16 Optics

Ray optics :

Reflection of light from plane and spherical Surfaces :

Mirrors

(1) Plane (2) Spherical

(i) Concave (f Negative) (ii) Convex (f positive)

For plane mirror : Radius of curvature $R = \infty$, forcal length $f = \infty$, mgnification $m = 1$,

– (object distance) = Image distance

$-u = v$

If object is moving with velocity v away / towards the mirror then image moves with velocity $2v$ away / towards mirror.

angle of Incidence (i) = angle of reflection (r)

When angle between two plane mirrors is θ, then number of images for object placed between them,

(1) $n = \dfrac{360°}{\theta} - 1$, Where $\dfrac{360°}{\theta} =$ even integer which is independent of position of object.

(2) If $\dfrac{360°}{\theta} =$ odd integer

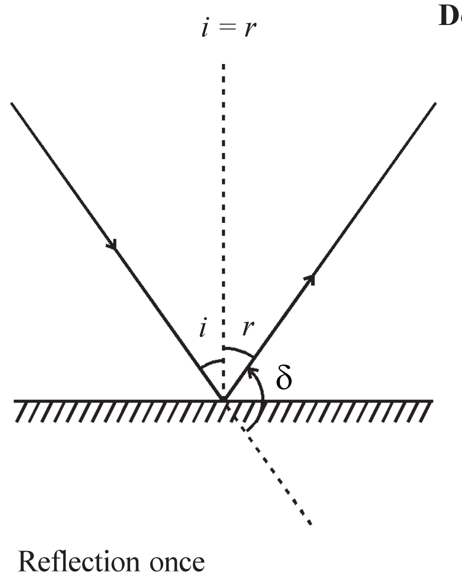
Two possibilities :

(i) If object is placed on bisector of angle between two mirror then take above equation.

(ii) If not placed as above then $n = \dfrac{360°}{\theta}$

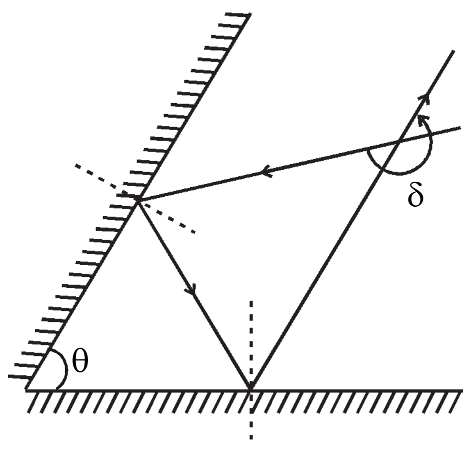
(3) For two parallel mirrors, $\theta = 0°$ $\therefore$ $n = \dfrac{360°}{0} = \infty$

Deviation



Reflection once

$\delta = 180° - 2i$



Reflection twice

$\delta = 360° - 2\theta$

For spherical Mirrors :

(1) $R = 2f$

(2) Gauss's equation

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

u = object distance, v = image distance

(3) Lateral magnification

(Transverse magnification)

$m = \frac{h'}{h}$ $\qquad h'$ = height of image; h = height of object

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

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

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

use sign convension

m is negative for real image, m is positive for virtual image

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(1) Light ray incident on plane mirror at angle of 30°. Then find the angle of deviation for incident ray so that it is reflected from second mirror placed at 60° angle with first mirror.

(A) 120° (B) 240° (C) 150° (D) 90°

(2) Light ray is incidenting on plane mirror. If mirror is rotated at angle θ then the reflected ray will be rotated at angle ________.

(A) 2θ (B) θ (C) 3θ (D) $\frac{\theta}{2}$

(3) The angle between two mirrors should be kept ________ . so that for both mirrors incident and reflected rays remains parallel to each other.

(A) 45° (B) 60° (C) 90° (D) 30°

(4) PQ is incident ray and RS is reflected ray of light. Both are parallel to each other. Then which mirror should be kept on right side so that it may possible ? there may be one or more reflections are possible by mirror.

(A) plane mirror (B) convex mirror

(C) plane and concave mirror (D) concave mirror

(5) on the axis of concave mirror of focal lenght f a small linear object of length b is placed at distance u from the pole. what will be volume of image ?

(A) $\left(\frac{f}{u-f}\right)^2 b$ (B) $(u-f)^2 b$ (C) $\left(\frac{f}{u-f}\right) b^2$ (D) $\left(\frac{u-f}{f}\right)^2 b$

(6) An object is moving with constant velocity v_o on the principal axis of concave mirror towards the mirror. If the verocity of image is $-v_o$ then find object distance for that.

(A) $2R$ (B) $3R$ (C) R (D) $\frac{R}{2}$

(7) For object distances u_1 and u_2 from pole of concave mirror the magnification obtained is same, then focal length of mirror is ________.

(A) $2(u_1+u_2)$ (B) $\frac{u_1+u_2}{2}$ (C) u_1+u_2 (D) $\frac{u_1+u_2}{3}$

(8) The real image obtained by concave mirror is n times larger than object. If focal length of mirror is f, then object distance will be ________.

(A) $\frac{(n+1)}{n} f$ (B) $(n-1) f$ (C) $\frac{f}{n-1}$ (D) $\frac{f}{n}$

(9) A candle is placed at 24 cm from the surface of convex mirror and a plane mirror is placed such that the virtual images by both mirrors coinsides. If object is at 15 cm from plane mirror then focal length of convex mirror will be ________ cm.

(A) 8 (B) 5 (C) 10 (D) 12

(10) A square plate of sides 3 cm is placed at 20 cm from concave mirror. The focal length of concave mirror is 15 cm. Then the area of image formed by concave mirror will be ________ cm^2.

(A) 124 (B) 81 (C) 144 (D) 169

Ans. : 1 (B), 2 (A), 3 (C), 4 (D), 5 (A), 6 (C), 7 (B), 8 (A), 9 (A), 10 (B)

Refraction, Total Internal Reflection and it's uses :

(1) $\frac{\sin\theta_1}{\sin\theta_2} = n_{21}$

$$= \frac{n_2}{n_1} = \frac{v_1}{v_2}$$

θ_1 = angle of incidence in medium - 1

θ_2 = angle of refraction in medium – 2

n_1 = absolute refractive index of medium – 1

n_2 = absolute refractive index of medium – 2

v_1 = velocity of light in medium – 1

v_2 = velocity of light in medium – 2

n_{21} = Refractive index of medium – 2 with respect to medium – 1

(2) $n = \frac{c}{v}$ $\quad$ $n =$ absolute refrective index of medium

$c =$ velocity of light in air (Vaccume)

$v =$ velocity of light in medium

(3) If $n_2 > n_1$, then $\sin\theta_1 > \sin\theta_2$

$\therefore \theta_1 > \theta_2$, deviation $= \theta_1 - \theta_2$

(4) If $n_1 > n_2$, then $\sin\theta_1 < \sin\theta_2$

$\therefore \theta_1 < \theta_2$, deviation $= \theta_2 - \theta_1$

(5) For transparent slab

(i) $n_{21} = \frac{1}{n_{12}}$ $\quad \therefore\ n_{21} \times n_{12} = 1$

(ii) For transparent slab

$n_{31} = n_{32} \times n_{21}$

$n_{51} = n_{54} \times n_{43} \times n_{32} \times n_{21}$

(6) Lateral shift

$$x = \frac{t \sin\left(\theta_1 - \theta_2\right)}{\cos\theta_2}; \qquad \left(n_2 > n_1\right)$$

$$= t\,\theta_1 \left(1 - \frac{\theta_2}{\theta_1}\right), \text{ if } \theta_1 \text{ is very small}$$

$t =$ thickness of homogeneous medium

(7) Real depth and virtual depth

(i) $\frac{h_i}{h_o} = \frac{n \text{ rarer}}{n \text{ denser}}$ (seeing from rarer medium)

h_i = Virtual depth of object

h_o = Real depth of object

Shift = $h_o - h_i = \left(1 - \frac{1}{n}\right)h_o$

(ii) $\frac{h_i}{h_o} = \frac{n \text{ (denser)}}{n \text{ (rarer)}}$ (seeing from denser medium)

Shift $d = h_i - h_o$

$= (n-1)h_o$

(iii) If different immissible liquids are in beaker then virtual depth of bottom.

$= \frac{d_1}{n_1} + \frac{d_2}{n_2} + ...$

$n_1, n_2, ...$ and $d_1, d_2....$ are refrective indices and real depth of respective liquids.

(8) (i) Total internal reflection

$\sin C = \frac{n_2}{n_1}$ $n_1 > n_2$, C = critical angle

$\sin C = \frac{1}{n}$ $n_2 = 1, n_1 = n$

(ii) The radius of circular path of vision of fish which is in water

$r = \frac{h}{\sqrt{n^2 - 1}}$, h = depth of fish

(iii) Area of circular path of vision, $A = \pi r^2$

$= \frac{\pi h^2}{n^2 - 1}$

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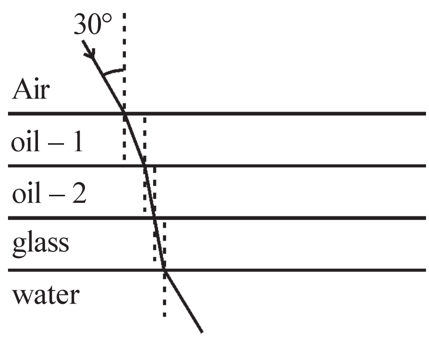
(11) As shown in the figure the light ray incident at angle of $30°$ on surface of air and oil–1. Then after passing through oil–1, oil–2, glass medium it enter to water. Find angle of refraction of ray in water. Refrective index of glass and water are 1.51 and 1.33 respectively.



