

Handwritten Notes
On
Atomic Structure



Atomic Structure.

1. α -particle approach, $R = \frac{4KZe^2}{m_\alpha V_\alpha^2}$

2. $R = R_0 A^{1/3}$ [$R_0 = 1.4 \times 10^{-13}$ cm & $A \rightarrow$ mass number]

3. $m' = \frac{m_0}{\sqrt{1-(v/c)^2}}$

4. Energy / Photon, $E = h\nu - \frac{hc}{\lambda} = \frac{12375}{\lambda} \text{ eV}$ [λ is in \AA]

5. $r_n = \frac{n^2 h^2}{4\pi^2 m Z e^2}$ | $r_n = 0.529 \cdot n^2$ | $r_n = \frac{0.529}{Z}$ [in cgs,]

$r_1 = 0.529 \text{ \AA}$

6. $v_n = \frac{2\pi Z e^2}{nh}$ | $v_n = 2.1847 \times 10^8 \cdot Z$ | $v_n = \frac{2.1847 \times 10^8}{n}$
[in cgs].

$v_1 = 2.1847 \times 10^8 \text{ cm/s}$

7. $E_n = -\frac{2\pi^2 Z^2 e^4 m}{n^2 h^2}$ | $E_n = -13.6 \cdot Z^2$ | $E_n = -13.6/n^2 \text{ eV}$

$E_1 = -21.72 \times 10^{-12} \text{ erg} = -13.6 \text{ eV}$

8. $\bar{\nu} = \frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$ [in cgs]. [$R_H = 109677 \text{ cm}^{-1}$]

9. $E = h\nu$ | $h\nu = h\nu_0 + \frac{1}{2} m v_{\max}^2 = \phi + \frac{1}{2} m e v_{\max}^2$

10. $mvr = m r^2 \omega = m \frac{h}{2\pi}$ | orbital angular momentum. $\sqrt{l(l+1)} \frac{h}{2\pi}$ | $S = \sqrt{s(s+1)} \frac{h}{2\pi}$

11. $\lambda = \frac{h}{mv} = \frac{h}{p}$

12. $eV = \frac{1}{2} m v^2$

$\Rightarrow v = \sqrt{\frac{2eV}{m}} = \sqrt{\frac{2E}{m}} = \frac{h}{m\lambda}$

$\Rightarrow \lambda = \frac{h}{\sqrt{2meV}} = \frac{h}{\sqrt{2mE}}$

$\Rightarrow \lambda = \frac{12.26 \times 10^{-10}}{\sqrt{V}} \text{ m}$
 $= \frac{1.226}{\sqrt{V}} \text{ nm}$

13. $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

14. radial node = $n-l-1$
angular node = l
total node = $n-1$

15. $n = 1, 2, 3, \dots$

$l = 0, 1, 2, \dots (n-1)$

$m = (-l) \dots 0 \dots (+l)$

$s = \pm \frac{1}{2}$ number of unpaired electrons.

16. $\mu_B = \frac{eh}{4\pi m}$

$\mu = \sqrt{h(h+2)} \text{ BN}$

17. No. of orbitals in subshell = $2l+1$.

18. Spectral lines \rightarrow Lyman (UV), Balmer (Visible),
Paschen (IR), Brackett (IR),
Pfund (Far IR), Humphrey (Far IR)

19. h , Planck's constant = 6.63×10^{-27} erg.s.

$$m_e = 9.11 \times 10^{-28} \text{ g} \quad | \quad \pi = 3.14$$

$$q_e = 4.8 \times 10^{-10} \text{ esu} \quad | \quad c = 3 \times 10^8 \text{ m/s}$$

$$N_A = 6.022 \times 10^{23} \quad | \quad \text{For SI,}$$

$$1 \text{ eV} = 1.602 \times 10^{-12} \text{ erg} \quad | \quad E = -\frac{Z^2 e^4 m}{8 \epsilon_0^2 h^2}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ coulomb}^2 / \text{newton} \cdot \text{m}^2 \quad | \quad (\text{m}^2 \text{N})$$