2007 F=ma Exam: Problem 11

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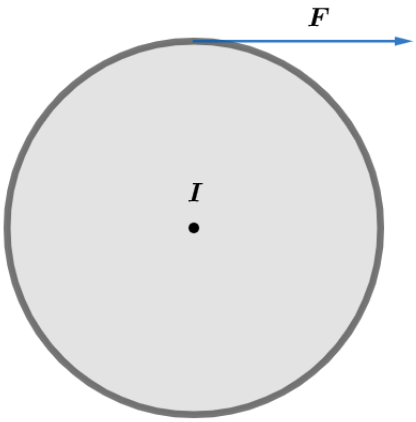

Recall for rotational motion,

$$\tau = I\alpha$$

From kinematics,

$$\omega = \omega_0 + \alpha t = \frac{\tau t}{I}$$

Thus, the kinetic energy of the objects after time t is given by

$$K = \frac{1}{2}I\omega^2 = \frac{1}{2}I\left(\frac{\tau t}{I}\right)^2 = \frac{\tau^2 t^2}{2I}$$

The torques on all the objects are the same so

$$K \propto \frac{1}{I}$$

Recall the moments of inertia:

$$I_{\text{disk}} = \frac{1}{2}MR^2$$
$$I_{\text{hoop}} = MR^2$$
$$I_{\text{sphere}} = \frac{2}{5}MR^2$$

Hence,

$$K_{\text{hoop}} < K_{\text{disk}} < K_{\text{sphere}}$$

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