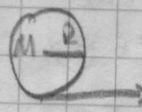
Unit 4 HW

2) 

No friction

$\frac{KE_{rot}}{KE_{tot}} = ?$

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

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

$\frac{K_{rot}}{K_{TOT}} = \frac{0.5I\omega^2}{0.5mv^2 + 0.5I\omega^2} = \frac{I\omega^2}{mv^2 + I\omega^2} = \frac{\frac{1}{2}(MR^2)\omega^2}{Mv^2 + \frac{1}{2}(MR^2)\omega^2} = \frac{0.5R^2\omega^2}{v^2 + 0.5R^2\omega^2}$

$\Sigma F = ma \quad \Sigma\tau = I\alpha \quad \Sigma\tau = \Sigma F \cdot R = rF\sin\theta$

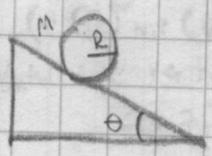
$I\alpha = maR \quad a = \frac{\alpha R}{2}$

$\frac{1}{2}MR^2\alpha = maR$

$v = a \cdot t, \ \omega = \alpha \cdot t$

$t = \frac{v}{a} = \frac{\omega}{\alpha}$, so $a = \frac{R\alpha}{2} \rightarrow v = \frac{R\omega}{2} \quad \omega = \frac{2v}{R}$

$\frac{K_{rot}}{K_{TOT}} = \frac{0.5R^2(\frac{2v}{R})^2}{v^2 + 0.5R^2(\frac{2v}{R})^2} = \frac{0.5 \cdot 4v^2}{v^2 + 0.5(4v^2)} = \frac{2}{1+2} = \boxed{\frac{2}{3}}$

3) 

$\theta = 30°$ $M = 8kg$ $R = 0.19m$ $\mu_s = 0.64$ $F_f = ?$

$a_R = \alpha$

$\Sigma F = ma: \ mg\sin\theta - F_f$

$\Sigma\tau = rF\sin\theta = \theta \cdot F_f = I\alpha$ $\quad \tau = F \cdot r$

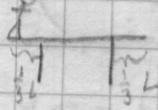
$I_{sphere} = \frac{2}{5}MR^2$

$F_g \quad R - F_f = \frac{2}{5}MR^2\alpha \quad F_f = \frac{2}{5}MR\frac{a}{R} \quad F_f = \frac{2}{5}Ma$

$a = \frac{5}{2M}F_f$

$mg: \ \frac{5}{2m}F_f = mg\sin\theta - F_f \rightarrow \frac{7}{2}F_f = mg\sin\theta$

$F_f = \frac{2}{7}mg\sin\theta = \frac{2}{7}(8)(9.8)\sin 30 = \boxed{11.2N}$

4) 

$m_1 = 41kg$

$m_2 = 108kg \quad L = 5m$

1) Force of left beam?

$\Sigma F = F_L + F_R - m_1g - m_2g = F_L + F_R = 401.8 - 1058.4$

$\Sigma\tau = \frac{1}{6}LF_L - \frac{1}{2}LF_1 - \frac{1}{6}LF_R = \frac{5}{6}F_L - \frac{5}{2}(401.8) - \frac{5}{6}F_R$

$\Sigma\tau = \frac{5}{6}F_L - \frac{5}{6}F_R - 1004.5 = 0 \quad \Sigma F = F_L + F_R - 1460.2 = 0$

$\frac{5}{6}F_R = \frac{5}{6}F_L - 1004.5 \rightarrow F_L + F_L - 1205.4 - 1460.2 = 0$

$F_R = F_L - 1205.4$ $\quad F_L = 1332.8N$

2. $F_R = ?$

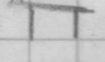
$F_L + F_R = 1460.2 \quad F_R = 1460.2 - F_L = \boxed{127.4N}$

3. How much mass held by gymnast to keep $F_R = 0$

$\Sigma F = F_L - F_1 - F_2$

$F_L - \frac{5}{6}F_1 - \frac{1}{2}F_1 = 0$

3. How much mass can the gymnast hold before it begins to tip: $F_R = 0$



$\Sigma F = F_L + F_R - m_1 g - m_2 g \rightarrow F_L - m_1 g - m_2 g = 0 \quad F_L = m_1 g + (108)(9.8)$