(A) $\sin^{-1}\frac{1}{3.02}$ (B) $\sin^{-1}\frac{1}{1.51}$ (C) $\sin^{-1}\frac{1}{2.66}$ (D) $\sin^{-1}\frac{1}{1.33}$

(12) A light ray is propagating from space to the medium having refractive index n. If angle of incidence is twice the angle of refraction then angle of incidence will be ________.

(A) $2\cos^{-1}\frac{n}{2}$ (B) $2\sin^{-1}\frac{n}{2}$ (C) $2\sin^{-1} n$ (D) $\cos^{-1}\frac{n}{2}$

(13) A light ray is incidenting on a plane slab of refrective index n and thickness t at very small incidence angle θ, then lateral shift in this case is ________.

(A) $\frac{t\theta}{n}$ (B) $\frac{t\theta(n-1)}{n}$ (C) $\frac{t\theta n}{n-1}$ (D) $t n \theta$

(14) A plate is placed on the surface of liquid. Refrective index of liquid is $\frac{5}{3}$. Source of light is at depth 4 m form the surface of liquid. The minimum diameter of plate should be ________ m so that light can't comes out.

(A) 12 (B) 8 (C) 9 (D) 6

(15) The depth of a container is t. In this container the oil with retrective index n_1 is filled up to half depth and for remaining half depth water of refractive index n_2 is filled. What will be virtual depth of an object placed at the bottom of container ?

(A) $\frac{t(n_1+n_2)}{2n_1n_2}$ (B) $\frac{2t(n_1+n_2)}{n_1n_2}$ (C) $\frac{2t\,n_1n_2}{n_1+n_2}$ (D) $\frac{t\,n_1n_2}{2(n_1+n_2)}$

(16) A light ray enter to denser medium from air. If reflected and refracted rays are propagating normal to each other then angle of incidence at medium is ________.

(A) $\sin^{-1}(\tan^{-1} C)$ (B) $\cos^{-1}(\tan C)$ (C) $\tan^{-1}(\sin^{-1} C)$ (D) $\sin^{-1}(\cos C)$

(17) The refractive index and critical angle of glass with respect to air is n and C respectively. Light ray is entering at angle of incidence C from air, if angle of refraction is r then $\sin r =$ ________.

(A) $\frac{1}{\sqrt{n}}$ (B) $\frac{1}{n}$ (C) $\frac{1}{n^3}$ (D) $\frac{1}{n^2}$

(18) A light rays takes time t_1 sec to cover distance d in air and t_2 sec to cover distance $5d$ in medium then critical angle of medium with respect to air is ________.

(A) $\tan^{-1}\frac{10t_1}{t_2}$ (B) $\sin^{-1}\frac{5\,t_1}{t_2}$ (C) $\sin^{-1}\frac{t_1}{t_2}$ (D) $\tan^{-1}\frac{t_1}{t_2}$

Ans. : 11 (C), 12 (A), 13 (B), 14 (D), 15 (A), 16 (C), 17 (D), 18 (B)

The deviation and dispersion of light by prism :

(i) Equation for prism

$i + e = A + \delta$ $\quad$ $i =$ angle of incidence, $e =$ angle of emergence

$A =$ angle of prism $\delta =$ angle of deviation

(ii) $A = r_1 + r_2$ $\quad$ $r_1 =$ Angle of refraction at first face $r_2 =$ Angle of incidence on second face

(iii) If $\delta = \delta_m$ $\quad$ (minimum angle of deviation)

then $i = e$ $\quad$ $\therefore\ i = \frac{A + \delta_m}{2}$

$$r = \frac{A}{2} \qquad (r_1 = r_2 = r)$$

(iv) Refractive index of prism

$$n = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$$

(v) For a thin prism (A < <) $\delta_m = A(n-1)$

(vi) Angular dispersion, $\delta_v = A(n_v - 1)$, $\quad$ $\delta_r = A(n_r - 1)$

(vii) $\theta = \delta_v - \delta_r = (n_v - n_r)A$

(viii) Disperssive power, $D = \frac{\delta_v - \delta_r}{\delta} = \frac{n_v - n_r}{n-1}$

where, $\delta = \frac{\delta_v + \delta_r}{2}$, and $n = \frac{n_v + n_r}{2}$

(ix) For maximum angle of deveation, $i = 90°$

(x) For no emergence, $r_2 > C$

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(19) The refractive index of material of prism is $\cot\frac{A}{2}$ where A is angle of prism. what will be minimum angle of deviation by this prism ?

(A) 180° – 2A $\quad$ (B) 180° – A $\quad$ (C) 90° – A $\quad$ (D) $\frac{A}{2}$

(20) On the prism having angle of prism 60° when light is made incident at angle 50° it suffer minimum deviation. The minimum angle of deviation will be ________.

(A) 60° $\quad$ (B) 55° $\quad$ (C) 40° $\quad$ (D) 45°

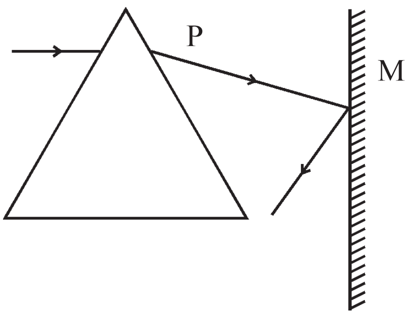
(21) Angle of prism is 60°. What will be minimum angle of deviation for this prism ? Refractive index of prism is $\sqrt{2}$.

(A) 45° $\quad$ (B) 30° $\quad$ (C) 60° $\quad$ (D) 35°

(22) The refractive index of prism is $\sqrt{2}$. The minimum angle of deviation and angle of prism is same for that prism. Then angle of prism will be ________.

(A) 30° (B) 45° (C) 60° (D) 90°

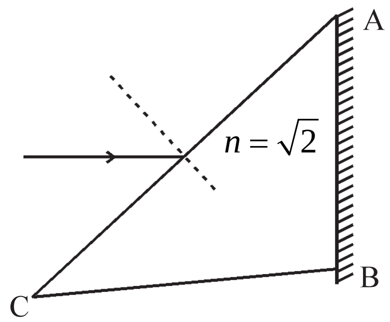
(23) A horizontal ray is incident on the prism having angle of prism 4° and refractive index 1.5 plane mirror is placed behind this prism as shown in figure, then find total angle of deviation for ray.



(A) 4° clockwise (B) 178° clockwise

(C) 8° clockwise (D) 2° clockwise

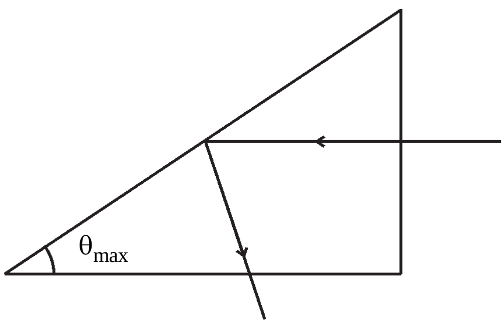
(24) As shown in the figure one side is silvered for prism ABC with refractive index $\sqrt{2}$. Angle of incidence is 45°. The refracted ray is reflected by the surface AB in the same direction, then $\angle CAB =$ ________.



(A) 20° (B) 10°

(C) 30° (D) 25°

(25) A ray of light propagating inside prism parallel to the base incident on the hypotenuse of prism of right angled prism. If refractive index of material of prism is n then for total internal reflection by hypotenuse the maximum value of the angle of base should be ________.



(A) $\cos^{-1}\frac{1}{n}$ (B) $\sin^{-1}\left(\frac{n-1}{n}\right)$

(C) $\tan^{-1}\frac{1}{n}$ (D) $\sin^{-1}\frac{1}{n}$

Ans. : 19 (A), 20 (C), 21 (B), 22 (D), 23 (B), 24 (C), 25 (A)

- **Equation of lens, Magnification, power of lens, combination of thin lenses in contact :**

Refraction at a spherically curved surface.

$$-\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R} \quad \text{(From rarer to denser medium)}$$

$$-\frac{n_2}{u}+\frac{n_1}{v}=\frac{n_1-n_2}{R}$$ (From denser to rarer medium)

n_1 = Refractive index of medium in which object is placed. n_2 = Refractive index of second medium.

u = object distance, v = Image distance, R = Radius of curvature.

For lens

(1) General equation of lens : $-\frac{1}{u}+\frac{1}{v}=\left(\frac{n_2-n_1}{n_1}\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

(2) Lens - Maker's equation, $\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

(3) Gauss, equation : $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

(4) Newton's equation : $x_1 x_2 = f_1 f_2$

(5) Lateral magnification : $m=\frac{v}{u}$

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

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

(6) Longitudinal magnification : $m=\frac{v_2-v_1}{u_2-u_1}$

For small object

$$m=\frac{dv}{du}=\left(\frac{v}{u}\right)^2=\left(\frac{f}{f+u}\right)^2=\left(\frac{f-v}{f}\right)^2$$

(7) Arial magnification : $m_s=\frac{\mathrm{A_i}}{\mathrm{A_o}}$ $\mathrm{A_i}$ = Area of image $\mathrm{A_o}$ = Area of object

$\therefore\ m_s=m^2$

(8) Power of lens

$\mathrm{P}=\frac{1}{f}$, unit is $D,\ m^{-1}$

(9) Combination of Lens :

(i) $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ (Two lens)

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + ... + \frac{1}{f_n}$ (Generalized)

(ii) Equivalent power (Far lenses in contact) : $P = P_1 + P_2 + ... + P_n$

(iii) For lenses with seperation

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$ $d =$ distance between lenses

Power, $P = P_1 + P_2 - dP_1P_2$

(iv) Magnification for lenses in contact.

