Wave Optics

Intensity of a Wave	$I = \frac{1}{2}\omega^2 A^2 \rho v$ ρ = density of medium v = speed of wave

Interference

Constructive Interference Phase difference, $\phi = 2n\pi$ Path difference, $\Delta x = n\lambda$ where, n = 0,1, 2, 3,...	**For Destructive Interference** Phase differnece, $\phi = (2n-1)\pi$ Path difference, $\Delta x = \frac{(2n-1)\lambda}{2}$ where, n = 0,1, 2, 3,...
Amplitude of Resultant Wave $R = \sqrt{a^2 + b^2 + 2ab\cos\phi}$ $R_{max} = (a+b)$ $R_{max} = (a-b)$	**Intensity of Wave** $I = a^2 + b^2 + 2ab\cos\phi$ $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

Young's Double Slit Experiment

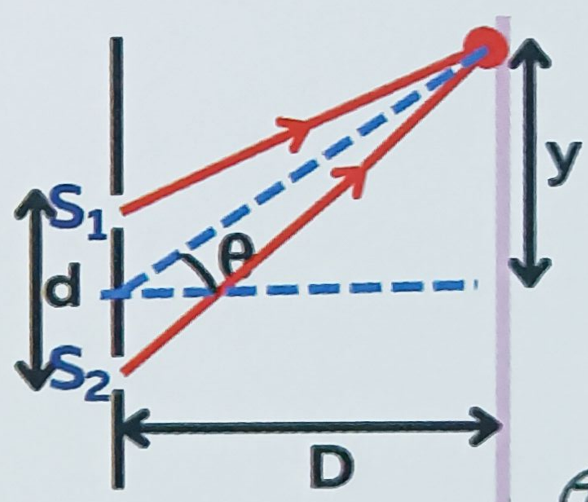
Position of bright fringe,

$$y_{bright} = \frac{n\lambda}{d}D$$

Position of dark fringe,

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

Fringe Width, $\beta = \lambda D/d$



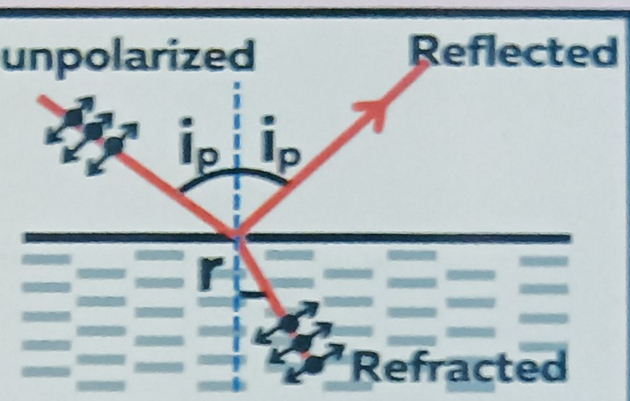
Angular Width	Insertion of Transparent Slab in YDSE of Thickness t
$\theta = \frac{\lambda}{d} = \frac{\beta}{D}$	$y = \frac{Dt(\mu - 1)}{d}$

Diffraction

For Secondary Minima	For Secondary Maxima
Path difference = $n\lambda$	Path difference = $\frac{(2n+1)\lambda}{2}$
Linear distance = $\frac{nD\lambda}{a} = \frac{nf\lambda}{a}$	Linear distance = $\frac{(2n+1)D\lambda}{2a} = \frac{(2n+1)f\lambda}{2a}$
Angular spread = $\frac{n\lambda}{a}$	Angular spread = $\frac{(2n+1)\lambda}{2a}$
where, λ = wavelength of light a = width of single slit D = distance of screen from the slit f = focal length of convex lens	

For Central Maxima

Linear width of central maxima, $\frac{2D\lambda}{a} = \frac{2f\lambda}{a}$	Angular width of central maxima, $2\theta = \frac{2\lambda}{a}$
Resolving Power	$RP = \frac{1.22\lambda}{2\mu \sin\theta}$

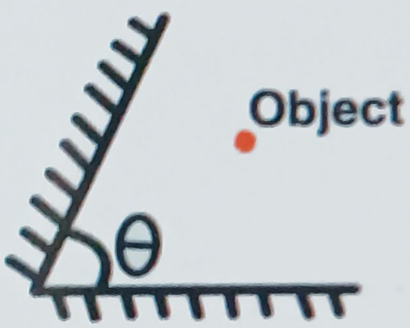
Brewster's Law	
$\mu = \tan i_p$ $i_p + r = 90°$	

Polarisation	
Intensity of light through analyser for Unpolarised light $= \frac{I_o}{2}\cos^2\theta$	Intensity of light through analyser for Polarised light $= I_o \cos^2\theta$

Ray Optics

Laws of Reflection

(i) The incident ray, the reflected ray and the normal at the point of incidence all three lie in the same plane.
(ii) Angle incidence (i)is = Angle reflection (r).

