Wave optics

(λ inc) Red shift

(λ dec) blue shift

① Interference

① $A_R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos \Delta\phi}$

or

$\boxed{A_R = 2A_0 \cos \frac{\Delta\phi}{2}}$ $\boxed{\frac{A_{max}}{A_{min}} = \frac{A_1 + A_2}{A_1 - A_2}}$

② $I_R = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \Delta\phi$ $\boxed{A^2 \propto I}$

or

$\boxed{I_R = 4I_0 \cos^2 \frac{\Delta\phi}{2}}$ for incoherent sources $\boxed{I_R = \frac{I_0}{2}}$

③ $I_{max} = 4I_0$, $I_{min} = 0$

$A_{max} = 2A_0$, $A_{min} = 0$

② YDSE

① $\boxed{\Delta x = d\sin\theta = dy/D}$ $= n\lambda$ or $(2n-1)\frac{\lambda}{2}$

② $\boxed{y_{nth}(max) = \frac{n\lambda D}{d}} = nw$

$\boxed{y_{nth}(minima) = \frac{(2n-1)\lambda D}{2d}}$

3) Fringe width (w)

$\boxed{w = \frac{\lambda D}{d}}$

4) Angular fringe width

$\boxed{\beta = w/D}$ $\Rightarrow$ $\boxed{B = \lambda/d}$ $\sin\theta$ for small fringe

5) $\boxed{\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x}$ $\boxed{\Delta\phi = k\Delta x} = \omega \Delta t$

5) Fringe visibility / contrast

$V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ or $\boxed{\frac{2\sqrt{n}}{n+1}}$

($n = I_1/I_2$)

* YDSE in Liquid $\lambda_{med} = \frac{\lambda_{air}}{\mu_{med}}$

$\boxed{y_{nth\,max}(liq) = \frac{n\lambda D}{\mu d}}$

Brewster law

$\tan \theta_p = \mu$

$\sin i_c = 1/\mu$

Doppler's shift : $\boxed{-c = \frac{v\lambda}{\Delta\lambda}} = \frac{vf}{\Delta f}$ (speed)

-ve sign means object goes distance

$\boxed{\text{Fresnel dist}}$: $\boxed{Z_f = \frac{a^2}{\lambda}}$

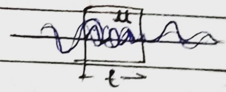
① new fringe width (w) $\boxed{w = \frac{\lambda D}{\mu d}}$

② angular fringe width (β) ($\sin\theta$) $\boxed{\beta = \frac{\lambda}{\mu d}}$

* YDSE when white light is used :

$\boxed{n_1\lambda_1 = n_2\lambda_2}$ $\boxed{y_1 = \frac{n_1\lambda_1 D}{d}}$

* $\boxed{\text{No. of wave} = \frac{t\mu}{\lambda_{air}}}$



* $\boxed{\text{optical path length} = \mu_{med} \times \text{thickness}}$

* Intro. of thin transparent sheet .

$\boxed{S = \frac{t(\mu-1)D}{d}} = \boxed{nw} = x = \frac{n\lambda D}{d}$

① $\boxed{y_{nth\,max} = \frac{n\lambda D}{d} + S}$ $\boxed{w = \lambda D/d}$ no effect on angular width

Diffraction

$\boxed{\sin\theta_{(min)} = \frac{n\lambda}{d}}$ $\boxed{\sin\theta_{(max)} = \frac{(2n+1)\lambda}{2d}}$

angular pos^n

$\sin\theta_1 = \frac{n\lambda}{d}$

angular width

$\boxed{2\theta_1 = \frac{2n\lambda}{d}}$

linear pos^n

* $\boxed{y_1 = \frac{\lambda D}{d}}$ linear width

linear width of minima

$\boxed{2y_1 = \frac{2\lambda D}{d}}$

linear width of max

* $\boxed{y_1 = 2 \times \frac{(2n+1)\lambda}{2d}}$

Reyleigh's criteria

$\boxed{\theta_{min} = \frac{1.22\lambda}{d}}$

polarization $\boxed{\frac{E_0}{B_0} = c}$

$I = I$ – Unpolarized

$I_0 = I/2$. → Polarizer

$I_f = I_0 \cos^2\theta$ → Analyser (1) → ~~Brewster~~ law of mallus

$\boxed{I_{trans} = I_0 \cos^2\theta_1 \cdot \cos^2\theta_2 \cdot \cos^2\theta_3 \ldots \cos^2\theta_n}$

दूसरे Pr से निकल आएगा तो $\cos^2\theta$ वाला होगा .

$\boxed{k = \frac{2\pi}{\lambda}}$

Wave

$\boxed{\Delta\phi = \omega \Delta t}$

$\boxed{\Delta\phi = k\,\Delta x}$

① $v = \lambda / T \Rightarrow f\lambda \Rightarrow \boxed{\omega/k}$

② Angular wave no. $\boxed{k = 2\pi/\lambda}$

③ Angular vel. $\boxed{\omega = \frac{2\pi}{T}}$

④ Transverse progressive wave eq^n

$$\boxed{y = A \sin(\omega t \mp kx + \phi_0)}$$

−ve sign → (RHS)
+ve sign → (LHS)

$$\boxed{v = A\omega \cos(\omega t - kx + \phi_0)}$$

→ All formulas of SHM but here we have to add only (kx).

$$\boxed{a = -A\omega^2 \sin(\omega t - kx + \phi_0)}$$

k → angular wave no.

