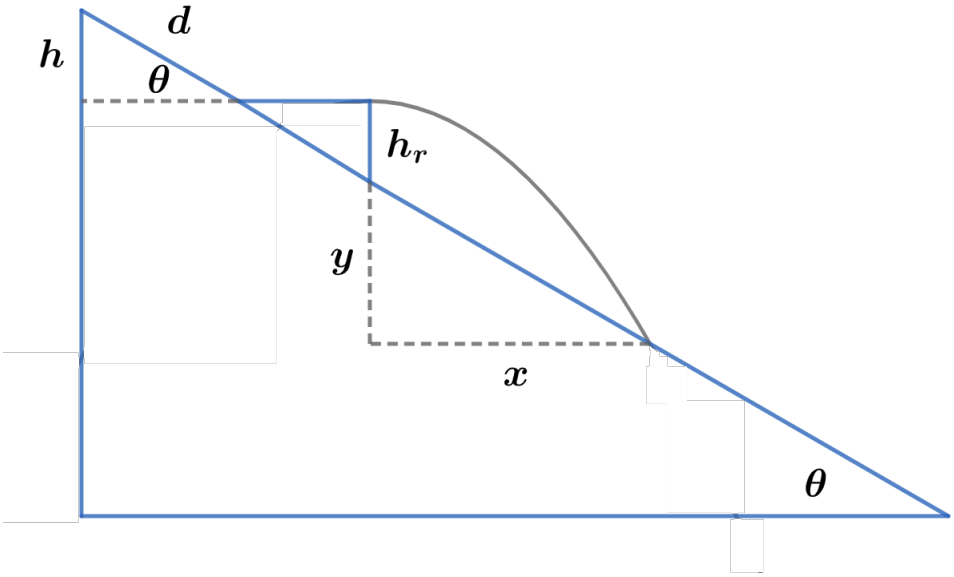
2023 F=ma Exam: Problem 25

Kevin S. Huang



By conservation of energy, the skier leaves the ramp with velocity

$$\frac{1}{2}mv^2 = mgh$$
$$v = \sqrt{2gh} = \sqrt{2gd\sin\theta}$$

Let t be the time the skier is in the air. The motion in the x-direction is constant velocity:

$$x = vt$$

The motion in the y-direction is constant acceleration (with no initial velocity):

$$y + h_r = \frac{1}{2}gt^2$$

Using the fact that $y = x\tan\theta$ and substituting $t = x/v$ yields

$$x\tan\theta + h_r = \frac{g}{2v^2}x^2$$
$$\frac{g}{2v^2}x^2 - (\tan\theta)x - h_r = 0$$

By the quadratic formula and taking the positive solution,

$$x = \frac{\tan\theta + \sqrt{\tan^2\theta + 2gh_r/v^2}}{g/v^2} = 181\,\text{m}$$

so the answer is $\boxed{\text{C}}$.