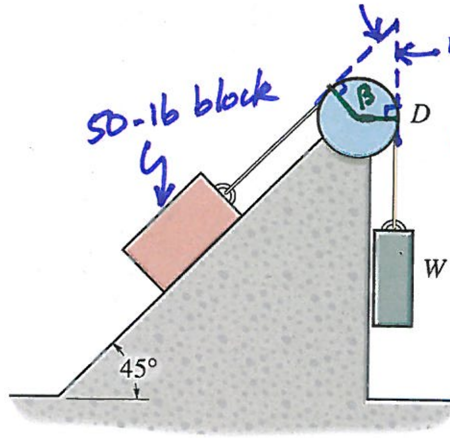
8-96

Determine the maximum and the minimum values of weight W which may be applied without causing the 50-lb block to slip. The coefficient of static friction between the block and the plane is $\mu_s = 0.2$, and between the rope and the drum D $\mu_s' = 0.3$.



$\beta = 135^\circ = 135 \frac{\pi}{180} = \frac{3}{4}\pi$ rad.

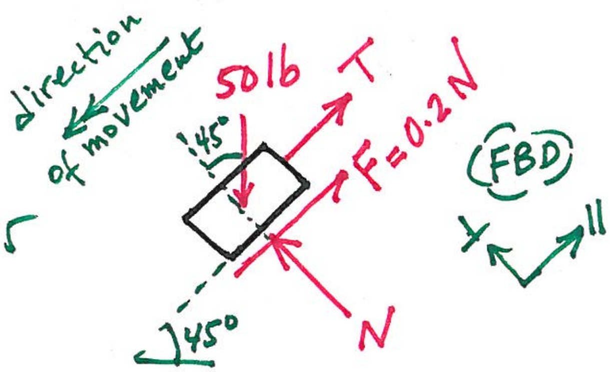
Case (1) 50-lb block is on the verge of sliding down

$\nwarrow \sum F_\perp = 0 = -50\cos 45 + N$

$N = 35.36 \text{ lb} \nwarrow$

$\nearrow \sum F_\parallel = 0 = T + 0.2(35.36) - 50\sin 45$

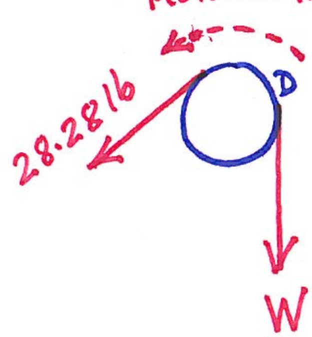
$T = 28.28 \text{ lb}$



Since $T_2 = T_1 e^{\mu_s' \beta}$

↳ opposes the direction of motion

↳ in the direction of motion (or impending motion)



$\beta = \frac{3}{4}\pi$ rad.

$\therefore\ 28.28 \text{ lb} = W e^{0.3 \times \frac{3}{4}\pi}$

↳ is in the direction of impending motion

$W = 13.95 \text{ lb} \Rightarrow \therefore$ if W is less than 13.95 lb the 50-lb block will slide down

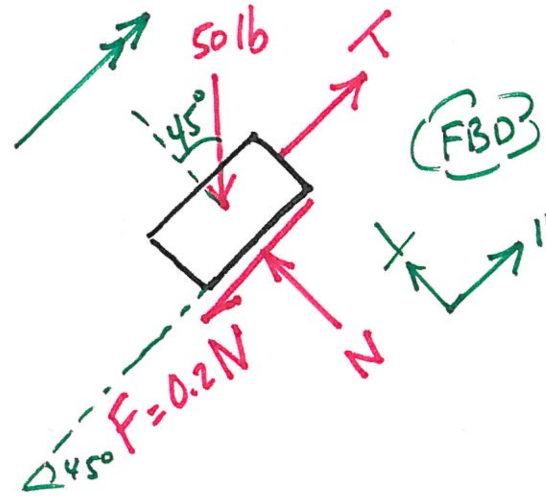
Case (2) 50-lb block is on the verge of sliding up

$\nwarrow \Sigma F_\perp = 0 = -50\cos 45 + N$

$N = 35.36 \text{ lb} \nwarrow$

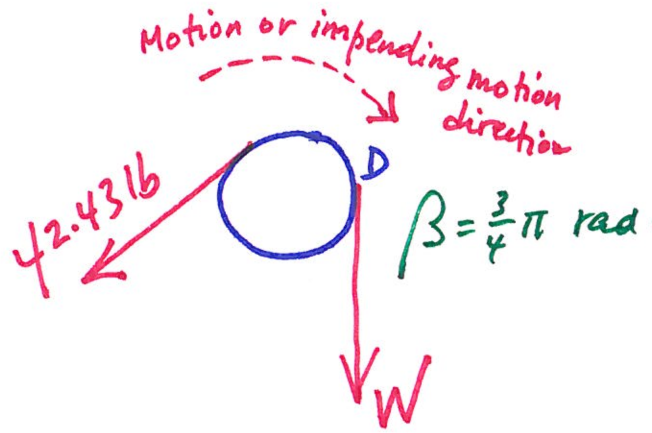
$\nearrow \Sigma F_{\parallel} = 0 = T - 0.2(35.36) - 50\sin 45$

