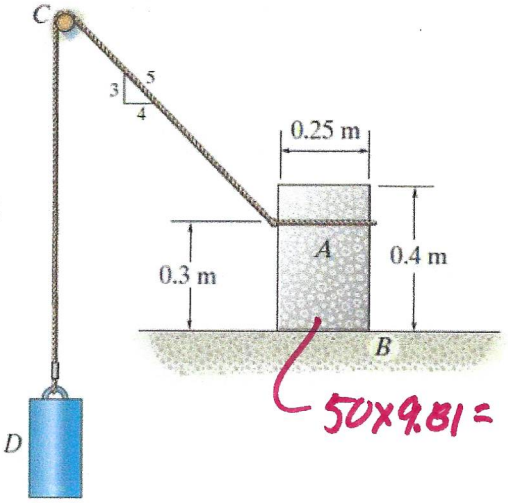
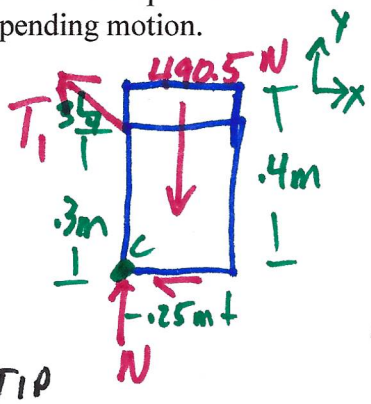
Problem 13: Block *A* has a mass of 50 kg and rests on surface *B* for which $\mu_s = 0.25$. If the coefficient of static friction between the cord and the fixed peg at *C* is $\mu'_s = 0.3$, determine the greatest mass of the suspended cylinder *D* without causing impending motion.



50×9.81 = 490.5 N

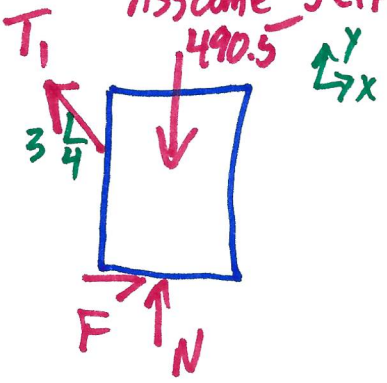
Assume Tipping



$\circlearrowleft \Sigma M_C = 0 = 490.5(.125) - \frac{4}{5}T_1(.3)$

$T_1 = 256\ N$ TO TIP

Assume SLIPPING



$\rightarrow \Sigma F_x = 0 = -T_1(\frac{4}{5}) + F$ but $\rightarrow F = F_{max} = \mu_s N$

$-\frac{4}{5}T_1 + .25N = 0$

$\uparrow \Sigma F_y = 0 = N + \frac{3}{5}T_1 - 490.5$

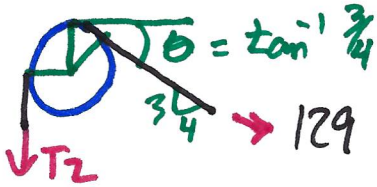
$\frac{3}{5}T_1 + N = 490.5$

SOLVE

$$\begin{bmatrix} -\frac{4}{5} & .25 \\ \frac{3}{5} & 1 \end{bmatrix} \begin{Bmatrix} T_1 \\ N \end{Bmatrix} = \begin{Bmatrix} 0 \\ 490.5 \end{Bmatrix} \quad \begin{Bmatrix} T_1 \\ N \end{Bmatrix} = \begin{Bmatrix} 129\ N \\ 413\ N \end{Bmatrix}$$

$T_1 = 129$ TO SLIP $\therefore$ SLIPS

BELT FRICTION



$\beta = \left(\frac{90 + 36.9}{180}\right)\pi = .705\pi$

$T_2 = 129e^{(.3)(.705\pi)} = 251\ N$

$m = \frac{T_2}{9.81} = 25.6\ kg$

ANSWER:

Mass of $D_{max} = 25.6$ kg