62. (a) The assumption is that the slope of the bottom of the slide is horizontal, like the ground. A useful analogy is that of the pendulum of length $R = 12$ m that is pulled leftward to an angle θ (corresponding to being at the top of the slide at height $h = 4.0$ m) and released so that the pendulum swings to the lowest point (zero height) gaining speed $v = 6.2$ m/s. Exactly as we would analyze the trigonometric relations in the pendulum problem, we find

$$h = R(1 - \cos\theta) \implies \theta = \cos^{-1}\left(1 - \frac{h}{R}\right) = 48^\circ$$

or 0.84 radians. The slide, representing a circular arc of length $s = R\theta$, is therefore $(12)(0.84) = 10$ m long.

(b) To find the magnitude f of the frictional force, we use Eq. 8-31 (with $W = 0$):

$$\begin{aligned} 0 &= \Delta K + \Delta U + \Delta E_{\text{th}} \\ &= \frac{1}{2}mv^2 - mgh + fs \end{aligned}$$

so that (with $m = 25$ kg) we obtain $f = 49$ N.

(c) The assumption is no longer that the slope of the bottom of the slide is horizontal, but rather that the slope of the top of the slide is vertical (and 12 m to the left of the center of curvature). Returning to the pendulum analogy, this corresponds to releasing the pendulum from horizontal (at $\theta_1 = 90^\circ$ measured from vertical) and taking a snapshot of its motion a few moments later when it is at angle θ_2 with speed $v = 6.2$ m/s. The difference in height between these two positions is (just as we would figure for the pendulum of length R)

$$\Delta h = R(1 - \cos\theta_2) - R(1 - \cos\theta_1) = -R\cos\theta_2$$

where we have used the fact that $\cos\theta_1 = 0$. Thus, with $\Delta h = -4.0$ m, we obtain $\theta_2 = 70.5^\circ$ which means the arc subtends an angle of $|\Delta\theta| = 19.5^\circ$ or 0.34 radians. Multiplying this by the radius gives a slide length of $s' = 4.1$ m.

(d) We again find the magnitude f' of the frictional force by using Eq. 8-31 (with $W = 0$):

$$\begin{aligned} 0 &= \Delta K + \Delta U + \Delta E_{\text{th}} \\ &= \frac{1}{2}mv^2 - mgh + f's' \end{aligned}$$

so that we obtain $f' = 1.2 \times 10^2$ N.