PRIT-EDUCATION

PRACTISE..! PERFORM..! PERFECT..!

TN CLASS 12

PHYSICS

Formulae Sheet...!

Ray Optics

BY

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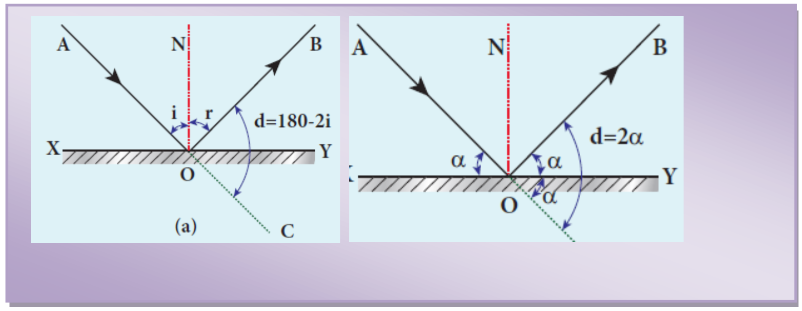
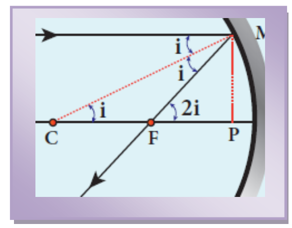
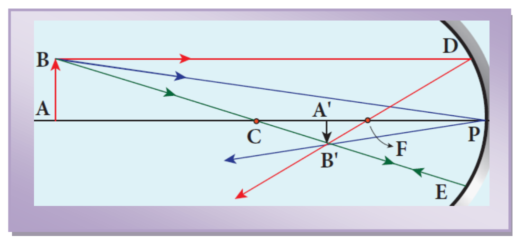
(XII-STD,2024-25)

FORMULAE	DIAGRAMS & EXPLANATION OF TERMS INVOLVED
<u>ANGLE OF DEVIATION DUE TO REFLECTION (D)</u> $d = 180 - 2i$ $d = 2a$	
<u>RELATION BETWEEN *f* & *R*</u> $R = 2f \Rightarrow f = \frac{R}{2}$	R = radius of curvature f = focal length 
<u>MIRROR EQUATION</u> $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$	f = focal length v = distance of image u = distance of object 
<u>LATERAL MAGNIFICATION IN SPHERICAL MIRRORS</u> $m = \frac{h'}{h} = -\frac{v}{u}$	$\text{magnification } (m) = \frac{\text{height of the image } (h')}{\text{height of the object } (h)}$ $m = \frac{h'}{h} = \frac{f-v}{f} = \frac{f}{f-u}$
<u>FIZEAU'S METHOD TO DETERMINE SPEED OF LIGHT</u> $v = \frac{2dN\omega}{\pi}$ $v = 2.99792 \times 10^8 \text{ m s}^{-1}$.	ω = angular speed (with unit rad s^{-1}) N = number of teeth/or no of cuts distance d is a known value from the arrangement
<u>REFRACTIVE INDEX</u> $n = \frac{c}{v}$	$\text{refractive index } n \text{ of a medium} = \frac{\text{speed of light in vacuum } (c)}{\text{speed of light in medium } (v)}$

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OPTICAL PATH

$$d' = nd$$

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Optical path of a medium is defined as the distance d' light travels in vacuum in the same time it travels a distance d in the medium.

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SNELL'S LAW

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

$$n_1 \sin i = n_2 \sin r$$

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The ratio of sine of angle of incident i in the first medium to the sine of angle of refraction r in the second medium is equal to the ratio of refractive index n2 of the second medium to the refractive index n1 of the first medium.

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RELATIVE REFRACTIVE INDEX

$$n_{21} = \frac{n_2}{n_1}$$

(i) Inverse rule:

$$n_{12} = \frac{1}{n_{21}} \text{ (or) } \frac{n_1}{n_2} = \frac{1}{n_2/n_1}$$

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relative refractive index of second medium with respect to the first medium which is denoted as n_{21}.