Angle of deviation	$\delta = 180 - 2i$
Number of Images formed by two Plain Mirrors 	$n = \left(\frac{360}{\theta} - 1\right)$ even integer $n = \frac{360}{\theta}$, odd integer
Focal length	$f = \frac{R}{2}$ R = radius of curvature
Mirror Formula u = distance of the object v = distance of the image	$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$
Linear Magnification	$m = -\frac{v}{u}$

Newton's formula for a concave mirror	$f = \sqrt{x_1 x_2}$ where, x_1 and x_2 are the distances of object and image from the focus

Refraction

Laws of Refraction

(i) The incident ray, the refracted ray and the normal at the point of incidence, all three lies in the same plane.

(ii) The ratio of sine of angle of incidence to the sin of angle of refraction is constant for a pair of two media,

$\frac{\sin i}{\sin r} = \mu$; μ = refractive index

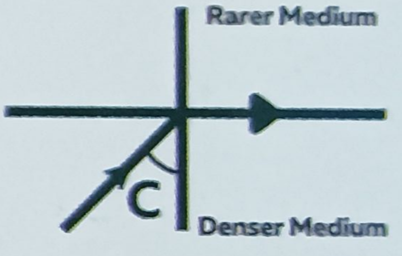
Angle of deviation	$\delta = i - r$

$$Apparent\ distance = \frac{Real\ depth}{\mu\ object\ w.r.t\ observer}$$

$$Shift\ of\ image = \left(d - \frac{d}{\mu}\right)$$

Critical Angle

$$\mu = \frac{1}{\sin C}$$

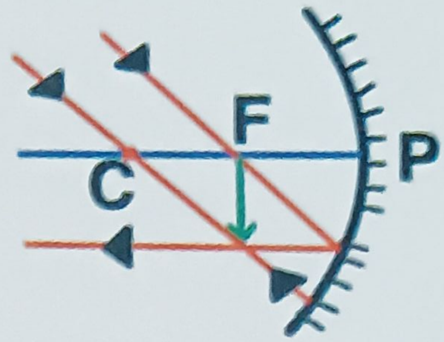
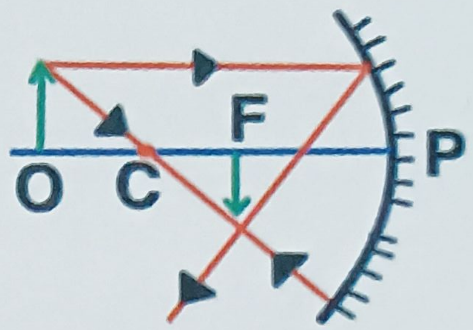
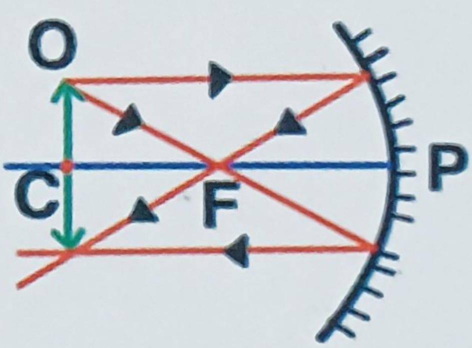
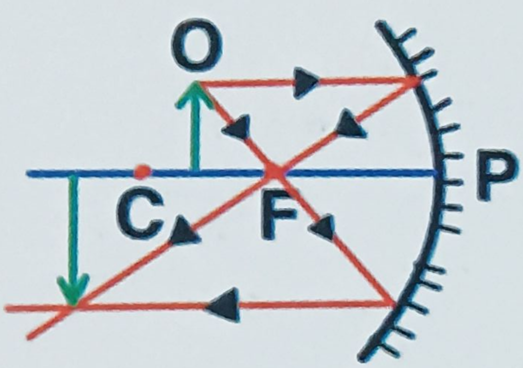


Total Internal Reflection

(i) The ray must travel from denser medium to rarer medium.

