OBJECTIVE - I

1. A point source of light is placed in front of a plane mirror.

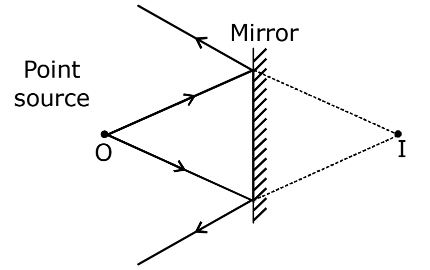
(A*) All the reflected rays meet at a point when produced backward.

(B) only the reflected rays close to the normal meet at a point when produced backward

(C) only the reflected rays making a small angle with the mirror, meet at a point when produced backward

(D) light of different colours make different images

Sol. **A**



All the reflected ray meet at a point when produced backward.

2. Total internal reflection can take place only if

(A) light goes from optically denser medium refractive index) to optically denser medium

(B*) light goes from optically denser medium to rarer medium

(C) the refractive indices of the two media are close to each other

(D) the refractive indices of the two media are widely different

Sol. **B**

T.I.R. (Total Internal reflection)

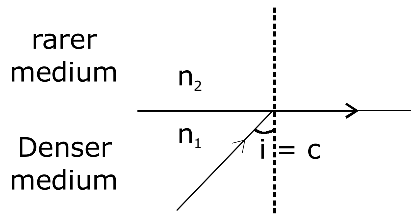
i < C (condition for T.I.R.)

By Snell's Law

$n_1 \sin i = n_2 \sin 90°$

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

Þ C = $\sin^{-1}$



$\because -1 \leq \sin i \leq 1$

\ $n_1 > n_2$ (so we can conclude that light goes from optically denser medium to rarer medium & incident angle is greater than the critical angle.)

3. In image formation from spherical mirrors, only paraxial rays are considered because they

(A) are easy to handle geometrically

(B) contain most of the intensity of the incident light

(C*) show minimum dispersion effect.

(D) show minimum dispersion effect

Sol. **C**

In Image formation from spherical mirrors, only paraxial rays are considered because they form nearly a point Image of a point source. Angle of Incidence of Paraxial rays is very small.

4. A point object is placed at a distance of 30 cm from a convex mirror of focal length 30 cm. The image will form at

(A) infinity

(B) pole

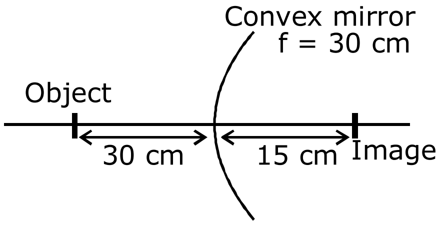
(C) focus

(D*) 15 cm behind the mirror

Sol. **A**

By mirror formula :-

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



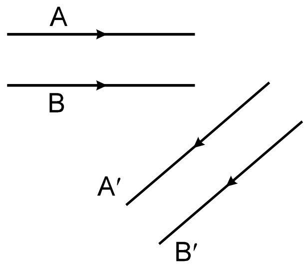
Here $u = -30$ cm

$f = +30$ cm

so $\frac{1}{V}-\frac{1}{30}=\frac{1}{30}$

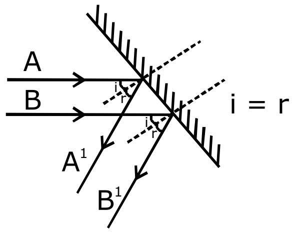
Þ $v = 15$ cm behind the mirror.

5. Figure shows two rays A and B being reflected by a mirror and going as A¢ and B¢. The mirror -



(A*) is plane
(B) is convex
(C) is concave
(D) may be any spherical mirror

Sol. **A**

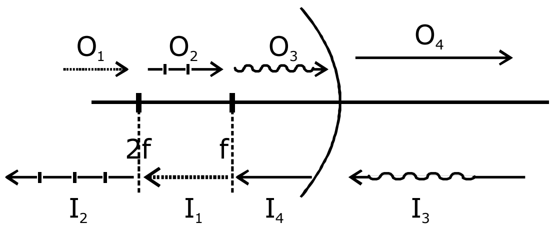


Here initially A & B is parallel to each other after reflection by teh plane mirror A' & B' goes Parallel to each other.

