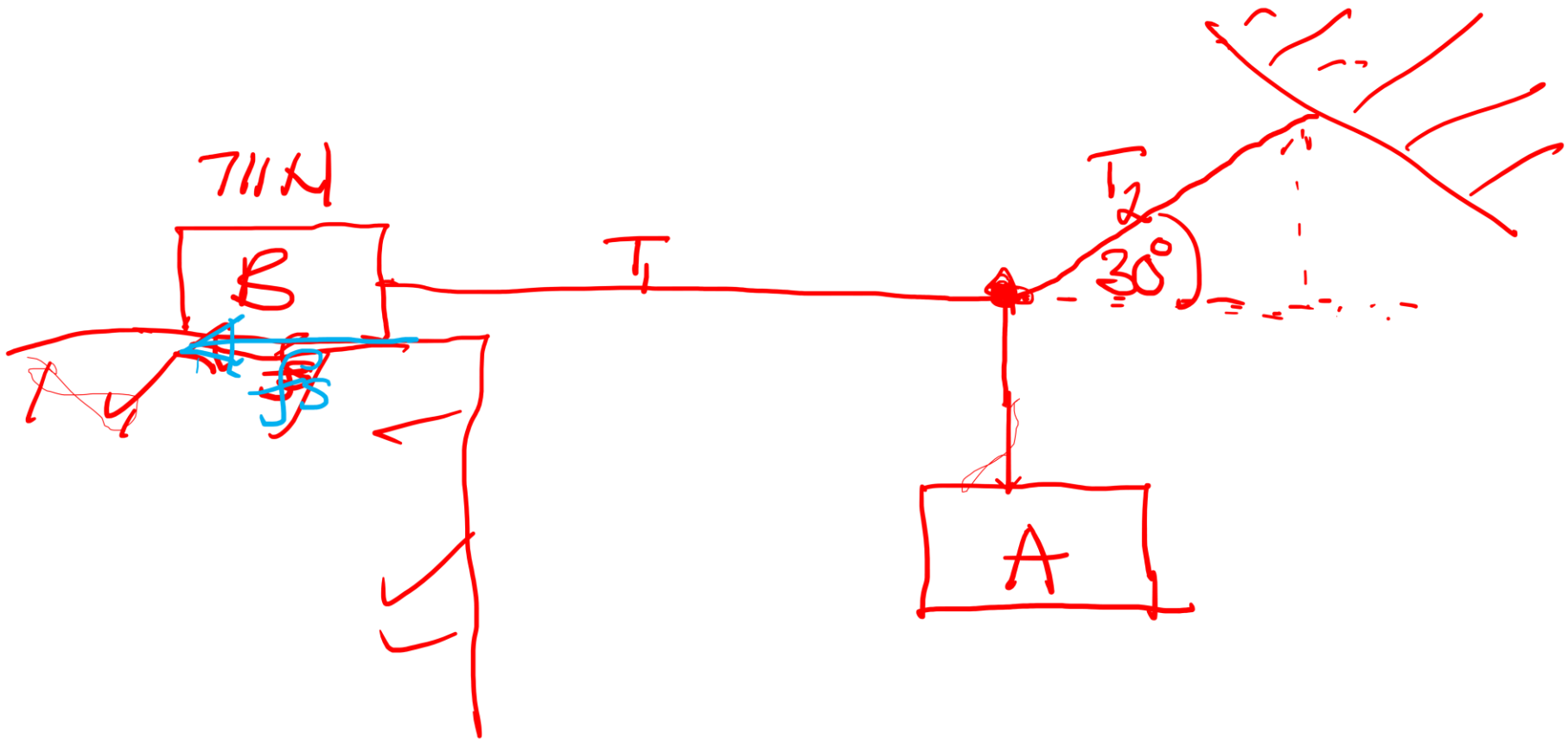
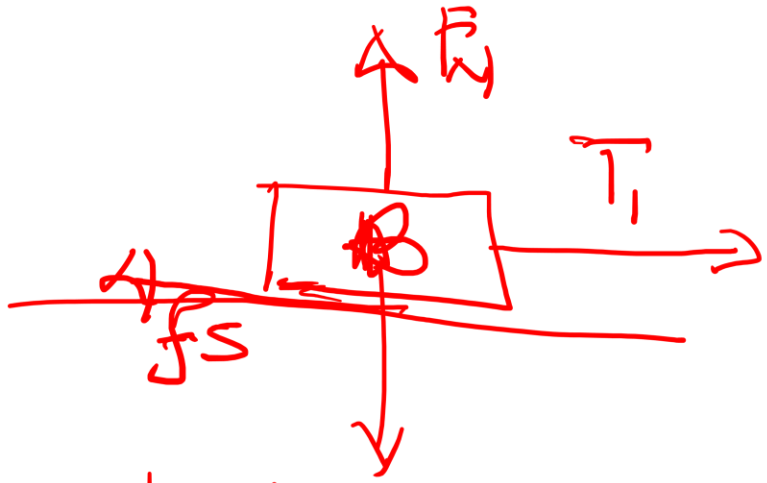
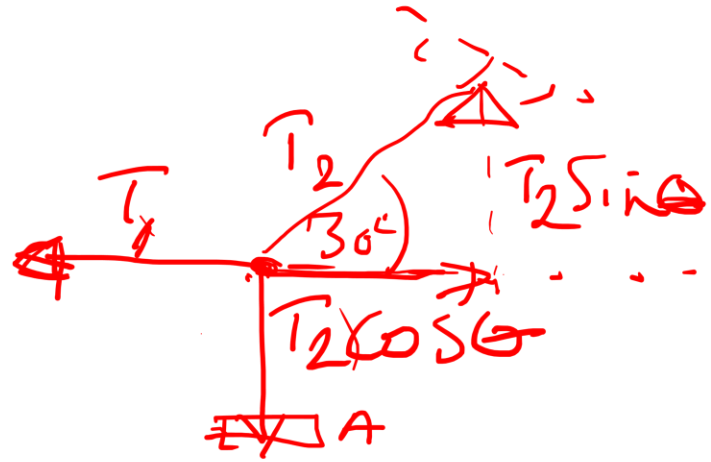
4. Block B weighs 711 N. The coefficient of static friction between block B and the table is 0.25. Assume the cord between block B and the knot is horizontal. Find the maximum weight of block A for which the system will be stationery. The angle for Tension 2 and the horizontal is 30°