(ii) Angle (Incidence) must be greater than Critical Angle

Image Formation by Concave Mirror

Position of Object	Ray Diagram	Properties of Image
At infinity		Real, inverted, very small at F
Between infinity and C		Real, inverted, diminished between F and C
At C		Real, inverted, equal in size at C
Between F and C		Real, inverted and very large between 2F and infinity

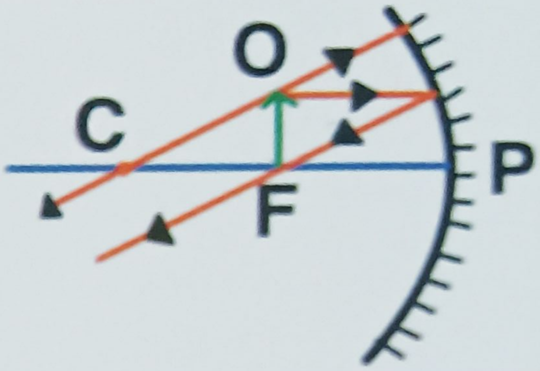
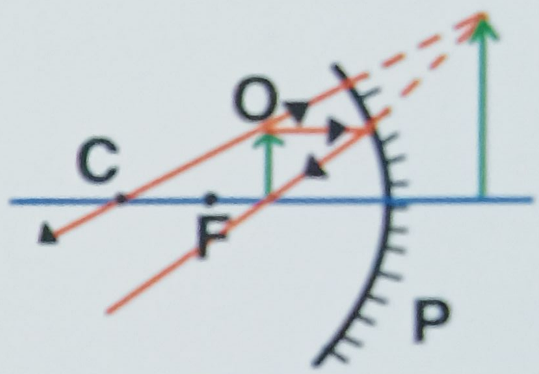
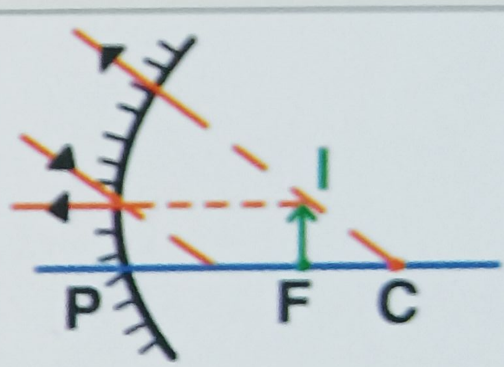
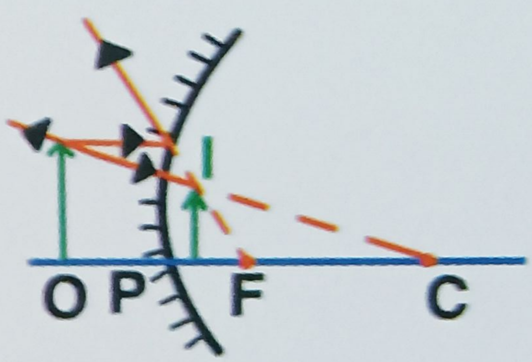
At F		Real, inverted, very large at infinity
Between F and P		Virtual, erect, large in size behind the mirror

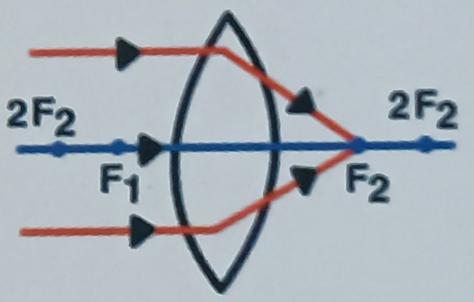
Image formation by convex mirror

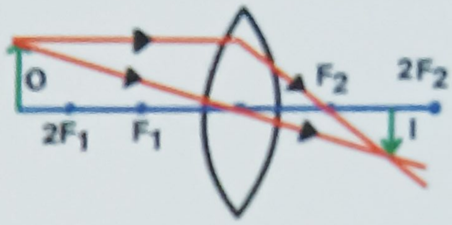
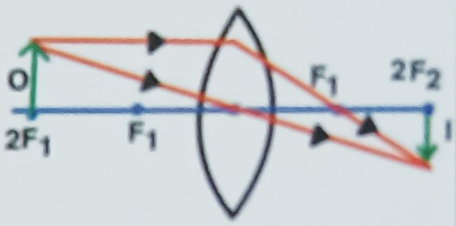
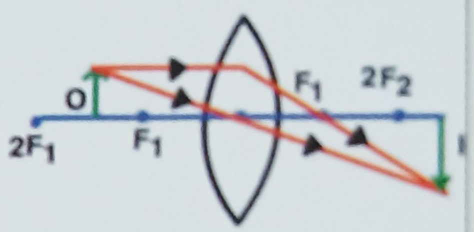
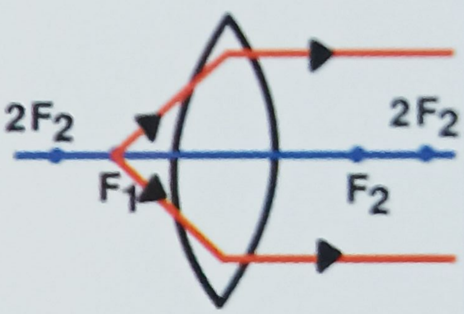
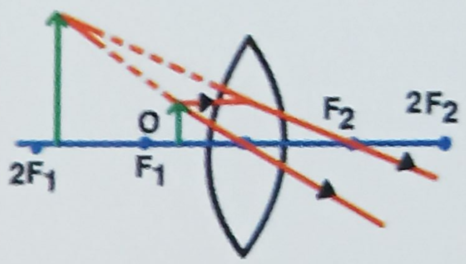
Position of Object	Ray Diagram	Details of Image
At infinity		Virtual, erect, very small in size at F
In front of mirror		Virtual, erect, diminished between P and F

