

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.

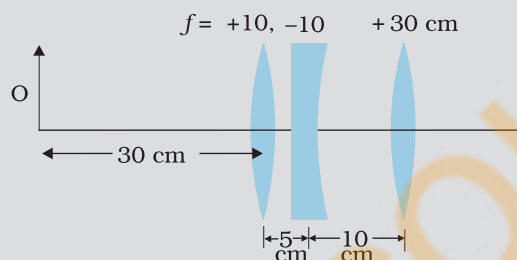


FIGURE 9.22

**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*,  $\delta$ .