## Answer on Question \#50966-Physics-Other

A uniform ball, hoop and disk, all of mass $\mathrm{M}=6 \mathrm{~kg}$ and radius R roll smoothly from rest down a ramp inclined at 30 to the horizontal. Which of the three objects reaches the bottom of the slope first?

## Solution

The moments of inertia for a sphere $=\frac{2}{5} M R^{2} ;$ disk $=\frac{1}{2} M R^{2}$; and a hoop $=M R^{2}$.
The fraction of kinetic energy which goes into translational motion,

$$
f=\frac{\frac{1}{2} M v_{c o m}^{2}}{\frac{1}{2} M v_{c o m}^{2}+\frac{1}{2} I_{c o m} \omega^{2}} .
$$

In general, $I_{\text {com }}=\beta M R^{2}$, where $\beta$ is a constant and $\omega=\frac{v_{\text {com }}}{R}$.

$$
f=\frac{\frac{1}{2} M v_{c o m}^{2}}{\frac{1}{2} M v_{c o m}^{2}+\frac{1}{2} \beta M R^{2}\left(\frac{v_{c o m}}{R}\right)^{2}}=\frac{1}{1+\beta}
$$

For hoop, $\beta=1$, $f=0.5$. For disk, $\beta=\frac{1}{2}$, $f=0.67$. For hoop, $\beta=\frac{2}{5}$, $f=0.71$.
Sphere rolls fastest, followed by the disk. The last will come a hoop.

