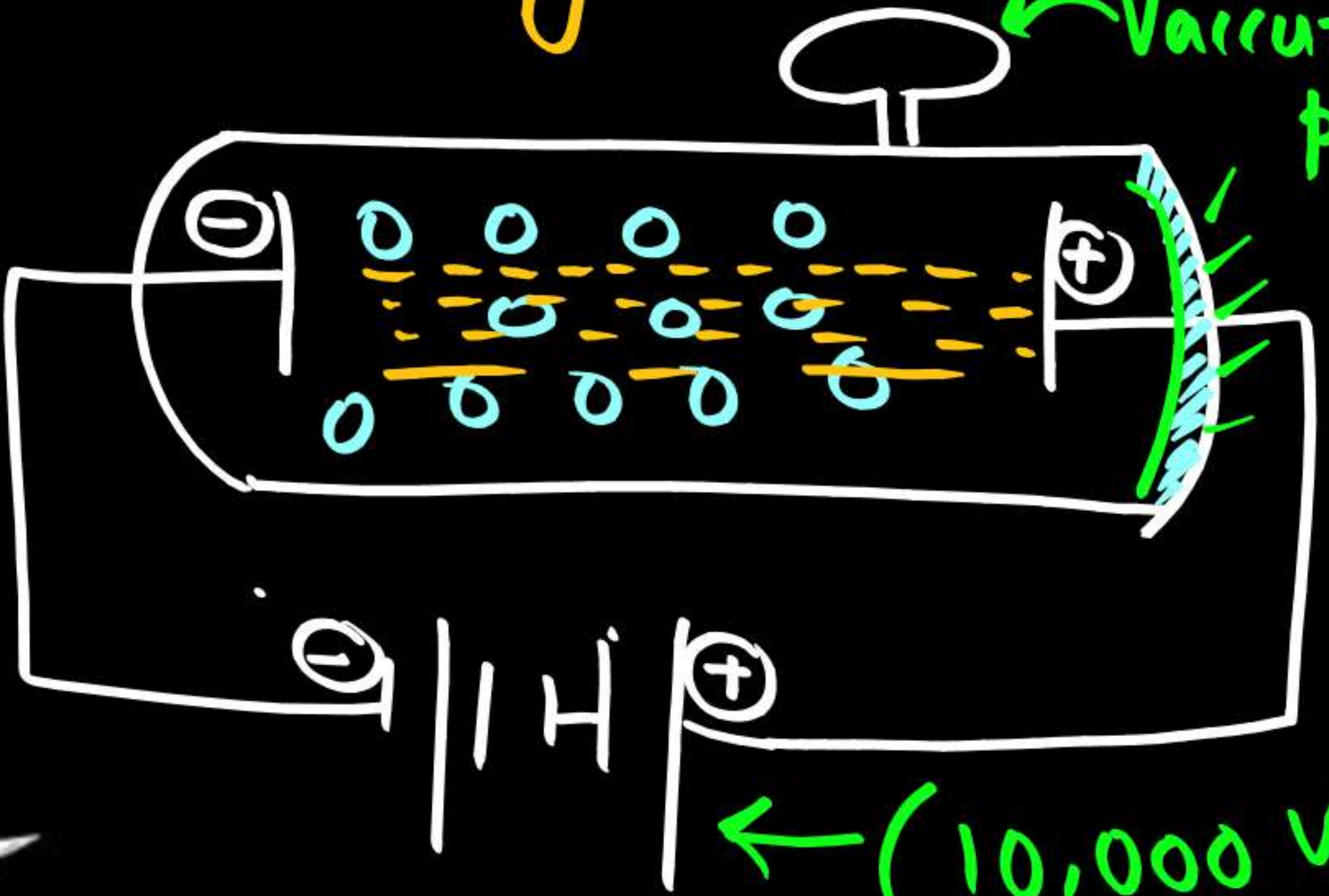
$d = \dfrac{PM}{RT}$

$= \dfrac{5 \times 28}{0.0821 \times 500} \Rightarrow$

Discovery of Electron

(Study of Cathode Ray)

William Crookes, Hertz.



Vaccum pump

(10^{-2} atm)

(10,000 volt)

Cathode ray → $e^{\ominus}$ [$e^{\ominus}$ was discovered by J.J. Thomson]