③ Speed of TPW on string

① $\boxed{v = \sqrt{\frac{T}{\mu}}}$ $\boxed{\mu = \text{mass of spring} / \text{linear mass density}}$ $\boxed{m/l}$ length of string

$$\boxed{v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho A}} = \sqrt{\frac{T}{m/l}}}$$ ← for thin rope

② for Thick rope → $\boxed{\text{time} = 2\sqrt{\frac{4l}{g}}}$

$\boxed{\lambda \propto \sqrt{\text{Hanging mass}}}$ → $\boxed{a = g/2}$ → $\boxed{v \propto \sqrt{gx}}$

$v \propto f\lambda$

∴ $\boxed{v \propto \sqrt{\text{Hanging mass}}\ (g/l)}$

→ In thin rope velocity const $\sqrt{T/\mu}$

→ In thick rope acc^n const $(g/2)$

⑥ Speed of sound wave

$$\boxed{v_{sound} = \sqrt{\frac{B_{ad}}{\rho}} = \sqrt{\frac{\gamma P}{\rho}} = \sqrt{\frac{\gamma RT}{M}}}$$

⑦ Intensity: $\boxed{\frac{\text{Power}}{\text{Area}}}$ point source ⇒ $4\pi r^2$

$\boxed{A_{max} = A_1 + A_2}$ $\boxed{2A_0}$

$\boxed{I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2}$ $\boxed{4I_0}$

⑧ Sound level

$$\boxed{\beta = 10 \log_{10} \frac{I}{I_0}}\ \text{(dB)}$$

$\boxed{I_0 = 10^{-12}\ \text{w/m}^2}$

$$\boxed{\beta_2 - \beta_1 = 10 \log \frac{I_2}{I_1}}$$

$$\frac{A_{max}}{A_{min}} = \frac{A_1 + A_2}{A_1 - A_2}$$

Interference

① $A_R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos\Delta\phi}$

② $I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\Delta\phi$

③ $\boxed{A_R = 2A_0 \cos\frac{\Delta\phi}{2}}$ ④ $\boxed{I_R = 4I_0 \cos^2\frac{\Delta\phi}{2}}$

constructive I.	Destructive I.
$\boxed{\Delta\phi = 2n\pi}$ सम संख्या	$\boxed{\Delta\phi = (2n-1)\pi}$ विषम संख्या
$\boxed{\Delta x = n\lambda}$	$\boxed{\Delta x = (2n-1)(\lambda/2)}$

④ $$\frac{I_{max}}{I_{min}} = \frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2}$$

Beats

① Beat time $\boxed{\Delta t = \frac{1}{|f_2 - f_1|}}$

② Beat freq. $\boxed{f_{Beat} = |f_2 - f_1|}$

③ loading with wax or filing of Tuning fork

Doppler's effect

$$\boxed{f_{app} = f\left(\frac{v - v_{obs}}{v - v_{source}}\right)}$$

+ve: S → O line, −ve: ←

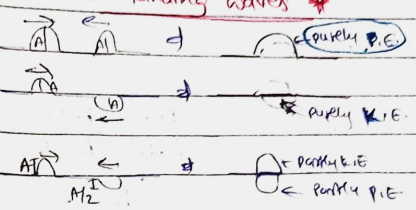
depends on Relative vel. but not on (dist.)

Transverse Progressive wave eq^n: $y = A\sin(\omega t \pm kx + \Delta\phi)$

standing wave eq^n: $\boxed{y = (2A\sin kx)\cos\omega t}$

→ Reflection of wave

Refle standing waves



① standing wave eq^n

$$\boxed{y = (2A\sin kx)\cos\omega t}$$

Resultant amplitude or $\boxed{(2A\cos kx)\sin\omega t}$

② SWP on string

eq. sonometer

Stretched at both ends	Stretched at one end only
① $f = \frac{nv}{2L} = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$	$f = \frac{(2n-1)v}{4L}$ $\boxed{f = (2n-1)\frac{v}{4L}}$
n = nth Harmonic	$(n-1)^{th}$ overtone
$(n-1) = (n-1)^{th}$ overtone	$(2n-1)^{th}$ Harmonic
$(n=1)$ $f = \frac{v}{2L}$ fundamental freq	$(2n-1)\ (n=1)$ fundamental freq

$$\boxed{f_{fundamental|one\ end} = \frac{1}{2} f_{fundamental|both\ end}}$$

eq.

SWP on open organ pipe	SWP on one end closed pipe

Resonance column

① $\boxed{\lambda = 2(L_2 - L_1)}$

② $\boxed{v = f\lambda}$

③ $L_1 + e = \lambda/4$

$L_2 + e = 3\lambda/4$

$L_3 + e = 5\lambda/4$

④ $\boxed{e = \frac{L_2 - 3L_1}{2}}$ end correction

string: $f = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$ organ pipe: $f = \frac{n}{2L}\sqrt{\frac{\gamma RT}{M}}$