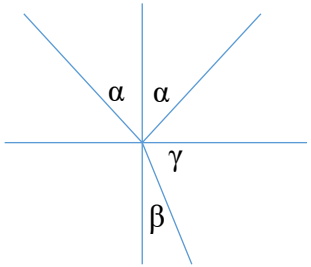
Optics

1. The light ray hits the glass made plate with refractive index $n = 1.5$ What was the incidence angle if he angle between refracted and reflected rays is $\gamma = 60°$?

Solution



The incidence angle and reflection angle are the same according to Snell's law: $\frac{\sin\alpha}{\sin\beta} = n \Rightarrow \sin\alpha = n\sin\beta$.

The angle between reflected and refracted rays is γ and so we have: $\beta = 180° - (\alpha + \gamma)$. We substitute this into previous equation and will obtain:

$$\sin\alpha = n(\sin\alpha\cos\gamma + \cos\alpha\sin\gamma) \Rightarrow \tan\alpha = \frac{n\sin\gamma}{1 - n\cos\gamma} \approx 79°06'$$

2. We have convex mirror $(a' < 0, f < 0)$. Find the location of the light source if its image is 60 cm from the mirror. The focal length of the mirror is 90 cm.

Solution

$a' = -60\,cm$, $f = -90\,cm$, $a = x\,cm$

$$\frac{1}{a} + \frac{1}{a'} = \frac{1}{f} \Rightarrow a = \frac{a'f}{a' - f} = \underline{\underline{180\,cm}}$$

3. Find the distance of the projection plane from the objective (biconvex lenses) to obtain the image magnified 50 times. The lenses focal length is 10 cm. The image made by biconvex lenses is real $(Z<0)$.

Solution

$$Z=-\frac{a'}{a}\Rightarrow a=\frac{a'}{50}$$

$$\frac{1}{a}+\frac{1}{a'}=\frac{1}{f}$$

$$\frac{1}{\frac{a'}{50}}+\frac{1}{a'}=\frac{1}{0.1m}\Rightarrow \underline{\underline{a'=5.1m}}$$

4. The object is placed 4 cm in front of the magnifying lense. The image is magnified 5 times. What is the optical power of the lense?

Solution

$$Z = -\frac{f}{a-f} \Rightarrow f = \frac{Z \cdot a}{Z-a} = 0.05m$$

$$\varphi = \frac{1}{f} = 20D$$