Ray Optics

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(1) $(\hat{I}\times\hat{R})\cdot\hat{N}=0$, $(\hat{I}\times\hat{N})\cdot\hat{R}=0$, $(\hat{N}\times\hat{R})\cdot\hat{I}=0$. [law of reflection]

(2) $\hat{R}=\hat{I}-2(\hat{I}\cdot\hat{N})\hat{N}$ (vector form of reflection).

(3) $\delta=\pi-2\theta$ (in anticlock), $\delta=\pi+2\theta$ (clockwise)

(4) No. of images →

(i) $x=\frac{360}{\theta}$, $x\to$ even, $n_i=x-1$

$x\to$ odd, $n_i=x-1$ (when obj is symm placed)

$n_i=x$ (when obj is not symm placed)

(5) velocity of image → (in mirror)

$\vec{V}_{IM}=-\vec{V}_{OM}$ (along x-axis), $V_I=V_0$ (along y axis).

(6) $f=R-\frac{R}{2\cos\theta}$, also, $f=R-\frac{R}{2}=\frac{R}{2}$ (when θ is small).

7 Mirror formula :→

$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

(8) Magnification →

$m=-\frac{v}{u}$

8 Longitudinal magnification

$m_L=\frac{\text{length of img}}{\text{length of obj}}=\frac{v_2-v_1}{u_2-u_1}$ } when object is big

$m_L=-\frac{v^2}{u^2}$ } when obj is small.

9 velocity of img in spherical mirrors :→

$\vec{V}_{IM}=-\frac{v^2}{u^2}\vec{V}_{OM}$ (along principal axis/x-axis)

$\vec{V}_{IM}=\frac{-v}{u}\vec{V}_{OM}$ (along y-axis / ⊥ to principal axis)

10 Parabolic Mirror :→

$y^2=4ax$

Focus $(a,0)$

(11) Refractive Index :→

${}_B n_A=\frac{C_B}{C_A}=\frac{v_B}{v_A}=\frac{n_A}{n_B}$

Critical Angle → (ray must travel from Denser to Rarer).

Angle in the denser medium so that angle in the rarer medium is $90°$

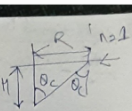
12 vector form of Snell's law :→

$n_1\sin i=n_2\sin r$

$n_1|\hat{i}\times\hat{n}|=n_2|\hat{r}\times\hat{n}|$.

13 fish eye view :→

$R=H\times\frac{1}{\sqrt{n^2-1}}$



13 Lateral displacement due to glass slab

$l=\sin(i-r)\frac{t}{\cos r}$, if $i\to0$, $r\to0$

$l\approx t(i-r)$ (for smaller angles)

$n_1 i=n_2 r$.

14 Apparent Depth →

$H'=\frac{H\,n_{obs}}{n_{obj}}$.

15. Formula for velocity

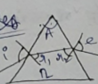
$v_{img}=\frac{v_{obj}\times n_{obs}}{n_{obj}}$

15 Image formation via glass slab

$\text{shift}=t\left(1-\frac{n_1}{n_2}\right)$.

16 Prism.

~~see from Notes~~



$r_1+r_2=A$.

and δ(deviation) $=i+e-A$.

→ δ_{min}, $i=e$, $r_1=r_2=r$.

$\therefore\delta_{min}=i+e-A$

$\Rightarrow\delta_{min}=2i-A$

$\Rightarrow i=\frac{\delta_{min}+A}{2}$

$r_1+r_2=A$

$\Rightarrow r=\frac{A}{2}$.

Now, from Snell's law,

$n_1\sin i=n\sin r$

$\Rightarrow 1\sin i=n\sin\left(\frac{A}{2}\right)$

$$\boxed{\Rightarrow n=\frac{\sin\left(\frac{\delta_{min}+A}{2}\right)}{\sin(A/2)}}$$

For smaller angles →

$n=\frac{\frac{\delta_{min}+A}{2}}{\frac{A}{2}}$

$\Rightarrow n=\frac{\delta_{min}+A}{A}$.