$e^{\ominus}$ $H-H \rightarrow H$ $\quad$ $H \rightarrow H^{+} + e^{\ominus}$

$\downarrow$

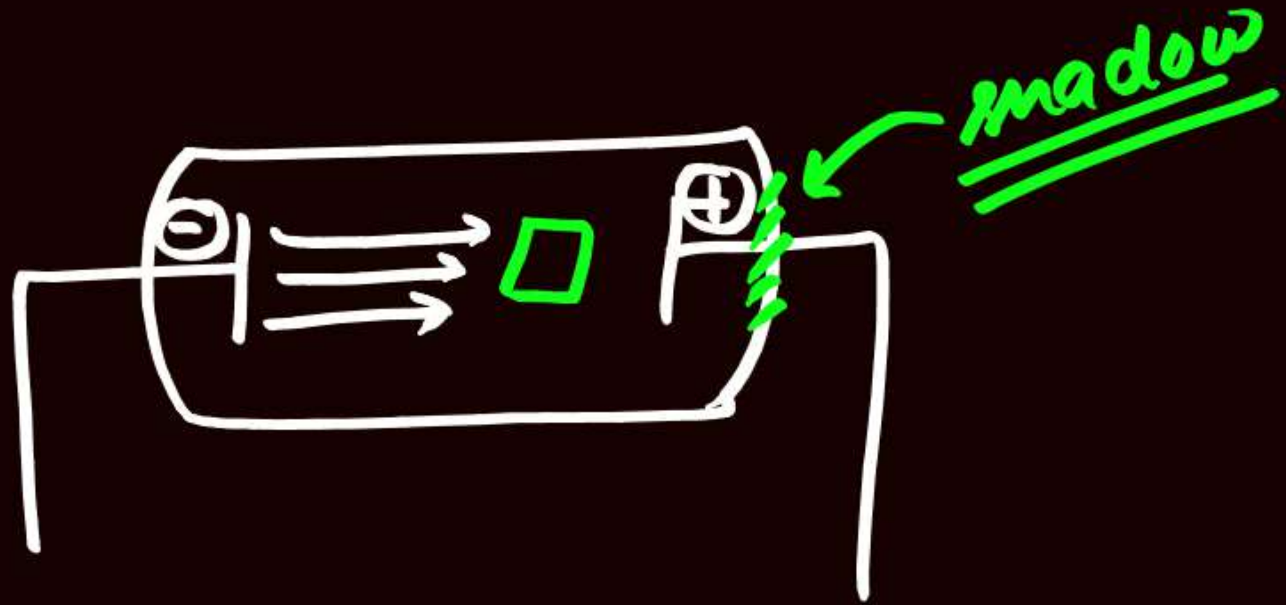
Cathode rays

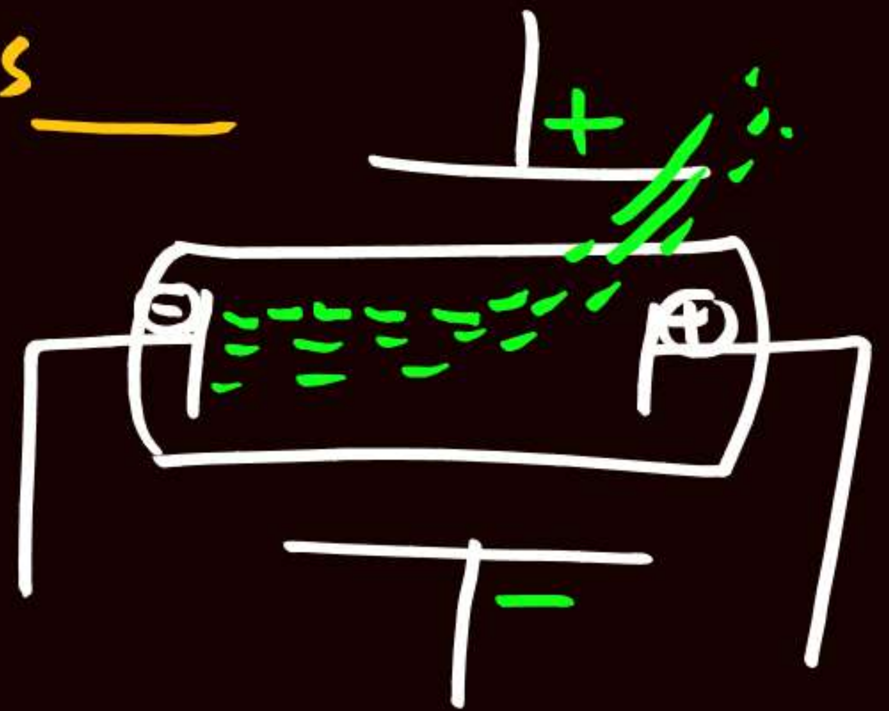
⇒ Cathode rays are the stream of -ively charged particles Negatrons.

⇒ Stoney gave them name $e^{\ominus}$ (electron)

