Friction

Example 6:
A mystery box (m = 10.0 kg) rests on a completely horizontal floor. The coefficient of static friction is 0.40 and the coefficient of kinetic friction is 0.30. Determine the following based on the magnitude of a horizontal force (F_A) applied to the box:

A. Calculate maximum static friction. What is this value?
B. F_A = 0 N
C. F_A = 20 N
D. F_A = 38 N
E. F_A = 40 N

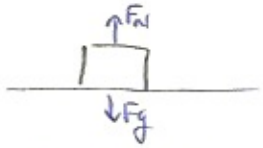
$F_{fs}^{MAX} = \mu_s \cdot F_N$

$\mu_s = 0.40$

$F_N = 98$ N

$F_{fs}^{MAX} = (0.40)(98)$

$F_{fs}^{MAX} = 39.2$ N



$\Sigma F_y = F_N - F_g$

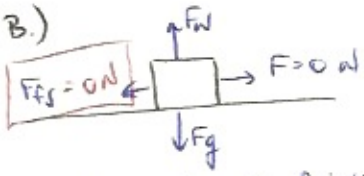
$0 = F_N - mg$

$0 = F_N - (10.0)(9.8)$

$0 = F_N - 98$

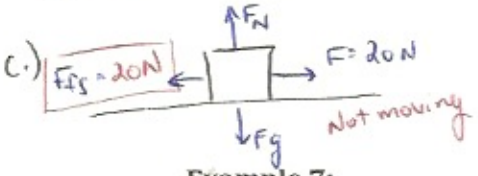
$F_N = 98$ N

B.)



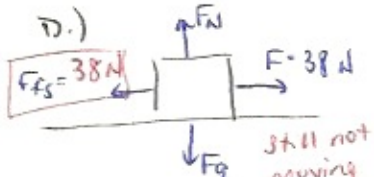
The force of static friction will match any opposing force up to its breaking point at 39.2 N.

C.)



Not moving

D.)



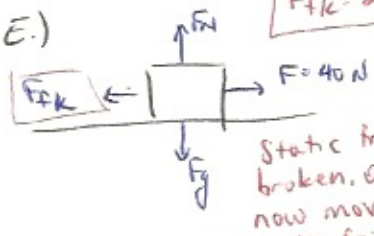
Still not moving

$F_{fk} = \mu_k \cdot F_N$

$F_{fk} = (0.30)(98)$

$F_{fk} = 29.4$ N

E.)

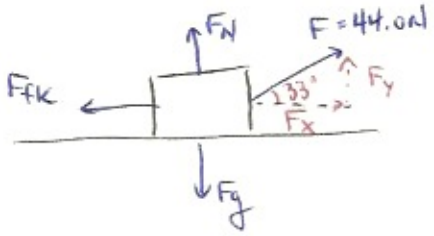


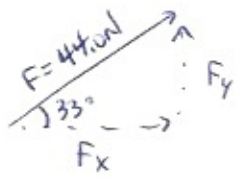
Static friction is broken. Object will now move with kinetic friction.

Example 7:
A little boy is pulling on a toy train that drags behind him at a **constant velocity.** The mass of the toy is 6.50 kg and the boy is pulling with a force of 44.0 N directed at 33.0° above the horizontal.

Equilibrium or Non-equilibrium ΣF_x: Equilibrium $\Sigma F = 0$
Equilibrium or Non-equilibrium ΣF_y: Equilibrium $\Sigma F = 0$

A. What is the normal force?
B. What is the coefficient of kinetic friction?





$F_x = \cos(33°) \cdot 44.0$

$F_x = 36.9$ N

$F_y = \sin(33°) \cdot 44.0$

$F_y = 24.0$ N

$\Sigma F_x = F_x - F_{fk}$

$0 = F_x - F_{fk}$

$0 = 36.9 - F_{fk}$

$F_{fk} = 36.9$ N

$\Sigma F_y = F_N + F_y - F_g$

$0 = F_N + 24.0 - mg$

$0 = F_N + 24.0 - (6.50)(9.8)$

$0 = F_N + 24.0 - 63.7$

$0 = F_N - 39.7$

$F_N = 39.7$ N

$F_{fk} = \mu_k \cdot F_N$

$36.9 = \mu_k \cdot 39.7$

$\mu_k = 0.929$