Name:_____ Date:_____

Mr. Croom's Physics Chapter 4: Force and the Law of Motion

Friction Review

(DON'T FORGET… READ Chapter 4 on Newton's Laws, especially the section about… you guessed it… friction!)

FRICTION: Friction is classified as **a force that opposes motion** between 2 material surfaces that are in contact. On a microscopic scale, all surfaces are rough. When two surfaces rub, the high points of one surface temporarily bond to the high points of the other. This process is called **molecular adhesion**. These bonds are of a chemical nature, and are caused by the *electromagnetic force*.

TYPES OF FRICTION:

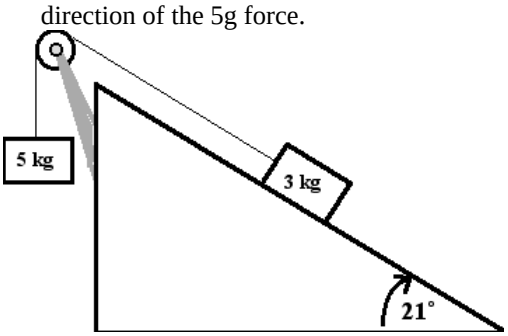
1. **Static Friction** - resistive force that must be overcome to start an object in motion.
2. **Kinetic or Sliding Friction** - resistive force between 2 surfaces already in motion, moving past each other.
3. **Rolling Friction** - resistive force between a surface and a rolling object.
4. **Fluid Friction** - resistive force of a gas or liquid as an object passes through. One example of fluid friction is **DRAG** (AIR RESISTANCE).

Force of Static Friction: $\mathbf{f_s \leq \mu_s N}$ where f = friction force, μ_s = coefficient of static friction, and N = the normal force between the object and the surface.

Force of Kinetic or Sliding Friction: $\mathbf{f_k = \mu_k N}$ where f = friction force, μ_k = coefficient of kinetic friction, and N = the normal force between the object and the surface.

Example:

A dynamic system is accelerating at 2.03 m/s^2 as shown below. Determine the **coefficient of kinetic friction** between the 3 kg block and the inclined plane if the friction force acting on the 3-kg block is 10 N. Assume the system is accelerating in the direction of the 5g force.



1. Do an **Force Body Diagram**.

2. Write an **N2L equation** for each block.

Taking down to be the negative direction for the 5-kg block, and taking up the inclined plane to be the negative direction for the 3-kg block, the 2 equations are:

$$T - 5g = -5a$$
$$-T + 3g \sin 21 + f = -3a$$

which, when added together equals:

$$-5g + 3g \sin 21 + f = -8a$$

3. Substitute in for a and g and solve for f to get:

$$f = 22.22 \text{ N}$$

4. Using the kinetic friction equation $f_k = \mu_k N$, solve for μ_k. On an inclined plane, the normal force N balances out the perpendicular weight component, mg cos θ. Therefore, we can assume N = mg cos θ.

$$22.22 = \mu_k (3g \cos 21)$$

which yields $\mu_k = 0.810$

DON'T FORGET that μ_k is a dimensionless number; it is a ratio of friction force to normal force.