(1) a. $\left(\frac{5}{16}\text{ inch}\right)\left(\frac{2.54\text{ cm}}{\text{inch}}\right)\left(\frac{1\text{ m}}{100\text{ cm}}\right) = 0.007936\text{ m}$ ← diameter

$\text{radius} = \frac{0.007936\text{ m}}{2} = 0.00397\text{ m}$

b. $\tau = F_r = 49\text{N}(0.00397\text{m}) = 0.194\text{ N·m}$

c. $\frac{\left(4\text{ inch}\right)\left(\frac{2.54\text{ cm}}{\text{inch}}\right)\left(\frac{1\text{ m}}{100\text{ cm}}\right)}{2} = 0.0508\text{ m}$ ← diameter

d. $\tau = F_f \quad 0.194\text{ N·m} = F(0.0508\text{m})$

$F = 3.82\text{N}$

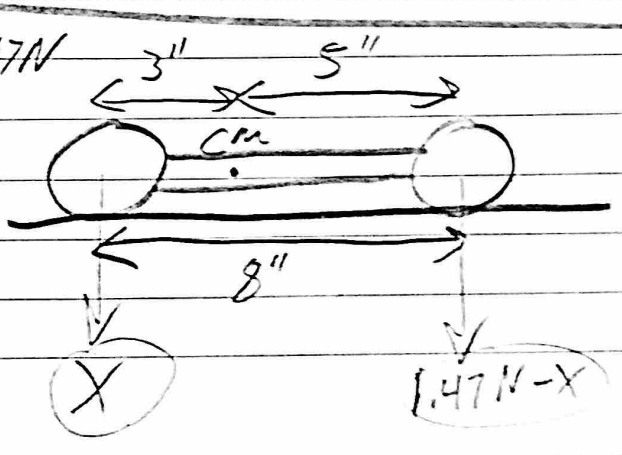
e. i. $F_{f_{static}} \leq \mu F_N = 0.4(0.8\text{N}) = 0.32\text{N}$

ii. $\tau = F_r \quad 0.194\text{ N·m} = 0.32\text{N}(r)$

$r = 0.606\text{ m}$ — 1.2m diameter!

(2) $w = mg = 0.15\text{kg}(9.8\text{m/s}^2) = 1.47\text{N}$

CM is fulcrum



Continued

(#2) continued

$\tau_{ccw} = \tau_{cw}$

$3''(x) = 5''(1.47N - x)$

$3x = 7.35N - 5x$

$8x = 7.35N$

$x = 0.919N$ = normal force against front wheels

$\therefore 1.47N - (0.919N) = 0.551N$ = Normal force against rear wheels

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(3) a. Average force = 15N

$W = F_{ave} d = 15N(0.3m) = 4.5\ J$

b. $F_{Ave} = 15N$ $W = 15N(0.15) = 2.25J$

c. $F_{Ave} = 15N$ Stretch Dist = 0.6m

$W = 15N(0.6m) = 9\ J$

d. $F_{Ave} = 15N$ Stretch Dist = 1.2m

$W = 15N(1.2m) = 18J$

* Force graph corresponds to sum of tensions in 2 strands. 1 strand must stretch 2x as far to achieve same force.

(4). Circumf $= \pi d = \pi\left(\frac{5}{16}\right) =$ 0.982 inch

$$\left(\frac{1\ rev}{0.982\ in}\right)\left(6\ in\right)\left(\frac{\pi(4.1\ in)}{rev}\right) = 76.8\ in$$

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(5) $KE = \frac{1}{2}mv^2 + \frac{1}{2}I_F\omega_F^2 + \frac{1}{2}I_R\omega_R^2$

$$KE = \frac{1}{2}mv^2 + \frac{1}{2}I_F\frac{v^2}{r_F^2} + \frac{1}{2}I_R\frac{v^2}{r_R^2}$$

$$\sqrt{\frac{2KE}{m + \frac{I_F}{r_F^2} + \frac{I_R}{r_R^2}}} = v = \sqrt{\frac{2(0.7)(1.9\,J)}{0.2kg + \frac{5\times10^{-5}\,kg\,m^2}{(0.03\,m)^2} + \frac{5\times10^{-5}\,kg\,m^2}{(0.05\,m)^2}}}$$

$$v = \sqrt{\frac{2.66\,J}{0.2kg + 0.0089kg + 0.02kg}}$$

$$v = \sqrt{\frac{2.66\,J}{0.2289kg}} = 3.41\ m/s$$

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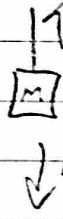
(6). $\Delta y = v_0 t + \frac{1}{2} a t^2$

a. $-0.15m = 0(4.8s) + \frac{1}{2} a (4.8s)^2$

$a = -0.0130 m/s^2$

b. $a = \alpha r \quad -0.0130 m/s^2 = \alpha (0.00397m)$

$\alpha = 3.27 rad/s^2$

c. 

$\Sigma F = T - mg = ma \Rightarrow T = m(g + a$

$T = 0.05kg (9.8 m/s^2 - 0.0130 m/s^2)$

$T = 0.489 N$

d. $\tau = Fr = 0.489N (0.00397m)$

$\tau_{friction} = 0.00194 N \cdot m$

e. $\omega = \omega_0 + \alpha t = 0 + (3.27 rad/s^2)(4.8s)$

$\omega = 15.7 rad/s$

f. $\omega = \omega_0 + \alpha t$

$0 = 15.7 rad/s + \alpha (25s)$

$\alpha = -0.628 rad/s^2$

g. Accel → $\tau_{Net} = \tau_{Friction} + 0.00194 N \cdot M = I (3.27 rad/s^2)$

($\tau_{net} = I\alpha$

2 equations

Decel → $\tau_{net} = I\alpha \Rightarrow \tau_{friction} = I (-0.628 rad/s^2)$

$I(-0.628 rad/s^2) + (0.00194 N \cdot m) = I(3.27 rad/s^2)$

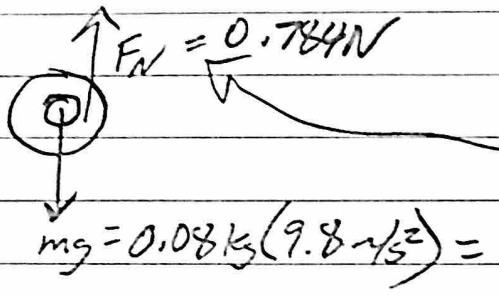
$I = 4.98 \times 10^{-4} kg m^2$

$\tau_{Frict} = (4.98 \times 10^{-4} kg m^2)(-0.628 rad/s^2)$

$\tau_{Fr} = -3.13 \times 10^{-4} N \cdot M$

h. $\tau_{Frict} = F_F r \Rightarrow -3.13\times10^{-4}\ N\cdot m = F(0.00584\ m)$

$F_F = 0.0536N$

i. 

$\Sigma F_x = 0 = F_N - mg$

$F_N = mg$

j. $F_F = \mu_K F_N \Rightarrow 0.0536N = \mu(0.784N)$

$\mu_K = 0.068$

7.