CLASS 12 PHYSICS — FORMULA SHEET

Chapter 10 : Wave Optics (NCERT)

10.1 Wavefront & Huygens' Principle

Concept	Detail
Wavefront	Locus of points vibrating in the same phase
Spherical wavefront	From a point source
Plane wavefront	From a source at infinity
Huygens' principle	Each point on a wavefront acts as a secondary source ; new wavefront is the tangent envelope
Ray	Always perpendicular to the wavefront

10.2 Interference — Young's Double Slit

Concept	Formula
Path difference	$\Delta = d \sin\theta \approx d\, x / D$ (x = distance on screen)
Constructive (bright)	$\Delta = n\lambda$ (n = 0, 1, 2, …)
Destructive (dark)	$\Delta = (2n - 1)\lambda/2$
Position of bright fringe	$x_n = n\lambda D \div d$
Position of dark fringe	$x_n = (2n - 1)\lambda D \div (2d)$
Fringe width	$\beta = \lambda D \div d$
Angular fringe width	$\theta = \lambda \div d$
Fringe width in medium	$\beta' = \beta \div n$

10.3 Intensity in Interference

Concept	Formula
Resultant intensity	$I = I_1 + I_2 + 2\sqrt{(I_1 I_2)} \cos\varphi$
Phase ↔ path difference	$\varphi = (2\pi/\lambda) \times \Delta$
Max intensity	$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$; for equal: $4I_0$
Min intensity	$I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2$; for equal: 0
Ratio	$I_{max}/I_{min} = [(\sqrt{I_1}+\sqrt{I_2})/(\sqrt{I_1}-\sqrt{I_2})]^2$
Equal sources	$I = 4I_0 \cos^2(\varphi/2)$
Condition for interference	Coherent sources (constant phase difference)

10.4 Diffraction — Single Slit

Concept	Formula
Central maximum width	Angular = 2λ/a ; Linear = 2λD/a

Concept	Formula
Minima (dark)	$a \sin\theta = n\lambda$ (n = 1, 2, 3, …)
Secondary maxima	$a \sin\theta = (2n + 1)\lambda/2$
Half angular width of central max	$\theta = \lambda \div a$
Width of secondary maxima	Half of the central maximum
Fresnel distance	$Z_F = a^2 \div \lambda$

10.5 Resolving Power & Polarisation

Concept	Formula
Resolving power of microscope	RP = $2n \sin\theta \div \lambda$; limit of resolution = $\lambda/(2n \sin\theta)$
Resolving power of telescope	RP = $D \div (1.22\lambda)$; limit = $1.22\lambda/D$
Polarisation	Restricting light vibrations to one plane (only transverse waves)
Malus's law	$I = I_0 \cos^2\theta$ (θ = angle between polariser axes)
Brewster's law	$\tan i_p = n$ (i_p = polarising angle)
At Brewster angle	Reflected & refracted rays are perpendicular ($i_p + r = 90°$)

★ QUICK MEMORY AIDS & TRICKS

Fringe width	$\beta = \lambda D/d$. Wider fringes with longer λ, bigger D, or smaller slit gap d.
Bright vs dark	Bright: $\Delta = n\lambda$. Dark: $\Delta = (2n-1)\lambda/2$. (Interference)
Single slit minima	$a \sin\theta = n\lambda$ — note this is OPPOSITE to interference bright condition.
Intensity (equal)	$I = 4I_0\cos^2(\varphi/2)$. Max = $4I_0$, Min = 0.
Central max width	Single slit central maximum is TWICE as wide as the others ($2\lambda D/a$).
Malus's law	$I = I_0\cos^2\theta$. Crossed polarisers ($\theta=90°$) → zero light.
Brewster's law	tan i_p = n. Reflected & refracted rays are 90° apart at this angle.
Resolving power	Telescope: $D/1.22\lambda$ (bigger aperture → better). Microscope: $2n \sin\theta/\lambda$.