(ii) Chain rule:

$$n_{32} = n_{31} \times n_{12} \text{ (or) } \frac{n_3}{n_2} = \frac{n_3}{n_1} \times \frac{n_1}{n_2}$$

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APPARENT DEPTH

$$d' = \frac{d}{n}$$

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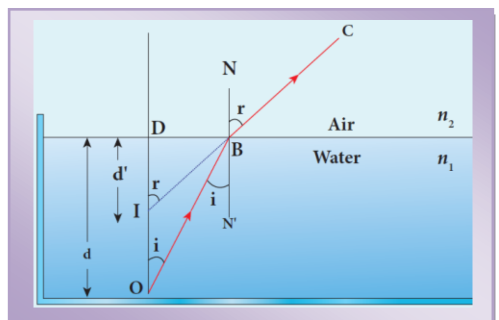
The bottom appears to be elevated by d-d'

$$d - d' = d\left(1 - \frac{1}{n}\right)$$



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CRITICAL ANGLE

$$\sin i_c = \frac{n_2}{n_1}$$

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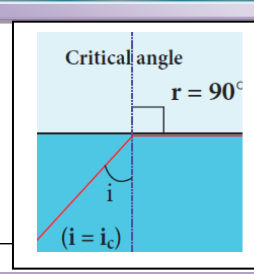
If the rarer medium is air,

$$i_c = \sin^{-1}\left(\frac{1}{n}\right)$$



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RADIUS OF ILLUMINATION (SNELL'S WINDOW)

$$R = d\sqrt{\frac{n_2^2}{(n_1^2 - n_2^2)}}$$

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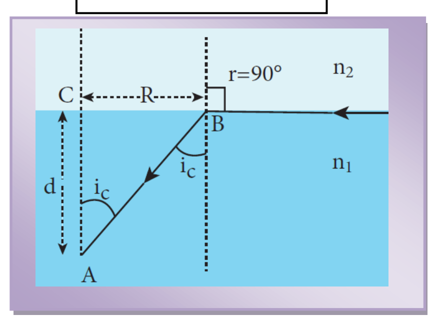
if rarer medium is air

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



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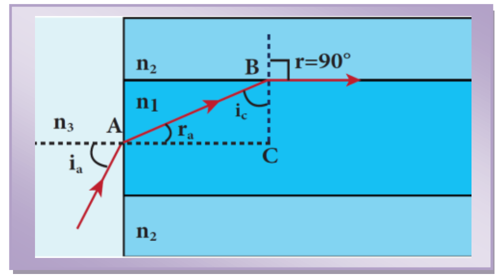
ACCEPTANCE ANGLE IN OPTICAL FIBRE

$$i_a = \sin^{-1}\left(\sqrt{\frac{n_1^2 - n_2^2}{n_3^2}}\right)$$

if rarer medium is air

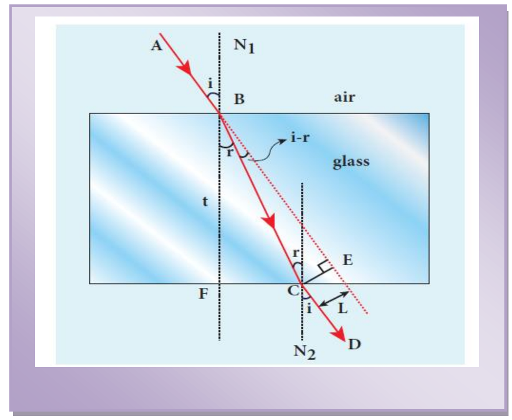
$$i_a = \sin^{-1}\left(\sqrt{n_1^2 - n_2^2}\right)$$



numerical aperture NA: $NA = \sin i_a = \sqrt{n_1^2 - n_2^2}$

REFRACTION IN GLASS SLAB (LATERAL DISPLACEMENT)

