Answer on Question #43896, Physics, Optics

Find the effective power of the combination of two lenses in contact having powers
(i) +5D and +3D
(ii) +5D and -3D.

Solution:

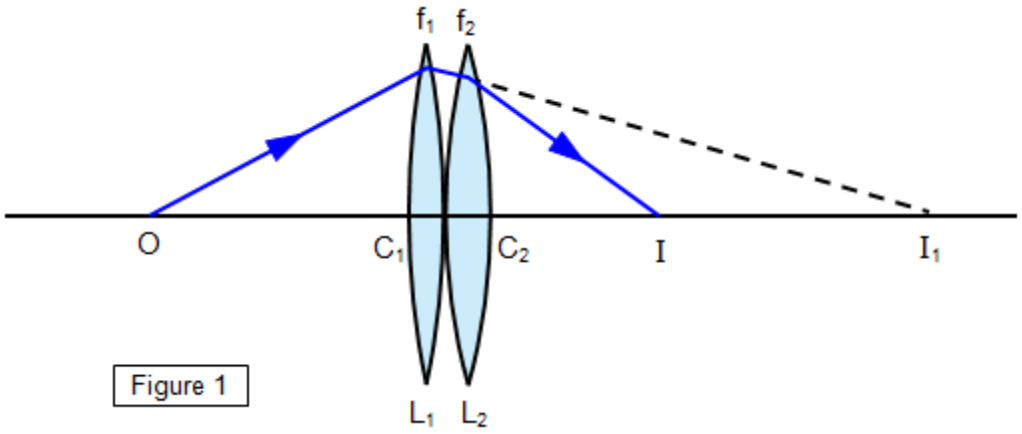

Figure 1

In Figure 1, let the focal lengths of the two lenses be f_1 and f_2.
$u_1 = OC_1$ and $v_1 = I_1C_1$
$u_2 = -C_1I_1$ which is approximately equal to $C_2 I_1$ and $v_2 = C_2I$ which is approximately equal to C_1I

Therefore

$$\frac{1}{u_1} + \frac{1}{v_1} = \frac{1}{f_1}$$

and

$$\frac{1}{u_2} + \frac{1}{v_2} = \frac{1}{f_2}$$

$$\frac{1}{OC_1} + \frac{1}{I_1C_1} = \frac{1}{f_1}$$

and

$$\frac{1}{-C_1I_1} + \frac{1}{C_{1I}} = \frac{1}{f_2}$$

Therefore:

$$\frac{1}{OC_1} + \frac{1}{I_1C_1} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F}$$

Combined focal length of two thin lenses in contact is given by:

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

For powers we will have

$$P = P_1 + P_2$$

(i) +5D and +3D

$$P = P_1 + P_2 = 5\,D + 3\,D = 8\,D$$

(ii) +5D and -3D.

$$P = P_1 + P_2 = 5\,D - 3\,D = 2\,D$$

Answer: (i) $P = 8\,D$, (i) $P = 2\,D$.