$\Rightarrow\delta_{min}=(nA-A)$

$$\boxed{\Rightarrow\delta_{min}=(n-1)A}$$

17 Angle of dispersion →

$\delta_R=(\mu_R-1)A$.

$\delta_V=(\mu_V-1)A$.

$\theta=(\delta_V-\delta_R)A$ {defination}.

Mean Deviation (Yellow)

$\delta_{mean}=(\mu_Y-1)A$.

Dispersion Power

$\omega=\frac{\theta}{\delta_{mean}}$

Dispersion without deviation

$\delta_1+\delta_2=0$; $\theta_1+\theta_2=0$

Note :→ Yellow coloured ray is parallel to the incident Ray.

$\Rightarrow$ $\lambda_R>\lambda_V$

$\mu_R<\mu_V$

$(C_R)_{medium}>(C_V)_{medium}$

$(\theta_c)_R<(\theta_c)_{violate}$ → Total Internal resistance.

Cutting of lens

18 Refraction at Curved Surfaces →

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

$n_2 \rightarrow$ R.I of medium in which ray goes after refraction.

$n_1 \rightarrow$ R.I of medium ~~or~~ before refraction

19 Len's Maker formula :→

$$\frac{1}{v} - \frac{1}{u} = \left(\frac{n_L}{n_s} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right).$$

$$\frac{1}{f} = \left(\frac{n_L}{n_s} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$+ \; R_1 \; R_2 \; -$

newton's law

$$\boxed{f = \sqrt{x_i x_o}}$$

20 $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$.

Lateral Magnification

$M = \frac{v}{u}$

Longitudinal Magnification

$M = \frac{v_1 - v_2}{u_1 - u_2}$ } object comparable in size

$M = \frac{v^2}{u^2}$ } if obj are small.

21 velocity of image and object

$\rightarrow \vec{v}_{iL} = \frac{v^2}{u^2} \vec{v}_{oL}$, $\uparrow \; \vec{v}_{iL} = \frac{v}{u} \vec{v}_{oL}$

22 Microscope Read from Notes.

Chromatic Abbrevation

unable to focus the light rays at a point.

Defect in Eyes

(i) Myopia (Near Sightness)

⇒ Need concave lens ($f = -ve$)

⊛ $u = -\infty$ (in all cases)

(ii) Heteromyopia (Far Sightness)

$f = +ve$, $P = +ve$

convex lens (+ve)

⊛ $u = -25$ cm (in all cases)

⊙ ↓λ, ↑f → Scatter more

⊛ Rayleigh scattering Theory is resonated for the red colour of the sun in the morning and blue colour of the sky

Simple Microscope (convex)

$$M.P = \frac{D}{u}$$

Case-I :- (Normal adjustment (Relax eye state)

$$M.P = \left|\frac{D}{f}\right|$$

Case-II :- D-adjustment (strained-eye position)

$$M.P = \left|1 + \frac{D}{f}\right|$$

Compound Microscope

$$M.P = \frac{V}{u} \times \frac{D}{u_e}$$

Case-I :- Normal adjustment (Relaxed eye strain)

$$M.P = \left|\frac{V}{u} \times \frac{D}{f_e}\right|$$

Case-II :- D-strain eye adjustment (strained eye)

$$M.P = \frac{V}{u} \times \left[1 + \frac{D}{f_e}\right]$$

Approximations

$$\boxed{\frac{V}{u} \simeq \frac{L}{f_o}}$$

$$\boxed{L = V + u_e}$$

Telescope

$$M.P = \frac{f_o}{u_e}$$

(i) Normal adjustment →

$$M.P = \frac{f_o}{f_e}$$

(ii) D-adjustment →

$$M.P = f_o\left[\frac{1}{f_e} + \frac{1}{D}\right]$$

Final Image is inverted