VIDYAPEETH

BATCH CODE: 19-PJ301EA 2025

SUBJECT NAME: CHEMISTRY

CHAPTER NAME:

Atomic Structure

Lecture No. 03

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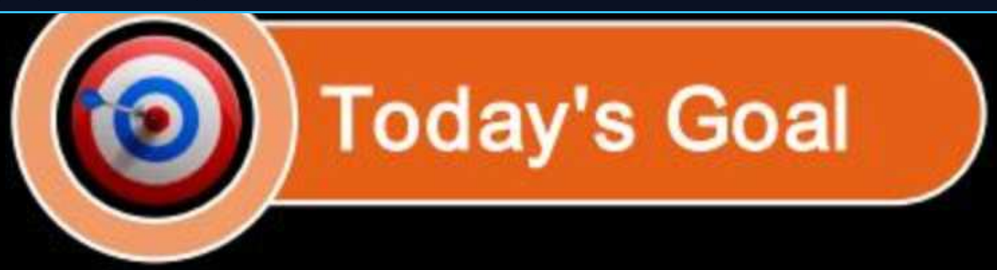

Subtopic

Plank's Theory

Photo electric effect

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Black Body Radiation ⇒

Plank's hypothesis ⇒

- Radiation in the form of Quanta
- each Quanta has fixed energy
- Energy of Quanta ∝ frequency of radiation ∝ $\frac{1}{\text{wavelength of radi}}$
- Energy in the form of bundles

→ $E \propto \nu$ ν = frequency of radiation $\boxed{\nu = \frac{c}{\lambda}}$

✓ $\boxed{E = h\nu} = \frac{hc}{\lambda}$

$h\nu, 2h\nu, 3h\nu, 4h\nu, \cdots$ Quanta received from sun

Photon.

~~1.2×10⁻⁷~~

Energy of photon $= E = h\nu = \frac{hc}{\lambda}$

h = universal plank Constant.

$= 6.6 \times 10^{-34}$ J-Sec.

$\Rightarrow J = \frac{h \times \nu}{\nu}$

$h = J - Sec.$

$E_n = -K \cdot \frac{Z^2}{n^2}$ for H-like atom

Electron transition

$(n_2 > n_1)$

ΔE absorbed

$n_1 \longrightarrow n_2$

ΔE radiated.

$n_2 \longrightarrow n_1$

$$E_{n_1} = -K \cdot \frac{Z^2}{n_1^2}$$

$$E_{n_2} = -K \cdot \frac{Z^2}{n_2^2}$$

$$\Rightarrow \boxed{E_{n_2} - E_{n_1} = KZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = \Delta E}$$

Energy radiated in the form of Quant

$$\boxed{\Delta E = h\nu = \frac{hc}{\lambda}}$$

λ = Wavelength { human eye } → Visible region

$$\Delta E = k \cdot z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{hc}{\lambda} = k \cdot z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

{ Spectrum }

$$\Rightarrow \boxed{\frac{1}{\lambda} = \left(\frac{k}{hc}\right) \cdot z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]}$$

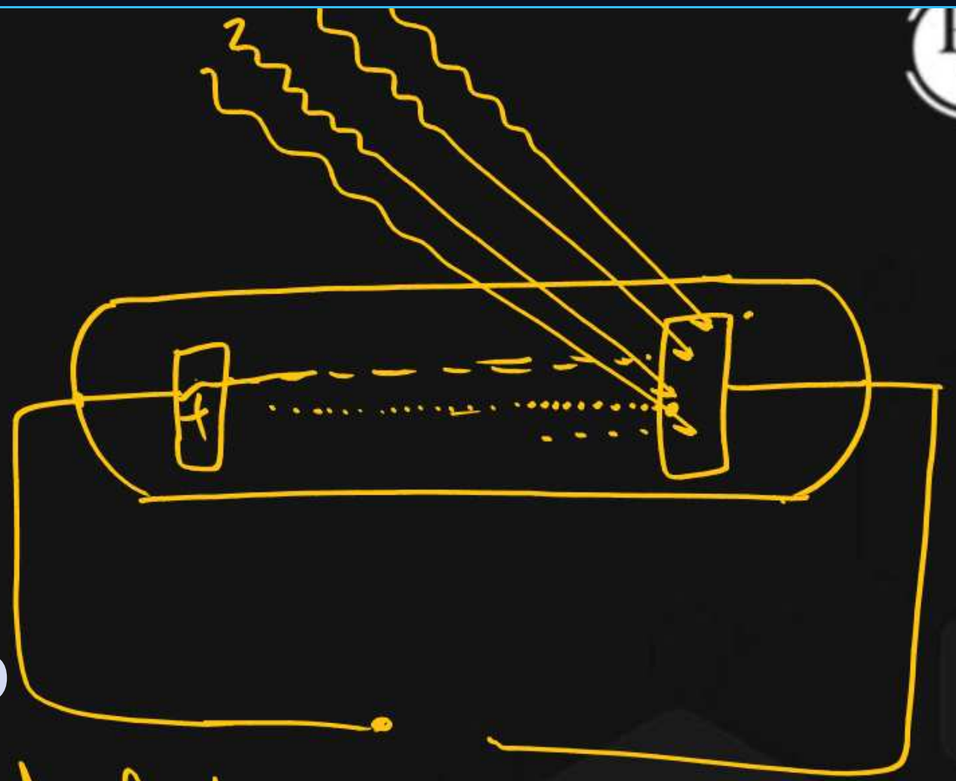
Photo electric effect :-

Threshold energy (E_0) → ϕ (work function)

Energy of incident radiation (E)

→ $E < E_0$; no photoelectric effect

→ $E > E_0$; photo electric effect



⇒ maximum Kinetic energy of emitted photo electron $= E - E_0$

⇒ $\frac{1}{2} m v_{max.}^2 = E - E_0$

According Planks theory

$\Rightarrow \boxed{\frac{1}{2}mv_{max}^2 = h\nu - h\nu_0}$

$\Rightarrow \boxed{\frac{1}{2}mv_{max}^2 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}}$

ν_0 = Threshold frequency

λ_0 = Threshold wavelength

ν = frequency of incident radiation

λ = Wavelength of incident radiation.

