Q 1. In a system, a revolving electron has potential energy given by: U = kelnr
Using Bohr's model, find radius of nth orbit of the electron

$$F = -\frac{\partial U}{\partial r}$$
$$= -\frac{d}{dr}(ke\ln r)$$
$$= -\frac{ke}{r}$$

$$\frac{ke}{r} = \frac{mv^2}{r}$$
$$mvr = \frac{nh}{2\pi}$$
$$v = \sqrt{\frac{ke}{m}}$$

$$\boxed{r = \frac{nh}{2\pi m}\sqrt{\frac{m}{ke}}}$$

Q 2. The wavelength of the first line in Balmer series in the hydrogen spectrum is λ. What is the wavelength of the second line

A). 20λ/27 B). 3λ/16 C). 5λ/36 D). 3λ4

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{4} - \frac{1}{n^2}\right)$$

$(n=3) \rightarrow \lambda$ $\quad \frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{9}\right)$

$$\lambda = \frac{36}{5R}$$

$$\frac{1}{\lambda'} = R\left(\frac{1}{4} - \frac{1}{4^2}\right)$$

$$\lambda' = \frac{16}{3R}$$

$$\lambda' = \frac{16 \times 5\lambda}{3 \times 36} = \frac{20}{27}\lambda$$

Q 3. In a hypothetical atom, if transition from n = 4 to n = 3 produces visible light then the possible transition to obtain infrared radiation is

A). n = 5 to n = 3

B). n = 4 to n = 2

C). n = 3 to n = 1

D). None of these

ABLES KOTA

Remaining 8 properties of electron in Bohr's atomic model

$$\omega_n = \frac{2\pi}{T_n} = \frac{v_n}{r_n} \propto \frac{(Z/n)}{(n^2/Z)} \propto \frac{Z^2}{n^3}$$

$$= 2\pi f_n \propto Z^2/n^3$$

$$\boxed{T_n \propto n^3/Z^2}$$

$$\underset{\text{(current)}}{i_n} = \frac{e}{T_n} \propto Z^2/n^3$$

$$\boxed{\omega_n / f_n / i_n \propto Z^2/n^3}$$

Remaining 8 properties of electron in Bohr's atomic model

B_n (Magnetic field) $\propto \frac{\mu_0 i_n}{2 r_n}$

$\propto \frac{\mu_0}{2} \times \frac{(Z^2/n^3)}{(n^2/Z)}$

$\propto Z^3/n^5$

a_n (centripetal acc.) $\propto v_n^2/r_n \propto (Z/n)^2/(n^2/Z) \propto Z^3/n^4$

ABLES KOTA

Remaining 8 properties of electron in Bohr's atomic model

M_n (Magnetic Moment) $\propto i_n \times \pi r_n^2$

$\propto \frac{Z^2}{n^3} \times \left(\frac{n^2}{Z}\right)^2$

$\propto n$

$\boxed{M_n = \frac{e n}{2m_e}} \rightarrow n=1 \quad \boxed{M_1 = \frac{e}{2m_e}}$ Bohr Magneton.

