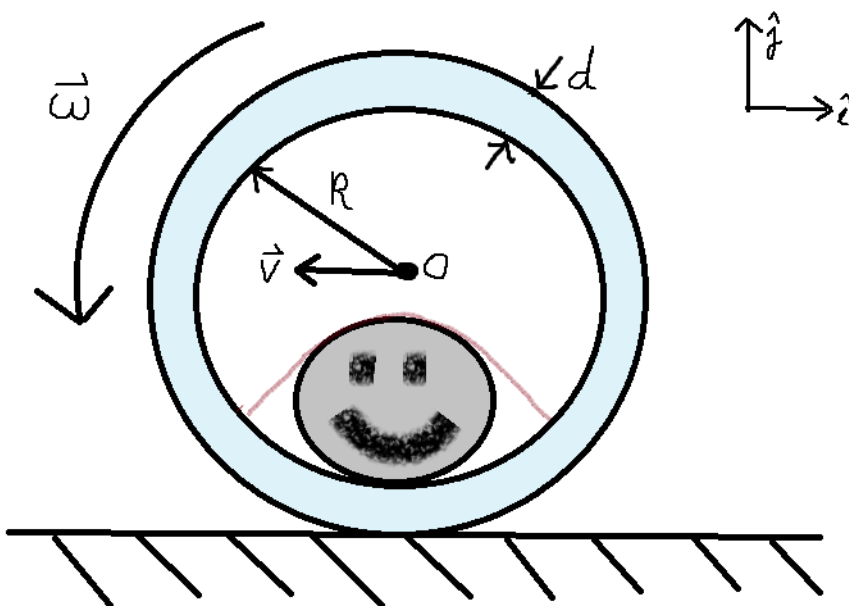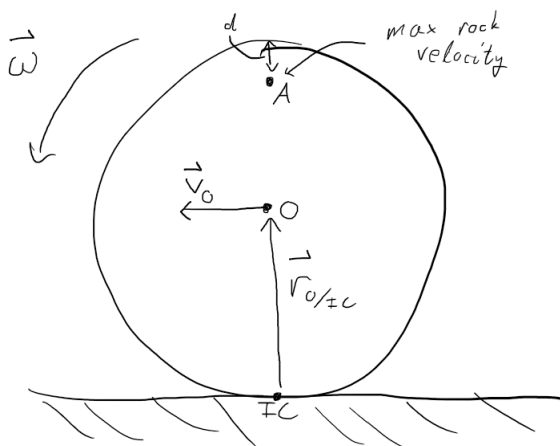# 22-R-KM-TW-7

Julie is taking her pet rock, Rocko, for a walk. Rocko is safely fastened to the inside of a hollow cylinder with inner radius $R = 10$ cm and thickness $d = 1$ cm. If the point O at the center of the cylinder is moving at a constant velocity of $-1\hat{i}$ m/s, what is the angular velocity of her pet rock?

Solution:

$$\vec{v} = \vec{\omega} \times \vec{r}_{O/IC}$$

$$-1\hat{i} = \omega\hat{k} \times (R+d)\hat{j} = -\omega(R+d)\hat{i}$$

$$\omega = \frac{v}{R+d}$$

$$\vec{\omega} = \frac{v}{R+d}\hat{k} = \frac{1}{0.11}\hat{k} = 9.09\hat{k} \ [\text{rad/s}]$$

What is the maximum speed her pet rock will experience at any point on its surface?

This will occur when the rock is at the top of the sphere at point A. The bottom of the sphere can be treated as an IC.

$$\vec{v}_A = \vec{\omega} \times \vec{r}_{A/IC}$$
$$= -\omega(2R + d)\hat{i}$$
$$v = |\vec{v}| = \omega(2R + d) = (9.09)(0.21) = 1.91 \ [\text{m/s}]$$