55. (a) We take the gravitational potential energy of the skier-Earth system to be zero when the skier is at the bottom of the peaks. The initial potential energy is $U_i = mgh_i$, where m is the mass of the skier, and h_i is the height of the higher peak. The final potential energy is $U_f = mgh_f$, where h_f is the height of the lower peak. The skier initially has a kinetic energy of $K_i = 0$, and the final kinetic energy is $K_f = \frac{1}{2}mv^2$, where v is the speed of the skier at the top of the lower peak. The normal force of the slope on the skier does no work and friction is negligible, so mechanical energy is conserved.

$$\begin{aligned} U_i + K_i &= U_f + K_f \\ mgh_i &= mgh_f + \frac{1}{2}mv^2 \end{aligned}$$

Thus,

$$v = \sqrt{2g\,(h_i - h_f)} = \sqrt{2(9.8)(850 - 750)} = 44 \text{ m/s} .$$

(b) We recall from analyzing objects sliding down inclined planes that the normal force of the slope on the skier is given by $N = mg\cos\theta$, where θ is the angle of the slope from the horizontal, 30° for each of the slopes shown. The magnitude of the force of friction is given by $f = \mu_k N = \mu_k mg\cos\theta$. The thermal energy generated by the force of friction is $fd = \mu_k mgd\cos\theta$, where d is the total distance along the path. Since the skier gets to the top of the lower peak with no kinetic energy, the increase in thermal energy is equal to the decrease in potential energy. That is, $\mu_k mgd\cos\theta = mg(h_i - h_f)$. Consequently,

$$\mu_k = \frac{(h_i - h_f)}{d\cos\theta} = \frac{(850 - 750)}{(3.2 \times 10^3)\cos 30^\circ} = 0.036 .$$