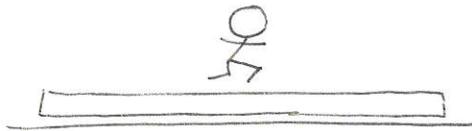


1) $\theta = \frac{1}{2} \alpha t^2 \rightarrow \text{Double Time, 4x Angle}$
 $\hookrightarrow \boxed{16 \text{ Revolutions}}$

2)



$$v_{rp} = \frac{40 \text{ m}}{4.4 \text{ s}} = \underline{9.09 \text{ m/s}}$$

Center of mass doesn't ~~move~~ ^{accelerate}

$$m_r v_{rg} + m_p v_{pg} = 0 \quad (i)$$

RELATIVE MOTION

$$v_{rg} = v_{rp} + v_{pg} \quad (ii)$$

Solve v_{pg} using (i) $v_{pg} = -\frac{m_r}{m_p} v_{rg}$

plug into (ii)

$$v_{rg} = v_{rp} - \frac{m_r}{m_p} v_{rg}$$

$$v_{rg} = \frac{v_{rp}}{\left(1 + \frac{m_r}{m_p}\right)} = \frac{9.09 \text{ m/s}}{\left(1 + \frac{60}{240}\right)} = \underline{7.27 \text{ m/s}}$$

3) a) $+mg(H-h)$

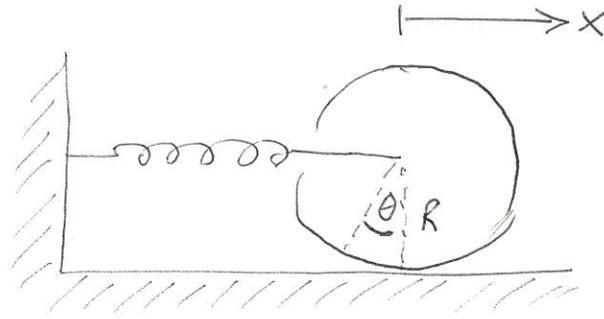
b) $mg(H-h) = \frac{1}{2} m v_{\text{wheel}}^2 ; v_{\text{wheel}} = \sqrt{2g(H-h)}$

c) $-mg(H-h)$

d) $W = \int \vec{F} \cdot d\vec{s}$

Normal force on skis \perp TO motion,
 \therefore Does NO work.

4)



$$K = \frac{1}{2} m \dot{x}^2 + \frac{1}{2} I \dot{\theta}^2 \quad \theta = \frac{x}{R} \quad (\text{rolls w/out slipping})$$

$$= \frac{1}{2} m \dot{x}^2 + \frac{1}{2} \left(\frac{1}{2} m R^2 \right) \left(\frac{\dot{x}}{R} \right)^2 \quad I_{\text{Disk}} = \frac{1}{2} m R^2$$

$$= \frac{3}{4} m \dot{x}^2$$

$$U = \frac{1}{2} k x^2$$

$$\mathcal{L} = K - U = \frac{3}{4} m \dot{x}^2 - \frac{1}{2} k x^2$$

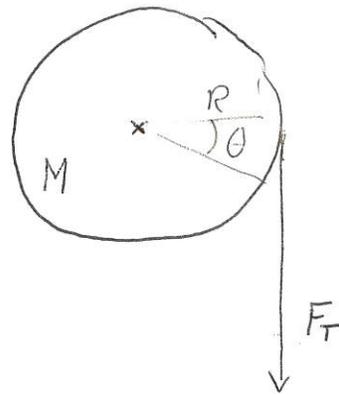
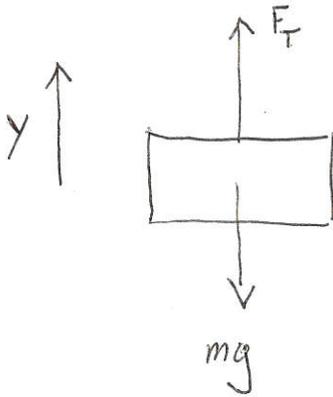
$$\frac{d}{dt} \left(\frac{\partial \mathcal{L}}{\partial \dot{x}} \right) - \frac{\partial \mathcal{L}}{\partial x} = \frac{3}{2} m \ddot{x} + k x = 0$$

$$\ddot{x} + \left(\frac{2}{3} \frac{k}{m} \right) x = 0$$

Simple HARMONIC OSCILLATOR EQUATION WITH

$$\omega = \sqrt{\frac{2}{3} \frac{k}{m}}$$

5)



$$\sum F_y = F_t - mg = ma_y$$

$$\sum \tau = -F_t R = I\alpha$$

$$= \left(\frac{1}{2}MR^2\right) \left(\frac{a_y}{R}\right)$$

$$F_t = -\frac{1}{2}Ma_y$$

$$-\frac{1}{2}Ma_y - mg = ma_y$$

$$a_y = -\frac{4}{5}g$$

$$a_y = \frac{-mg}{\left(m + \frac{M}{2}\right)}$$

6)

$$M\ddot{x}_1 = -(k+k_{12})x_1 + k_{12}x_2$$

$$M\ddot{x}_2 = -(k+k_{12})x_2 + k_{12}x_1$$