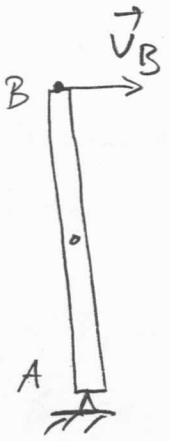
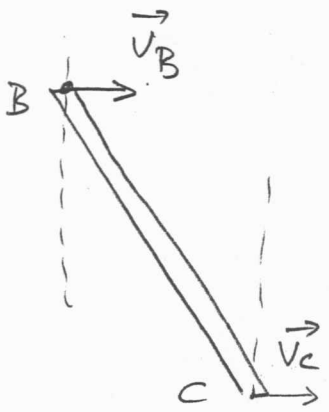
HW 10

18.7





Block C:

$$T_c = \frac{1}{2} m_c v_c^2 = \frac{1}{2}(4)(1)^2 = 2\,J$$

link CB

$r_{B/IC} = r_{C/IC} \to \infty$ moves translational! $v = 1\,m/s$

$$T_{CB} = \frac{1}{2} m v^2 = \frac{1}{2} \frac{200}{9.81} (1)^2 = 10.194\,J$$

link AB

$$v_B = 1\,m/s = r_{AB}\,\omega_{AB} = 1\,\omega_{AB} \Rightarrow \omega_{AB} = 1\,rad/s$$

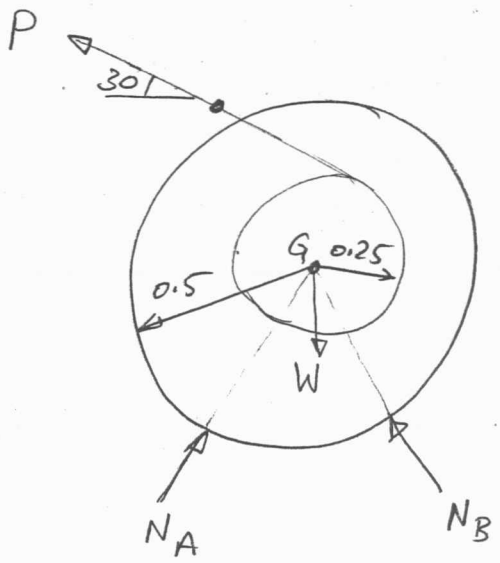
$$T_{AB} = \frac{1}{2} I_A \omega^2 = \frac{1}{2} \frac{1}{3} m_B (1)^2 (1)^2$$

$$= \frac{1}{6} \frac{100}{9.81} = 1.6989$$

$$T = T_c + T_{CB} + T_{AB}$$

$$= 13.893\,J$$

18-91



starting from rest
↳ $\omega_1 = 0$

$\Sigma U_{1-2} = T_2 - T_1$

- only force P does work

displacement of P

$s_P = 2(2\pi)(0.25) = \pi\ m$

- pure rotation about a fixed axis

$I_G = m k_G^2 = (175)(0.42)^2 = 30.87\ kg\ m^2$

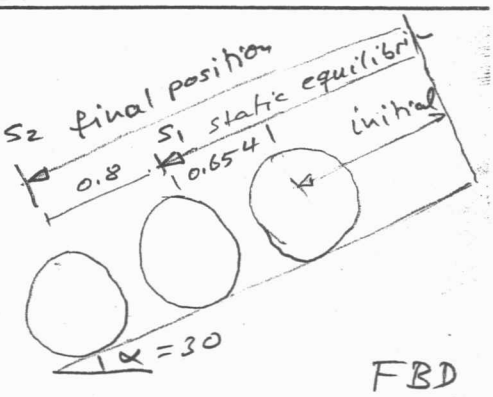
$\Sigma U_{1-2} = T_2 - T_1$

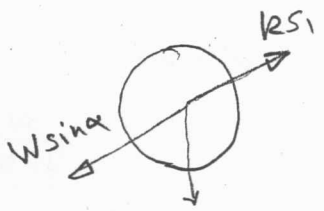
$P s_P = \frac{1}{2} I_G \omega^2 - 0$

$20(\pi) = \frac{1}{2}(30.87)\ \omega^2$

↳ $\omega = 2.0176\ rad/s$

18-22



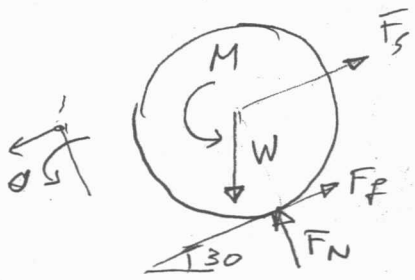


static equilibrium

$ks_1 = mg\sin\alpha$

$s_1 = \frac{mg\sin\alpha}{k} = 0.654\ m$

FBD



$I_G = \frac{1}{2}mr^2 = \frac{1}{2}(20)(0.2)^2 = 0.4\ kg\,m^2$

$s = \theta r$ without slipping

$\Rightarrow \theta = \frac{s}{r} = \frac{0.8}{0.2} = 4\ rad$

$v_G = \omega r_G = 0.2\omega$

$T_1 + \sum U_{1-2} = T_2$

$0 + mg\sin\alpha(0.8) - \frac{k}{2}(s_2^2 - s_1^2) + M\theta = \frac{1}{2}mv_G^2 + \frac{1}{2}I_G\omega^2$

$20(9.81)\sin 30(0.8) - \frac{150}{2}[(0.8+0.654)^2 - (0.654)^2] + 30(4)$

$= \frac{1}{2}(I_G + mr_G^2)\,\omega^2 \qquad r_G = 0.2\ m$

$\hookrightarrow \omega = 10.96\ rad/s$

18-36

$T_1 + V_1 = T_2 + V_2$

$0 = \frac{1}{2} m_c v_c^2 + 4\left[\frac{1}{2} m_w v_w^2 + \frac{1}{2} I_w \omega_w^2\right] - [m_c + 4m_w] g h$

$m_c = \frac{550}{9.81} = 56.07 \text{ kg}$

$m_w = \frac{25}{9.81} = 2.548$

$v_c = v_w \qquad v_w = r_w \omega_w$

$\omega_w = \frac{v_w}{0.15} = \frac{v_c}{0.15}$

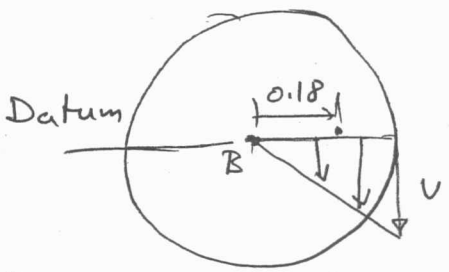
$h = 30 \sin 30 = 15$

$0 = \left[\frac{1}{2}(56.07) + 4\left(\frac{1}{2}(2.548) + \frac{1}{2}(2.548)(0.09)^2\right)\right] v_c^2 -$

$- [56.07 + 4(2.548)](9.81)(15)$

$\hookrightarrow v_c = 17.14 \text{ m/s}$

18-56



$v_c = 0.18 \omega_B \Rightarrow \omega_B = \frac{v_c}{0.18}$

$T_1 + V_1 = T_2 + V_2$

$0 - W_c(1.5) = \frac{1}{2} m_c v_c^2 + \frac{1}{2} I_B \omega_B^2 - W_c(3)$

$-10(9.81)(1.5) = \frac{1}{2}(10)(9.81) v_c^2 + \frac{1}{2}(15)(0.18)^2 \frac{v_c^2}{(0.18)^2} - 10(9.81)(3)$

$\hookrightarrow v_c = 1.613 \text{ m/s}$