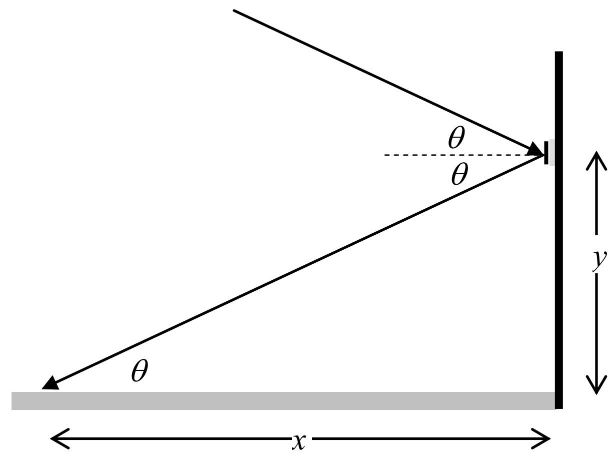
8. ***REASONING*** The drawing shows the ray of light reflecting from the mirror and striking the floor. The angle of reflection θ is the same as the angle of incidence. The angle θ is also the angle that the light ray makes with the floor (see the drawing). Therefore, we can use the inverse tangent function to find θ as a function of y and x; $\theta = \tan^{-1}\left(\frac{y}{x}\right)$. Since the mirror is facing east and the sun is rising, the angle of incidence θ becomes larger (see the drawing). As the angle θ becomes larger, the distance x becomes smaller.



SOLUTION When the horizontal distance is x_1 = 3.86 m, the angle of incidence θ_1 is

$$\theta_1 = \tan^{-1}\left(\frac{y}{x_1}\right) = \tan^{-1}\left(\frac{1.80\text{ m}}{3.86\text{ m}}\right) = 25.0^\circ$$

When the horizontal distance is x_2 = 1.26 m, the angle of incidence θ_2 is

$$\theta_2 = \tan^{-1}\left(\frac{y}{x_2}\right) = \tan^{-1}\left(\frac{1.80\text{ m}}{1.26\text{ m}}\right) = 55.0^\circ$$

As the sun rises, the change in the angle of incidence is 55.0° – 25.0° = 30.0°. Since the earth rotates at a rate of 15.0° per hour, the elapsed time between the two observations is

$$\text{Elapsed time} = (30.0^\circ)\left(\frac{1\text{ h}}{15.0^\circ}\right) = \boxed{2.00\text{ h}}$$