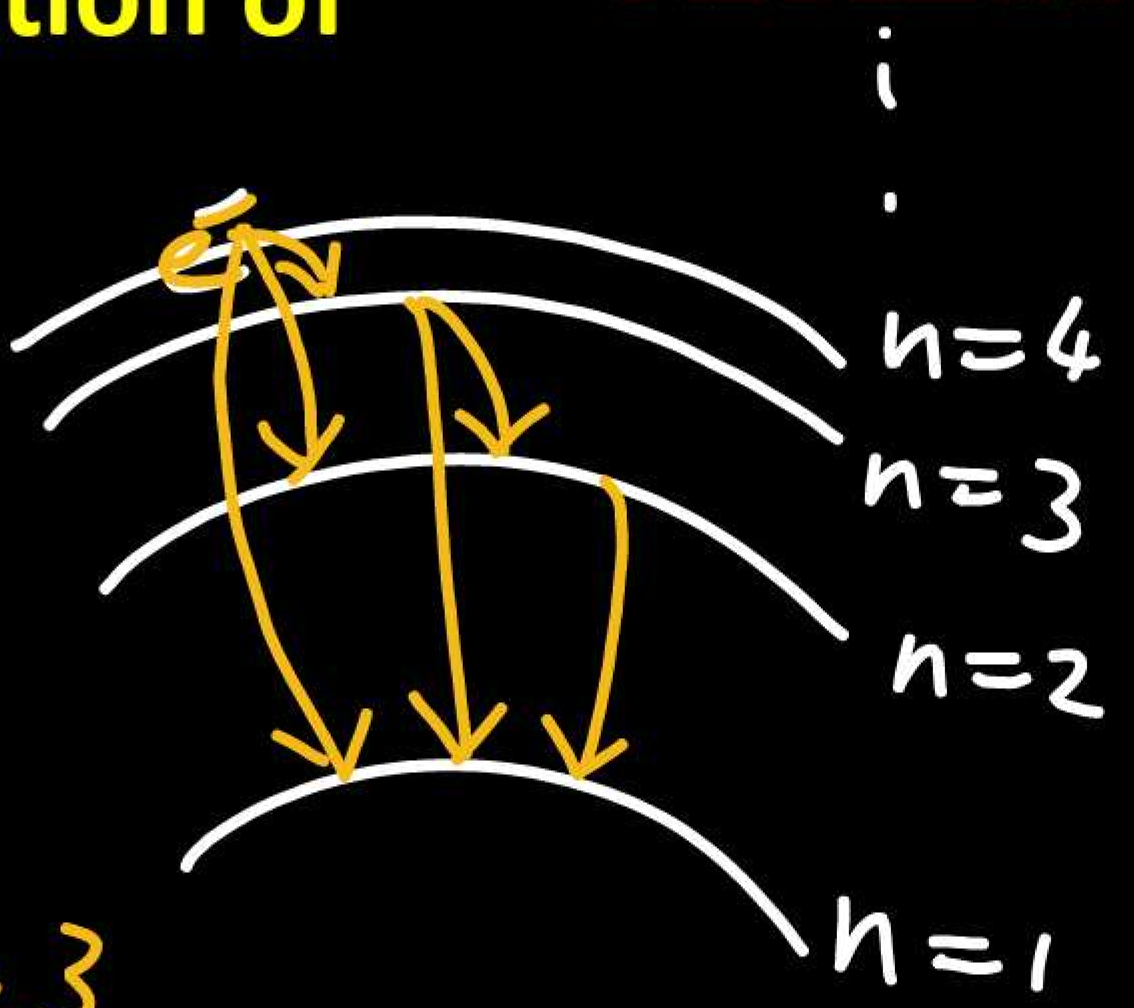
Remaining 8 properties of electron in Bohr's atomic model

$$L_n = \frac{nh}{2\pi}$$

(Angular Momentum)

Bohr's Atomic Model **(1913): De-Excitation of an atom**

