HW 11

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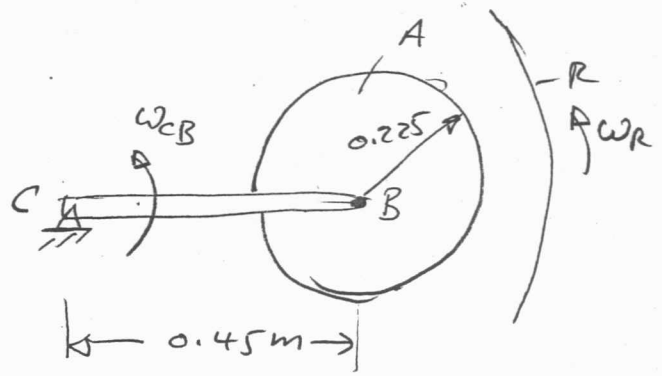
19–41

$m_A = 2\,kg \quad k_B = 0.15\,m$

$H_C = ?$

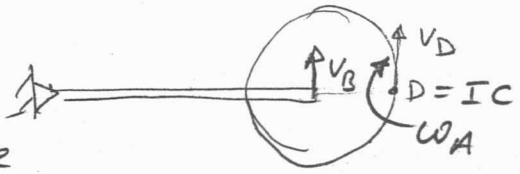


1. Case

$\omega_{CB} = 30\,rad/s \quad \omega_R = 0$

$V_B = \omega_{CB} r_{BC}$

$= 30(0.45) = 13.5\ m/s$



$V_D = 0$, since gear rack R at rest $\omega_R = 0$, gear A rotates momentarely about an axis through point D.

$\hookrightarrow \omega_A = \frac{V_B}{r_{B/D}} = \frac{13.5}{0.225} = 60\ rad/s$

$\circlearrowright \quad H_C = m_A V_B r_{CB} - I_B \omega_A \qquad I_B = m_A k_B^2$

$= (2)(13.5)(0.45) - (2)(0.15)^2(60) = 9.45\ kg\,m^2/s$

2. Case:

$V_B = \omega_{CB} r_{BC} = 13.5\ m/s \qquad \vec{V}_B = 13.5\vec{j}$

$V_D = \omega_R (0.45 + 0.225) = 20(0.675) = 13.5 \qquad \vec{V}_D = 13.5\vec{j}$

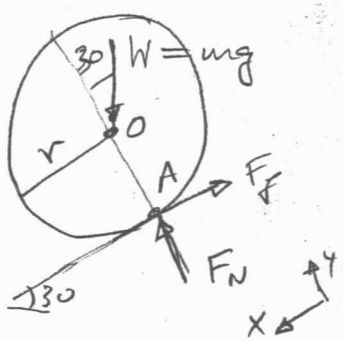
since 2 points have the same velocity → disk moves translational → $\omega_A = 0$

$\hookrightarrow H_C = m_A V_A r_{BC}$

$= 2(13.5)(0.45) = 12.15\ kg\,m^2/s$

19-171

$r = 0.3$ $m = 70\ kg$ $k_o = 0.125\ m$ $t: 0 \to 2\ sec$



$H_{A1} + \Sigma \int M_A\, dt = H_{A2}$

$0 + \int mg \sin 30\, r\, dt = [m k_o^2 + m r^2]\omega$

$0 + 70(9.81)\sin 30(0.3)(2) = 70(0.125^2 + 0.3^2)\omega$

$\hookrightarrow \omega = 27.9\ rad/s$

$mv_{x1} + \Sigma \int F_x\, dt = mv_{x2}$ $\quad v_{x2} = \omega r =$

$0 + \int [mg \sin 30 - F_f]\, dt = m\omega r$

$0 + 70(9.81)\sin 30(2) - F_f(2) = 70(27.9)(0.3) \Rightarrow F_f = 50.79\ N$

$mv_{y1} + \Sigma \int F_y\, dt = mv_{y2}$

$0 + \int (F_N - W\cos 30)\, dt = 0$

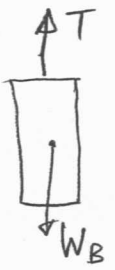
$[F_N - 70(9.81)\cos 30](2) = 0 \Rightarrow F_N = 594.7\ N$