$m = m_1 \times m_2 \times .... \times m_n$

(10) Combination of lens and cenvex mirror

$f = \frac{R}{2} = \frac{1}{2}(v - d)$

$d =$ distance of lens from mirror

(11) Relationship between velocity of object and velocity of image. If object is moving from large distance toward lens, then velocity of image is,

$$v_i = \left(\frac{f}{f+u}\right)^2 v_o$$

Initially v_i increases showly then increases repidly.

(12) For silvered lens

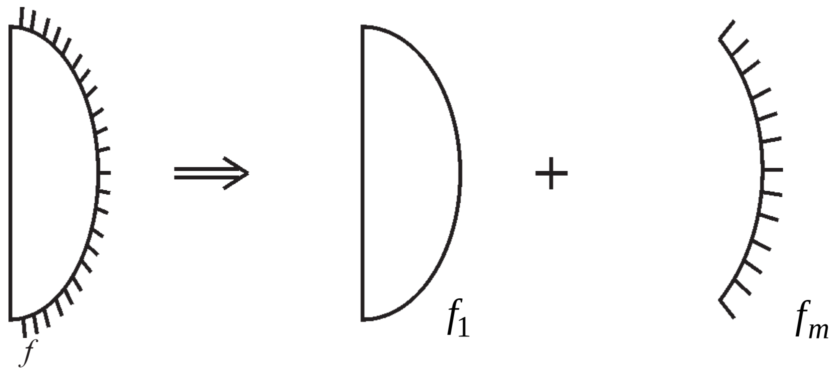
If one surface of lens is silvered then it behave as mirror so it's focal length.

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_m}$

$f_1 =$ Focal length of lens due to which refraction takes place.

$f_m =$ Focal lenght of mirror due to which reflection takes place.

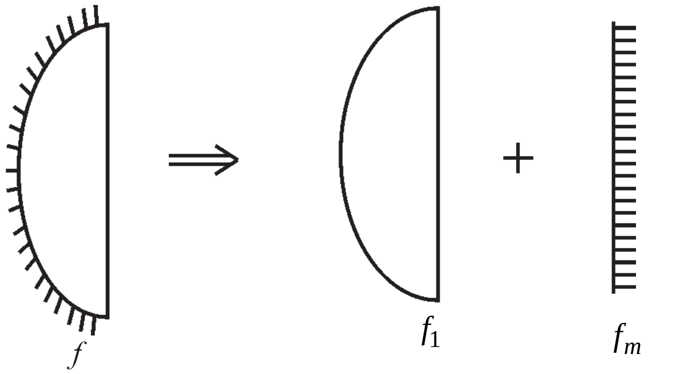
(i) For plano convex lens.



$$f_1 = \frac{R}{n-1} \qquad f_m = \frac{R}{2}$$

$$\therefore \; f = \frac{R}{2n}$$

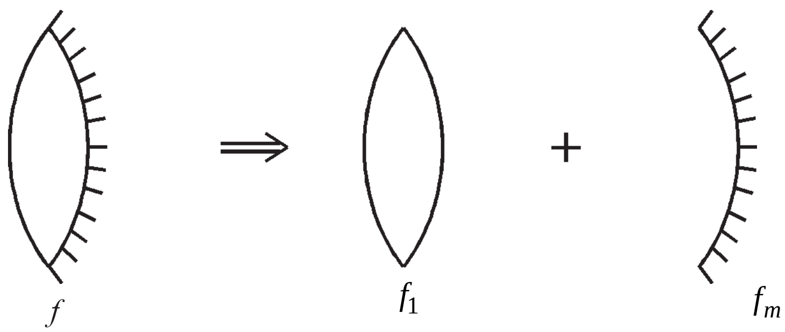
(ii) For convex plano lens



$$f_1 = \frac{R}{n-1} \qquad f_m = \infty$$

$$\therefore \; f = \frac{R}{n-1}$$

(iii) For cenvex lens



$$f_1 = \frac{R}{2(n-1)} \qquad \therefore \; f_m = \frac{R}{2}$$

$$\therefore \; f = \frac{R}{n-1}$$

(13) Displacement method :

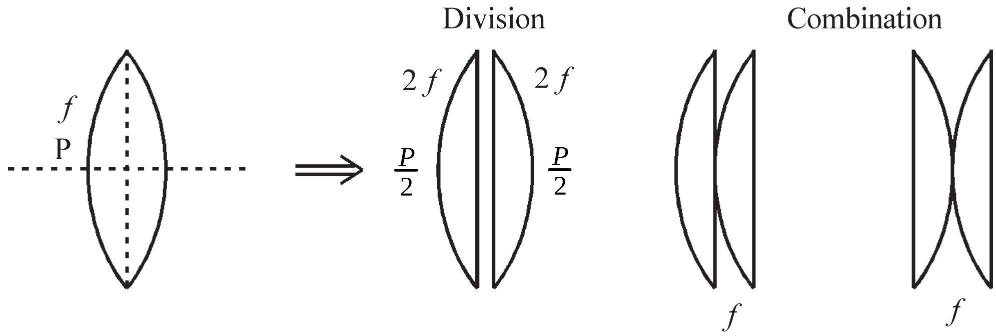
When distance between object and screen $D > 4f$ than by keeping it constant if convex lens of focal length of f is placed between object and screen then real image at length I_1 is formed on the screen. When lens is displaced by distance x the image of length I_2 obtained on screen then.

(i) $f = \dfrac{D^2 - x^2}{4D}$

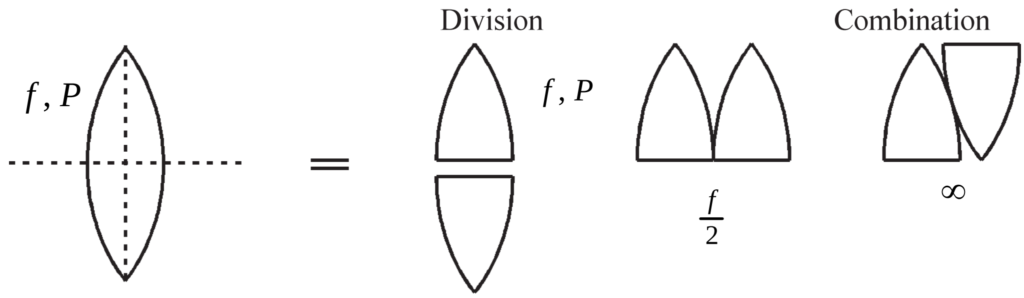
(ii) length of object $= \sqrt{I_1 I_2}$

(14) Division of lens in equal parts and combination

(i) In the direction of optical axis :



(ii) If the direction of principal axis :



where f is focal lenght of main lens and P is it's power

(26) If lens is displaced towards object by 20 cm then the magnification remains same so focal length of lens will be ________ cm.

(A) 17.5 (B) 18.5 (C) 16.5 (D) 15.5

(27) Convex lens form real image of object on the screen placed at constant distance. Lens is moved on principal axis away from screen with constant velocity $v = 0.5\ \text{ms}^{-1}$. object is also given proper velocity to keep image on the screen. When height of object is twice the height of image at that time find velocity of object.

(A) $1.5\ \text{ms}^{-1}$ away from screen (B) $1.5\ \text{ms}^{-1}$ towards the screen

(C) $2.5\ \text{ms}^{-1}$ towards the screen (D) $2.5\ \text{ms}^{-1}$ away from screen

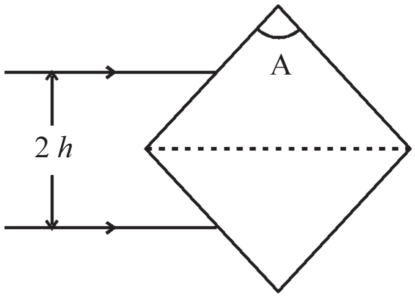
(28) An object is place on principal axis at 10 cm on left hand side of cenvex lens L_1 having focal length 20 cm. Another lens L_2 of focal length 10 cm is placed at 5 cm on right hand side of first lens co-axially. Find the distance of final image from second lens and magnification.

(A) $\frac{-50}{3}$ cm, $\frac{3}{4}$ (B) $\frac{70}{3}$ cm, $\frac{3}{4}$ (C) $\frac{50}{3}$ cm, $\frac{4}{3}$ (D) $\frac{25}{3}$ cm, $\frac{3}{4}$

(29) For plano cenvex lens the cenvex surface is silvered. It's radius of curvature is R. Find the focal length of cencave mirror formed by it. $n = 1.5$

(A) $-R$ (B) $\frac{-R}{4}$ (C) $\frac{-R}{2}$ (D) $\frac{-R}{3}$

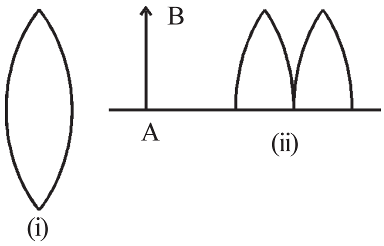
(30) Two thin prism of angle of prism A and refractive index n are placed so that their bases are in contact with each other. This system behave as convex lens. As shown in figure parallel rays are made incident on it then find it's focal length.



