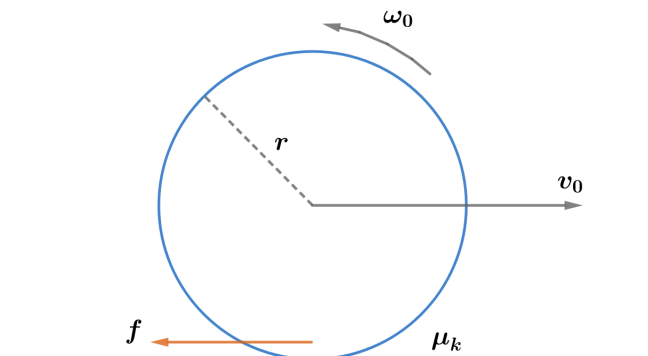


2019B F=ma Exam: Problem 17

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If we replaced the hoop with a disk, then $I = \frac{1}{2}Mr^2$ so

$$a = \frac{f}{M} = \mu g$$

$$\alpha = \frac{fr}{I} = \frac{fr}{\frac{1}{2}Mr^2} = \frac{2\mu g}{r}$$

We find when the hoop starts rolling without slipping:

$$v(t) = r\omega(t)$$

$$(-v_0 + at) = r(\omega_0 - \alpha t)$$

$$-v_0 + at = r\left(\frac{3v_0}{r} - \alpha t\right)$$

$$-v_0 + \mu gt = 3v_0 - 2\mu gt$$

$$T = \frac{4v_0}{3\mu g}$$

Note that

$$v(T) = -v_0 + a\left(\frac{4v_0}{3\mu g}\right) = \frac{v_0}{3} < v_0$$

so the disk stops slipping too soon. Thus, the answer is D.