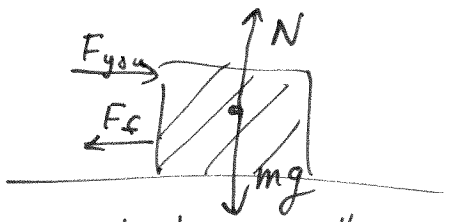
Chapter 6 Problem 48

$\mu_s \leq 0.500$ $\mu_k = 0.300$

$m = 120\,kg$



a) What maximum force can you exert horizontally on the crate without moving it?

From the diagram

$$\Sigma \vec{F} = m\vec{a}$$

$$\vec{N} + \vec{W} + \vec{F}_{you} + \vec{F}_f = m\vec{a} = 0 \quad \text{(crate is not moving)}$$

$$N\hat{j} - mg\hat{j} + F_{you}\hat{i} - \mu N\hat{i} = 0$$

x-dir: $F_{you} = \mu N$ (#1)

y-dir: $N = mg$ (#2)

Substitute (#2) into (#1) gives

$$F_{you} = \mu mg = (0.500)(120\,kg)(9.80\,m/s^2) = \boxed{588\,N}$$

b) F_{you} stays the same, but now the crate is moving + $\mu_k = 0.300$

Find the acceleration

We can still use ~~equations~~ (#1) # # the previous equation except acceleration is non-zero.

$$\vec{N} + \vec{W} + \vec{F}_{you} + \vec{F}_f = m\vec{a}$$

$$N\hat{j} - mg\hat{j} + F_{you}\hat{i} - \mu N\hat{i} = ma\hat{i}$$

x-dir: $F_{you} - \mu N = ma \rightarrow a = \dfrac{F_{you} - \mu N}{m}$ (#3)

y-dir: $N - mg = 0 \rightarrow N = mg$ (#4)

sub (#4) into (#3)

$$a = \frac{F_{you} - \mu mg}{m} = \frac{F_{you}}{m} - \mu g$$

$$= \frac{588\,N}{120\,kg} - 0.300\,(9.80\,m/s^2) = \boxed{1.96\,m/s^2}$$