

# Notes on Forces

10/22/19

$F_w$  = weight  $\rightarrow$  force on an object due to gravity

$F_w = mg$   
\* to find an object's weight, multiply the mass by 9.8.

$F_N$  = normal force  $\rightarrow$  perpendicular to the surface.

$F_f$  = friction force  $\rightarrow$  force resisting the motion of an object.

$F_{net}$  = Net force  $\rightarrow$  sum of all forces.

$F_A$  = Applied force  $\rightarrow$  pushing an object.

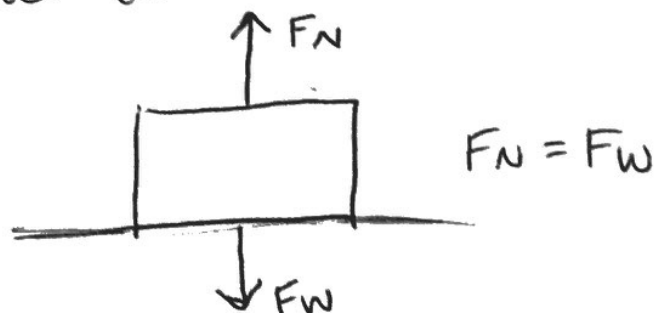
$F_{||}$  = parallel force

$F_{\perp}$  = perpendicular force

• All forces are measured in Newtons (N).

• On a level surface, an object is not moving in the vertical direction.  
Therefore,  $F_N = F_w$ .

In vertical direction  
 $F_{net} = 0$



$$F_f = \mu F_N$$

$F_f$  = friction force (N)

$\mu$  = coefficient of friction

$F_N$  = Normal force (N)

Coefficient of friction is a value that tells us how rough or smooth the surface is.

Ice has a low coefficient of friction  
Sand paper has a high coefficient of friction.

Coefficient of friction does not have a unit.

$\mu$  is always going to be a # between 0 & 1.

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A 100 kg object is sitting on a surface with a coefficient of friction of 0.15.  
What is the force of friction?

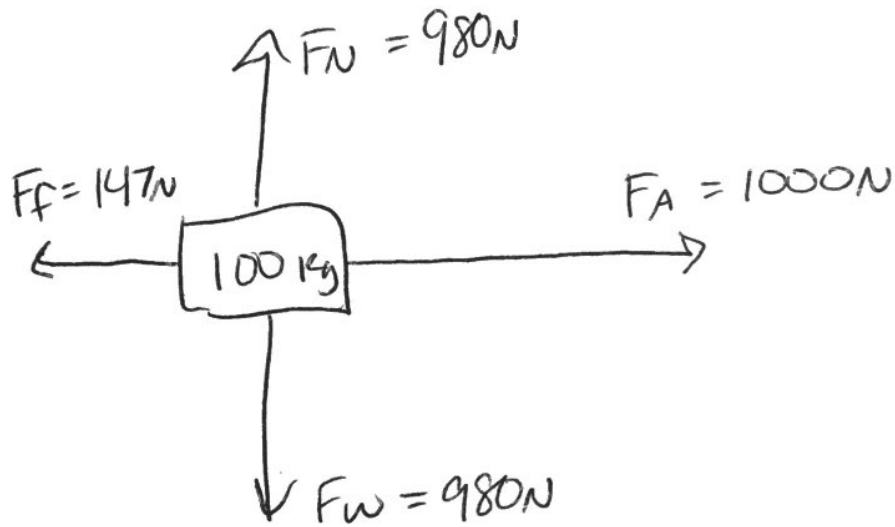
Step 1:

$$F_w = mg$$
$$F_w = (100 \text{ kg})(9.8 \text{ m/s}^2)$$
$$F_w = 980 \text{ N}$$

Step 2:

$$F_f = \mu F_N$$
$$F_f = (0.15)(980 \text{ N})$$
$$F_f = 147 \text{ N}$$

If I apply a force of 1000N, what is the acceleration of the object?



$$F_{\text{net}} = F_A - F_f$$

$$1000\text{N} - 147\text{N}$$

$$F_{\text{net}} = 853\text{N}$$

At what rate is the object accelerating?

$$F_{\text{net}} = ma$$

$$\frac{853\text{N}}{100} = \frac{(100\text{kg})}{100}(a)$$

$$a = 8.53\text{m/s}^2$$

## Steps for solving forces on a horizontal surface:

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- ① Find an object's weight

$$F_w = mg$$

\* To find an object's weight, multiply mass by 9.8.

- ② On a level surface,  $F_N = F_w$

- ③ Solve for force of friction (if given coefficient of friction):

$$F_f = \mu F_N$$

- ④ ~~Solve for~~ net force:  $F_{\text{net}} = F_A - F_f$

- ⑤ Solve for acceleration:

$$F_{\text{net}} = ma$$

## Example:

A 45kg object is sitting on a level surface with a coefficient of friction of 0.35.

Step 1: solve for weight  $F_w = mg$   $F_w = (45\text{kg})(9.8)$   
 $F_w = 441\text{N}$

Step 2:  $F_N = F_w$   $F_N = 441\text{N}$

Step 3:  $F_f = \mu F_N$   $F_f = 0.35(441\text{N})$   
 $F_f = 154.4\text{N}$

Step 4:  $F_{\text{net}} = F_A - F_f$   
 $200\text{N} - 154.4\text{N}$   
 $F_{\text{net}} = 45.6\text{N}$

Step 5:  $F_{\text{net}} = ma$   
 $\frac{45.6\text{N}}{45} = \frac{(45\text{kg})a}{45}$

$a = 1.01\text{m/s}^2$

$F_A$	Moving Y/N	$a$
50N	N	0
100N	N	0
150N	N	0
200N	Y	$1.01\text{m/s}^2$