6. The image formed by a concave mirror
(A) is always real
(B) is always virtual
(C*) is certainly real if the object is virtual
(D) is certainly virtual if the object is real

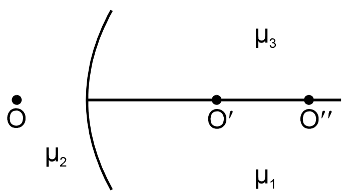
Sol. **C**

Object	Image
O_1	I_1
O_2	I_2
O_3	I_3
O_4	I_4



Here O_4 is virtual object & I_4 is real Image.

7. Figure shows three transparent media of refractive indices μ_1, μ_2 and μ_3. A point object O is placed in the medium μ_2. If the entire medium on the right of the spherical surface has refractive index μ_1. the image forms at O¢. If this entire medium has refractive index μ_3, the image forms at O¢¢. In the situation shown,



(A) the image forms between O¢ and O¢¢ (B) the image forms to the left of O¢
(C) the image forms to the right of O¢¢ (D*) two images form, one at O' and the other at O¢¢

Sol. **D**

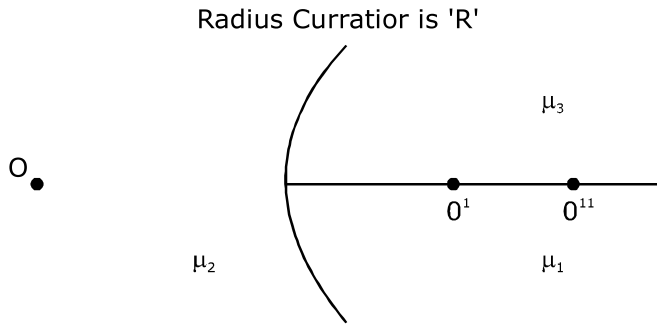
(i) m_1, Image is 0^1

(ii) m_3, Image is 0^{11}

Spherical Surface formula

$$\frac{\mu^{11}}{v} - \frac{\mu_1}{\mu} = \frac{\mu^{11} - \mu^1}{R}$$

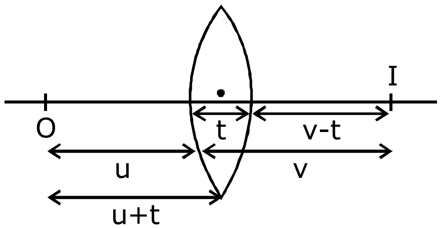
If ray goes to m_2 to m_1 than Image is formed at 0^1 and if ray goes to m_2 to m_3 than Image is formed at 0^{11}.



8. Four modifications are suggested in the lens formula to include the effect of the thickness t of the lens. Which one is likely to be correct?

(A) $\frac{1}{v} - \frac{1}{u} = \frac{t}{uf}$ (B) $\frac{t}{v^2} - \frac{1}{u} = \frac{1}{f}$ (C*) $\frac{1}{v+t} - \frac{1}{u+t} = \frac{1}{f}$ (D) $\frac{1}{v} - \frac{1}{u}\frac{t}{uv} = \frac{t}{f}$

Sol. **C**

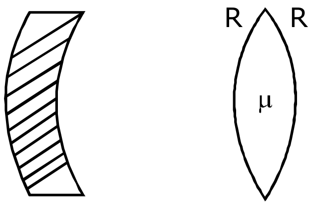


$$\frac{1}{v-t} - \frac{1}{u+t} = \frac{1}{f}$$

9. A double convex lens has two surfaces of equal radii R and refractive index μ = 1.5. We have,

(A) f = R/2 (B*) f = R (C) f = – R (D) f = 2R.

Sol. **B**



$$\Rightarrow \quad \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

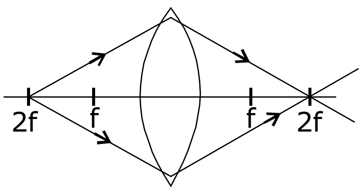
$$\Rightarrow \quad \frac{1}{f} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{R} - \left(-\frac{1}{R}\right)\right)$$

$$\frac{1}{f} = \frac{1}{R}$$

$$f = R$$

10. A point source of light is placed at a distance of 2 f from a converging lens of focal length f. The intensity on the other side of the lens is maximum at a distance

Sol. **C**



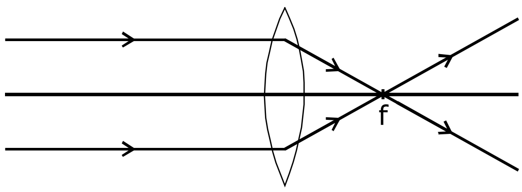
The Intensity on the other side of the lans is maximum at a distance 2f.

