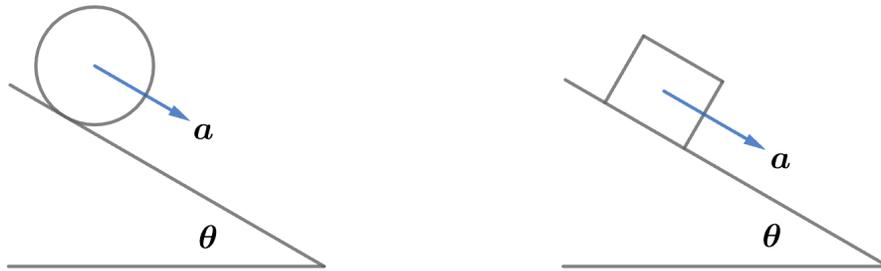# 2011 F=ma Exam: Problem 25

Kevin S. Huang

Recall the acceleration of an object rolling without slipping down an inclined plane is given by

$$a = \frac{g \sin \theta}{1 + \beta}$$

where the moment of inertia of the object is $I = \beta m r^2$. Recall the acceleration of a block sliding down an inclined plane is given by

$$a = g(\sin \theta - \mu \cos \theta)$$

Since the hollow cylinder and block reach the bottom at the same time, they both have the same acceleration:

$$\frac{g \sin \theta}{1 + \beta} = g(\sin \theta - \mu \cos \theta)$$

$$\mu \cos \theta = \sin \theta \left(1 - \frac{1}{1 + \beta} \right)$$

For a hollow cylinder, $\beta = 1$:

$$\mu \cos \theta = \frac{\sin \theta}{2}$$

$$\mu = \frac{\tan \theta}{2}$$

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

1