① Prove that $\left(V - \frac{h^2}{8\pi^2 m v^2} \right)\psi = E\psi$

→ The equation of a stationary wave is designated by.

$$\psi = A \sin \frac{2\pi x}{\lambda}$$

Double Diff.

$$\frac{d\psi}{dx} = A \cos \frac{2\pi x}{\lambda} \cdot \frac{d}{dx}\left(\frac{2\pi x}{\lambda}\right)$$

$$= A \cos \frac{2\pi x}{\lambda} \cdot \frac{2\pi}{\lambda}$$

Now. diff. again ;

$$\frac{d^2\psi}{dx^2} = - A \sin \frac{2\pi x}{\lambda} \cdot \frac{2\pi}{\lambda} \cdot \frac{2\pi}{\lambda}$$

$$\frac{d^2\psi}{dx^2} = - \psi \cdot \frac{4\pi^2}{\lambda^2}$$

$$\frac{d^2\psi}{dx^2} + \frac{4\pi^2}{\lambda^2}\psi_{(x)} = 0 \text{ —— ①}$$

Now,

$\lambda = \frac{h}{mv}$, $\lambda = \frac{h}{P}$ ⇒. $P = \frac{h}{\lambda}$

$T.E = K.E + P.E$

$= \frac{1}{2}mv^2 + V.$

$⇒ \frac{1}{2}mv^2 = \frac{1}{2}\frac{m^2v^2}{m} = \frac{1}{2}\frac{(p)^2}{m}$

$k = \frac{p^2}{2m} = \frac{h^2}{2m`$

$$\boxed{\lambda^2 = \frac{h^2}{2mK}}$$

Now, put λ^2 in eq-①.

$$\frac{d^2\psi}{dx^2} + \frac{4\pi^2 \times 2m(E-V)\psi}{h^2} = 0.$$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0$$

Now, $$\left(\frac{-h^2}{8\pi^2 m^2}\frac{d^2}{dx^2} + V\right)\psi = E\psi$$

$$\Rightarrow \left(V - \frac{h^2}{8\pi^2 m^2}\frac{d^2}{dx^2}\right)\psi = E\psi.$$

Now,

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} + \frac{8\pi^2 m^2}{h^2}(E-V)\psi = 0$$

