(PHYSICS) **RAY OPTICS**

DPP – 3

CLASS – 12th

TOPIC – Refraction through surface and lense maker's formula

Q.1 A convex refracting surface of radius of curvature 20 cm separates two media of refractive indices 4/3 and 1.60. An object is placed in the first medium (μ= 4/3) at a distance of 200 cm from the refracting surface. Calculate the position of the image formed

Q.2 The radius of curvature of convex surface is 10 cm and if an object lies at a distance of 20 cm from it in the rarer medium, find the position of the image assuming that refractive index of the rarer medium is 1.0, while that of the denser medium is 2.0

Q.3 A spherical refracting surface of denser medium (μ= 1.5) is placed in a rarer medium (mu = 1.3) For an object lying in rarer medium at 20 cm from the surface, the virtual image is formed at 60 cm in rarer medium. Find out the radius of curvature of the surface

Q.4 A plano-convex lens (μ= 1.5) has a curved surface of radius 15 cm. What is its focal length ?

Q.5 A small object is 2 cm below the concave meniscus of water in a test tube. The radius of the meniscus is 5 mm and μ for water is 4/3. Find the nature and position of the image.

Q.6 The radii of curvature of a double convex lens are 15 cm and 30 cm and its refractive index is 1-5. Calculate its focal length

Q.7 The radii of curvature of a double convex lens are 30 cm and 60 cm and its refractive index is 1.5. Calculate its focal length

Q.8 A biconvex lens has a focal length 2/3 times the radius of curvature of either surface. Calculate the refractive index of lens material.

Q.9 The radii of curvature of the faces of a double convex lens are 10 cm and 12 cm respectively. If the focal length of the lens is 12 cm, find the refractive index of the material of the lens.

Q.10 The focal length of a concavo-convex lens of radii of curvature 5 cm and 10 cm is 20 cm. What will be its focal length in water (μ= 4/3) ?

Q.11 If the refractive index from air to glass is 3/2 and that from air to water is 4/3 find the ratio of the focal length of glass lens in water and in air.

Q.12 An object is kept 0.2 m from a convex lens of focal length 0-15 m. Find the position of the image

Q.13 A convex lens of focal length 30 cm and a concave lens of focal length 60 cm are placed in contact. If the object is placed 40 cm away from the combination, find the position of the image.

SOLUTION

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Sol.1. Now, $-\frac{\mu_1}{u}+\frac{\mu_2}{v}=\frac{\mu_2-\mu_1}{R}$

Here, $R = 20$ cm, $\mu_1 = 4/3$, $\mu_2 = 1{\cdot}60$, $u = -200$ cm

$\therefore -\frac{4/3}{-200}+\frac{1{\cdot}60}{v}=\frac{1{\cdot}60-4/3}{20}$

or $v =$ **240 cm (in denser medium)**

Sol.2. at 40 cm (in denser medium)

Sol.3. 5 cm

Sol.4. $\mu = 1{\cdot}5, R_1 = 15$ cm, $R_2 = -\infty$

Now, $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)=(1{\cdot}5-1)\left(\frac{1}{15}-\frac{1}{-\infty}\right)$

or $f =$ **30 cm**

Sol.5. Here $u = -2$ cm, R = 5 mm = 0·5 cm, $\mu = 4/3$

Now, $-\frac{\mu}{u}+\frac{1}{v}=\frac{1-\mu}{R}$

or $\frac{-4/3}{-2}+\frac{1}{v}=\frac{1-4/3}{0{\cdot}5}$

or $v =$ **– 0·75 cm**

(virtual image inside water)

Sol.6. Here $R_1 = +15$ cm, $R_2 = -30$ cm, $\mu = 1{\cdot}5$

Now, $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)=(1{\cdot}5-1)\left(\frac{1}{15}-\frac{1}{-30}\right)$

or $f =$ **20 cm**

Sol.7. 40 cm

Sol.8. 1.75

Sol.9. Here $R_1 = +10$cm, R_2 cm, f=12 cm

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

or $\frac{1}{12}=(\mu-1)\left(\frac{1}{10}-\frac{1}{-12}\right)=(\mu-1)\times\frac{11}{60}$

or $\mu =$ **1·455**

Sol.10. $R_1 = -5$ cm ; $R_2 = -10$ cm ; $f_{air} = -20$ cm

Now, $\frac{1}{f_{air}} = ({}^{a}\mu_{g} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

or $-\frac{1}{20} = ({}^{a}\mu_{g} - 1)\left(\frac{1}{-5} - \frac{1}{-10}\right)$

or ${}^{a}\mu_{g} = 1{\cdot}5$

When lens is immersed in water :

$$\frac{1}{f_w} = \left(\frac{{}^{a}\mu_{g}}{{}^{a}\mu_{w}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \left(\frac{1{\cdot}5}{4/3} - 1\right)\left(\frac{1}{-5} - \frac{1}{-10}\right)$$

or $f_w = -80$ cm

Sol.11. 4

Sol.12. 0.6 m

Sol.13. The focal length of the combination is given by

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{30} + \frac{1}{-60} = \frac{1}{60}$$

or $f = 60$ cm