

## Area Of Study 2, Interactions Of Light And Matter, Formula And Data Sheet

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### Wave Formulæ

Period and Frequency:  $f = \frac{1}{T} = T^{-1} \rightarrow T = \frac{1}{f} = f^{-1}$

Velocity:  $v = \frac{\lambda}{T} = f\lambda$

Reflection:  $r^\circ = i^\circ$

Refraction:  $\frac{\sin i^\circ}{\sin r^\circ} = \frac{n_2}{n_1} = \frac{v_1}{v_2}$

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### Diffraction and Interference Formulæ

Path difference along antinodal lines:  $pd = m\lambda$

Path difference along nodal lines:  $pd = (n - \frac{1}{2})\lambda$

Double slit interference:  $\lambda = \frac{xd}{L}$

Single slit interference:  $\lambda = \frac{xw}{L}$

Interference pattern comparison:  $\lambda_{unknown} = \frac{\text{Number of bright bands in pattern of } \lambda_{known}}{\text{Number of bright bands in pattern of } \lambda_{unknown}} \times \lambda_{known}$

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### Photoelectric Effect Formulæ

Stopping Voltage and Photoelectron Energy:  $V_0 = E_K$

Electron Volts to Joules:  $1\text{eV} = 1.6 \times 10^{-19}\text{J}$

Photon Energy:  $E_{\text{photon}} = hf = \frac{hc}{\lambda}$

Photon Energy:  $E_{\text{photon}} = E_K + W$

Photoelectron Energy:  $E_K = E_{\text{photon}} - W$

Work Function:  $W = hf_0$

Photon Momentum:  $p = \frac{hf}{c} = \frac{h}{\lambda}$

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### Matter Waves Formulæ

de Broglie Wavelength:  $\lambda = \frac{h}{p} \rightarrow \lambda = \frac{h}{mv}$

Kinetic Energy and Velocity:  $E_K = \frac{1}{2}mv^2 \rightarrow v = \sqrt{\frac{2E_K}{m}}$

Photon Emission Energy:  $E_{\text{photon}} = E_{\text{electron\_at\_higher\_energy\_level}} - E_{\text{electron\_at\_lower\_energy\_level}}$

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### Constants

Light Speed, c:  $3.0 \times 10^8 \text{ms}^{-1}$

Electron Mass:  $9.11 \times 10^{-31} \text{kg}$

Planck's Constant:  $6.63 \times 10^{-34} \text{Js}$  or  $4.14 \times 10^{-15} \text{eVs}$