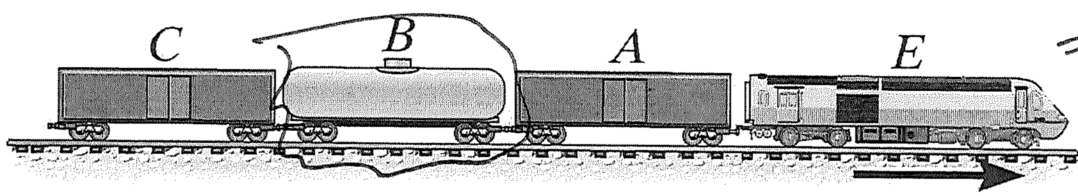
PHYSICS 151 TEST 4

Name: ______________________

(a.) The engine of a train is pulling three cars A, B, and C. Explain why, as a physics student, you would say that the following statement is false: "The train's engine is exerting a force on car B". *(3pts)*

* (Also track ⇒ Normal Force)

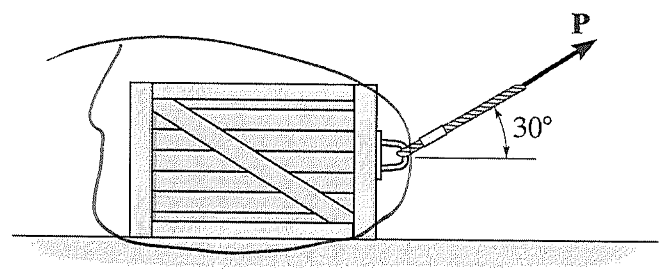


Circling B shows us that the only objects in Contact with B are Cars A and C* ⇒ they pull on B. The Connectors are like Ropes ⇒ tension.

B's f.b.d.: $\vec{T}_{C on B}$ ←, $\vec{n}_B$ ↑, $\vec{T}_{A on B}$ →, $\vec{w}_B$ ↓

If Accelerating fast $T_{A on B}$ is larger than $T_{C on B}$

(b.) A crate is made to slide to the right by applying a pulling force at the 30° angle shown. If the pulling force is not large enough to lift the crate off the floor, is the normal force acting on the crate bigger, smaller, or equal to the crate's weight? Explain your answer. *(3pts)*



Forces on Crate: $\vec{P}$ at 30°, $\vec{n}$ up since horizontal floor

May be kinetic friction to left since crate is moving to right and $\vec{w}$ down

$\vec{f}_k$ ←, $\vec{n}$ ↑, $\vec{P}$ at 30°, $\vec{w}$ ↓

No motion in y-direction ⇒ $\sum F_y = 0$

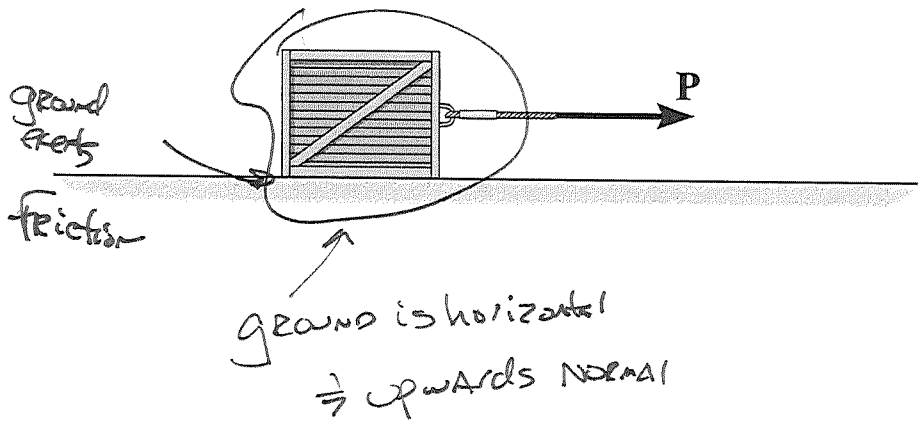
⇒ $n_y + P_y + w_y + f_{k,y} = 0$ ⇒ $+n + P_y - w = 0$ ⇒

(only y; only y; no y-comp.; $f_{k,y} = 0$)

$n = w - P_y$ ⇒ Smaller than weight

P_y upwards ⇒ Positive ($\vec{P}$ components P_x, P_y)

(c.) A 25-kg crate is pulled to the right by a $P = 75\,N$ pulling force. If the coefficient of kinetic friction between the create and the floor is 0.3, what is the crate's acceleration? Assume any drag force on the crate is negligible. *(4pts)*



Forces on Crate

$\vec{P}$ to Right, $P = 75N$

Normal, $\vec{n}$ up, $n = ?$

Moving ⇒ Kinetic friction $\vec{f_K}$ to Left.

Weight, $\vec{w}$ Down

$w = mg = (25kg)(9.8m/s^2) = 245N$

f.b.d. $\vec{f_K}$ ← ⊙ → $\vec{P}$, $\vec{n}$ ↑, $\vec{w}$ ↓

Motion to Right ⇒ $a_x = a = ?$

$a_y = 0$

$\therefore \Sigma F_x = ma_x \Rightarrow$

$n_x + P_x + w_x + f_{K,x} = ma \Rightarrow +P - f_K = ma$

(n_x: up; P_x: +P since to right; w_x: down; $f_{K,x}$: $-f_K$, to left)

Need f_K. Use $f_K = \mu_K n$.

$\Sigma F_y = 0 \Rightarrow n_y + P_y + w_y + f_{K,y} = 0$

(n_y: up ⇒ +n; P_y: Right; w_y: Down ⇒ −w; $f_{K,y}$: Left)

$\Rightarrow n - w = 0 \Rightarrow n = w = 245N \therefore f_K = 0.3(245N) = 73.5N$

$\therefore P - f_K = ma \Rightarrow 75N - 73.5N = 25kg\,a \Rightarrow a = \frac{1.5N}{25kg} = 0.06m/s^2$