

Such a system of combination of lenses is commonly used in designing lenses for cameras, microscopes, telescopes and other optical instruments.

Example 9.9 Find the position of the image formed by the lens combination given in the Fig. 9.22.

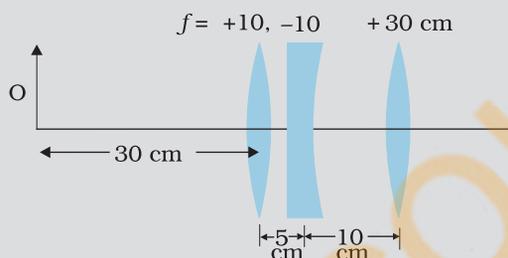


FIGURE 9.22

Solution Image formed by the first lens

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

$$\frac{1}{v_1} - \frac{1}{-30} = \frac{1}{10}$$

$$\text{or } v_1 = 15 \text{ cm}$$

The image formed by the first lens serves as the object for the second. This is at a distance of $(15 - 5) \text{ cm} = 10 \text{ cm}$ to the right of the second lens. Though the image is real, it serves as a virtual object for the second lens, which means that the rays appear to come from it for the second lens.

$$\frac{1}{v_2} - \frac{1}{10} = \frac{1}{-10}$$

$$\text{or } v_2 = \infty$$

The virtual image is formed at an infinite distance to the left of the second lens. This acts as an object for the third lens.

$$\frac{1}{v_3} - \frac{1}{u_3} = \frac{1}{f_3}$$

$$\text{or } \frac{1}{v_3} = \frac{1}{\infty} + \frac{1}{30}$$

$$\text{or } v_3 = 30 \text{ cm}$$

The final image is formed 30 cm to the right of the third lens.

EXAMPLE 9.9

9.6 REFRACTION THROUGH A PRISM

Figure 9.23 shows the passage of light through a triangular prism ABC. The angles of incidence and refraction at the first face AB are i and r_1 , while the angle of incidence (from glass to air) at the second face AC is r_2 and the angle of refraction or emergence e . The angle between the emergent ray RS and the direction of the incident ray PQ is called the *angle of deviation*, δ .