

ATOMIC STRUCTURE

Particle	Symbol	Charge	Relative charge	Mass	Relative mass w.r.t H	$\frac{e}{m}$ ratio
Electron	e^-	$-1.6 \times 10^{-19} \text{ C}$	-1	$9.1 \times 10^{-31} \text{ gram}$	$\frac{1}{1837}$	1837
Proton	p^+	$+1.6 \times 10^{-19} \text{ C}$	+1	$1.672 \times 10^{-24} \text{ g}$	1	1
Neutron	n^0	Zero	Zero	$1.672 \times 10^{-24} \text{ g}$	1	0
α -Particle	${}_2\text{He}^+$	$2 \times 1.6 \times 10^{-19} \text{ C}$	+2	$4 \times 1.672 \times 10^{-24} \text{ g}$	4	$\frac{1}{2}$

Thomson's atomic model

(Plum pudding / Watermelon model)

- +ve charge \rightarrow uniformly distributed
- -ve charge \rightarrow embedded in cloud of the charge.
- Limitation \rightarrow doesn't explain stability

Rutherford's experiment

(Discovery of nucleus)

Atom $\begin{cases} \rightarrow \text{Nucleus (Proton)} \\ \rightarrow \text{Extranuclear part (e}^-) \end{cases}$

$$r_{\text{nucleus}} = K(A)^{1/3}$$

$$\left(\frac{dr_{\text{nuc}}}{dA}\right)_1 = \left(\frac{A_1}{A_2}\right)^{1/3}$$

$$V_{\text{nucleus}} = \frac{4}{3} \pi R^3 \rho$$

$$\frac{V_{\text{nuc}1}}{V_{\text{nuc}2}} = \frac{A_1}{A_2}$$

$$V_{\text{atom}} \approx 10^{15} \times V_{\text{nucleus}}$$

Term associated with element

Z $\begin{cases} \nearrow A \rightarrow \text{Mass number (P+n)} \\ \searrow \rightarrow \text{Atomic number (P)} \end{cases}$

- **Isotope** $\rightarrow Z \rightarrow$ same $A \rightarrow$ different
- **Isobar** $\rightarrow Z \rightarrow$ different $A \rightarrow$ same
- **Isotone** $\rightarrow A - Z = n \rightarrow$ same
- **Isotectonic** \rightarrow Same no. of e^- (NO^0, CO)
- **Isosteric** \rightarrow Same no. of atom and e^- (CO_2, N_2)
- **Isotophers** $\rightarrow (n-p) \text{ or } (A-2Z) \rightarrow$ same
- **Paramagnetic** \rightarrow Having nonzero unpaired e^-
- **Diamagnetic** \rightarrow Having zero unpaired e^-

Dual nature of light

Wave nature

• Wave length (λ)
distance between 2 crest or trough or length of one wave.

• Wave no. $\left[\nu = \frac{1}{\lambda} \right]$

• frequency $\left[\nu = \frac{c}{\lambda} \right]$

$c \rightarrow 3 \times 10^8 \text{ m/s}$

$\nu \propto \frac{1}{\lambda} \rightarrow \left[\frac{\nu_1}{\nu_2} = \frac{\lambda_2}{\lambda_1} \right]$

Particle nature

• photon \rightarrow quanta of light.

$$E = h\nu$$

$h \rightarrow$ plank's constant
 $h = 6.6 \times 10^{-34} \text{ joule sec}$

$$E = n \times E_{\text{min}}$$

\downarrow
integral multiple

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

$$\frac{E_1}{E_2} = \frac{\nu_1}{\nu_2} \quad \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$$

Photoelectric effect

- example of particle nature.
- Surface phenomena
- Single photon release single e^-

$$h\nu = \omega + KE \quad \omega \rightarrow \text{work function}$$

$$h\nu = h\nu_0 + \frac{1}{2} m_e v_e^2 \quad \nu \rightarrow \text{incident frequency of photon}$$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + \frac{1}{2} m_e v_e^2 \quad \nu_0 \rightarrow \text{Threshold frequency of metal.}$$

$\nu > \nu_0 \rightarrow e^-$ emitted with KE
($\lambda < \lambda_0$)

$\nu = \nu_0 \rightarrow e^-$ emitted without KE
($\lambda = \lambda_0$)

$\nu < \nu_0 \rightarrow e^-$ not emitted.
($\lambda > \lambda_0$)

Chemistry Notes Chapter 5 Atomic Structure And The

JS Bruner



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