$T = 42.43 \text{ lb} \nearrow$



$T_2 = T_1 e^{\mu_s' \beta}$

Note that in this case W is in the direction of the impending motion



$\therefore W = 42.43\, e^{0.3 \times \frac{3}{4}\pi}$

$W = 86.0 \text{ lb} \Rightarrow \therefore$ if W is greater than 86.0 lb the 50-lb block will slide up.

$\Rightarrow \therefore$ For the 50-lb block NOT to slide

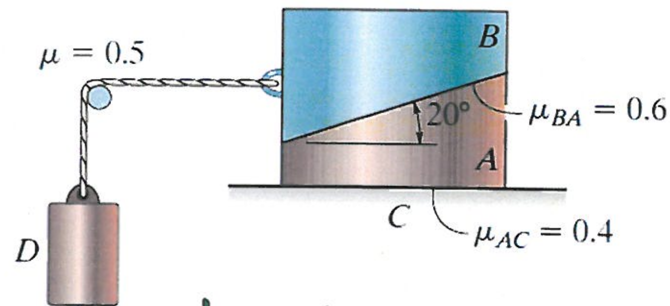
$$13.95 \text{ lb} \leq W \leq 86.0 \text{ lb}$$

$\therefore W_{max} = \underline{\underline{86.0 \text{ lb}}}$

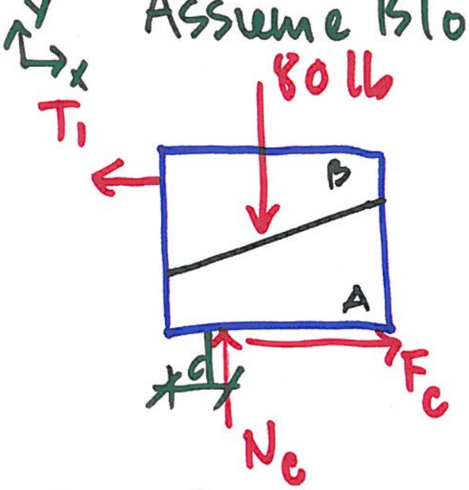
and $W_{min} = \underline{\underline{13.95 \text{ lb}}}$

8-103

Blocks A and B weigh 50 lb and 30 lb, respectively. Using the coefficients of static friction indicated, determine the greatest weight of block D without causing motion.



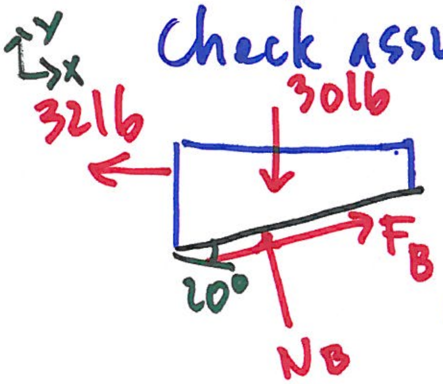
Assume Block B does not slip (on Block A) & impending motion for A and B @ surface C: $F_C = \mu_{AC} N_C = 0.4 N_C$



$+\uparrow \Sigma F_y = 0 = N - 80 \Rightarrow N_C = 80 \text{ lb} \uparrow$

$\xrightarrow{+} \Sigma F_x = 0 = -T_1 + F_C$ ($F_C \to 0.4 \times 80$) $\Rightarrow T_1 = 32 \text{ lb}$

Check assumption (B does not slip)



$\xrightarrow{+} \Sigma F_x = 0 = -32 - N_B \sin 20° + F_B \cos 20°$ (1)

$+\uparrow \Sigma F_y = 0 = -30 + N_B \cos 20° + F_B \sin 20°$ (2)

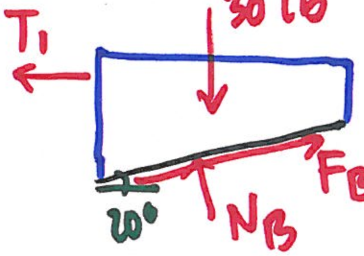
Solve (1) & (2): $F_B = 40.3 \text{ lb}$; $N_B = 17.25 \text{ lb}$