$\Sigma \tau = \frac{5}{6} F_L - \frac{5}{6} F_R - \frac{5}{2} m_1 g \rightarrow \frac{5}{6} F_L - \frac{5}{2} m_1 g = 0 \quad \frac{5}{6} F_L = \frac{5}{2} m_1 g \quad 2F_L = 6 m_1 g$

$2(m_1' g + 1058.4) = 6 m_1 g \qquad 2116.8 = 4 m_1' g - m_1 g = 529.2 \quad m_1' = 54$

$m_1' - m_1 = 54 - 41 = \boxed{13 \text{ kg}}$

4.

Directly over R, what is F_L?

$\Sigma F = F_L + F_R - m_1 g - m_2 g = 0 \quad F_R = m_1 g + m_2 g - F_L$

$\Sigma \tau = \frac{5}{6} F_L - \frac{5}{6} F_R + \frac{5}{6} F_1 = 0 \quad F_R = F_L + m_1 g$

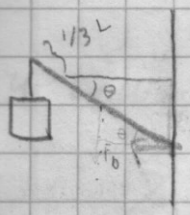
$m_1 g + m_2 g - F_L = F_L + m_1 g \quad m_2 g = 2F_L$

$F_L = \frac{m_2 g}{2} = \frac{(108)(9.8)}{2} = 529.2 \text{ N}$

5. $F_R = ?$

$F_R = m_1 g + m_2 g - F_L = 401.8 + 1058.4 - 529.2 = \boxed{931 \text{ N}}$

5)



$m_b = 6.1 \text{ kg} \quad \theta = 32.6°$

$m_s = 16.8 \text{ kg} \quad \Sigma F_y = m_b g - m_s g + F_{hy} = 0$

$L = 2.43 \text{ m} \quad \Sigma F_x = -F_w + T_x = 0$

$\Sigma \tau = -(2.43)(16.8)(9.8)\sin(57.4) - 1.215(6.1)(9.8)\sin(57.4) + (1.62) T \sin(32.6) = 0$

1. $(-400.0752 - 72.6327)\sin(57.4) + 1.62 T \sin(32.6) = 0$

$T = 456.267 \text{ N} \qquad T \sin(32.6) = 245.8233872$

2. If of hinge on beam?

$\Sigma F_x = T_x - F_{hx} = 0 \quad T_x = F_{hx} = T = 456.267 \text{ N}$

$\Sigma F_y = F_{hy} - m_b g - m_s g = 0 \quad F_{hy} = 224.42 \text{ N}$

$\Sigma F_h \rightarrow F_h = \sqrt{F_{hy}^2 + F_{hx}^2} = \boxed{508.472 \text{ N}}$

3. $T_{max} = 977 \text{ N}$

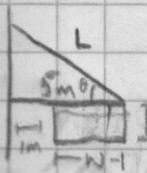
Max $m_s = ? = m'$

$\Sigma \tau = (1.62)(977)\sin(32.6) - (2.43) m' (9.8)\sin(57.4) - 1.215(6.1)(9.8)\sin(57.4) = 0$

$791.5444801 = (2.43) m' (9.8)\sin(57.4) \quad m' = 39.454596 \text{ kg}$

Homework 20

1)



$m = 1050 \text{ kg} \quad h = 1 \text{ m} \quad w = 4 \text{ m} \quad \theta = 23°$

μ to keep the sign up?

$\Sigma \tau = -T(w-1)\sin\theta + (1 + \frac{w}{2}) mg = 0 \quad -5T\sin(23) + 3(1050)(9.8) = 0 \quad T = 15801.$

$\Sigma F_x = F_N - T_x = 0 \quad F_N = T_x = T\cos\theta = 14545.03 \text{ N}$

$\Sigma F_y = \mu F_N + T_y - mg = 0 \quad \mu F_N = mg - T_y$

$\mu 14545 = (1050)(9.8) - 15801\sin 23$

$\mu = 0.2829832108$