(A) $\frac{h}{(n-1)A}$ (B) $\frac{hA}{(n-1)}$

(C) $\frac{2h}{(n-1)A}$ (D) $\frac{2hA}{n-1}$

(31) As shown in figure (i) a thin convex lens having focal lenght of 10 cm is cutted in two equal parts. These two parts are arranged as shown in figure (ii). An object of height 1 cm is placed at distance 7.5 cm from this system then height of image will be ________ cm.



(A) 1 (B) 2

(C) 0.5 (D) 4

(32) The power of convex lens in air is + 10 D. The refractive index of convex lens is 1.5. If on left side of lens is air and on right side of lens is water of retractive index 1.33 then find the power of lens.

(A) 2.42 D (B) 3.67 D (C) 4.42 D (D) 6.70 D

(33) The power of convex lens in air is +5 D. If it is immersed in water then it's power will be ________.

(A) 4.25 D (B) 1.25 D (C) 2.25 D (D) 3.25 D

(34) For two symmetric convex lens A and B focal lengths are same but radius of curvature are different so that $R_A = 0.9\,R_B$. If $n_A = 1.63$ then $n_B = ?$

(A) 1.7 (B) 1.6 (C) 1.5 (D) $\frac{4}{3}$

(35) Convex lens of focal length 25 cm and concave lens of focal length 20 cm are placed co-axially at distance d from each other. If the resultant power of system is zero then find d.

(A) 5 m (B) 5 cm (C) 3 cm (D) 0.5 m

(36) The distance between an object and screen is 1 m. From the possible positions of lens for one position is at 40 cm at that time the image of object is obtained on the screen, then the power of lens is ________.

(A) 5 D (B) 6 D (C) 2 D (D) 4 D

Ans. : 26 (A), 27 (B), 28 (C), 29 (D) 30 (A), 31 (B), 32 (D), 33 (B), 34 (A), 35 (B) 36 (A)

Microscope and Astronomical Telescope (Reflecting and Refracting) and their magnifying power

(1) Simple microscope (Magnifying lens)

(i) magnification : $m = 1 + \frac{D}{f}$ (Image is obtained at D.)

$= 1 + \frac{D-a}{f}$ (Distance between eye and lens is a)

D = Distance of distinct vision

f = Focal length of lens

(ii) $m = \frac{D}{f}$ (If image is formed at infinite distance)

$= \frac{D-a}{f}$ (If eye is at distance a from lens)

(2) Compound Microscope :

Resultant Magnification, $m = m_o \times m_e$

$= \frac{L}{f_o} \times \frac{D}{f_e}$

L = Tube length, D = Distance between eye piece and image, f_o = Focal lenght of objective,

f_e = focal length of eyepiece

$f_e > f_o$

Final image obtained is enlarged, virtual and inverted.

(3) Astronomical Telescope :

(i) Magnification : $m = \frac{\beta}{\alpha}$

$= \frac{f_o}{f_e}$ $\left(f_o > f_e\right)$

(ii) $m_D = \frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right)$

α = angle subtended by the object with objective or eye

β = Angle subtended by the final image with eye.

optical length $= f_0 + f_e$

Tube length $L \geq f_o + f_e$

Final image formed is small, virtual and inverted.

(4) Terestrial Telescope

– To observe distant object from Earth

– Three lens : objective, eye piece and Erecting lens.

– Final image formed is small virtual and eracted.

magnification $m = \frac{f_o}{f_e}$

$L = f_o + f_e + 4f$

$f =$ focal length of eracting lens

(5) Galelian Telescope :

– It is one type of terestrial telescope but it's vision range is small

– Convex lens is objective

– Concave lens is eyepiece

$$m = \frac{f_o}{f_e}$$

$$L = f_o - f_e$$

(6) Reflecting Telescope :

magnification, $m = \frac{f_o}{f_e}$

$f_o =$ Focal length of main concave mirror

$f_e =$ Focal lenght of eyepiece

(7) Defect of vision

(A) Near sightedness (myopia)

Removel - concave lens

(i) $f = -d$ $\quad$ $f =$ focal length, $d =$ distance of defect

(ii) Person can see up to distance x and what to see up to distance y then

$$f = \frac{xy}{x - y} \qquad y > x$$

$$P = \frac{x - y}{xy}$$

(B) Far sightedness : (Hypermetropia)

Removel - convex lens

If person can't see object away from d and object is at distance D from eye then to see that object.

$$f = \frac{dD}{d - D}, \qquad P = \frac{dD}{d - D}$$

(C) Astigmatism

Removel - cylindrical lens

(D) Press Biopia

Removel - Bifocal lens

(37) In compound microscope focal length of objective is 1 cm and focal length of eye piece is 5 cm and both lenses are at 12.2 cm from each other. The object should be placed from objective at distance ________ cm so that final image is formed at the distance of distinct vision and the resultant magnification by instrument will be ________.

(A) 6, 22 (B) 8, 44 (C) 8, 34 (D) 6, 32

(38) Focal length of eyepiece of telescope is 5 cm. Final image is formed at very large distance. At that time magnification is 10. If image is formed at distance of distinct vision 25 cm at that time find the magnification.

(A) 60 (B) 50 (C) 10 (D) 12

(39) Astronomical telescope is adjusted for infinite distance. If objective is replaced by slit of length x. The image formed by eyepiece of this slit is of length y, then magnification of telescope will be ________.

(A) $x - y$ (B) $x + y$ (C) $\frac{x}{y}$ (D) $\frac{y}{x}$

(40) Diameter of moon is 3.5×10^6 m and it is at distance 3.8×10^8 m from Earth. It is observed with the telescope having objective focal length of 2 m and eyepiece focal length of 10 cm then image will be formed at angle ________.

(A) $11°$ (B) $21°$ (C) $31°$ (D) $41°$

(41) For Galelian telescope focal length of objective and eyepiece 50 cm and 5 cm respectively. If in normal condition it is used for large distance then it's magnification will be ________ and tube length will be ________ .

(A) 5, 25 (B) 10, 55 (C) 10, 40 (D) 10, 45 cm

(42) A person can see the objects easily between 20 cm to 75 cm. If he wear the spects of power 1 D then give range of his vision.

(A) 25 cm to 300 cm (B) 25 cm to 200 cm (C) 30 cm to 200 cm (D) 30 cm to 300 cm

Ans. : 37 (B), 38 (D), 39 (C), 40 (A), 41 (D), 42 (A)

Wave optics

Interference, young's experiment of two slits and equation of width of fringe

(1)

	Type of wave front	Indensity	Amplitude
(i)	Spherical wavefront	$I \alpha \frac{1}{r^2}$	$A \alpha \frac{1}{r}$
(ii)	cylindrical wavefront	$I \alpha \frac{1}{r}$	$A \alpha \frac{1}{\sqrt{r}}$
(iii)	Plane wavefront	$I \alpha r^{\circ}$	$A \alpha r^{\circ}$
	$r =$ distance from the source		

(2) (i) Phase difference $\delta = k\left(r_2 - r_1\right) = k$ (Path difference), $k = \frac{2\pi}{\lambda}$

(ii) Phase difference $=\omega$ (time difference), $\omega = \frac{2\pi}{T}$

(3) Average intensity of light at a point due to superposition of two harmonic waves, emitted from two point like sources.

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\left\langle \cos\left(\delta_2 - \delta_1\right)\right\rangle$$

(i) In coherent sources

$\omega_1 \neq \omega_2$, $I = I_1 + I_2$

(ii) Coherent sources

$\omega_1 = \omega_2$, $\phi_2 - \phi_1 =$ Constant

$I = I_o \cos^2 \dfrac{\delta}{2}$, Phase difference $= \delta$

$$= k\left(r_2 - r_1\right)$$

Path difference $= r_2 - r_1$

(4) Methods to obtain coherent sources

(i) By division of wavefront (Young's Experiment)

(ii) By division of Amplitude (Reflection by thin film layers)

(5) **Condition for constructive interference**

$$\left.\begin{array}{l} \text{phase} - \text{difference, } k\left(r_2 - r_1\right) = 2n\pi \\ \text{path} - \text{difference, } \left(r_2 - r_1\right) = n\lambda \end{array}\right\} n = 0,1,2,3,....$$

Intensity $I = I_o = 4I'$, I' intensity of both waves $\left(I_1 = I_2 = I'\right)$

(6) **Distructive Interterence**

$$\left.\begin{array}{l} \text{Phase} - \text{difference } k\left(r_2 - r_1\right) = (2n-1)\,\pi \\ \text{Path} - \text{difference } r_2 - r_1 = (2n-1)\dfrac{\lambda}{2} \end{array}\right\} n = 1, 2, 3, ...$$

Intensity $I = 0$

(7) Young's two slit experiment

(**i**) Path difference $= r_2 - r_1$ $\quad d =$ Distance between two coherent sources