Lens

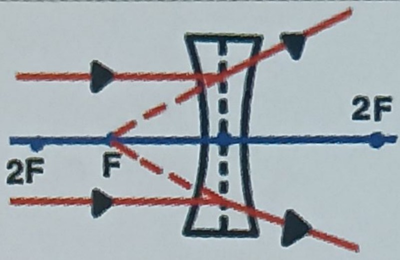
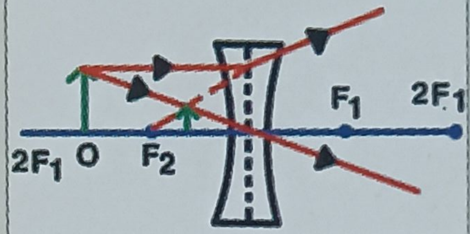
Lens Formula	$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$
Lens Maker's formula	$\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$
Power of a Lens	$P=\frac{1}{f}$
Focal Length of a Lens Combination	
When lenses are in contact $\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}$	When lenses are separated by a distance d $\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{1}{f_1 f_2}$
Linear Magnification	$m=\frac{v}{u}$

Formation of Image by Convex Lenses

Position of Object	Ray Diagram	Position of Image	Nature and Size of Image
At infinity		At the principal focus (F_2) or in the focal plane	Real, inverted and extremely diminished

Beyond $2F_1$		Between F_2 and $2F_2$	Real, inverted and diminished
At $2F_1$		At $2F_2$	Real, inverted and of same size as the object
Between F_1 and $2F_1$		Beyond $2F_2$	Real, inverted and highly magnified
At F		At infinity	Real, inverted and highly magnified
Between F_1 and optical centre		On the same side as the object	Virtual, erect and magnified

Formation of Image by Concave Lenses

Position of Object	Ray Diagram	Position of Image	Nature and Size of Image
At infinity		At the focus	Virtual erect and point size
Anywhere except on the principal axis		Between lens and F_2	Virtual, erect, diminished

Prism

The refractive index of material of prism	$\mu = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$;A = angle of prism
Angle of Deviation	$\delta = i + e - A;\ \delta_{min} = 2i - A$
Magnifying Power of Simple Microscope	$m_{max} = 1 + \frac{D}{f};\ m_{min} = \frac{D}{f}$
Magnifying Power of Compound Microscope	$m_{max} = \frac{v_0}{u_0}\left(1 + \frac{D}{f}\right);\ m_{min} = \left(\frac{v_0}{u_0}\right)\frac{D}{f}$

Astronomical Telescope	
When final image is formed at least distance of distinct vision	**When final image is formed at infinity**
$M = \frac{f_0}{f_e}\left(1 + \frac{D}{f_e}\right)$	$M = \frac{f_0}{f_e}$
Length of the telescope, $L = f_0 + u_e$	Length of the telescope, $L = f_0 + f_e$

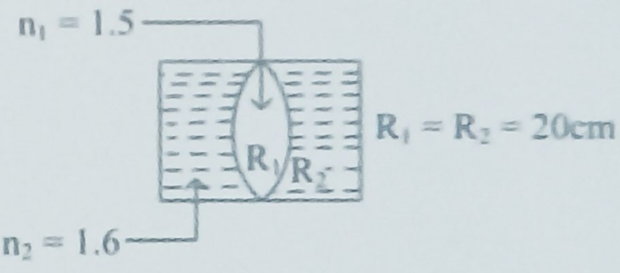
- Light travels a distance x in time t1 in air and 10x in time t2 in another denser medium. What is the critical angle for this medium?

$$\theta_c = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$$

- For Young's double slit experiment, two statements are given below :

Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.
Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.
In the light of the above statements, choose the correct answer from the options given below :
Statement I is true but Statement II is false

- In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin) ? **-100cm**



- Two thin lenses are of same focal lengths (f), but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be : **infinite**