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} = \nabla^2$$

$$\nabla^2 + \frac{8\pi^2 m^2}{h^2}(E-V)\psi = 0 \longrightarrow ②$$

Now, multiply $\frac{-h^2}{8\pi^2 m^2}$ in eq ②

$$\left(\frac{-h^2}{8\pi^2 m^2}\nabla^2 + V\right)\psi = E\psi$$

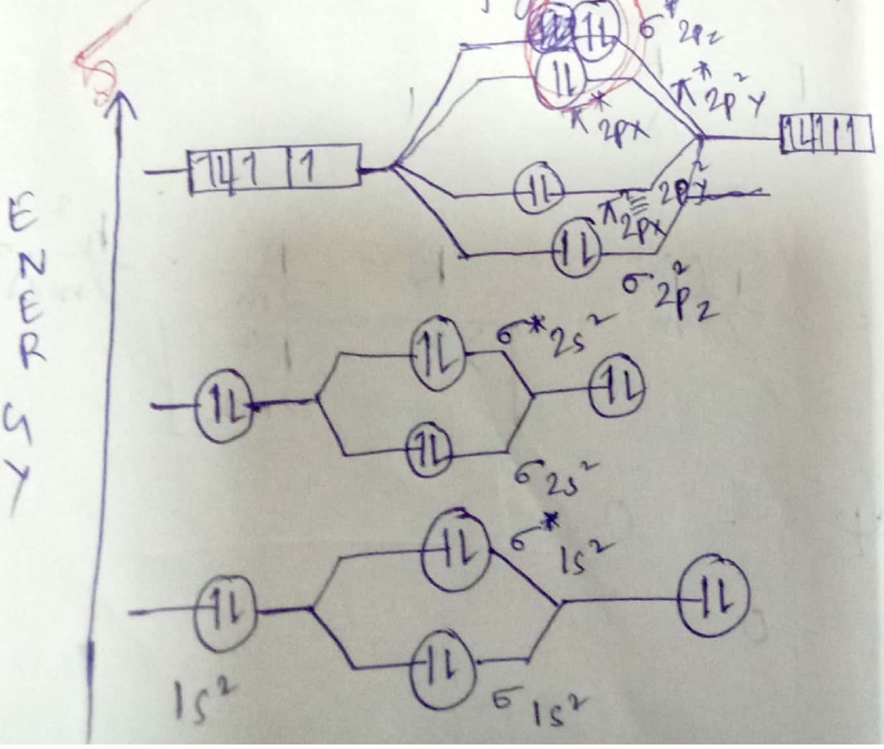
$$\hat{H}\psi = E\psi.$$ Proved

---

② Paramagnetic Behaviour of O_2
↓
It has unpaired (e^-).

Electronic Configuration → $1s^2\ 2s^2\ 2p^4$

$\boxed{\uparrow\downarrow}$ $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow\downarrow|\uparrow|\uparrow}$



$$\sigma_{1s^2} < \sigma^*_{1s^2} < \sigma_{2s^2} < \sigma^*_{2s^2}$$
$$\sigma_{2p_z}^2 < \pi_{2p_x}^2 \equiv \pi_{2p_y}^{*2} <$$
$$\pi^*_{2p_x}{}^2 \equiv \pi^*_{2p_y}{}^2 < \sigma^*_{2p_z}$$

$$\Rightarrow \frac{N_b - N_A}{2} = ②$$

$$\Rightarrow \frac{10-6}{2} = \frac{4}{2} = ②$$

Because O_2 is having the M.O picture.

③ **Vander Waals forces** :- ~~Et~~ Vanderwaals forces are weak electrostatic forces that attract neutral forces. particles in liquid or air vibrates constantly. The particles including ~~rotate~~ collide with each other media particle such as water. This is calle BROWNIAN MOTION.

4 NATURE :-

→ The gas molecules are moving in a random, chaotic motion.

→ The collision between the gas molecules and to the walls is perfectly elastic.

→ The attraction between the gas molecules (repulsive / attraction) is negligible.

④ Equation of state for real gas -

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

$P \rightarrow$ Pressure of Real gas

$V \rightarrow$ volume of Real gas

$R \rightarrow$ gas constant = $R = 8.314$ J/mol

A gas obeys the ideal gas equation $PV = nRT$ under all the condition of temperature and pressure called Ideal gas.

There is no gas which doesn't obeys the Ideal gas under all conditions of tempt and pressure.

significance of constant a and b →

a → Constant a provides the correction for the Intermolecular forces.

b → Constant b provides the volume occupied by a gas particle. It represents the correction for finite molecular size and its value is volume of one mole of the atom/ molecule.

5

⑤ **CHEMICAL POTENTIAL** :— Chemical potential of a substance is the chemical energy per mole of the substance. In the Gibb's free energy is chemical energy, and substance can be a pure substance or a multi component of system.

DERIVATION :—

~~ΔG and ΔH~~

~~$\Delta G = \Delta H - TS$~~

$\Delta G = \Delta H - T\Delta S$.

$w = nFE$ (cell)

W = work.

nFE → total energy.

$\Delta_r G = -W$

$\Delta_r G = -nFE$

emf and ΔG

$\Delta G^\circ = -nFE^\circ_{cell}$

$\Delta G^\circ = -RT\ln K$

$-nFE^\circ_{cell} = -RT\ln K$

$$\boxed{E^\circ_{cell} = (RT/nF) \ln K}$$

Relation Between Emf of cell and ΔH

$$\Delta H = \Delta A - U \Delta TS$$

nFE = total energ.

$$\Delta_r H = -nFE^\circ_{cell}$$

$$\Delta_r H = -RT \ln K.$$

$$-nFH^\circ_{cell} = -RT \ln K.$$

5

$$\boxed{H^\circ_{cell} = RT/nF \ln K}$$