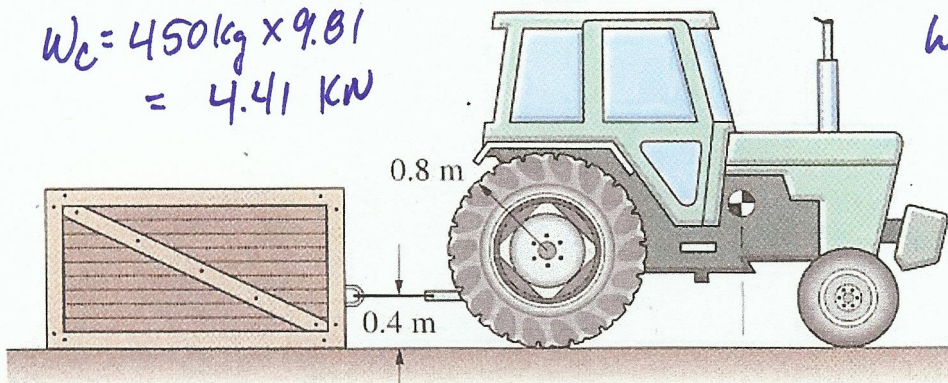


Problem 2: Friction II

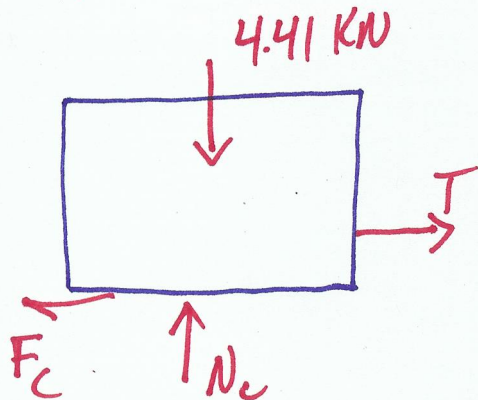
The coefficient of static friction between the tires of the 1000-kg tractor and the ground and between the 450-kg crate and the ground are both $\mu_s = 0.8$ and $\mu_s = 0.3$, respectively. Starting from rest, what torque must the tractor's engine exert on the rear wheels to cause the crate to move? (The front wheels can turn freely.)

$$W_c = 450 \text{ kg} \times 9.81 \\ = 4.41 \text{ kN}$$

$$W_t = 1000 \text{ kg} \times 9.81 \\ = 9.81 \text{ kN}$$



FBD CRATE



$$\uparrow \sum F_y = 0 \quad -4.41 + N_c = 0$$

$$N_c = 4.41$$

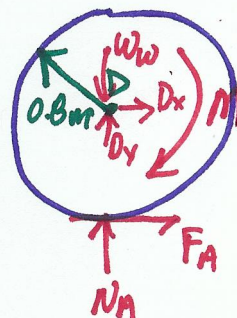
$$F_c = \mu_s N = 0.3(4.41) = 1.323 \text{ kN}$$

$$\rightarrow \sum F_x = 0 \quad -F_c + T = 0$$

$$F_c - 1.323 + T = 0$$

$$T = 1.323 \text{ kN}$$

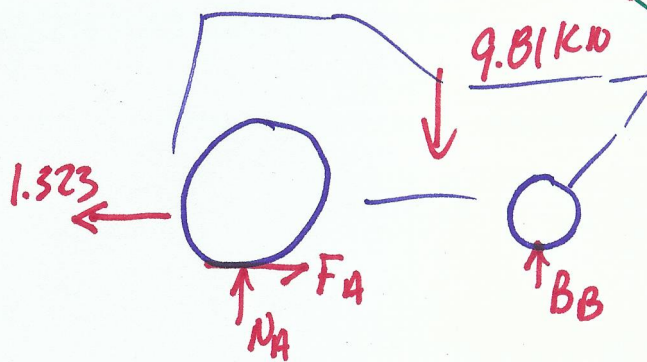
FBD REAR WHEEL



$$\sum M_D = 0 \quad M - 0.8 F_A = 0$$

$$M = 1.06 \text{ kNm}$$

FBD TRACTOR



$$\rightarrow \sum F_x = 0 \quad -1.323 + F_A = 0$$

$$F_A = 1.323 \text{ kN}$$