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physical chemistry by akk sir

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

energy of a photon

planck's const $= 6.626 \times 10^{-34}$ J-sec

C = speed of light $= 3 \times 10^{8}$ m/sec

$$\boxed{1\,eV = 1.6 \times 10^{-19}\,J}$$

$$E = \frac{hc}{\lambda} = \frac{1240\ nm.eV}{\lambda(nm)}$$

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Q.1 find Energy of a photon of wavelength = 6626 Å (Joule)

Q.2 find energy of a photon (in eV) having $\lambda = 310$ nm.

Q.1 $E = \dfrac{\cancel{6.626} \times 10^{-34} \times 3 \times 10^{8}}{\cancel{6626} \times \cancel{10^{-10}}}$ $\cancel{10^{3}}$ 10^{-7}

$= 3 \times 10^{-19}$ J

3×10^{-34}

4.8×10

3×10^{-28}

3×10^{-29}

3×10^{-11}

Q.2 $E = \dfrac{1240 \cancel{\text{nm}}.\text{eV}}{310 \cancel{\text{nm}}} = 4\text{eV} = \underline{4 \times 1.6 \times 10^{-19}\ \text{J}}$

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Q. find the number of photon emitted by a bulb of capacity $\underline{60\ W}$ if it emits light of $\lambda = 3313\ \mathring{A}$ only. in 1 sec

(Watt = J/sec)

$$E = \frac{\cancel{6.626}^{\,2} \times 10^{-34} \times 3 \times 10^{8}}{\cancel{10^{3}} \times \cancel{3313} \times \cancel{10^{-10}}\ 10^{-7}}$$

$$= 6 \times 10^{-19}\ J$$

$$\text{no. of photon} = \frac{60}{6 \times 10^{-19}}$$

$$= 10^{20}$$

Q. find the ~~minimum~~ maximum wavelength of a photon required to break the H–H bond. Given

[$BE_{H-H} = 6.62 \times 6.022 \times 10 \ kJ/mol$

$H - H$

$$\frac{\text{Bond energy}}{\text{one bond}} = \frac{\cancel{6.62} \times \cancel{6.022} \times 10^4}{\cancel{6.022} \times 10^{23}} J = \frac{hc}{\lambda} = \frac{\cancel{6.62} \times 10^{-34} \times 3 \times 10^8}{\lambda}$$

$$\lambda = \frac{10^{-34} \times 3 \times \cancelto{10^4}{10^8} \times 10^{23}}{\cancel{10^4}}$$

$$= \underline{3 \times 10^{-7} m} = 3000 \times 10^{-10} m = 3000 Å$$

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Drawbacks of Rutherford Model

(1) 

According to Maxwell electromagnetic theory, charged particles when accelerated must emit energy. Therefore an e^- in a circular path will emit energy and should fall in the nucleus following a spiral path, but anything like this does not happen. Rutherford failed to explain this.

(2) It says nothing about distribution of e^- around the nucleus and the energies of these electrons

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Bohr model :– It is based on Rutherford Model and plancks quantum theory.

Postulates of Bohr Model

1). An atom have a nucleus where all the neutrons and protons are present and e^- revolves in circular path (orbit) around the nucleus.

2.)

Out of infinite no. of circular orbit an e^- can revolve in only those orbits for which angular momentum is integral multiple of $\frac{h}{2\pi}$

$$mvr = n\frac{h}{2\pi} \qquad n = 1, 2, 3 \ldots$$

This is knowas as Bohr's quantisation of angular momentum.

these orbits are called stationary orbit.

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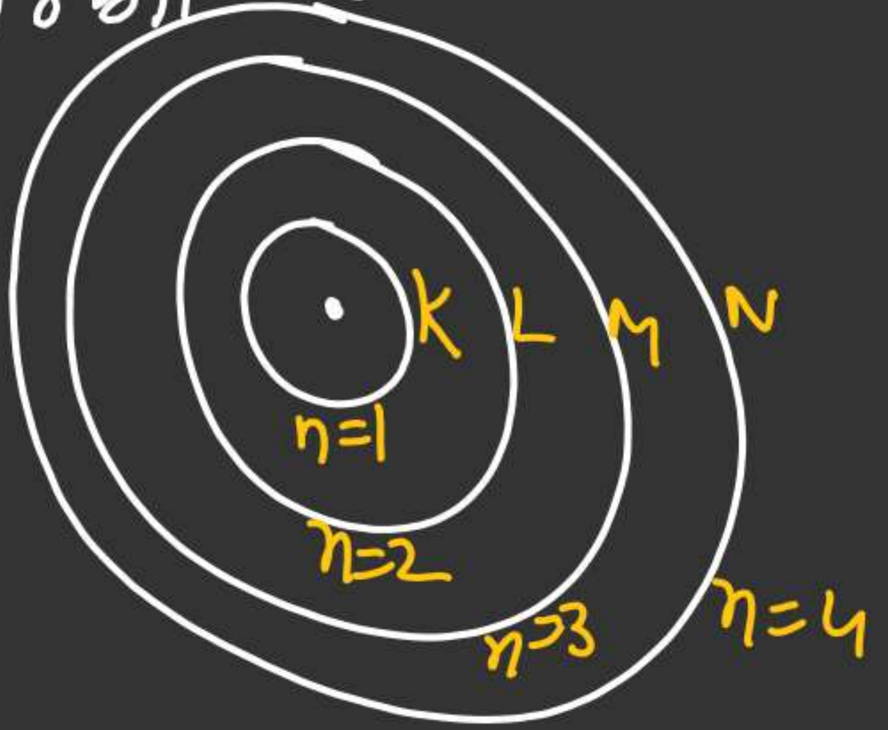
(3) An e^- does not loose or gain energy as far as it revolves in a stationary orbit.

