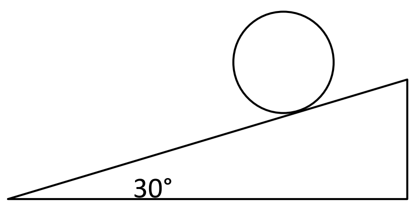
152 Homework Assignment

Please show the details of your calculation. Just a result is not acceptable.

A very thin ring with a mass of 5.0 kg rolls down a slope of 30°. (Thing ring means you may assume the thickness of the wall and assume all the mass of the ring has a distance *r* away from the center.) The radius of the ring is 1.0 m.



(a) *Solution: Without friction, the ring does* ***not*** *roll. Instead, it slides as in the question of box sliding down a slope. Using energy-conservation,* $mgsin(30°)l = \frac{1}{2}mv^2$*,one can easily get v=7.0 m/s. Since the ring is not rolling,* $\omega = 0$. $a = gsin(30°) = 4.9m/s^2$

(b) *Solution: With pure rolling, the Newton's 2nd law for the center of mass is:* $mgsin(30°) - f = ma$
The rotational motion is described as $T = I\alpha$. *Plug in* $T = f \times r$, $I = mr^2$, *and* $\alpha = \frac{a}{r}$. *One can find*
$f = \frac{1}{2}mgsin(30°) = 24.5N$
The velocity and angular velocity can be found from $mgsin(30°)l = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$, *and* $v = \omega r$
Therefore, v=4.95 m/s, and ω=4.95 s^{-1}.

(c) *Solution: Similar to the previous step, we only need to replace the rotational inertia of the ring with the rotational inertia of a disc. Therefoer, the Newton's 2nd law for the center of mass is:*

$$mgsin(30°) - f = ma$$

The rotational motion is described as $T = I\alpha$. *Plug in* $T = f \times r$, $I = \frac{1}{2}mr^2$, *and* $\alpha = \frac{a}{r}$. *One can find*
$f = \frac{1}{3}mgsin(30°) = 16.3N$

The velocity and angular velocity can be found from $mgsin(30°)l = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$, *and* $v = \omega r$

Therefore, v=5.72 m/s, and ω=5.72 s^{-1}.