$= d\sin\theta$ $\quad D =$ Distance between slit and screen

$= d\tan\theta$ $\quad x =$ Distance of fringe from centre of screen

$= \dfrac{dx}{D}$ $\quad \theta =$ angular distance

(**ii**) Constructive Interference in Young's experiment (For bright fringes)

$$d \sin \theta = n\lambda$$

$$\frac{dx}{D} = n\lambda,\ n = 0,1,2,3,....$$

(iii) Destructive interfrence in young's experiment (Dark fringes).

$$d \sin \theta = (2n-1)\frac{\lambda}{2}$$

$$\frac{dx}{D} = (2n-1)\frac{\lambda}{2}, \quad n = 1,2,....$$

(iv) Distance between two consecutive bright or dark fringes in Young's experiment.

$$\bar{x} = \frac{\lambda D}{d}$$

(v) Width of fringe $= \frac{\bar{x}}{2} \quad = \frac{\lambda D}{2d}$

(vi) In Young's experiment if $n_2{}^{\text{th}}$ bright fring of light with wavelength λ_2 superpose to $n_1{}^{\text{th}}$ bright fringe of wave length λ_1 then,

$$\frac{dx}{D} = n_1 \lambda_1$$

$$\frac{dx}{D} = n_2 \lambda_2$$

$$\therefore n_1 \lambda_1 = n_2 \lambda_2$$

(vii) **In Young's experiment If transparent sheet of thickness *t* and refractive index *n* is placed in the path of one ray,**

(a) Optical path difference between two rays $= nt - t = (n-1)\,t$

(b) If fringe is displaced by x, then path difference $= (n-1)\,t$

$$\frac{dx}{D} = (n-1)\,t$$

$$x = \frac{D}{d}(n-1)\,t$$

x is called Lateral shift.

The fringes will shifts towards the light rays in the path of which the sheet is placed, that shifting does not depends on the order of fringe and wavelength.

(viii) For any wavelength absent on screen against the slit (Distructive interference)

$$\lambda = \frac{d^2}{(2n-1)D} \quad n = 1,2,3,....$$

Absent wavelengths, $\lambda = \frac{d^2}{D}, \frac{d^2}{3D}, \frac{d^2}{5D}, ...$

(ix) Distance between fringes (Δx)

(a) Distance between n^{th} and m^{th} bright fringes

(i) $\Delta x = \frac{\lambda D}{d}(n-m) \qquad n > m$

(b) Distance between n^{th} bright and m^{th} dark fringes

$$\Delta x = \left(n - m + \frac{1}{2}\right)\frac{\lambda D}{d} \qquad n > m$$

(ii) $\Delta x = \left(m - n - \frac{1}{2}\right)\frac{\lambda D}{d} \qquad m > n$

(x) Visibility of fringes

$$V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

$$= \frac{2\sqrt{\alpha}}{\alpha + 1} \qquad \left[\frac{I_1}{I_2} = \alpha\right]$$

$$= \frac{2\sqrt{I_1 I_2}}{I_1 + I_2}$$

(a) If $I_{min} = 0$, $V = 1$ (maximum)

(b) If $I_{max} = 0$, $V = -1$

(c) If $I_{max} = I_{min}$, $V = 0$

(8) Interference by thin film

(i) For reflecting light

(a) $2\mu t \cos r = (2n-1)\frac{\lambda}{2}$ $n = 1, 2, 3,...$ (constructive Interference)

(b) $2\mu t \cos r = n\lambda$, $n = 1, 2, 3,...$ (Destructive Interference)

$r =$ angle of reflection

(ii) For refracting light

(a) $2\mu t \cos r = n\lambda$ (constructive Interference) $n = 1, 2, 3,...$

(b) $2\mu t \cos r = (2n-1)\frac{\lambda}{2}$ (Destructive Interference) $n = 1,2,3,...$

(9) Lord's mirror

Path-Difference $\left(S_2P - S_1P\right) = n\lambda$ (Destructive Interference) $n = 1, 2, 3, ...$

$= \left(2n - 1\right)\frac{\lambda}{2}$ (Constructive Interference)

$n = 0, 1, 2, 3, ...$

(10) Fresnel Biprism

Fresnel biprism is made by joining base of two prisms having small prism angle.

$d =$ Distance between two coherent sources, $a =$ Distance of slit from biprism,

$b =$ Distance of screen from biprism $D = a + b =$ Distance of screen from slit,

α = Prism Angle,

$n =$ Refractive index of material of prism

width of fringes $= \dfrac{\lambda D}{d}$

Where, $D = a + b$

$d = 2a\left(n - 1\right)\alpha$

(11) Newton's Ring

Placing convex lens on the plane glass plate and incidenting light normally on it the circular rings of different radius are observed.

R = Radius of curvature of cenvex surface.

At the centre, dark and then successive bright and dark rings are observed.

(i) radius of n^{th} dark ring, $r_n = \sqrt{\lambda R}\,\sqrt{n}$, $n = 0, 1, 2, 3, ...$

$r_n \;\alpha\; \sqrt{n}$

(ii) radius of n^{th} bright ring $r_n = \sqrt{2n + 1}\,\sqrt{\frac{\lambda R}{2}}$ $n = 1, 3, 5, ...$

$r_n \;\alpha\; \sqrt{2n + 1}$

(iii) Diameters of n^{th} dark ring D_n and $\left(n + P\right)^{th}$ ring is $D_n + P$ then wavelength

$$\lambda = \frac{D_{n+P}^2 - D_n^2}{4\,PR}$$

(12) Doppler effect for Light

$f =$ real frequency, $\lambda =$ real wavelength

$f' =$ virtual frequency, $\lambda' =$ virtual wavelength

$v =$ Velocity of light source with respect to steady listener

$c =$ velocity of light

(i) If listener is steady and source of light is moving towards listener then $\lambda > \lambda'$

$\Delta \lambda = \lambda \frac{v}{c}$ (Violet shift)

(ii) If listener is steady and source of light is moving away from the listener then $\lambda' > \lambda$

Doppler shift $\Delta \lambda = \lambda \frac{v}{c}$ (Red shift)

(iii) Doppler Broadening

When gas is filled in electric discharge tube then the range of spectrum due to random motion of atoms of gas.

$\Delta f = \frac{v}{c} f \Rightarrow \pm \Delta f = \pm \frac{v}{c} f$

$\Delta \lambda = \frac{v}{c} \lambda \Rightarrow \pm \Delta \lambda = \pm \frac{v}{c} \lambda$

(13) Radar

For microwaves transmitted towards the plane and reflected from it, the frequency difference,

$\Delta f = \frac{2v}{C} f$

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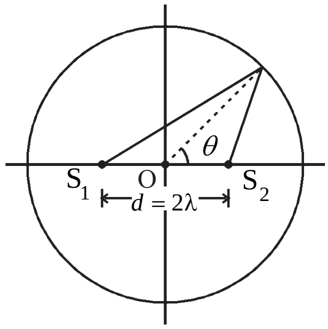
(43) In Young's experiment of two slit the maximum intensity is I_0. The distance between two slits is $d = 5\lambda$, $\lambda =$ wavelength of monochromatic light. Then find the intensity at a point on the screen in front of the slit Distance between slit and screen $D = 5d$.

(A) I_0 (B) 0 (C) $\frac{I_o}{2}$ (D) $2I_0$

(44) As shown in the figure from the centre of a circle of large radius at same distances two point like coherent sources S_1 and S_2 are placed. Where $d = 2\lambda$, $\lambda =$ wavelength of emitted light, then find the possible values of θ for which on the semi circle the intensity is maximum.



(A) 20°, 50°, 150° (B) 30°, 80°, 120°
(C) 45°, 90°, 170° (D) 30°, 90°, 150°

(45) The monochromatic, collimated light beam is incidenting in Young's experiment, which makes an angle $\theta = \sin^{-1} \frac{\lambda}{2d}$ with a normal to the plane of slit, then find the intensity at the centre of screen.

(A) I_0 (B) $2I_0$ (C) 0 (D) $4I_0$

(46) Find the ratio of intensity of central bright fringe to the intensity at position situated at distance one fourth of the distance between two successive fringes.

(A) 2 (B) $\frac{1}{2}$ (C) 4 (D) 16

(47) In Young's experiment when a glass plate of retractive index of 1.5 is placed in the path of one ray of the rays forming interference, the fring pattern is displaced by y. When this plate is replaced by sheet of mica having same thickness then fringe pattern is displaced by $\frac{3}{2}y$. Then find the refractive index of second plate.

(A) 1.5 (B) 1.75 (C) 1.25 (D) 1.00

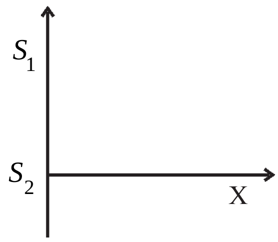
(48) In young's experiment of two slits the light of wavelength 600 nm is used. If a transparent plate of thickness 1.8×10^{-5} m having refractive index 1.6 is placed in the path of one ray then how many fringes of same type will be displaced.

(A) 18 (B) 9 (C) 36 (D) 12

(49) In Young's experiment the distance between two slits is 0.055 cm and distance of screen from slit is 100 cm. Then find the distance between second bright fringe at upper side of centre to the third dark fringe at lower side of centre. Wavelength of light is 4000 $\mathring{A}$.

