NAME:____________________________________

U2:L7 Friction

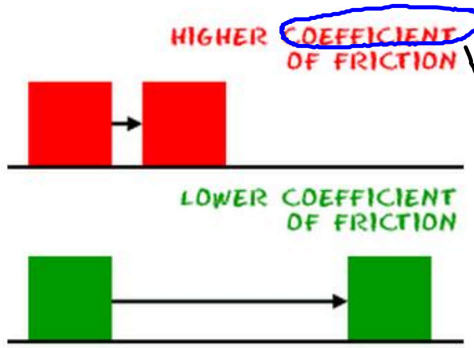
Static vs Kinetic Friction

Static	Staying still stationary Still stopped	$\vec{F_N}$, $\vec{F_g}$, $\vec{F_f}$, $\vec{F_{app}}$ — $\Sigma\vec{F} = 0N$
Kinetic	moving Kinematics Kinetics motion	$\vec{F_f}$, $\vec{F_{app}}$ — $\Sigma\vec{F} \neq 0N$ $\vec{F_f}$, $\vec{F_{app}}$ — $\Sigma\vec{F} = 0N$, $\vec{a} = 0m/s^2$, $\vec{v} \neq 0m/s$ — constant $\vec{v}$

Notice the difference between the scale reading as we pull on the mass.

When is the reading largest? @ start of motion (INSTANT)

What happens once the block begins to move? $\vec{F_f}$ becomes smaller.



$\underline{5}x^2$ — constant multiplied by your variable

The coefficient of friction is the ratio between the Force of Friction and the Normal Force:

$$\mu = \frac{\vec{F_f}}{\vec{F_N}} \qquad \frac{\text{friction}}{\text{normal}}$$

pronounced "mew"

The symbol μ can be thought of as a numerical description of the nature of the surfaces. The equation μ = 0 corresponds to a frictionless surface: small values correspond to two surfaces that are slippery, with the friction becoming larger with larger values of μ.

↑μ = more friction
↓μ = less friction
μ = 0 frictionless

Measures of friction are based on the type of materials that are in contact. Concrete on concrete has a very high ***coefficient of friction****. That coefficient is a measure of how easily one object moves in relationship to another. When you have a high coefficient of friction, you have a lot of friction between the materials. Concrete on concrete has a very high coefficient, and Teflon on most things has a very low coefficient.* ***Teflon*** *is used on surfaces where we don't want things to stick; such as pots and pans.*

VELCRO = ↑μ

Scientists have discovered that there is even less friction in your joints than in Teflon!

We can specify our equations for static and kinetic friction:

$\mu_s = \frac{\vec{F}_{sf}}{\vec{F}_N}$ OR $\vec{F}_{sf} = \mu_s(\vec{F}_N)$
$\mu_k = \frac{\vec{F}_{kf}}{\vec{F}_N}$ OR $\vec{F}_{kf} = \mu_k(\vec{F}_N)$

The force of friction is only dependent on the coefficient of friction and the normal force. What does **not** change the force of friction?

Speed + Surface Area

Does acceleration effect the frictional force?

$\vec{F} = ma$

★ μ ≠ units — DOES NOT HAVE UNITS

EXAMPLES:

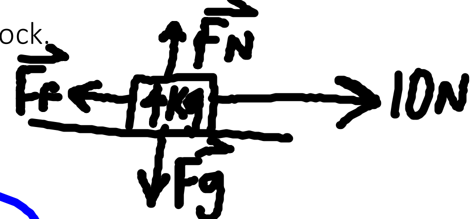
1. A hockey puck has a coefficient of kinetic friction of $\mu_k = .10$. If the puck feels a normal force (F_N) of 5 N, what is the frictional force that acts on the puck?

$\vec{F}_{KF} = \vec{F}_N \mu_K$

$\vec{F}_{KF} = 5N(0.1) = \boxed{0.5N}$

2. Suppose a 10 N force is applied to the side of a 4.0 kg block that is sitting on a table. The block experiences a frictional force against the force that is applied.

   a. Draw a force diagram for the block.



   b. What is the weight of the block (F_G)?

$F = ma$

$F_g = mg$

$\vec{F}_g = 4Kg(9.8 m/s^2)$

$\boxed{\vec{F}_g = 39.2N}$

   c. What is the normal force on the block (F_N)?

$\boxed{39.2N}$

$\Sigma \vec{F}_y = 0_N$

   d. If the coefficient of kinetic friction is $\mu_k = .20$, what is the frictional force on the block (F_f)?

$\vec{F}_{Kf} = \vec{F}_N \mu_K$

$\vec{F}_{KF} = 39.2N(0.2)$

$\boxed{7.84N}$

   e. What is the net force on the block? $\longrightarrow (+)$

$\Sigma \vec{F}_x = \vec{F}_{app} + \vec{F}_f$

$\Sigma \vec{F}_x = 10N + (-7.84N)$

$\boxed{+2.16N}$

   f. What is the acceleration of the block from the net force?

$\Sigma \vec{F}_x = ma$

$a = \frac{\Sigma \vec{F}_x}{m} = \frac{2.16N}{4Kg} = \boxed{0.54 m/s^2}$