11. A parallel beam of light is incident on a converging lens parallel to its principal axis. As one moves away from the lens on the other side on its principal axis, the intensity of light

(A) remains constant (B) continuously increases

(C) continuously decreases (D*) first increases then decreases

Sol. **D**

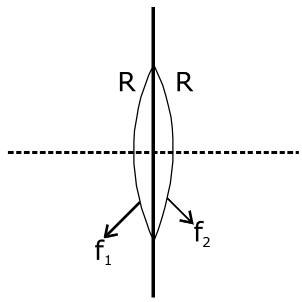


The intensity o light is first increases then decreases.

12. A symmetric double convex lens is cut in two equal parts by a plane perpendicular to the principal axis. If the power of the original lens was 4 D, the power of a cut lens will be -

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

Sol. **A**



Before cut

$$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right) = 4D \quad ....(1)$$

After cut

$$\frac{1}{f_1} = (\mu - 1)\left(\frac{1}{R}\right) + \frac{1}{f_2} = (\mu - 1)\left(\frac{1}{2}\right) \quad ....(2)$$

From eq. (1) we get Power of f_1 = power of f_2

$$P = \frac{1}{f_1} = \frac{1}{f_2} = 2D$$

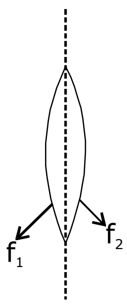
13. A symmetric double convex lens is cut in two equal parts by a plane containing the principal axis. If the power of the original lens was 4D, the power of a divided lens will be -

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

Sol. **C**

Before cut :-

$$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right) = 4D$$



After cut :-

$$\frac{1}{f_1} = (\mu - 1)\left(\frac{1}{R}\right) = P_1$$

$$\& \ \frac{1}{f_2} = (\mu - 1)\left(\frac{1}{R}\right) = P_2$$

Power of a divided lens will be $= P_1 + P_2$

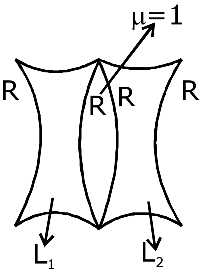
$$= (\mu - 1)\left(\frac{2}{R}\right)$$

$$= 4D$$

14. Two concave lenses L_1 and L_2 are kept in contact with each other. If the space between the two lenses is filled with a material of refractive index μ » 1, the magnitude of the focal length of the combination

(A) becomes undefined
(B) remains unchanged
(C*) increases
(D) decreases

Sol. **D**



$$\frac{1}{f}=\frac{1}{f_{L_1}}+\frac{1}{f_{L_2}}$$

$$\frac{1}{f_{L_1}}=(\mu-1)\left(\frac{-2}{R}\right)=\frac{1}{f_{L_2}}$$

Local length of the combination :-

$$\frac{1}{f}=(\mu-1)\left(\frac{-2}{R}\right)+(\mu-1)\left(\frac{-2}{R}\right)$$

$$\frac{1}{f}=-4(\mu-1)\left(\frac{1}{R}\right)$$

$$f=\frac{R}{4(\mu-1)}$$

where $f_{L_1}=f_{L_2}=\dfrac{R}{2(\mu-1)}$

$$\left(f_{L_1}=f_{L_2}\right)>f$$

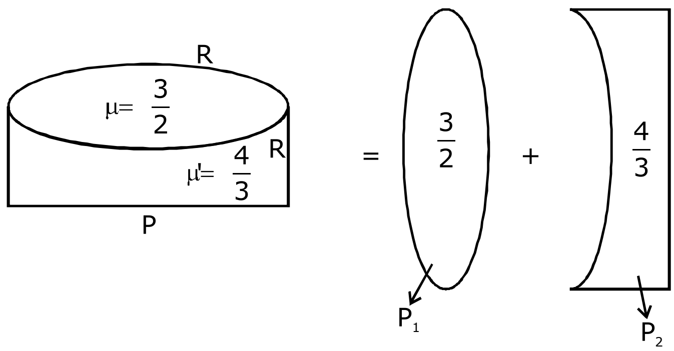
15. A thin lens is made with a material having refractive index μ = 1.5. Both the sides are convex. It is dipped in water (μ = 1.33). It will behave like

(A*) a convergent lens
(B) a divergent lens
(C) a rectangular slab
(D) a prism

Sol. A

Here P, P_1 & P_2 are the power of Lenses.