(A) 0.3 cm (B) 0.5 cm (C) 0.4 cm (D) 0.6 cm

(50) As shown in the figure two coherent sources S_1 and S_2 are placed on Y-axis. The wavelength of light emitted from it is λ. Distance between two sources is $d = 2\lambda$, then at what distance on positive X-axis first dark fringe will be obtained.



(A) $\frac{5\lambda}{12}$ (B) $\frac{3\lambda}{12}$

(C) $\frac{7\lambda}{12}$ (D) $\frac{15\lambda}{12}$

(51) The ratio of intensities of light emitted from two coherent sources is 4, then find visibility of fringes.

(A) $\frac{3}{5}$ (B) 4 (C) 9 (D) $\frac{4}{5}$

(52) In young's experimnt the width of fringe is 2 mm when wavelength of light is 6000 $\mathring{A}$. If the entire instrument is immersed in water having refractive index 1.33 then what will be width of slit ?

(A) 0.5 *m*m (B) 3.5 m (C) 1.5 *m*m (D) 2.5 m

Ans. : 43 (B), 44 (D), 45 (C), 46 (A), 47 (B), 48 (A), 49 (C), 50 (C), 51 (D), 52 (C)

Diffraction :

(1) Diffraction $\alpha \frac{\lambda}{d}$ $\lambda =$ wavelength, $d =$ width of slit

(2) Types of Diffraction : (i) Fresnel (ii) Fraunhoffer

(3) Fraunhoffer Diffraction by single slit

(A) Central (Zeroth order) maximum

(i) $\theta = 0°$

(ii) Maximum Intensity $= I_0$

(B) Minimum of n^{th} order

(i) $\sin\theta_n = \frac{n\lambda}{d},\ n = 1, 2, 3, ...$ $\theta_n =$ angle of Diffraction for n^{th} order minimum

$\lambda =$ Wavelength

If θ_n is very small then,

$\sin\theta_n \simeq \theta_n \approx \tan\theta_n$

$\theta_n = \frac{n\lambda}{d}$

$[\theta_n =$ Angular width of n^{th} order minima from central maxima$]$

$\tan\theta_n = \frac{x_n}{D}$, $x_n =$ Distance of n^{th} minima from centre of central maxima

$\therefore \frac{n\lambda}{d} = \frac{x_n}{D}$

(ii) $x_n = n\frac{\lambda D}{d} = \frac{n\lambda f}{d}$, $D =$ Distance between slit and screen

$f =$ focal length of convex lens

(iii) $\alpha = n\pi$ Intersity $I = 0$

Where $\alpha = \frac{\pi d\sin\theta}{\lambda}$

(C) n^{th} order maximum

(i) $\sin\theta_n = (2n+1)\frac{\lambda}{2d}$, $n = 1,2,3,...$

$\theta_n =$ Diffraction angle for n^{th} order maxima

θ_n is very small $\sin\theta_n \approx \theta_n \approx \tan\theta_n$

(ii) Distance of n^{th} order maxima from centre of central maxima,

$x_n = (2n+1)\frac{\lambda}{2d}D$, $D = f$

(iii) Intensity, $I = I_0\left(\frac{\sin\alpha}{\alpha}\right)^2$

$\alpha = \frac{\pi d\ \sin\theta}{\lambda}$, $\alpha = (2n+1)\frac{\pi}{2}, n = 1,2,3,...$

Intensity decreases rapidly with increase in the order of maxima

(4) Fresnel distance :

The distance up to which bending of light is very less.

$$Z_f = \frac{d^2}{\lambda}$$ $d =$ Linear dimension of obstacle

(5) Diffraction by Grating :

The device formed by equispaced paralled slits having equal width is called grating.

$d = a + e$ $a =$ width of part of obstacle $d =$ grating element,

$d = \frac{\text{Total width}}{\text{ruling}}$ $e =$ Width of slit

$d \sin\theta = n\lambda$, $n = 0, 1, 2, 3, ...$

Total bright fringes $= 2n + 1$ (For bright fringes), $\theta =$ Diffraction angle

(6) In the diffraction due to circular obstacle the central ring formed is bright. Which is called Airy's disc. In the surrounding of it bright and dark concentric rings are observed which is called Airy's rings.

(7) (A) Rayligh's criteria for circular obstacle like lens

$$\sin\theta \approx \theta = \frac{1.22\lambda}{D}$$ $\lambda =$ wavelength of light $D =$ Diameter of lens

(B) (i) Angular resolution of telescope, $\alpha_{\min} = \frac{1.22\lambda}{D}$

(ii) Resolving power of telescope, $RP = \frac{1}{\alpha_{\min}}$

$$= \frac{D}{1.22\,\lambda}$$

(C) (i) For microscope

$$d_m = \frac{1.22\,\lambda}{D} f$$ $d_m =$ The minimum distance between two point like object so that it can be seen distinet

$$= \frac{1.22\,\lambda}{2\sin\beta}$$ $\lambda =$ wavelength

$f =$ Focal length of objective

$D =$ Diameter of objective

(ii) If medium of large refractive index (n) is between objective and object then

$$RP = \frac{2n\sin\beta}{1.22\lambda},$$ $n\sin\beta =$ Numerical Aperture

$$RP\ \alpha\ \frac{1}{\lambda}$$

(8) Malus law : $I = I_0 \cos^2\theta$, θ = Angle between optic axis of two parallel Tourmaline plates

I_0 = Intensity of incident light, I = Intensity of emerging light

$\theta = \frac{\pi}{2}, \frac{3\pi}{2}$ ......, then $I = 0$ (Crossed)

$\theta = 0, \pi$ ......, then $I = I_0$

When unpolarized light passes through the polarizer then for emerging light, $I_{ave} = \frac{I_o}{2}$

(9) Brewster's law

$\theta_p + r = 90°$ — θ_p = angle of incidence, r = angle of refraction

$n = tan\,\theta_p$ — n = Refrative index of transparent medium

(10) Methods to obtain polarized light

(i) Polaroid, e.g. Tourmaline plate
(ii) Polarization by reflection
(iii) Double refraction, e.g. Nicol prism
(iv) By scattering

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(53) In the Fraunhoffer diffraction by a single slit the distance between first and fifth minima is 0.40 *m*m. The wavelength of light incident normal to slit is 550 nm and distance of screen from slit is 50 cm, then find the angle for first order minimum.

(A) 1.5×10^{-4} rad (B) 2×10^{-4} rad (C) 3×10^{-4} rad (D) 2.5×10^{-4} rad

(54) In the Fraunhoffer diffraction by single slit the width of slit is 0.60 *m*m. Wavelength of light normal to slit is 600 nm. Distance of screen from slit is 60 cm, then find width of central maximum.

(A) 1.2 *m*m (B) 0.6 *m*m (C) 2.4 *m*m (D) 4.8 *m*m

(55) In the Fraunhoffer diffraction by single slit the wavelength of light incidenting normal to slit is 5000 $\mathring{A}$, distance between screen and slit is 100 cm. First order minima is obtained at 5 *m*m from central maximum then find the width of slit.

(A) 0.5 *m*m (B) 0.2 *m*m (C) 1 *m*m (D) 0.1 *m*m

(56) In the Fraunhoffer diffraction by a single slit the light of wavelength λ is incidenting normally on the slit of width *d*. Distance of screen from slit is D. If linear width of central maximum is half then the width of slit, then d = ________ .

(A) $\sqrt{\frac{\lambda D}{4}}$ (B) $\sqrt{\lambda D}$ (C) $\sqrt{4\lambda D}$ (D) $\sqrt{2\lambda D}$

(57) Light of wavelength 600 nm incident on an obstacle and least bending of light is up to 15 m then find the linear dimension of obstacle.

(A) 3 *m*m (B) 2 *m*m (C) 4 *m*m (D) 5 *m*m

(58) In the Fraunhoffer diffraction by single slit, if wavelength of light incidenting normal to slit is doubled, distance between slit and screen made three times and width of slit is made $\frac{3}{2}$ times then width of central maximum will be ________.

(A) Three times (B) Four times (C) Double (D) Half

(59) Light of wavelength 800 nm incident normally on the grating having $1.25 \times 10^5 \frac{\text{line}}{\text{meter}}$. How many maximum number of bright fringes can be obtained on the screen kept at large distance ?

(A) 17 (B) 19 (C) 21 (D) 23

(60) For the telescope having objective aperture of 4.88 m, the wavelength of light is 6000 $\mathring{A}$, then what should be minimum resolving angle ? 1 rad = 2×10^5 sec.

(A) 3×10^{-2} second (B) 2×10^{-2} second (C) 2.5×10^{-2} second (D) 3.5×10^{-2} second

(61) In electron microscope the accelerated potential difference is increased from 10 kV to 90 kV then new value of resoalving power will be ________.

(A) 4 R (B) 2 R (C) 3 R (D) $\frac{R}{2}$

(62) Five polaroids are arranged such that the optic axis of each is making 30° with optic axis of previous one. unpolarized light incident on first poleroid then how much part of light will emerge ?

(A) $\frac{1}{128}$ (B) $\frac{1}{256}$ (C) $\frac{81}{512}$ (D) $\frac{1}{512}$

(63) The unpolarized light with energy 3×10^{-3} J incident on the polarizer of area 3×10^{-4} m^2. If polarizer is rotating with angular speed of 3.14 rad s^{-1} then find the energy emerging per 1 rotation.