Stopping potential = V_0

$eV_0 = (K.E.)_{max.}$

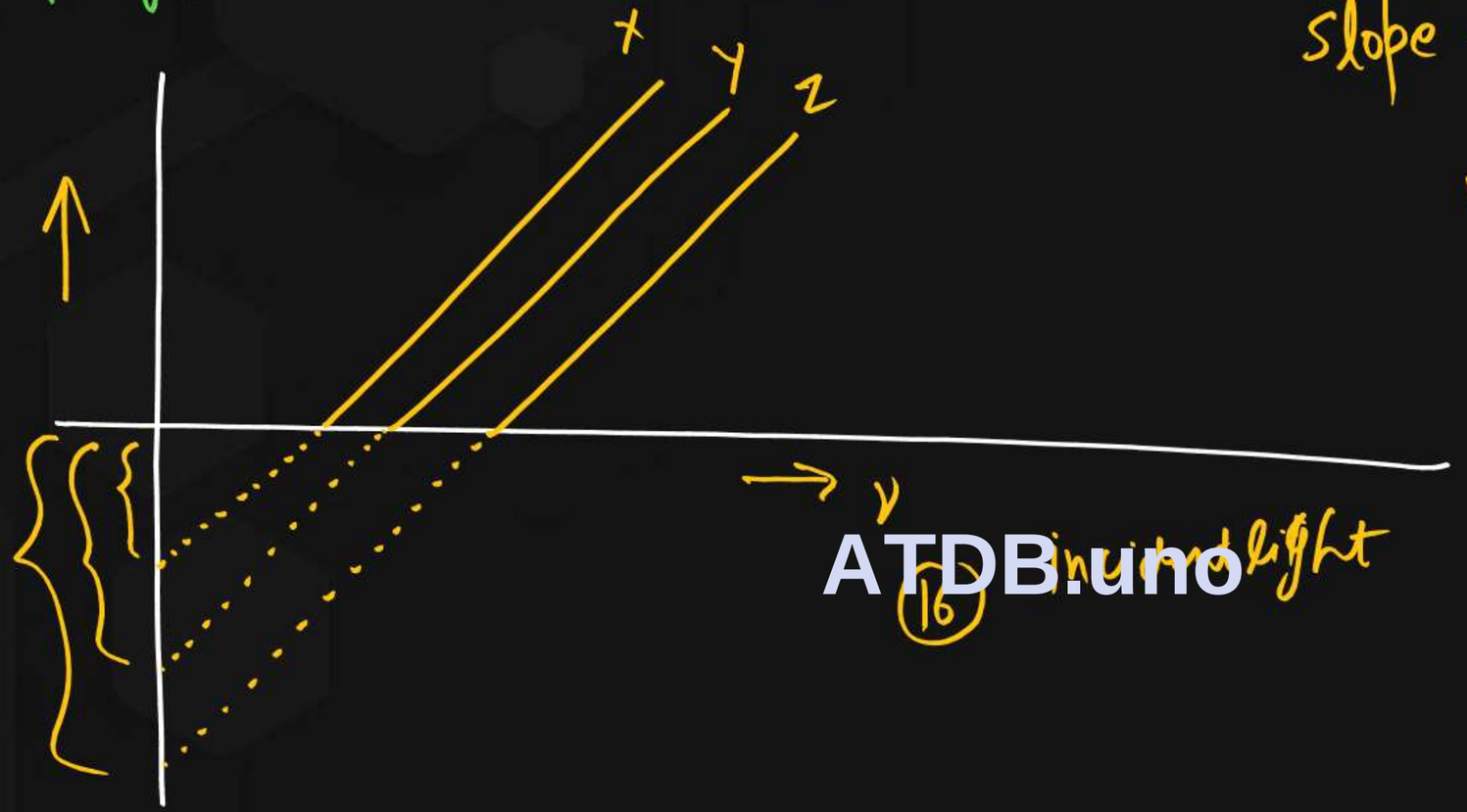
$\Rightarrow eV_0 = h\nu - h\nu_0$

$\Rightarrow V_0 = \left(\frac{h}{e}\right)\nu - \frac{h\nu_0}{e}$

$Y = mX + C$

$\Rightarrow eV_0 = h\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$

Stopping potential V/S Frequency of incident radiation



$$\text{Slope} = \frac{h}{e} \quad \text{(constant)}$$

Work-function
↳ intercept on Y axis

deeper more

incident light electro

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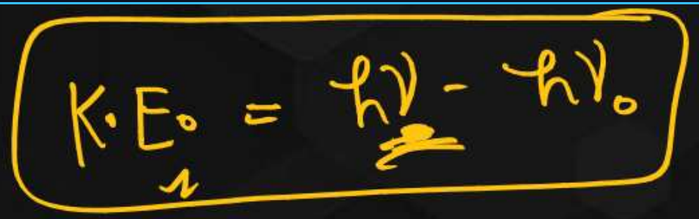

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