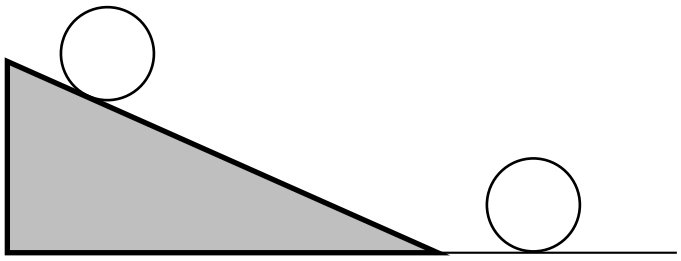
A solid disk and a steel hoop (ring) are set side by side, released from rest at the same moment, and roll down an inclined plane toward its bottom.



The disk has a radius R_{disk} and the hoop has a radius R_{hoop}. The disk has a mass M_{disk} and the hoop has a mass M_{hoop}.

Choose the most definitive statement.
The "hoop" is always slower than the "disk" if

A) $R_{hoop} = R_{disk}$.

B) $M_{hoop} = M_{disk}$.

C) $R_{hoop} = R_{disk}$ and $M_{hoop} = M_{disk}$.

D) The ring is slower regardless of the values of mass and radius.

The time it takes the hoop or disk to reach the bottom of the inclined plane can be determined from its acceleration.

$$\sum \tau = I\,\alpha$$

$$M\,g\,R\sin\theta = I\,\frac{a}{R}, \quad \text{so}$$

$$a = \frac{M\,R^2}{I}\,g\sin\theta, \quad \text{since}$$

$$I_{disk} = \frac{1}{2}\,M\,R^2 \quad \text{and}$$

$$I_{hoop} = M\,R^2, \quad \text{we have}$$

$$a_{disk} = 2\,g\sin\theta \quad \text{and}$$

$$a_{hoop} = g\sin\theta, \quad \text{so}$$

$$a_{disk} = 2\,a_{hoop} \quad \text{always.}$$

Answer **D**.