$P=P_1+P_2$



$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$$

$$=(\mu-1)\left(\frac{2}{R}\right)+(\mu^1-1)\left(\frac{-1}{R}\right)$$

$$=\left(\frac{3}{2}-1\right)\left(\frac{2}{R}\right)-\left(\frac{4}{3}-1\right)\left(\frac{1}{R}\right)$$

$$\frac{1}{f}=\frac{1}{R}-\frac{1}{3R}$$

$$\frac{1}{f}=\frac{3-1}{3R}$$

$$f=\frac{3R}{2}$$

focal length of combined is positive means it will behave like a canvergent lens.

16. A convex lens is made of a material having refractive index 1.2. Both the surfaces of the lens are convex. If it is dipped into water (μ = 1.33), it will behave like

(A) a convergent lens (B*) a divergent lens

(C) a rectangular slab (D) a prism

Sol. **B**

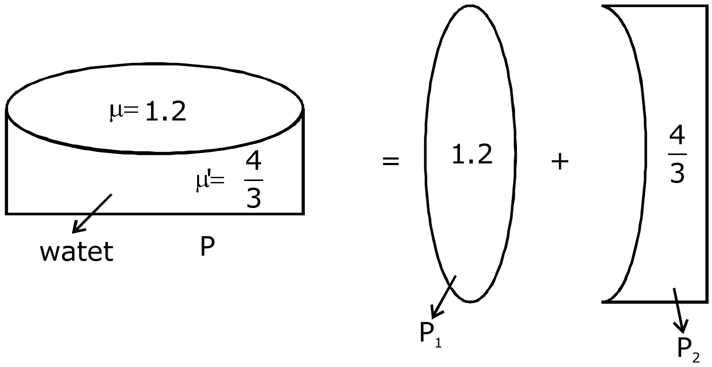
Here P, P_1 & P_2 are the Power of Lenses.

$P = P_1 + P_2$

$$\frac{1}{f} = \frac{1}{f_1} = \frac{1}{f_2}$$

$$(\mu - 1)\left(\frac{2}{R}\right) + (\mu' - 1)\left(\frac{-1}{R}\right)$$

$$(1.2 - 1)\left(\frac{2}{R}\right) - \left(\frac{4}{3} - 1\right)\left(\frac{1}{R}\right)$$



$$\frac{1}{f} = \frac{2}{5R} - \frac{1}{3R}$$

$$\frac{1}{f} = \frac{6-5}{15R}$$

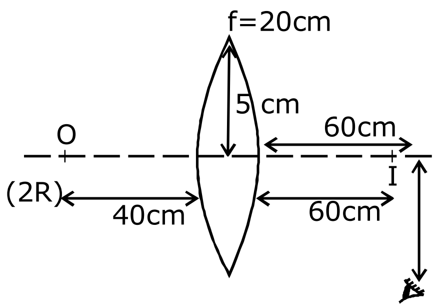
$f = 15R$

Focal lenght of combined is positive, but it's magnitude in capair to f_1 & f_2 is High. So it will be hare like a divergent lens.

17. A point object O is placed on the principal axis of a convex lens of focal length f = 20 cm at a distance of 40 cm to the left of it. The diameter of the lens is 10 cm. An eye is placed 60 cm to right of the lens and a distance h below the principal axis. the maximum value of h to see the image is

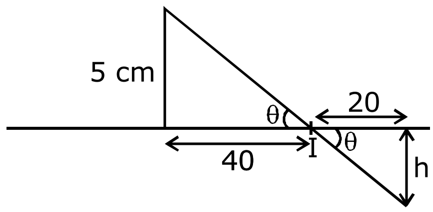
(A) 0 (B*) 2.5 cm (C) 5 cm (D) 10 cm

Sol. **B**



$$\tan\theta = \frac{5}{40} = \frac{h}{20}$$

$$h = \frac{5}{2} = 2.5\,\text{cm}$$



The maximum value of "h=2.5 cm" to see the Image of the object.

18. The rays of different colours fail to converge at a point after going through a converging lens. This defect is called -

(A) spherical aberration (B) distortion

(C) coma (D*) chromatic aberration

Sol. **D**

The rays of different colours fail to converge at a Point after going through a converging Lens. This defect is called chromatic oberration.

OBJECTIVE - II

1. If the light moving in a straight line bends by a small but fixed angle, it may be a case of
(A*) reflection (B*) refraction (C) diffraction (D) dispersion

Sol. **AB**

2. Mark the correct option
(A) if the incident rays are converging, we have a real object
(B*) if the final rays are converging, we have a real image
(C) the image is virtual, the corresponding object a virtual object
(D) if the image is virtual, the corresponding object is called a virtual object.

