12 Physics – Modern Physics Formula List

Photon's energy

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

Photon's momentum

$$p = \frac{h}{\lambda} = E/c$$

Max. KE of ejected photo-electron

$$K_{max} = h\nu - \emptyset$$

Threshold freq. in photo-electron effect

$$\nu_0 = \frac{\emptyset}{h}$$

De Broglie wavelength

$$\lambda = \frac{h}{p}$$

Energy in nth Bohr's orbit

$$E_n = -\frac{mZ^2e^4}{8\epsilon_0^2 h^2 n^2}$$

Radius of the nth Bohr's orbit

$$r_n = \frac{\epsilon_0 h^2 n^2}{\pi m Z e^2}$$

Wavelength of emitted radiation

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

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 uncertainty principle

$$\Delta p \Delta x \geq \frac{h}{2\pi}, \qquad \Delta E \Delta t \geq \frac{h}{2\pi},$$

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Nuclear radius	$R = R_0 A^{\frac{1}{3}},\ R_0 \approx 1.1 \times 10^{-15} m$
Decay rate	$\frac{dN}{dt} = -\lambda N$
Population at time	$N = N_0 e^{-\lambda t}$
Half life	$t_{\frac{1}{2}} = \frac{0.693}{\lambda}$
Average Life	$t_{av} = \frac{1}{\lambda}$
Population after n half lives	$N = \frac{N_0}{2^n}$
Mass defect	$\Delta m = \left[Zm_p + (A-Z)m_n\right] - M$
Binding energy	$B = \left[Zm_p + (A-Z)m_n - m\right]c^2$
Q- value	$Q = U_i - U_f$
Energy released in nuclear reaction	$\Delta E = \Delta m c^2$ where $\Delta m = m_{reactants} - m_{products}$.
Relationship between r_p, μ, and g_m	$\mu = r_p \times g_m$
Current in a transistor	$I_e = I_b + I_c$