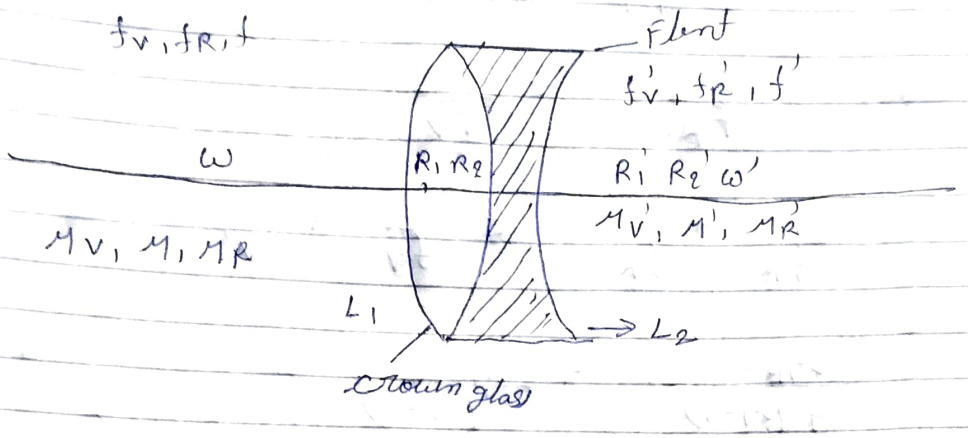
condition for achromatism of two lenses placed in contact



For lens maker formula (L_1)

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

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

For Red focus

$$\frac{1}{f_R} = (\mu_R - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f_R} = \frac{\mu_R - 1}{f(\mu - 1)} \quad \text{---(ii)}$$

Similarly for violet Focus

$$\frac{1}{f_V} = \frac{(\mu_V - 1)}{f(\mu - 1)} \quad \text{---(iii)}$$

For Lens L_2

$$\frac{1}{f_R'} = \frac{\mu_R' - 1}{f'(\mu' - 1)} \quad \text{---(iv)}$$

$$\frac{1}{f_V'} = \frac{(\mu'_V - 1)}{f'(\mu' - 1)} \quad \text{---(V)}$$

$$F_R = F_V$$

$$\frac{1}{F_R} = \frac{1}{F_V}$$

$$\frac{1}{f_R} + \frac{1}{f_R'} = \frac{1}{f_V} + \frac{1}{f_V'}$$

$$\frac{(\mu_R - 1)}{f(\mu - 1)} + \frac{(\mu_R' - 1)}{f'(\mu' - 1)} = \frac{(\mu_V - 1)}{f(\mu - 1)} + \frac{(\mu'_V - 1)}{f'(\mu' - 1)}$$

$$\frac{(\mu_R - 1)}{f(\mu - 1)} + \frac{(\mu_R' - 1)}{f'(\mu' - 1)} - \frac{(\mu_V - 1)}{f(\mu - 1)} - \frac{(\mu'_V - 1)}{f'(\mu' - 1)} = 0$$

$$\frac{\mu_R}{f(\mu - 1)} - \frac{1}{f(\mu - 1)} + \frac{\mu_R'}{f'(\mu' - 1)} - \frac{1}{f'(\mu' - 1)} - \frac{\mu_V}{f(\mu - 1)} + \frac{1}{f(\mu - 1)}$$

$$- \frac{\mu_V'}{f'(\mu' - 1)} + \frac{1}{f'(\mu' - 1)} = 0$$

$$\frac{1}{f(\mu - 1)} (\mu_R - \mu_V) + \frac{1}{f'(\mu' - 1)} (\mu_R' - \mu_V')$$

$$\boxed{\frac{\omega}{f} + \frac{\omega'}{f'} = 0} \qquad \boxed{\because \frac{\mu_R - \mu_V}{\mu - 1} = \omega}$$

$$\Rightarrow \frac{\omega}{f} = -\frac{\omega'}{f'}$$

$$\boxed{\Rightarrow -\frac{f'}{f} = \frac{\omega'}{\omega}}$$

— x —