(A) 47.1×10^{-4} J (B) 27.1×10^{-4} J (C) 37.1×10^{-4} J (D) 17.1×10^{-7} J

(64) Two polaroids are in crossed position and the intensity of emerging light is zero. If a third polaroid is placed between these two polaroid at the half angle of angle between optic axies of those two, then intensity of emerging light will be ________. Where I_0 is maximum intensity of incident light.

(A) $\frac{I_0}{2}$ (B) $\frac{I_0}{4}$ (C) I_0 (D) $\frac{I_0}{8}$

(65) velocity of light in air is 3×10^8 ms^{-1} and in glass is 2×10^8 ms^{-1}. If light ray incident at angle of polarization then find angle of refraction.

(A) 37.7° (B) 27.7° (C) 17.7° (D) 47.7°

Ans. :	**53 (B), 54 (A), 55 (D), 56 (C), 57 (A), 58 (B), 59 (C), 60 (A), 61 (C), 62 (C), 63 (A) 64 (D), 65 (A)**

Experimental Techniques :

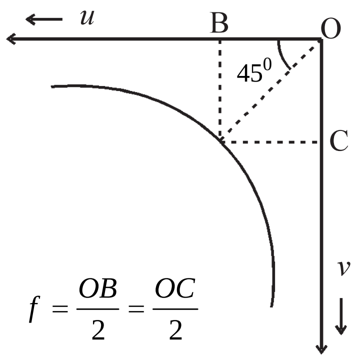
(1) (i) Convex mirror (ii) Concave mirror (iii) To measure focal length of convex lens.

(2) Draw the graph of angle of deviation versus angle of incidence using equilateral prism. From that deremine refractive index of materical of prism.

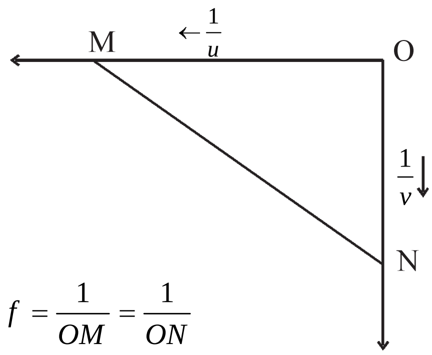
(3) Determine refractive index of a slab using travelling microscope.

Graphs

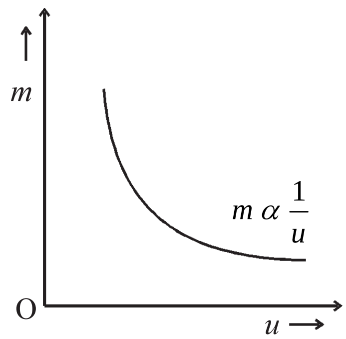
(i) Concave mirror, $v \to u$ (Both Negative)



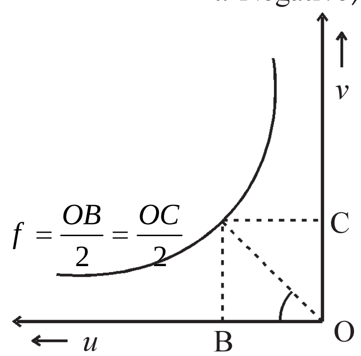
(ii) Concave mirror, $\frac{1}{v} \to \frac{1}{u}$ (Both Negative)



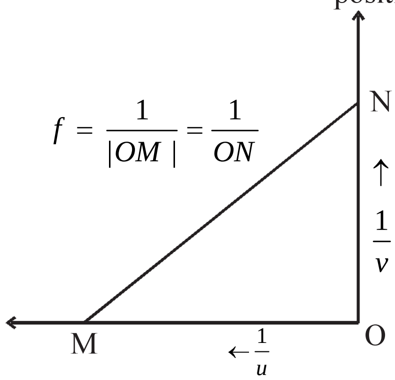
(iii) Concave mirror, $m \to u$, $m =$ magnification
$u =$ distance from pole (Both Negative)



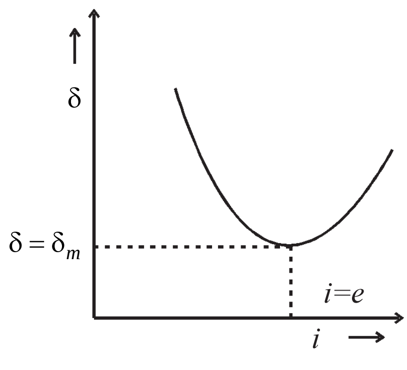
(iv) Convex lens, $v \to u$ (v positive
u Negative)



(v) Convex lens $\frac{1}{v} \to \frac{1}{u}$ ($\frac{1}{u}$ Negative, $\frac{1}{v}$ positive)

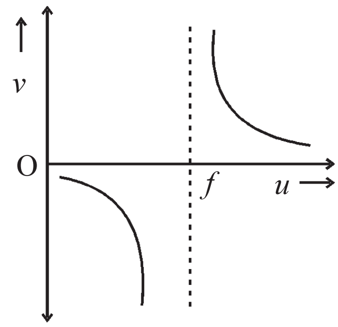


(vi) Prism $\delta \to i$

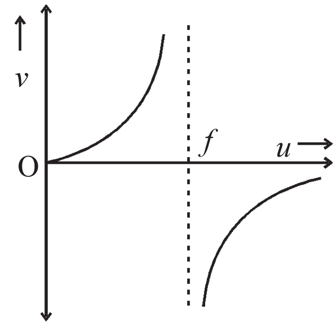


(66) Which graph is $v \rightarrow u$ for concave mirror. Where $f =$ focal length of concave mirror. Both distances changes from zero to infinity.

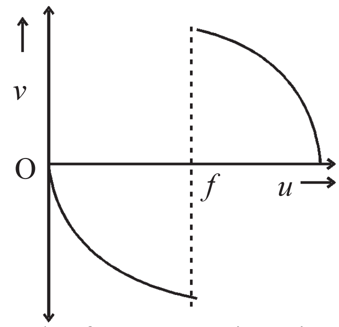
(A)



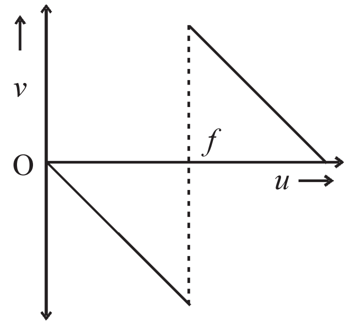
(B)



(C)



(D)



(67) Focal length of concave mirror is 20 cm. The lateral magnification obtained by it is 4 then find object distence.

(A) 30 cm (B) 25 cm (C) –25 cm (D) –30 cm

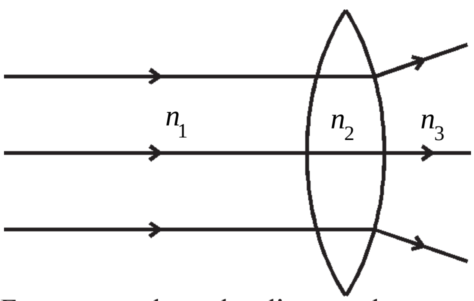
(68) In the experiment of combination of convex mirror and convex lens the distance between these two is 10 cm. When object is placed at a certain distance it's image is formed at the same position. When only convex lens is used the image is formed at 60 cm then focal length of mirror will be ________ cm.

(A) 20 (B) 30 (C) 15 (D) 25

(69) By the convex mirror having focal length 12 cm the image of an object is obtained one fourth of length of object, Then find the distance between object and image. Linear object is on axis normal to axis.

(A) 45 cm (B) 40 cm (C) 30 cm (D) 37.5 cm

(70) A bearn of parallel rays incident on convex lens. Their path is as shown in figure.



(A) $n_1 = n_2 > n_3$ (B) $n_1 < n_2 < n_3$

(C) $n_1 > n_2 > n_3$ (D) $n_1 = n_2 < n_3$

(71) For convex lens the distance between object and real image is d. If lateral magnification is m then find it's focal length.

(A) $\dfrac{d}{(1+m)^2}$ (B) $\dfrac{md}{(1+m)^2}$ (C) $\dfrac{1}{m(1+m)^2}$ (D) $\left(1+m^2\right)d$

(72) Refractive index of a prism having prism angle A is $\sqrt{3}$. If it's minimum angle of deviation is A then find it's angle of prism.

(A) 45° (B) 30° (C) 60° (D) 90°

(73) For thin convex lens object distance is 0.2 m and image distance is 0.5m. Image is formed on other side of lens then it's focal length will be ________ m.

(A) 0.143 (B) 0.243 (C) 0.343 (D) 0.443

(74) The depth of a well is 6.65m. If well is completely filled with water and refractive index of water is 1.33 then seeing from above the bottom of well will be observed shifted upward by ________ .

(A) 3.65m (B) 5m (C) 1.65m (D) 12.65m

Ans. : 66 (B), 67 (C), 68 (D), 69 (A), 70 (A), 71 (B), 72 (C), 73 (A), 74 (C)

Assertion - Reason type Question :

Instruction : Read assertion and reason carefully, select proper option from given below.

(a) Both assertion and reason are true and reason explains the assertion.

(b) Both assertion and reason are true but reason does not explain the assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false and reason is true.

---

(75) **Assertion :** For spherical mirrors the Gauss's equation is applicabale only when aperture of mirror is small.

Reason : Laws of reflections are true only for plane mirrors.

