DefenceGuru™

(Physics)

6 Modern Physics

6.1: Photo-electric effect

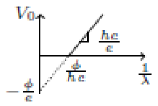
Photon's energy: $E = h\nu = hc/\lambda$

Photon's momentum: $p = h/\lambda = E/c$

Max. KE of ejected photo-electron: $K_{\max} = h\nu - \phi$

Threshold freq. in photo-electric effect: $\nu_0 = \phi/h$

Stopping potential: $V_o = \frac{hc}{e}\left(\frac{1}{\lambda}\right) - \frac{\phi}{e}$



de Broglie wavelength: $\lambda = h/p$

6.2: The Atom

Energy in nth Bohr's orbit:

$$E_n = -\frac{mZ^2e^4}{8\epsilon_0{}^2h^2n^2}, \quad E_n = -\frac{13.6Z^2}{n^2}\text{ eV}$$

Radius of the nth Bohr's orbit:

$$r_n = \frac{\epsilon_0 h^2 n^2}{\pi m Z e^2}, \quad r_n = \frac{n^2 a_0}{Z}, \quad a_0 = 0.529\text{ Å}$$

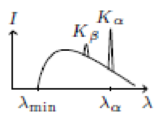
Quantization of the angular momentum: $l = \frac{nh}{2\pi}$

Photon energy in state transition: $E_2 - E_1 = h\nu$

Wavelength of emitted radiation: for a transition from nth to mth state:

$$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n^2} - \frac{1}{m^2}\right]$$

X-ray spectrum: $\lambda_{\min} = \frac{hc}{eV}$



Moseley's law: $\sqrt{\nu} = a(Z - b)$

X-ray diffraction: $2d\sin\theta = n\lambda$

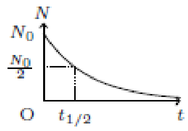
Heisenberg uncertainity principle:
$\Delta p\Delta x \geq h/(2\pi), \quad \Delta E\Delta t \geq h/(2\pi)$

6.3: The Nucleus

Nuclear radius: $R = R_0A^{1/3}, \quad R_0 \approx 1.1\times10^{-15}$ m

Decay rate: $\frac{dN}{dt} = -\lambda N$

Population at time t: $N = N_0e^{-\lambda t}$



Half life: $t_{1/2} = 0.693/\lambda$

Average life: $t_{\text{av}} = 1/\lambda$

Population after n half lives: $N = N_0/2^n$.

Mass defect: $\Delta m = [Zm_p + (A - Z)m_n] - M$

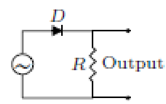
Binding energy: $B = [Zm_p + (A - Z)m_n - M]\,c^2$

Q-value: $Q = U_i - U_f$

Energy released in nuclear reaction: $\Delta E = \Delta mc^2$ where $\Delta m = m_{\text{reactants}} - m_{\text{products}}$.

6.4: Vacuum tubes and Semiconductors

Half Wave Rectifier:



Full Wave Rectifier: