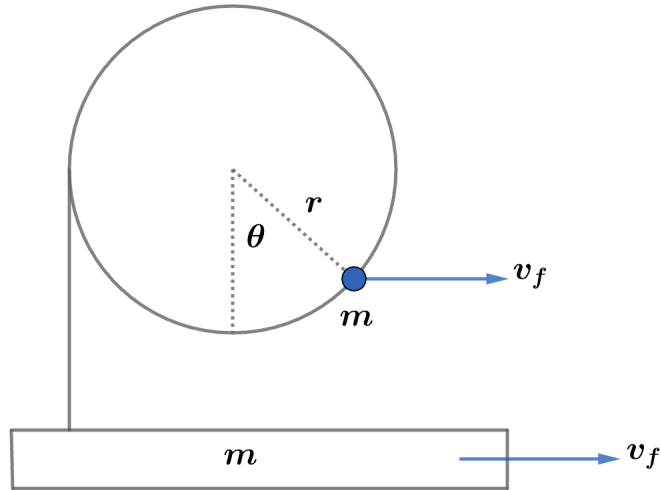


2024 F=ma Exam: Problem 14

Kevin S. Huang



Conserving linear momentum, we have

$$mv = (m + m)v_f$$

$$v_f = \frac{v}{2}$$

Conserving energy, we have

$$\frac{1}{2}mv^2 = mgh + \frac{1}{2}mv_f^2 + \frac{1}{2}mv_f^2 = mgr(1 - \cos \theta) + m\left(\frac{v}{2}\right)^2$$

$$\frac{v^2}{4} = gr(1 - \cos \theta)$$

Solving for θ ,

$$\cos \theta = 1 - \frac{v^2}{4gr} = 1 - \frac{(2 \text{ m/s})^2}{4(10 \text{ m/s}^2)(0.2 \text{ m})} = 0.5$$

$$\theta = 60^\circ$$

so the answer is C.