Q. What could be the maximum number of possible different photons emitted from nth state?



$$^{n}C_2 = \boxed{\frac{n(n-1)}{2\times 1}}$$

$$^{3}C_2 = \frac{3\times 2}{2\times 1} = 3$$

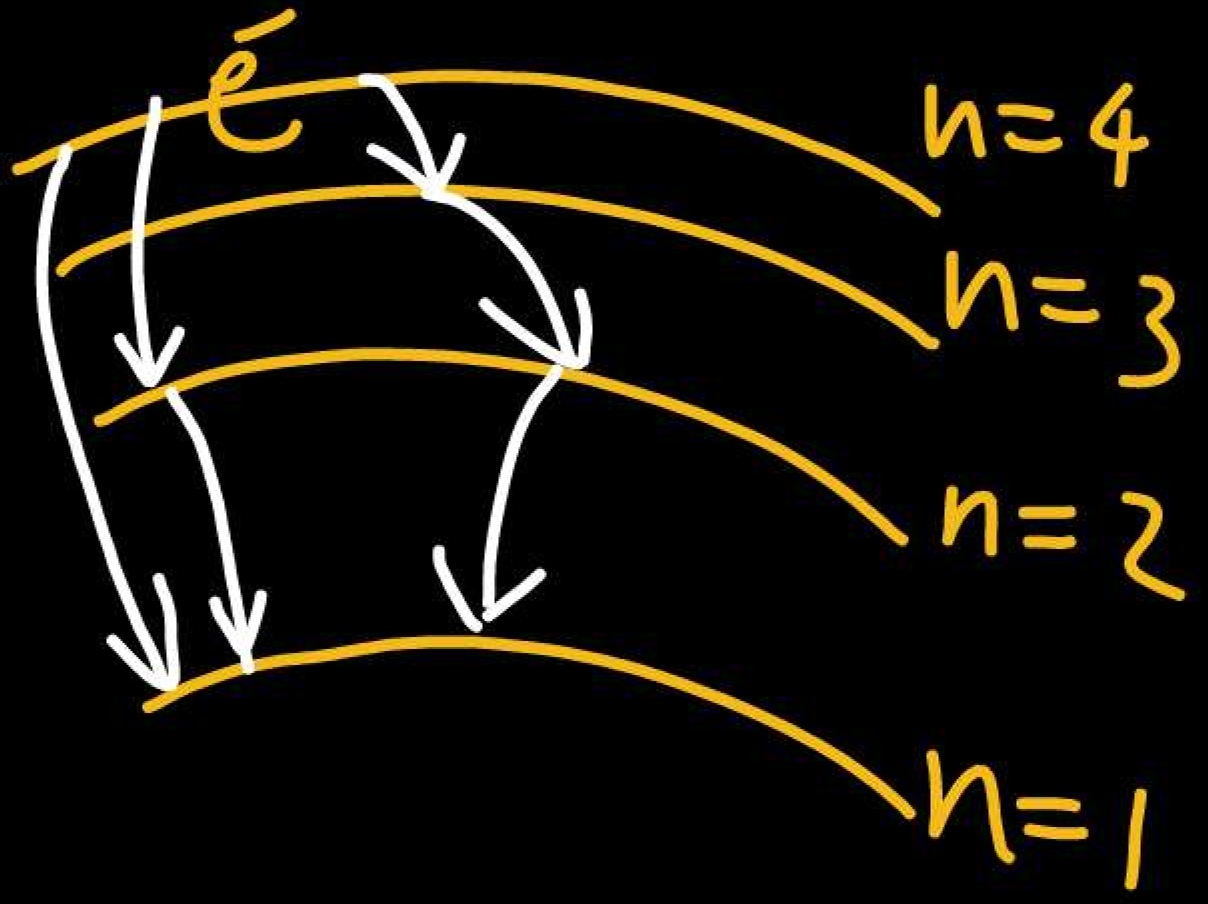
$$^{4}C_2 = \frac{4\times 3}{2\times 1} = 6$$