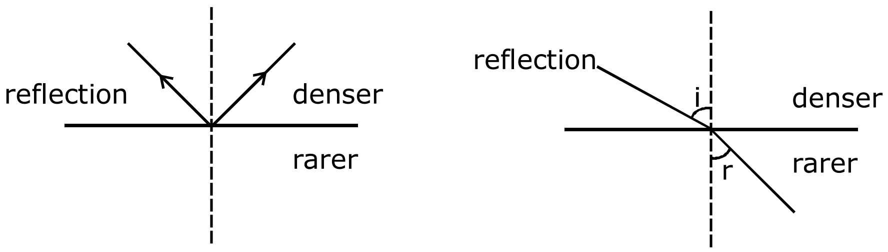
Sol. **B**
If the final rays are converging, we have a real Image.

3. Which of the following (referred to a spherical mirror) do (does) not depend on whether the rays are paraxial or not ?
(A*) pole (B*) focus (C*) radius of curvature (D) principal axis

Sol. **ACD**
If Paraxial rays comes to parallel to the spherical mirror is pasees to the Focus of the spherical mirror.

4. The image of an extended object, placed perpendicular to the principal axis of a mirror, will be erect if
(A) the object and the image are both real (B) the object and the image are both virtual
(C*) the object is real but the image is virtual (D*) the object is virtual but the image is real

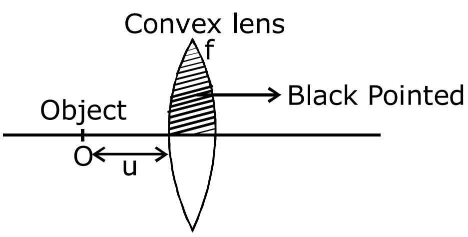
Sol. **CD**



$m = \frac{-v}{\mu} = \frac{h_I}{h_0}$ (for mirror)

Image will be erect mean height of the object and Image will e lies in same side. It mean if object isreal then Image in virtual. If object is virtula then Image is real.

5. A convex lens forms a real image of a point object placed on its principal axis. If the upper half of the lens is painted black,
(A) the image will be shifted downward (B) the image will be shifted upward
(C*) the image will not be shifted (D*) the intensity of the image will decrease
Sol. **CD**



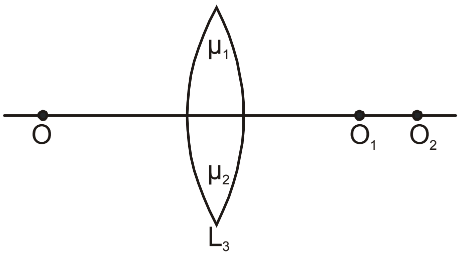
By lens formula

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

Due to Black Pointed focal Lenght of the Lens will not change.

So Image will not be shifted due to Black point. But Intensily of Image will decrease.

6. Consider three converging lenses L_1, L_2 and L_3 having identical geometrical construction. The index of refraction of L_1 and L_2 are μ_1 and μ_2 respectively. The upper half of the lens L_3 has a refractive index μ_1 and the lower half has μ_2 (figure). A point object O is imaged at O_1 by the lens L_1 and at O_2 by the lens L_2 placed in same position. If L_3 is placed at the same place,

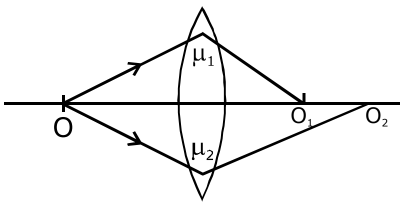


(A*) there will be an image at O_1 (B*) there will be an image at O_2

(C) the only image will form somewhere between O_1 and O_2

(D) the only image will form away from O_2

Sol. **AB**



It rays are Passing through m_1 then Image will be form at "O_1" and If rays are Passing through m_2 then Image will be form at "O_2".

7. A screen is placed a distance 40 cm away from an illuminated object. A converging lens is placed between the source and the screen and it is attempted to form the image of the source on the screen. If no position could be found, the focal length of the lens

(A) must be less than 10 cm (B*) must be greater than 20 cm

(C) must not be greater than 20 cm (D) must not be less than 10 cm.

Sol. **B**

$v = (40 - 4)$

$$\frac{1}{f} = \frac{1}{40-4} - \frac{1}{(-u)}$$

$$\frac{df}{du} = 0 \text{ for f minimum.}$$

$$\frac{df}{du} = 1 - \frac{u}{20} = 0$$

$u = 20$

$f_{min} = 10$ cm