$$K_{r_{(com)}} + K_{t_{(com)}} = K_{r_{(p)}}$$

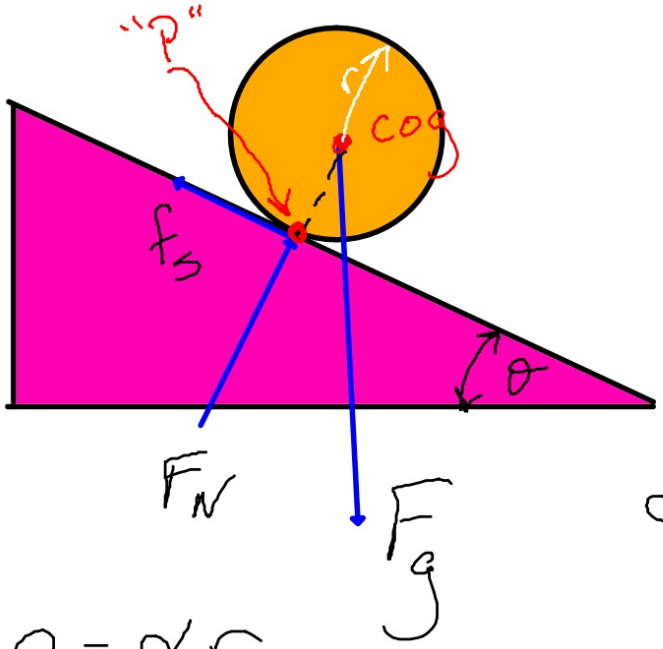
$$\frac{1}{2} I_{com} \omega^2 + \frac{1}{2} m v_{com}^2 = \frac{1}{2} I_p \omega^2$$

$$\frac{1}{2}\left(I_{com}\left(\frac{v^2}{r^2}\right) + mv^2\right) = \frac{1}{2}\left(I_{com} + Mh^2\right)\frac{v^2}{r^2}$$

$$\frac{1}{2}\left(I_{com}\frac{v^2}{r^2} + mv^2\right) = \frac{1}{2}\left(I_{com}\frac{v^2}{r^2} + Mr^2\left(\frac{v^2}{r^2}\right)\right)$$

$$\| \qquad = \frac{1}{2}\left(I_{com}\frac{v^2}{r^2} + mv^2\right)$$

This shows that looking at rotation (around the center of mass) PLUS translation (linear motion) IS equal to looking at purely rotation around the point of contact with the ground see p298



$a = ?$

$$\alpha_P = \frac{\Sigma \tau_P}{I_P}$$

$$\alpha_P = \frac{\vec{r} \times \vec{F_g}}{I_{com} + mh^2}$$

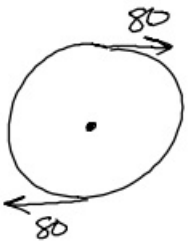
$$a = \alpha r$$

$$\frac{a}{r} = \frac{(r)(mg)\sin\theta}{I_{com} + mr^2}$$

$$a = \frac{r^2 mg \sin\theta}{I_{com} + mr^2}$$

1. a) $V_{com} = ?$ (relative to car)

zero !



b) $V_{top} = ?$

$80\ km/_h\ \hat{i}$

c) $V_{bottom} = ?$ $-80\ km/_h\ \hat{i}$

d) $a = ?$ (centripetal or radial)

$a = \frac{v^2}{r} = \frac{(22.2 m/s)^2}{.33} = 1496 m/s^2$ down

$-1496 m/s^2 \hat{j}$

e) $a = ?$ middle

zero ($v = 0$)

f) $a = ?$ bottom $a_r = +1496 m/s^2 \hat{j}$

g) $V = ?$ (center - to viewer on earth)

$V = 22.2 m/s\ \hat{i}$

h) $v = ?$ top

$V = 2V_c = 44.4 m/s\ \hat{i}$

i) $V_{bottom} = 0$

j) k) l) same as d) e) f explained in class

5.

$m = 1000\ kg$ (w/ wheels)

$m_{wheel} = 10\ kg$

$\frac{K_{rot}}{K_{total}}$

$K_{total} = K_{car} + K_{rot}$ ← of 4 wheels

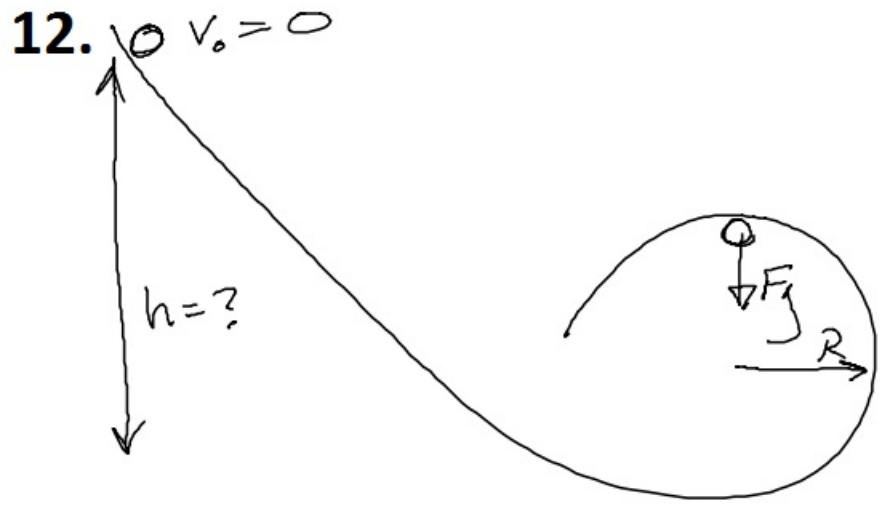
$\frac{K_{rot}}{K_{tot}} = \frac{K_{rot}}{K_{car} + K_{tot}} = \frac{4\left(\frac{1}{2} I \omega^2\right)}{\frac{1}{2} m V^2 + \left(\frac{1}{2} I \omega^2\right) 4}$

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

$V = \omega r$

$\omega = V/r$

12.



$$U_{g_0} = U_{g_f} + K_f$$

$$mgh = mg(2R) + \tfrac{1}{2} I_p \omega^2$$

$$mgh = mg(2R) + \tfrac{1}{2}\left(\tfrac{2}{5}mr^2 + mr^2\right)\frac{v^2}{r^2}$$

$$gh = 2gR + \frac{7}{10}v^2$$

$$\Sigma F_c = \frac{mv^2}{R}$$

$$mg = \frac{mv^2}{R}$$

$$g = \frac{v^2}{R}$$

$$gR = v^2$$

$$gh = 2gR + \frac{7}{10}gR$$

$$h = 2R + \frac{7}{10}R$$

$$h = 2.7R$$

$$= 2.7(0.14)$$

$$\boxed{h = 0.378\,m}$$