$x = 0 + 8(0.777) + \frac{1}{2}(-2.94)(0.777)^2$

$\boxed{x \approx 5.3\text{ m}}$

e) $v_f = ?$

$v_0 + at = v_f$

$8 - 2.94(0.7771) = \boxed{5.71562\text{ m/s}}$ $\frac{1}{2}(3.4)$

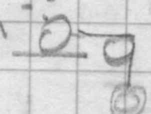
f) $K_0 = \frac{1}{2} m v_0^2 = 108.8$ $\quad K_f = K_T + K_{rot}$ $\quad 108.8 = 55.53813 + K_{rot}$

$K_{rot} = 53.26 < K_T$

2) 

$m_H = 2.4$ kg $\quad m_d = 1.8$ kg $\quad m_s = 4.3$ kg

$R_H = 0.15$ m $\quad R_d = 0.09$ m $\quad R_s = 0.2$ m

a) $a_h = ?$ 

$F_{g_H} = 23.52$ N $\quad \Sigma\tau = I\alpha$ $\quad \Sigma F = ma$ $\quad \tau = F \cdot R$ $\quad$ Gen f... $I = MR$...

$= \frac{I}{R^2} \cdot a$ $\quad M = \frac{I}{R^2}$ ✓

$I_s = \frac{2}{5} mR^2 + MR^2 = \frac{7}{5} MR^2$

$I_d = \frac{1}{2} mR^2$

$a = \frac{F}{m} = \frac{F}{I/R^2} = \frac{23.52}{2.4 + \frac{1}{2}(1.8) + \frac{7}{5}(4.3)} \approx \boxed{2.52\text{ m/s}^2}$

c) $\alpha_d = ?$ $\quad a = \alpha R$

$\frac{2.52}{R_d} = \frac{2.52}{0.09} \approx \boxed{28\text{ rad/s}^2}$

d) $\alpha_s = ?$

$\alpha_s = \frac{2.52}{0.2} = 12.6\text{ rad/s}^2$

e) Tension$_{sph. pulley}$ = ? $\quad F = m \cdot a \rightarrow \Sigma F = \frac{7}{5} m_s a$ $\quad \Sigma F = T_s \approx \boxed{15.17\text{ N}}$

f) Tension$_{h, pulley}$ = ? $\quad \Sigma F_H = T_H - F_g = ma$ $\quad 2.4(2.52) = T_H - 23.52$

$-T_H = -17.472$

$T_H = 17.472$ N

g) Time for hoop to fall 1.68 m? $\quad y = y_0 + v_0 t + \frac{1}{2} a t^2$

$1.68 = 0 + 0 + \frac{1}{2}(2.52) t^2$ $\quad t^2 = 1.\bar{3}$ $\quad \boxed{t \approx 1.1547\text{ s}}$

h) V_{f_h} @ 1.68 drop? $\quad v = v_0 + at$ $\quad v_f = 0 + 2.52 \cdot 1.1547 \approx \boxed{2.}$

i) $\omega_{f_s} = ?$ $\quad v_{sf} = 2.52 \cdot 1.1547 \approx 2.9$ m/s $\quad v = \omega R$

$\omega = \frac{v}{R} = \frac{2.9}{0.2} = 14.549\text{ rad/s}$

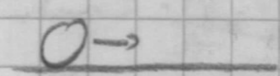
Newton's 2nd Law for Rotations

2nd Law: $mg\sin\theta - f = ma_x$

for rot: $fR = I_{cm}\alpha_{cm}$

$\rightarrow \frac{f}{2/5 M} = a_x \qquad a_x = \frac{5}{7} g \sin\theta$

Slipping to rolling



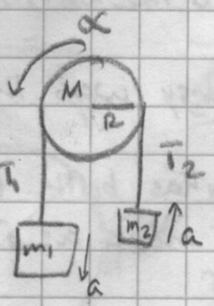
While sliding: $F = \mu_k mg \rightarrow$ constant a: $v_{cm} = v_0 - \mu_k g t$

Friction causes torque: $\tau = Fr = \mu_k mgr = I\alpha$

constant α: $\omega = \alpha t = \mu_k mgrt/I$

Rolling condition occurs when $v_{cm} = \omega r$

Example Problem:



1. If it accelerates counterclockwise, what is true of the tensions (now that there is mass for the pulley)?

τ to the left > τ to the right, so: $\boxed{T_1 > T_2}$

2. $\tau = I\alpha$

$m_1 g - T_1 = m_1 a \qquad T_1 R - T_2 R = \frac{1}{2} MR^2 \alpha$

$T_2 - m_2 g = m_2 a$

$T_1 - T_2 = \frac{1}{2} Ma$

- -

Phys Unit 18 HW

1)

$m = 3.4\,kg \quad R = 0.112\,m \quad v_0 = 8\,m/s \quad \mu = 0.3$ Slipping @ First

a) $\alpha = ?$ $\quad \tau_{net} = I\alpha \quad \tau = rF\sin\theta \quad I_s = \frac{2}{5}MR^2$

$I_s = \frac{2}{5}(3.4)(0.112)^2 \Rightarrow \frac{2}{5}MR^2 \cdot \alpha = R f \sin\theta$

$\frac{2}{5}(3.4)(0.112)^2 \cdot \alpha = 0.112 \cdot (N \cdot \mu) \sin 90$

$\frac{2}{5}(3.4)(0.112)\alpha = 0.3 \cdot 3.4 \cdot 9.8$

$\alpha = 65.625\ rad/s^2$

b) $a = ?$ $\quad$ Slipping, so: $F_f = ma \rightarrow 0.3(\cancel{3.4})(9.8) = \cancel{3.4}a$

$a = 2.94\ m/s^2$

c) How long for the ball to start rolling?

$v_b = v_0 - at$

$\omega = \alpha t$

Ball starts rolling when $v = \omega R$, so:

$v_0 - at = \omega R \qquad v_0 - at = \alpha t R$

$v_0 - at = (65.625)(0.112)t$

$8 - 2.94t = 7.35t$

$t = 0.777\,s$