$F_B = 40.3 \text{ lb} > \mu_{BA} N_B = 0.6(17.25) = 10.35 \text{ lb}$

→ assumption not OK

→ impending motion b/w Blocks B & A

$\Rightarrow F_B = \mu_{BA} N_B = 0.6 N_B$



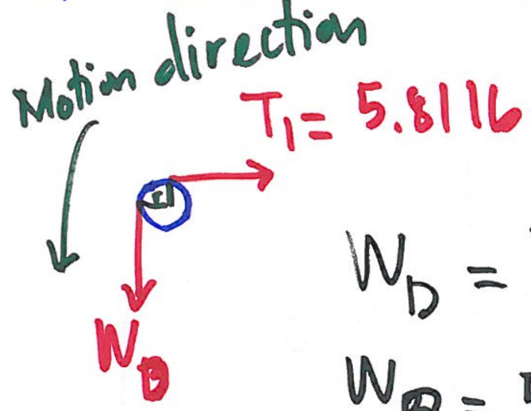
$+\uparrow \Sigma F_y = 0 = -30 + N_B \cos 20° + 0.6 N_B \sin 20°$

$N_B = 26.2 \text{ lb}$

$\xrightarrow{+} \Sigma F_x = 0 = -T_1 - N_B \sin 20° + 0.6 N_B \cos 20°$

$\Rightarrow T_1 = 5.81 \text{ lb}$

Problem 8.103 (Con't):



opposes the direction of motion

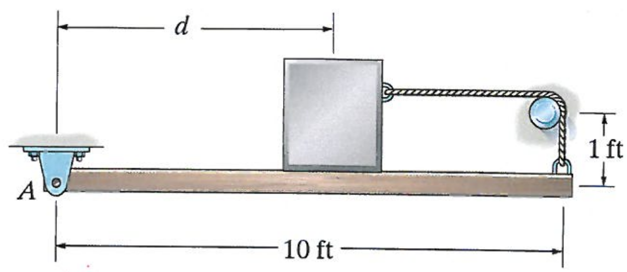
$$W_B = T_2 = T_1 e^{\mu\beta} \qquad \left(\beta = \frac{\pi}{2}\ \text{rad}\right)$$

$$W_B = 5.81\, e^{0.5\left(\frac{\pi}{2}\right)} = \underline{\underline{12.74\ lb}}$$

Ans.

8-106

The uniform 50-lb beam is supported by the rope which is attached to the end of the beam, wraps over the rough peg, and is then connected to the 100-lb block. If the coefficient of static friction between the beam and the block, and between the rope and the peg, is $\mu_s = 0.4$, determine the maximum distance that the block can be placed from A and still remain in equilibrium. Assume the block will not tip.



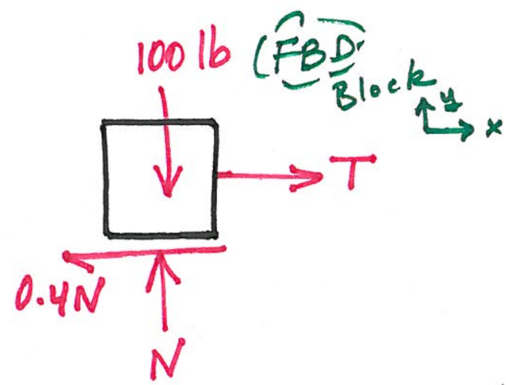
Block

$+\uparrow \Sigma F_y = 0 = -100\text{ lb} + N$

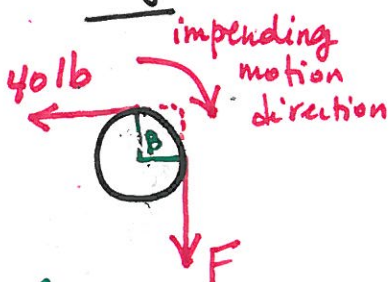
$N = 100\text{ lb} \uparrow$ on Block

$\xrightarrow{+} \Sigma F_x = 0 = T - 0.4(100\text{lb})$

$T = 40\text{ lb} \rightarrow$ on Block



Peg



$F = 40\, e^{0.4 \times \frac{\pi}{2}}$

$F = 74.98\text{lb}$

$\beta = 90° = \frac{\pi}{2}\text{ rad.}$

Block & Beam

$\circlearrowleft \Sigma M_A = 0 = -50\text{lb}(5\text{ft}) - 40\text{lb}(1\text{ft}) - 100\text{ lb}(d) + 74.98\text{lb}(10\text{ft})$

$d = \underline{\underline{4.60\text{ ft}}} = d_{max}$