(4) An e^- can emit or absorb energy when it jumps from one stationary orbit to another.

(5) As we move away from the nucleus energy of orbit increases.



$$E_K < E_L < E_M < E_N$$

K-shell

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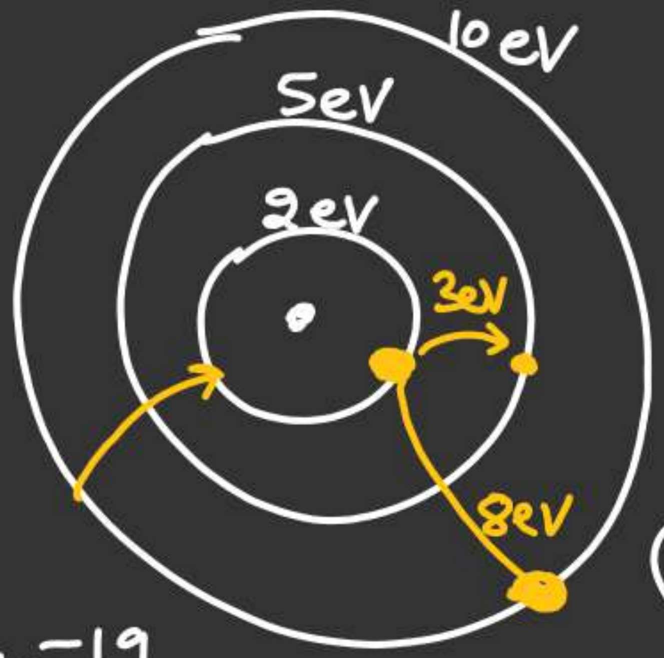
⑥ An e^- emit or absorb only one photon per jump

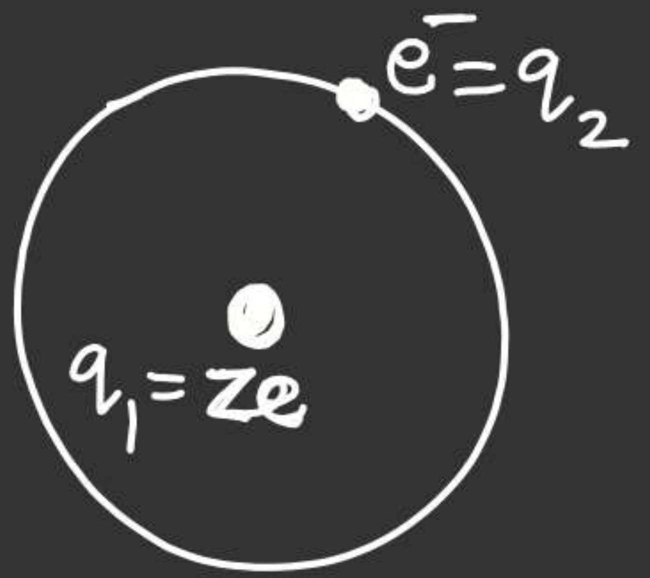


energy of photon $= E_{higher} - E_{lower}$

$$h\nu = \frac{hc}{\lambda} = E_{higher} - E_{lower}$$

$e = 1.6 \times 10^{-19}$

⑦ Electrostatic force betn e^- and nucleus provide the required centripetal force



$$\frac{mv^2}{r} = \text{centripetal force} = \frac{Kq_1q_2}{r^2}$$

$$\frac{mv^2}{r} = \frac{K(Ze)(e)}{r^2} = \frac{KZe^2}{r^2}$$

(for single e^- specie)

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$$mvr = \frac{nh}{2\pi} \quad \text{— (1)}$$

$$\frac{mv^2}{r} = \frac{KZe^2}{r^2} \quad \text{— (2)}$$

by eq (1)

$$v = \frac{nh}{2\pi mr}$$

by putting it in eq (2)

$$\frac{m}{r}\left(\frac{n^2h^2}{4\pi^2 m^2 \cancel{r^2}}\right) = \frac{KZe^2}{\cancel{r^2}}$$

$$\boxed{r = \frac{n^2h^2}{4\pi^2 KZe^2 m}}$$

$h = 6.626 \times 10^{-34}$

$k = 9 \times 10^{9}$

$e = 1.6 \times 10^{-19}$

$m = 9.1 \times 10^{-31}$ kg

$$\boxed{r = 0.529 \frac{n^2}{Z} \text{ A}^\circ}$$

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$$\cancel{m}v\left(\frac{n^2h^2}{4\pi^2KZe^2\cancel{m}}\right)=\frac{nh}{2\pi}$$

$$\boxed{v=\frac{2\pi KZe^2}{nh}}$$

$$\boxed{=2.188\times10^6\,\frac{Z}{n}}\ \ m/sec$$

$$\boxed{r\propto\frac{n^2}{Z}}$$

$$\boxed{v\propto\frac{Z}{n}}$$

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$\boxed{\begin{array}{ll} 0-I & 1-4 \\ S-I & 1-8 \end{array}}$

Atomic str

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$$1 \overset{\circ}{A} = 10^{-10} m$$

$$1 nm = 10^{-9} m$$

$$1 pm = 10^{-12} m$$

$$1 fm = 10^{-15} m$$

$\uparrow$

fermi