$\Sigma F = ma$

$\Sigma F = Ma$

$\Sigma F = m\alpha$

Notes - 4.4 Newton's Third Law of Motion: Symmetry in Forces

1. State Newton's 3rd Law of Motion.

Every force has an equal and opposite force

2. Forces always occur in pairs, and one body cannot exert a force on another without experiencing the same force. This is sometimes referred to as action-reaction.

3. Consider the swimmer pushing off from the side of a pool in Figure 4.9. She pushes against the pool wall with her feet and accelerates in the direction opposite to that of her push. The wall has exerted an equal and opposite force back on the swimmer. Why does the swimmer accelerate? Don't these two forces cancel each other out?

They don't cancel, because only one of the two forces is acting on the swimmer

this one

4. Describe some other examples of Newton's 3rd Law.

Walking: Foot pushes floor backward; floor pushes foot forward

Car: Tires push road left; road pushes tires right

Helicopter: Blades push air down; Air pushes blades up

5. Rockets

A. What is the common misconception regarding rocket propulsion? What is the reality?

they push air

Rockets push their exhaust backward

B. What observation disproves this misconception?

they work in space

Notes

$\mu_s = 0.5$

$F_N = 5N$

Notes - 5.1 Friction

1. What is friction? A force opposing the sliding of two surfaces in contact

2. When there is relative motion between objects in contact, the friction is called Kinetic friction. Its symbol is F_{Frk}

3. When there is no motion between objects in contact, the friction is called Static friction. Its symbol is F_{Frs}

4. The harder two objects are pushed together, the greater the friction becomes.

5. Write the equation for the magnitude of static friction. $F_{Frs} \leq \mu_s F_N$

6. Write the equation for the magnitude of kinetic friction. $F_{Frk} = \mu_k F_N$

7. Looking at Table 5.1, which coefficient of friction is greater, static or kinetic?

8. From Table 5.1, give the ~~three~~ highest examples of the coefficient of static friction.

Rubber on dry concrete

$\mu_s = 1$

9. From Table 5.1, give the ~~three~~ lowest examples of the coefficient of kinetic friction.

Bone lubricated by synovial fluid

$\mu_k = 0.015$

10. A skier is sliding along a horizontal field of snow If the overall of mass of the skier plus her skis is 62kg, and if she is experiencing a 30N force of friction, what is the coefficient of friction between the skis and the snow? Is this static or kinetic friction?

$W = mg$
$= 62kg\,(9.8\,N/kg)$
$= 607N$

$F_{Frk} = \mu_k F_N$

$-30N = \mu_k (607N)$

$\mu_k = 0.049$

62

$\Sigma F = ma$

$\Sigma F = -30N$

Notes, Ch. 4.5: Normal, Tension, and Other Examples of Forces

1. What is tension? The action reaction pair of pulling forces acting at each end* of a stretched* object.

2. In our physics problems, almost all of the ropes, chains, wires, cables, or strings will be massless. In massless objects such as these the force of tension at every point is equal. We know this because of Newton's 3rd law.

Analyzing Multibody Systems (and writing net force equations for those systems)

3. What is a "system" in Physics? Whatever portion of the universe you choose to analyze

4. The diagram on the right represents blocks of matter that are connected by a massless string. The pulley and the air are frictionless, but there is friction between the surface and the blocks.

- Draw several (or possibly all) of the individual systems that you can find in the diagram.
- For each system, write equations for net force in terms of:
  - The sum of individual forces
  - Newton's 2nd Law

$\Sigma F_{All} = W_3 + W_4$

$\Sigma F_{All} = (m_1 + m_2 + m_3 + m_4)a$

$\Sigma F_{m_1+m_2} = T_2$

$\Sigma F_{m_1+m_2} = (m_1+m_2)a$

$\Sigma F_{m_3+m_2} = (m_2+m_3)a$

$\Sigma F_{m_3+m_2} = -T_1 + T_3 + W_3$

$\Sigma F_{m_4} = T_3 - W_4$

$\Sigma F_{m_4} = m_4(a)$