RAY OPTICS

Plane mirror

(i) Angle of deviation
$\boxed{\delta = 180 - 2\alpha}$

(ii) length of mirror to see a Body of height 'H'
$\boxed{x = \frac{H}{2}}$

(iii) length of mirror so that Boy can see complete wall. $\boxed{x = \frac{L}{3}}$ → length of wall.

(iv) No. of images
$\boxed{n = \frac{360}{\theta}}$
→ even: $(n-1)$
→ odd → symm $(n-1)$; unsym (n)

(iv) velocity of image
• If obj perpendicular
$\boxed{\vec{V_m} = \frac{\vec{V_o} + \vec{V_I}}{2}}$

• If vel of obj ∥ to mirror $\boxed{V_o = V_I}$

Spherical Surfaces

converging → concave
diverging → convex.

(i) focus :- $\frac{R}{2}$

actual, for marginal ray
$\boxed{F = R - \frac{R}{2\cos i}}$

(ii) mirror formula :-
$\boxed{\frac{1}{F} = \frac{1}{v} + \frac{1}{u}}$
$\boxed{v = \frac{fu}{u-f}}$

(iii) magnification :-
Transverse / lateral →
$\boxed{m_t = \frac{h_i}{h_o} = -\frac{v}{u}}$
$\boxed{m_t = \frac{f}{f-u}}$

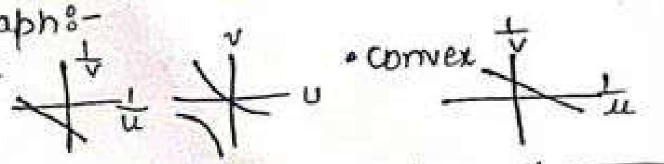
(iv) ~~transverse~~ longitudinal magnification :-
$\boxed{m_L = \frac{L_i}{L_o} = \frac{|v_2 - v_1|}{|u_1 - u_2|}}$
$\boxed{m_L = \frac{L_i}{L_o} = \frac{v^2}{u^2} = m_t^2}$ only magnitude

(v) Newton's formula :-
$\boxed{f = \sqrt{x_1 x_2}}$

(vi) Velocity of spherical mirror
• Obj is moving along principle axis:-
$\boxed{\vec{V_I} - \vec{V_m} = -m_t^2 (\vec{V_o} - \vec{V_m})}$

• Obj is ⊥ to principle axis:-
$\boxed{\vec{V_I} - \vec{V_m} = -m_t (\vec{V_o} - \vec{V_m})}$

(vi) graph:-
• concave • convex



Refraction

$\boxed{\mu = \frac{c}{v}}$ → vacuum, → medium

$\boxed{\mu_{air} = 1}$

$\boxed{\mu_{water} = \frac{4}{3}}$

$\boxed{\mu_{glass} = \frac{3}{2}}$

• $c = \frac{1}{\sqrt{\mu_o \epsilon_o}}$ $v_m = \frac{1}{\sqrt{\mu_m \epsilon_m}}$

$\epsilon_r = \frac{\epsilon_m}{\epsilon_o}$ $\mu_r = \frac{\mu_m}{\mu_o}$

$\boxed{\eta = \sqrt{\frac{\mu_m}{\mu_o} \times \frac{\epsilon_m}{\epsilon_o}}}$

μ, $\boxed{\eta = \sqrt{\mu_r \epsilon_r}}$

for medium :-
$\frac{c}{v} = \mu$ $\boxed{v = \frac{c}{\mu} = \frac{c}{\sqrt{\mu_r \epsilon_r}}}$

(ii) • rarer to denser
$\angle i > \angle r$
$\boxed{\delta = \angle i - \angle r}$ (deviation)

• denser to rarer
$\angle r > \angle i$
$\boxed{\delta = \angle r - \angle i}$

(iii) Cauchy's formula :-
$\boxed{\lambda \propto \frac{1}{\mu}}$

(iv) $\boxed{\frac{\mu_1}{\mu_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1}}$

(v) Snell's Law :-
$\boxed{\mu_1 \sin i = \mu_2 \sin r}$

• $\boxed{i = \tan^{-1} \mu}$

• $\angle i = \angle e$ (emergent)
$\boxed{\sin i = \mu \sin r}$
$\boxed{\mu \sin r = \sin e}$

(vi) $\boxed{\tan i = \frac{\mu_2}{\mu_1}}$

(vii) Real & Apparent Depth

for large angles :-
$\boxed{\frac{\tan i}{\tan r} = \frac{h(app)}{H(Real)}}$

for small angles :-
$\tan \approx \sin$

$\frac{\sin i}{\sin r} = \frac{x/H}{x/h}$

$\mu_1 \sin i = \mu_2 \sin r$
$\mu_1 \times \frac{x}{H} = \mu_2 \times \frac{x}{h}$

$\boxed{\frac{\mu_1}{\mu_2} = \frac{H}{h}}$ → H: from where rays are coming; h: ~~to~~ To where rays are going

$\boxed{h\,(\text{apparent depth}) = \frac{\mu_2}{\mu_1} \times H\,(\text{Real depth})}$

(viii) Velocity in case of refraction.
surface ⇒ refference

$\vec{V_{Is}} = \frac{\mu_2}{\mu_1} \vec{V_{os}}$

$\boxed{\vec{V_I} - \vec{V_s} = \frac{\mu_2}{\mu_1} (\vec{V_o} - \vec{V_s})}$

(ix) Optical path
$\boxed{O.P = \mu d}$
d = dist travelled by light in medium