711 N
B
T_1
T_2
30°
A



$W = mg$

$F_N = mg$



$W = mg$

Vertical components

$mg = T_2 \sin\theta$

Horizontal components

$T_2 \cos\theta = T_1$

Block B

Horizontal components

$T_1 = f_s$

$f_s = \mu_s F_N$

$T_1 = \mu_s mg$

but $\therefore T_1 = T_2 \cos\theta$

$\mu_s mg = T_2 \cos\theta$

$T_2 \sin\theta = m_A g$

$$T_2 = \frac{M_A g}{\sin\theta} \quad \text{---(i)}$$

$$T_1 = \mu_s M_B g$$

$$T_2 = \frac{T_1}{\cos\theta}$$

$$T_2 = \frac{\mu_s M_B g}{\cos\theta}$$

$$\frac{M_A g}{\sin\theta} = \frac{\mu_s M_B g}{\cos\theta} \quad \text{(ii)}$$

$$\frac{W_A}{\sin\theta} = \frac{\mu_s W_B}{\cos\theta}$$

$$W_A \times \frac{\cos\theta}{\sin\theta} = \mu_s W_B$$

$$\frac{\cos\theta}{\sin\theta} = \cot\theta$$

$$W_A \cot\theta = \mu_s W_B$$

$$\mu_s = \frac{W_A}{W_B}\tan\theta$$

$$= 0.25 \times \frac{11}{11}\tan\theta$$

$W_{block\,A} = \mu_s W_B \tan\theta$

$= 0.25 \times 711 \times \tan 30^\circ$

$W_{block\,A} = 102.6\,N$

$M_A g = T_2 \sin\theta$

$102.6 = T_2 \sin\theta$

$T_2 = \frac{102.6}{\sin\theta} = \frac{102.6}{\sin 30^\circ} = \frac{102.6}{0.5} = 205.2\,N$

$T_1 = \mu_s M_B g = 0.25 \times 711 = 177.75\,N$