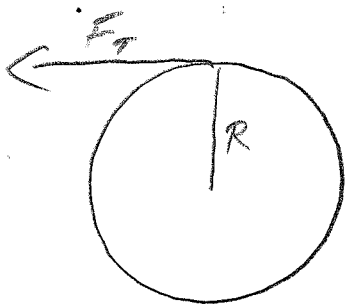
Physics 10154 - Exam #8B

Each problem is worth 50 points. Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. A massive 350-kg stone wheel acts like a cylinder 3.0 meters in diameter. A thin rope is wrapped around the wheel and a tension of 270 Newtons is applied tangent to the edge of the wheel to get it rotating. How long does it take (seconds) in order to get the wheel to make one complete revolution starting from rest?

$$I = \frac{1}{2}(350)(1.5)^2 = 394\ kg \cdot m^2$$



$$\Sigma\tau = +RF_T \sin 90 = I\alpha$$

$$(1.5)(270) = (394)\alpha$$

$$\alpha = 1.03\ rad/s^2$$

$\Delta\theta = 6.28\ rad$

$\omega_0 = 0$

$\omega = ?$

$\alpha = 1.03\ rad/s^2$

$t = ?$

$$\Delta\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$6.28 = 0 + \frac{1}{2}(1.03)t^2$$

$$\boxed{t = 3.5\ s}$$

2. A sphere of radius 14 cm is rolling up a long ramp angled 37° above the horizontal. The sphere is initially rolling with a linear speed of 8.0 m/s.

a) What fraction of the sphere's initial kinetic energy is rotational?

b) At what distance up the ramp does the sphere stop rolling?

$$I = \frac{2}{5}MR^2 = .00784M$$

$$\omega = \frac{v}{R} = \frac{8.0}{.14} = 57.1 \text{ rad/s}$$

$$K_{rot} = \frac{1}{2}I\omega^2 = 12.8M$$

$$K_{Trans} = \frac{1}{2}mv^2 = 32M$$

$$K_{TOT} = 44.8M \quad , \quad \frac{K_{rot}}{K_{TOT}} = \frac{12.8M}{44.8M} = \boxed{29\%}$$

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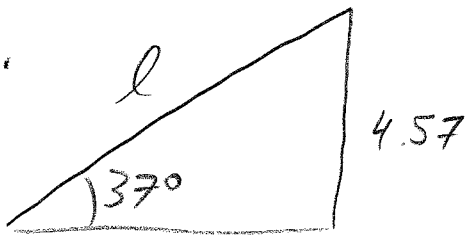
b) $W_{grav} = \Delta K$

$$-mgh = -(1+A)\frac{1}{2}mv^2$$

$$-mgh = -\left(\frac{7}{5}\right)\frac{1}{2}mv^2$$

$$h = \frac{7v^2}{10g} = 4.57$$



$$\ell = \frac{h}{\sin 37^\circ} = \boxed{7.6\text{ m}}$$