(A) a (B) b (C) c (D) d

(76) **Assertion :** object is placed at focal point of concave mirror the image is obtained at intinite distance.

Reason : Concave mirror behave as diverging surface.

(A) a (B) b (C) c (D) d

(77) **Assertion :** For the observer in denser medium the object observed in rarer medium is seen uplitted.

Reason : This is observed due to refraction.

(A) a (B) b (C) c (D) d

(78) **Assertion :** The phenonenon in which white light gets divided in to it's constituent colours is called dispersion of light.

Reason : The spectrum obtained by a prism made up of flint gless is wider, more dispersed and more detaited as compared to one obtained by common crown glass.

(A) a (B) b (C) c (D) d

(79) **Assertion :** To rectity the defect of near sightedness convex lens is used.

Reason : For far Sightedness the image of distant object is formed behind ratina.

(A) a (B) b (C) c (D) d

(80) **Assertion :** When light ray passes from glass to air at that time the critical angle for violet is minimum.

Reason : Wavelength of violet colour is more than other colours.

(A) a (B) b (C) c (D) d

(81) **Assertion :** In Young's two slit experiment the interference is observed.

Reason : The effect produced by superposition of two or more waves is called interference.

(A) a (B) b (C) c (D) d

(82) **Assertion :** In Young's double slit experiment the path difference for first order maximum fringe is λ.

Reason : Path difference $= \frac{\lambda}{2\pi}$ (phase difference)

(A) a (B) b (C) c (D) d

(83) **Assertion :** Due to intense scattering of blue light sky seems bluish.

Reason : Intensity of scattered light inversly praportional to fourth power of wavelength of light.

(A) a (B) b (C) c (D) d

(84) **Assertion :** Touemelive plate is a natural polarizer.

Reason : The device convert unpolarized light in to polarized light is called polarizer.

(A) a (B) b (C) c (D) d

Ans. : 75 (C), 76 (C), 77 (A), 78 (B), 79 (D), 80 (C), 81 (A), 82 (B), 83 (A), 84 (A)

Comprehension Type Questions :

paragraph :

The ray of light incidenting on transperent medium at an angle of 60° is reflected as totally polarized light. For that only 15 percent components is reflected from incidenting σ components.

(85) Find refractive index of transparent medium.

(A) 1.51 (B) 1.73 (C) 1.61 (D) 1.41

(86) What will be angle of refraction in transparent medium ?

(A) 30° (B) 60° (C) 45° (D) 50°

(87) For transperent medium what will be angle between reflected ray and refracted ray.

(A) 45° (B) 30° (C) 60° (D) 90°

(88) In refracted ray π components will be ________ %.

(A) 85 (B) 15 (C) 100 (D) 70

Pragraph : Radius of curvature of concave mirror is 30 cm. Object is placed at 20 cm on principal axis.

(89) Focal length of concave mirror will be ________ cm.

(A) 15 (B) –15 (C) –30 (D) 30

(90) Image distance will be ________ cm.

(A) –20 (B) –30 (C) –40 (D) –60

(91) Find magnification of image.

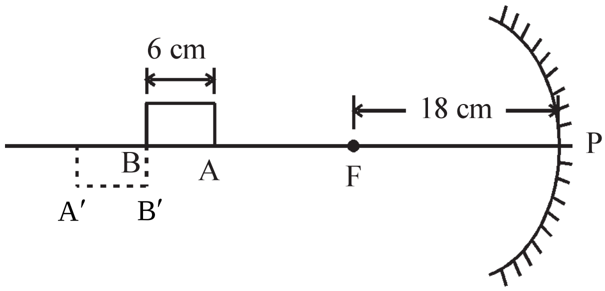
(A) 2 (B) 3 (C) –3 (D) –2

(92) Give the type of Image.

(A) Real, Inverted, enlarged (B) Virtual, erect, enlarged

(C) Virtual, erect, small (D) Real, Inverted, small

Paragraph : As shown in the figure a thin rod AB of length 6 cm is placed on the principal axis of concave mirror in such a way that it's real image $B'A'$ is obtained. Focal length of mirror is 18 cm.



(93) Distance of B' from the pole of mirror will be ________ cm.

(A) 18 (B) 36 (C) 30 (D) 24

(94) Distance of A from the pole of mirror will be ________ cm.

(A) 30 (B) 24 (C) 32 (D) 45

(95) Distance of A' from P ________ cm.

(A) 27 (B) 30 (C) 24 (D) 45

(96) Length of image will be ________ cm.

(A) 12 (B) 27 (C) 9 (D) 6

Paragraph : In Young's experiment distance between two slits is 0.1 *m*m and distance of screen from slit is 1 m. If wavelength of light is 5000 $\mathring{A}$ then,

(97) Find distance between two consecutive bright fringes.

(A) 5 cm (B) 5 *m*m (C) 10 *m*m (D) 10 cm

(98) Angular distance of third bright fringe from centre of central fringe will be ________ *rad.*

(A) 0.15 (B) 0.075 (C) 0.030 (D) 0.015

(99) Find the distance of fourth dark fringe from centre of central fringe.

(A) 1.75×10^{-2} m (B) 1.75 *m*m (C) 3.5×10^{-2} cm (D) 3.5 *m*m

(100) Find the width of fringe.

(A) 0.25 *m*m (B) 2.5 *m*m (C) 5 *m*m (D) 0.25 cm

Ans. :	**85 (B), 86 (A), 87 (D), 88 (C), 89 (B), 90 (D), 91 (C), 92 (A), 93 (B), 94 (A), 95 (D), 96 (C), 97 (B), 98 (D), 99 (A), 100 (D)**

Match the columns :

(101) Focal length of concave mirror is 10 cm then,

Column-1		Column-2	
	Objict Distence		**Imege**
(a)	5 cm	(p)	enlarged, inverted, Real
(b)	15 cm	(q)	Size of object, inverted, Real
(c)	20 cm	(r)	small, Erected, Virtual
(d)	25 cm	(s)	Enlarged, Erected, Virtual

(A) a $\rightarrow$ p, b $\rightarrow$ q, c $\rightarrow$ r, d $\rightarrow$ s

(B) a $\rightarrow$ s, b $\rightarrow$ r, c $\rightarrow$ p, d $\rightarrow$ q

(C) a $\rightarrow$ q, b $\rightarrow$ p, c $\rightarrow$ r, d $\rightarrow$ s

(D) a $\rightarrow$ s, b $\rightarrow$ p, c $\rightarrow$ q, d $\rightarrow$ r

(102)

Column-1		Column-2	
(a)	Young's Double slit experiment.	(p)	Incoherent sources
(b)	Sources having different angular frequencies.	(q)	Coherent sources
(c)	Each point on wave front behave as source.	(r)	Principle of Superposition
(d)	Displacement of particle is	(s)	Hygen's Principle

(A) a $\rightarrow$ p b $\rightarrow$ r c $\rightarrow$ q d $\rightarrow$ s

(B) a $\rightarrow$ q b $\rightarrow$ p c $\rightarrow$ s d $\rightarrow$ r

(C) a $\rightarrow$ p b $\rightarrow$ q c $\rightarrow$ r d $\rightarrow$ s

(D) a $\rightarrow$ r b $\rightarrow$ p c $\rightarrow$ s d $\rightarrow$ q

(103)

Column-1		Column-2	
(a)	Angular Dispersion	(p)	$\frac{n_v - n_r}{n-1}$
(b)	Thin prism	(q)	$\delta_v - \delta_r$
(c)	Dispersive power	(r)	$A(n-1) = A'(n'-1)$
(d)	Dispersion without deviation for two prism	(s)	$\delta = A(n-1)$

(A) a $\rightarrow$ q b $\rightarrow$ s c $\rightarrow$ p d $\rightarrow$ r

(B) a $\rightarrow$ p b $\rightarrow$ q c $\rightarrow$ r d $\rightarrow$ s

(C) a $\rightarrow$ p b $\rightarrow$ s c $\rightarrow$ q d $\rightarrow$ r

(D) a $\rightarrow$ s b $\rightarrow$ q c $\rightarrow$ r d $\rightarrow$ p

(104)

Column-1		Column-2	
(a)	Brewstor's law	(p)	$I = I_0 \cos^2 \theta$
(b)	Snell's law	(q)	$x_1 x_2 = f^2$
(c)	Malus law	(r)	$\dfrac{\sin \theta_1}{\sin \theta_2} = n_{21}$
(d)	Newton's equation	(s)	$n = \tan \theta_p$

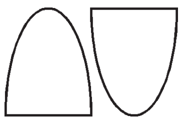
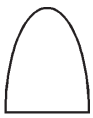
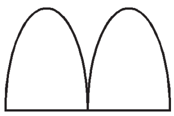
(A) a → p b → s c → r d → q

(B) a → q b → p c → r d → s

(C) a → s b → c c → p d → q

(D) a → s b → q c → r d → p

(105) Focal length of Convex lens is f. In column - I it's division and combination is given and in column-2 it's focal length is given match properly.

Column-1		Column-2	
(a)		(p)	$2f$
(b)		(q)	f
(c)		(r)	$\frac{f}{2}$
(d)		(s)	∞

(A) a → s b → p c → q d → r

(B) a → p b → q c → r d → s

(C) a → q b → r c → s d → p

(D) a → r b → s c → q d → p

Ans. : 101 (D), 102 (B), 103 (A), 104 (C), 105 (A)