Bohr’s Atomic Model **(1913): De-Excitation of an atom**

Q. What could be the maximum/minimum number of spectral lines emitted by one atom from nth state?

1

$(n-1)$ spectral lines (Max^m)



Bohr's Atomic Model **(1913): Ionization & Excitation of an atom**

(TE) $E_n = -(13.6\,eV)\frac{Z^2}{n^2}$

$E_1 = -13.6\,eV$ (Lower energy)

$E_4 = -0.84\,eV$ (Higher energy)

Bohr's Atomic Model **(1913): Ionization & Excitation of an atom**

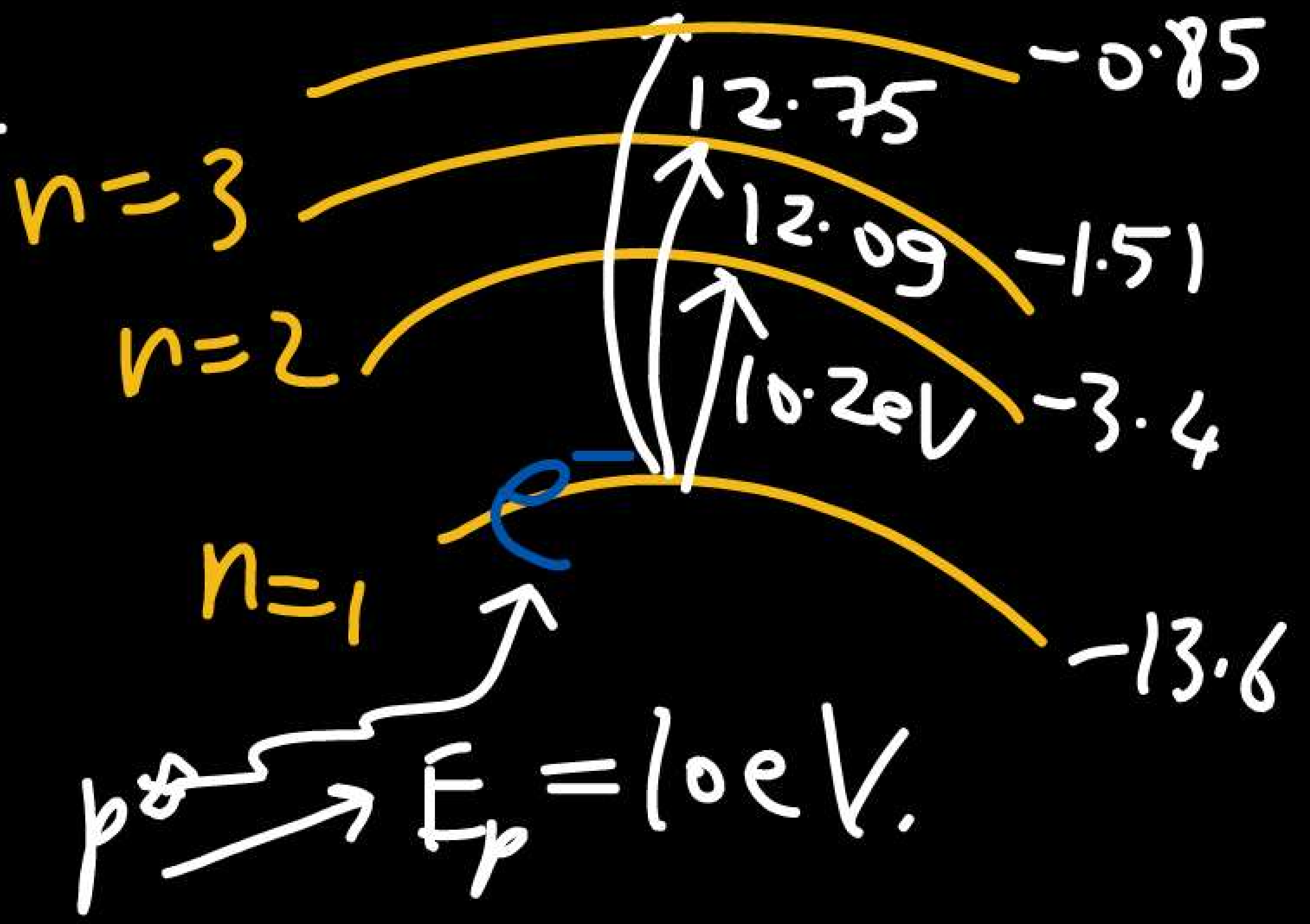
Excitation → $n = n_1$ to $n = n_2$

Ionization → $n = n$ to ∞

Two ways to excite/ionize e^-

1). Striking EM radiation (Photons)

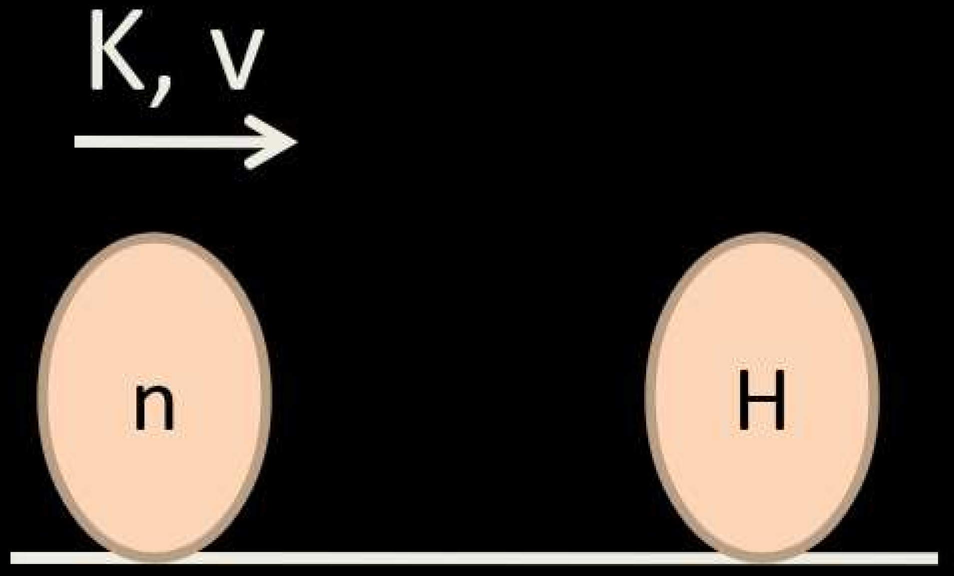
2). through Collision.



Bohr's Atomic Model **(1913): Ionization & Excitation – Atomic Collision**

Q 1). H-atom at rest in ground state & free to move. Neutron with kinetic energy, **K** collides with it. What will be the type of collision, if

K = $\boxed{14 \text{ eV}}$, 20.4 eV, 22 eV, 24.18 eV



if $K = 14\,eV$, $\Delta E_N = (0, 7\,eV)$
elastic collision.

if $K = 20.4\,eV$, $\Delta E_N = (0, 10.2\,eV)$

$\Delta E = [0, 10.2\,eV, 12.09\,eV, 12.75\,eV \ldots]$

As per Newtonian Mech. $\Delta E = ?$

$\Delta E = [0, K/2]$

(Energy loss in Collision) →

→ K, v_0

n

H atom.

$\boxed{K_1 = \frac{1}{2} m v_0^2}$

@rest

$\Delta E = [0, K/2]$

1). elastic collision, $\Delta E = 0$.

2). perfectly inelastic Collision.

$\boxed{\Delta E_{max} = K/2}$

Conservation of momentum → $m v_0 = 2m v_f$

$v_f = v_0/2$

final K.E. = $K_f = \frac{1}{2} \times 2m v_f^2$

$K_f = \frac{1}{2} 2m v_0^2/4 = \frac{m v_0^2}{4}$

$\boxed{K_f = K_i/2}$