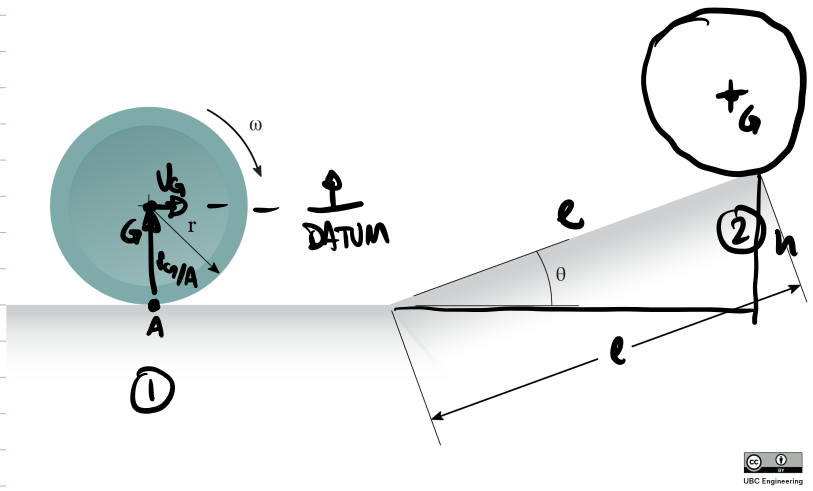
A metal cylinder of mass m = 15 kg and radius r = 1 m is rolling without slipping towards an incline of θ = 40°. What is the angular velocity at the moment the cylinder starts rolling up the incline if it travels a distance l = 10m? (Use g = 9.81 m/s^2 and assume no energy is lost due to friction)



$$\vec{V}_G = \vec{\omega} \times \vec{r}_{G/A}$$

$$V_G = \omega r_{G/A} = \omega r$$

$$I_G = \frac{1}{2} m r^2$$

$$T_1 + V_1 = T_2 + V_2$$

$$T_1 = \frac{1}{2} m V_G^2 + \frac{1}{2} I_G \omega^2 = \frac{1}{2} m \omega^2 r^2 + \frac{1}{2}\left(\frac{1}{2} m r^2\right)\omega^2 = \frac{3}{4} m \omega^2 r^2$$

$$V_2 = mgh = mg\, l \sin\theta$$

$$\frac{3}{4} m \omega^2 r^2 = mg\, l \sin\theta \rightarrow \omega = \sqrt{\frac{(15\,kg)(9.81\,m/s^2)(10\,m)\sin(40^\circ)}{\frac{3}{4}(15\,kg)(1\,m)^2}}$$

$$\boxed{\omega = 9.17\ rad/s\ \hat{k}}$$