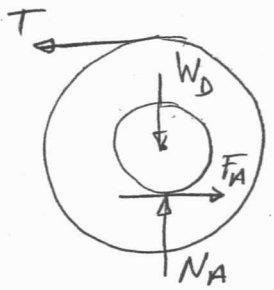
$F_f \neq \mu_s F_N$

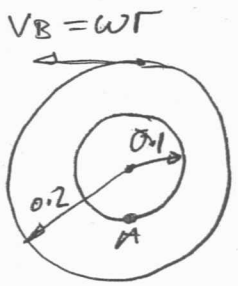
$F_{f\max} = \mu_s F_N = 0.4(594.7) = 237.87\ N > 50.79\ N$

OK

19-23







No slipping

from rest

Block:

$+\downarrow: m_B v_{B_1} + \sum \int F_y dt = m_B v_B$

$0 + (W_B - T)\Delta t = 10 v_B$

$\hookrightarrow T = W_B - \frac{10}{\Delta t} v_B = 98.1 - 5 v_B$

$W_B = m_B g = 10(9.81) = 98.1 N$

$\Delta t = 2 s.$

No slipping $\quad v_B = \omega r = 0.3\omega$

Spool:

$\zeta_+ \; H_{A_1} + \sum \int M_A dt = H_{A_2}$

$0 + 0.3 T \Delta t = (I_G + m_s r_G^2)\omega$

$0.6 T = \frac{300}{9.81}[(0.13)^2 + (0.1)^2]\omega$

$k_G = 0.13$

$m_s = \frac{300}{9.81} = 30.581$

$0.6[98.1 - 5(0.3)\omega] = 0.8226\omega$

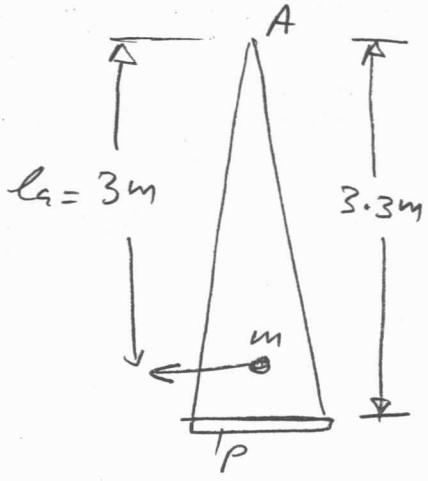
$v_B = 10.2 m/s$

$58.86 = 1.7226\omega \Rightarrow \omega = 34.17 rad/s$

$\hookrightarrow v_B = 0.3\omega = 10.25 m/s$

$T = 46.85 N$

19-36



$\circlearrowleft H_{A1} = H_{A2}$

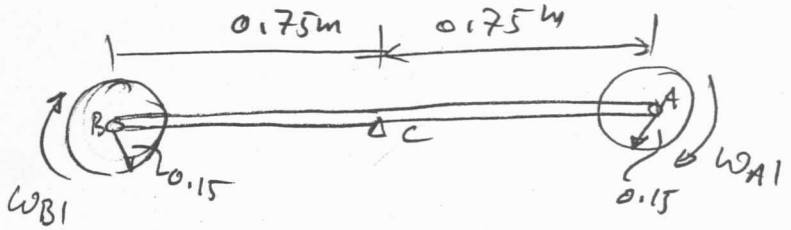
$0 = I_p \omega - m_M v_M l_A$

$= \left[\frac{1}{12}(100)(1.2)^2 + (100)(3.3)^2\right]\omega$

$- 75(1.5 - 3\omega)(3)$

$\hookrightarrow \omega = 0.19 \text{ rad/s}$

19-41



$\circlearrowleft H_1 = H_2$

$I_{DB}\omega_1 + I_{AD}\omega_1 + I_{RC}\omega_0 = I_{DB}\omega + I_{AD}\omega + m_D v_B(0.75) + m_D v_A(0.75) + I_{RC}\omega$

$\omega_0 = 0 \qquad \omega_1 = 5 \text{ rad/s} \qquad v_A = v_B = 0.75\omega$

$I_{DB} = I_{DA} = \frac{1}{2}(4)(0.15)^2 \qquad I_{RC} = (2)\frac{(0.75+0.75)^2}{12}$

$\hookrightarrow 2\left[\frac{1}{2}(4)(0.15)^2\right](5) = 2\left[\frac{1}{2}(4)(0.15)^2 + 4(0.75)^2\right]\omega + \frac{1}{12}(2)(1.5)^2\omega$

$\hookrightarrow \boxed{\omega = 0.0906 \text{ rad/s}}$