3. A block slides down a rough incline sloped at an angle of 40.0° from the horizontal. Starting from rest, it slides a distance of $0.800\,\mathrm{m}$ down the slope in $0.600\,\mathrm{s}$. What is the coefficient of kinetic friction for the block and surface?

The problem is illustrated in Fig. 5.8. From the information given about the motion of

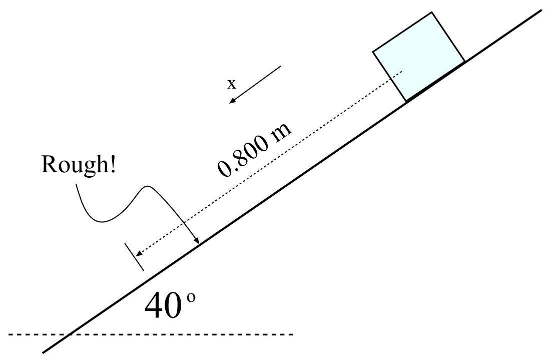

Figure 5.8: Block slides down rough inclined plane in Example 3.

the block we can find its acceleration; with the x axis pointed down the slope (as we often do in these problems), with $v_{0x} = 0$ we have:

$$x = 0 + \tfrac{1}{2}a_x t^2 \qquad \Longrightarrow \qquad a = \frac{2x}{t^2}$$

Plug in the numbers and get a_x:

$$a = \frac{2(0.800\,\mathrm{m})}{(0.600\,\mathrm{s})^2} = 4.44\,\tfrac{\mathrm{m}}{\mathrm{s}^2}$$

We've solved the general problem of a block sliding down a rough inclined plane; In Eq. 5.6 we found:

$$a_x = g\sin\theta - \mu_{\mathrm{k}} g\cos\theta = g(\sin\theta - \mu_{\mathrm{k}}\cos\theta)$$

where θ is the angle of the incline. Since μ_{k} is the only thing we don't know here, we can do some algebra and solve for it:

$$\sin 40^\circ - \mu_{\mathrm{k}}\cos 40^\circ = \frac{a_x}{g} = \frac{(4.44\,\frac{\mathrm{m}}{\mathrm{s}^2})}{(9.80\,\frac{\mathrm{m}}{\mathrm{s}^2})} = 0.454$$

$$\mu_{\mathrm{k}}\cos 40^\circ = \sin 40^\circ - 0.454 = 0.189$$

$$\mu_{\mathrm{k}} = \frac{(0.189)}{\cos 40^\circ} = 0.247$$

So we get a coefficient of friction of 0.247 for the block sliding on the surface.