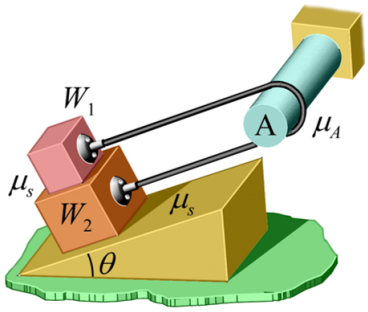
STATICS

Friction

Dr. Umit N. ARIBAS

Question : Determine the minimum weight W_1 that will not cause the weight $W_2 = 1\text{kN}$ to slide downwards. The coefficient of friction on the pipe A is $\mu_A = 0.2$ and on the other surfaces is $\mu_s = 0.15$. $(\theta = 30°)$.



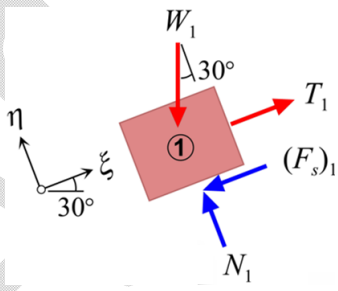
Solution:

The equilibrium equations are used in order to obtain the reactions and frictional forces of the weight W_1 as,

$\sum F_\eta = 0; \quad N_1 - W_1 \cos 30° = 0 \qquad N_1 = 0.866 W_1$

$(F_s)_1 = \mu_s N_1 \cong 0.13 W_1$

$\sum F_\xi = 0; \quad T_1 - W_1 \sin 30° - (F_s)_1 = 0 \qquad T_1 \cong 0.63 W_1$



The equilibrium equations are used in order to obtain the reactions and frictional forces of the weight W_2 as,

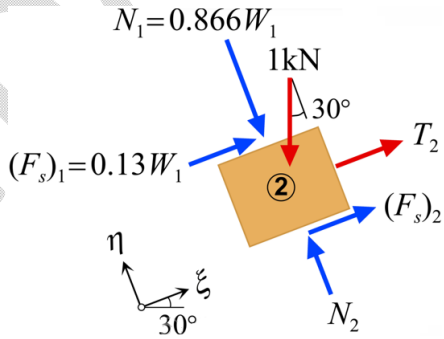
$\sum F_\eta = 0; \quad N_2 - N_1 - 1000 \cos 30° = 0$

$N_2 = 0.866 W_1 + 866$

$(F_s)_2 = \mu_s N_2 = 130 + 0.13 W_1$

$\sum F_\xi = 0; \quad T_2 - 1000 \sin 30° + (F_s)_1 + (F_s)_2 = 0$

$T_2 = 370 - 0.26 W_1$



Since the rotation is clockwise direction,

$T_2 = T_1 e^{\mu_A \beta} \quad \Rightarrow \quad 370 - 0.25 W_1 = 0.63 W_1 e^{0.2\pi} \quad \Rightarrow \quad W_1 = 256.78\,\text{kN}$