$$L = t\left(\frac{\sin(i-r)}{\cos(r)}\right)$$

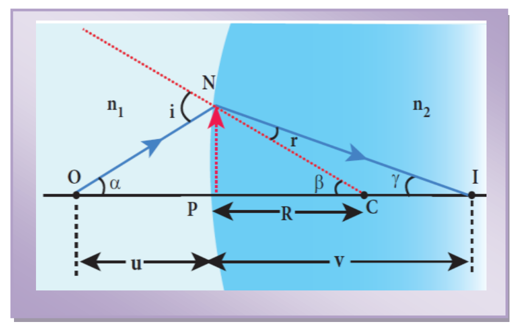


EQUATION FOR REFRACTION AT SINGLE SPHERICAL SURFACE

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

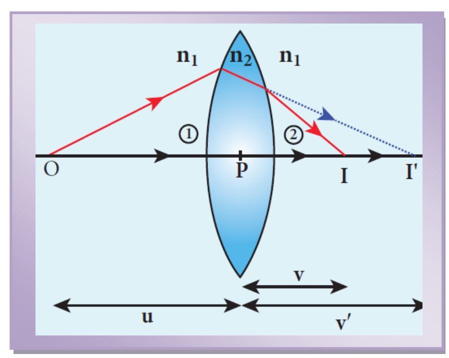
If the first medium is air

$$\frac{n}{v} - \frac{1}{u} = \frac{(n-1)}{R}$$



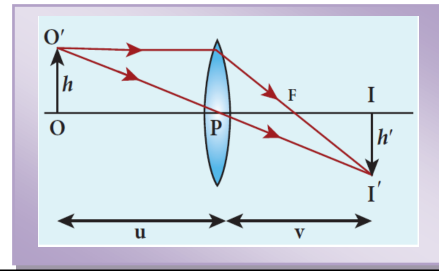
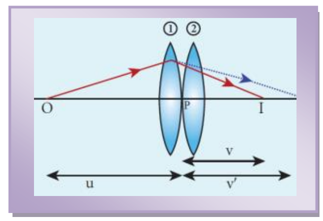
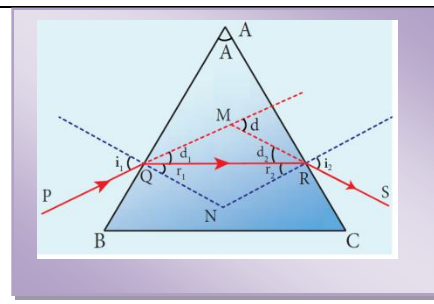
LENS MAKER'S FORMULA

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



LENS EQUATION

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

LATERAL MAGNIFICATION IN THIN LENS $m = \frac{h'}{h} = \frac{v}{u}$	$m = \frac{h'}{h} = \frac{f}{f+u}$ (or) $m = \frac{h'}{h} = \frac{f-v}{f}$ 
POWER OF A LENS $P = \frac{1}{f}$	$P = \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ unit: dioptre
FOCAL LENGTH OF LENSES IN CONTACT $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \frac{1}{f_4} + \ldots\ldots$	**Magnification:** **m = m1 × m2 × m3 . . . .** 
ANGLE OF DEVIATION PRODUCED BY PRISM	$d = i_1 + i_2 - A$ 
REFRACTIVE INDEX OF THE MATERIAL OF THE PRISM	$n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$
DISPERSIVE POWER $\omega = \frac{\text{angular dispersion}}{\text{middle deviation}} = \frac{\delta_V - \delta_R}{\delta}$ $\omega = \frac{(n_V - n_R)}{(n-1)}$	**Dispersive power ω is defined as the ratio of the angular dispersion for the extreme colours to the deviation for any middle colour.**
RAYLEIGH'S SCATTERING. $I \propto \frac{1}{\lambda^4}$	**If the scattering of light is by atoms and molecules which have size a very much less than that of the wave length λ of light, (a<< λ), then the scattering is called Rayleigh's scattering.**