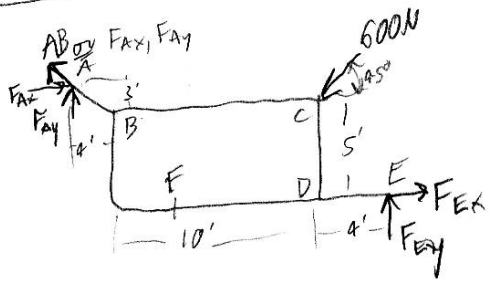
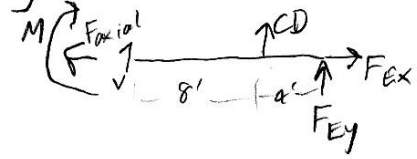
PS #11 Solutions

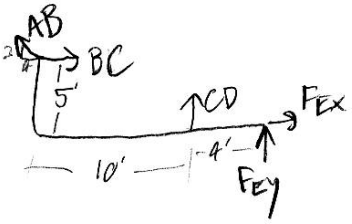
① a)



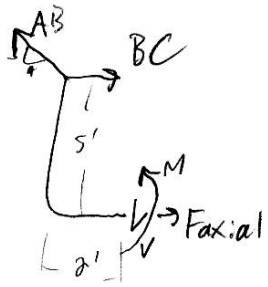
c)



b)



d)



e) $\Sigma F_x = 0 = F_{Ex} - F_{axial}$

$\Sigma F_y = 0 = V + CD + F_{Ey}$

$\Sigma M_C = 0 = -M + CD(8') + F_{Ey}(12')$

F) want reactions at A, E; $\Sigma M_E = 0 = -AB\left(\frac{3}{5}\right)(14') + AB\left(\frac{4}{5}\right)5' + 600N\left(\frac{1}{\sqrt{2}}\right)(5') + 600N\left(\frac{1}{\sqrt{2}}\right)(4')$ (for full body)

$(4.40ft)AB = \frac{5400\ ft\cdot N}{\sqrt{2}} \rightarrow AB = 867.813N$

$\Sigma F_x = 0 = -\left(\frac{4}{5}\right)AB - \frac{600N}{\sqrt{2}} + F_{Ex}$

$\rightarrow F_{Ex} = 1118.514N$

$\Sigma F_y = 0 = \left(\frac{3}{5}\right)AB - \frac{600}{\sqrt{2}}N + F_{Ey}$

$\rightarrow F_{Ey} = 96.424N$

at A:

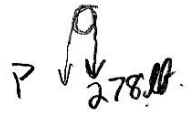
$\Sigma F_x = 0 = \frac{4}{5}AB + F_{Ax} \rightarrow F_{Ax} = -694.25N$

$\Sigma F_y = 0 = F_{Ay} - \left(\frac{3}{5}\right)AB \rightarrow F_{Ay} = 520.69N$

$F_{Ax} = -694N$
$F_{Ay} = 521N$
$F_{Ex} = 1119N$
$F_{Ey} = 96.4N$

(2) $\beta = 1\frac{1}{2}(2\pi) = 3\pi$

$\mu_s = 0.28$



at lower extreme of P: $\ln\left(\frac{278\,lb}{P}\right) = 0.28(3\pi)$

$\rightarrow P = 19.86\,lb$

at upper extreme of P: $\ln\left(\frac{P}{278\,lb}\right) = 0.28(3\pi)$

$P = 3891.5\,lb$

$$19.9\,lb \geq P \geq 3891\,lb$$

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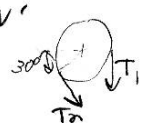
(3) at drum:



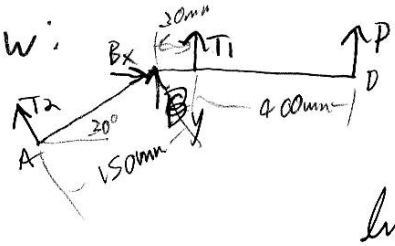
$\beta = 180° + 30° = \frac{210}{180}\pi = \frac{7\pi}{6}$

$\mu_d = 0.33$

if torque = 200 N·m, then $(T_1 - T_2)(140\,mm) = 200\,N\cdot m$

[or $(T_2 - T_1)$, depending on direction]

a) drum CCW:



$T_1 > T_2$, so:

$$\ln\left(\frac{T_1}{T_2}\right) = \left(0.33\frac{7\pi}{6}\right) \rightarrow T_1 = 3.35185\,T_2$$

For ABD:

$$\Sigma M_B = 0 = -T_2(150\,mm) + T_1(30\,mm) + P(430\,mm)$$

$$(T_1 - T_2)(140\,mm) = 200\,N\cdot m$$

substitute $T_1 = 3.35185\,T_2$

$\rightarrow T_2 = 607.424\,N$

$\rightarrow T_1 = 2.035994\,kN$

substitute into $\Sigma M_B = 0$ $\rightarrow$ $\boxed{P = 69.8\,N}$

(3b): drum CW, so $T_2 > T_1$:

$$\ln\left(\frac{T_2}{T_1}\right) = (0.33)\frac{7\pi}{6} \rightarrow T_2 = 3.35185\,T_1$$

$$\text{torque} = 200\ \text{N}\cdot\text{m} = (T_2 - T_1)\,140\ \text{mm}$$

$$\rightarrow T_1 = 607.424\ \text{N}$$

$$\rightarrow T_2 = 2.035994\ \text{kN}$$

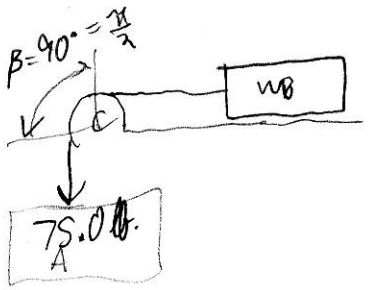
For ABD:

$$\Sigma M_B = 0 = -T_2(150\ \text{mm}) + T_1(30\ \text{mm}) + P(420\ \text{mm})$$

$$\rightarrow P = 667.85\ \text{N}$$

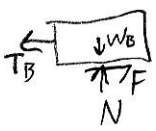
$$\rightarrow \boxed{P = 668\ \text{N}}$$

(4)



$\mu_s = 0.45$

at B:



$$\Sigma F_y = 0 = -W_B + N$$

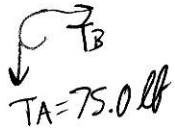
$$\rightarrow N = W_B$$

$$\Sigma F_x = 0 = -T_B + F$$

$F_{max} = \mu_s(N)$, so

$$T_{B_{max}} = \mu_s(W_B)$$

at C: pulley eqn: ln



$$\ln\left(\frac{T_A}{T_B}\right) = \mu_s\beta = (0.45)\left(\frac{\pi}{2}\right) = \ln\left[\frac{75.0\ \text{lb}}{(\mu_s W_B)}\right]$$

solve for: $\boxed{W_B = 82.2\ \text{lb}}$