Properties of Cathode Rays

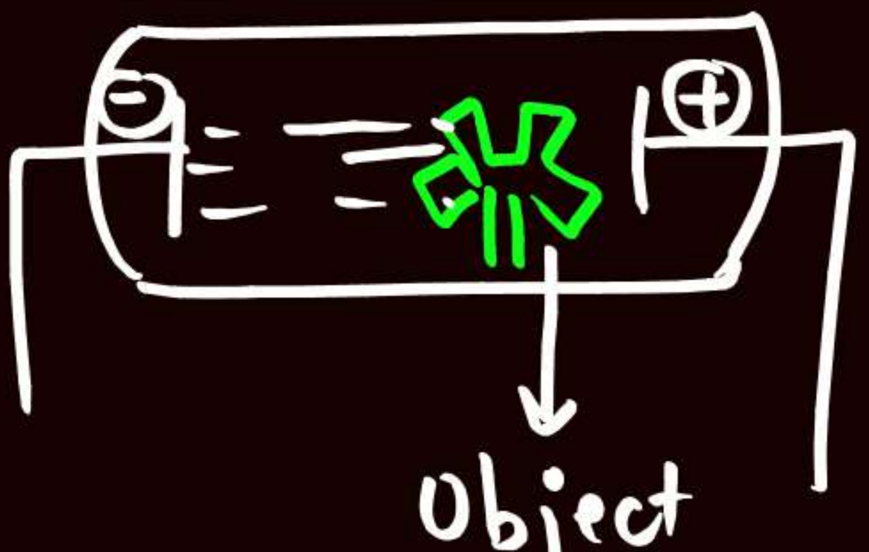
⇒





⇒ Cathode rays travels in straight line in the absence of Electric field & M.F. (Magnetic field)

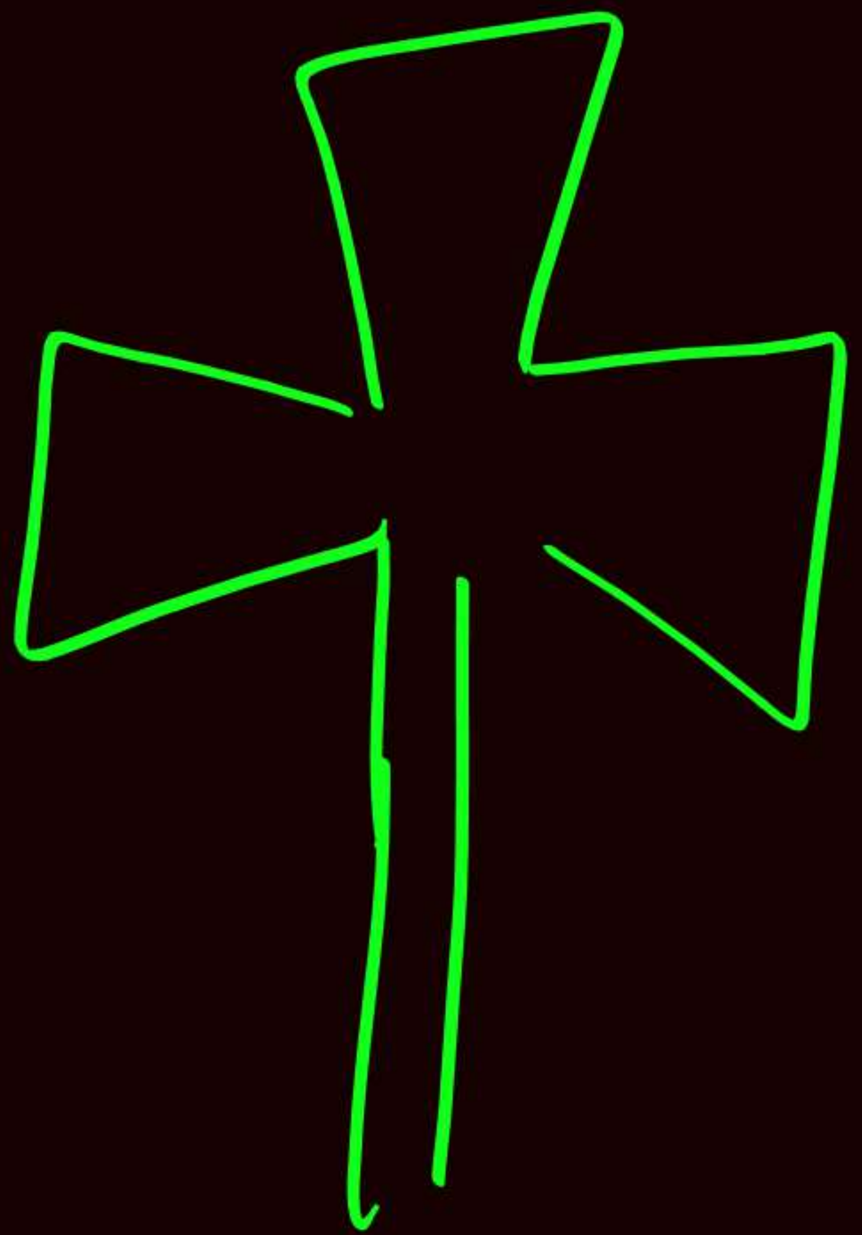
⇒ Cathode rays having particle-nature, Kinetic Energy remains Conseved.



starts rotating

$\Rightarrow$ charge on $e^{\ominus} \Rightarrow -1.6 \times 10^{-19}$ C

$\Rightarrow$ mass of $e^{\ominus} \Rightarrow 9.1 \times 10^{-31}$ Kg



⇒ Specific charge $\left(\frac{\text{charge}}{\text{mass}}\right)$ of Cathode rays is independent of nature of gas and material of metal rod.

it always remains same.

→ $e^{\ominus} \longrightarrow He \longrightarrow He^{+} + e^{\ominus}$

Cathode ray


vaccum pumb
Cathode

thanks
for watching

ARJUNA