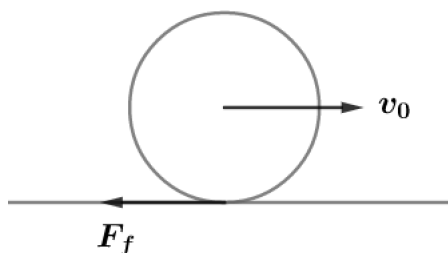# 2018A F=ma Exam: Problem 21

Kevin S. Huang

Friction will decrease the ball's translational velocity and increase the ball's angular velocity until it rolls without slipping. We have

$$F_f = ma$$

$$F_f R = I\alpha = \frac{2}{3}mR^2\alpha$$

Thus,

$$v = v_0 - at = v_0 - \frac{F_f}{m}t$$

$$\omega = \alpha t = \frac{3F_f}{2mR}t$$

$F_f = \mu mg$. Recall $v = R\omega$ for rolling without slipping:

$$v_0 - \mu gt = \frac{3\mu g}{2}t$$

$$v_0 = \frac{5\mu g}{2}t$$

Therefore,

$$t = \frac{2v_0}{5\mu g}$$

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