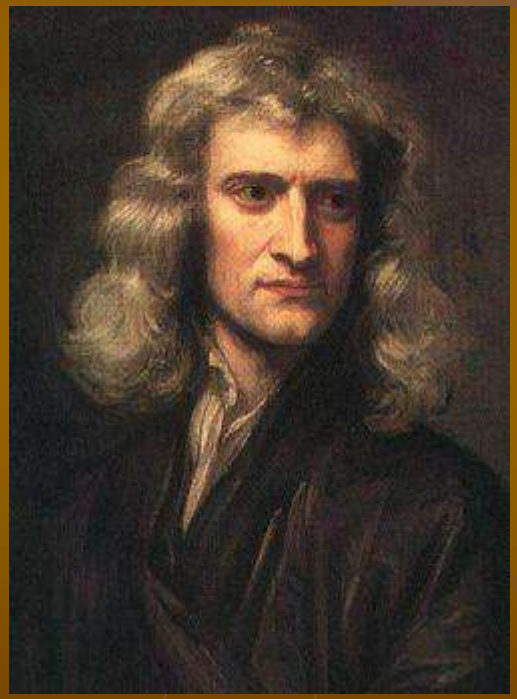
Newton's 2nd Law Note-sheet



To be used with handout "Newton's 2nd Law Notesheet" (Word Document)

What is the Connection?

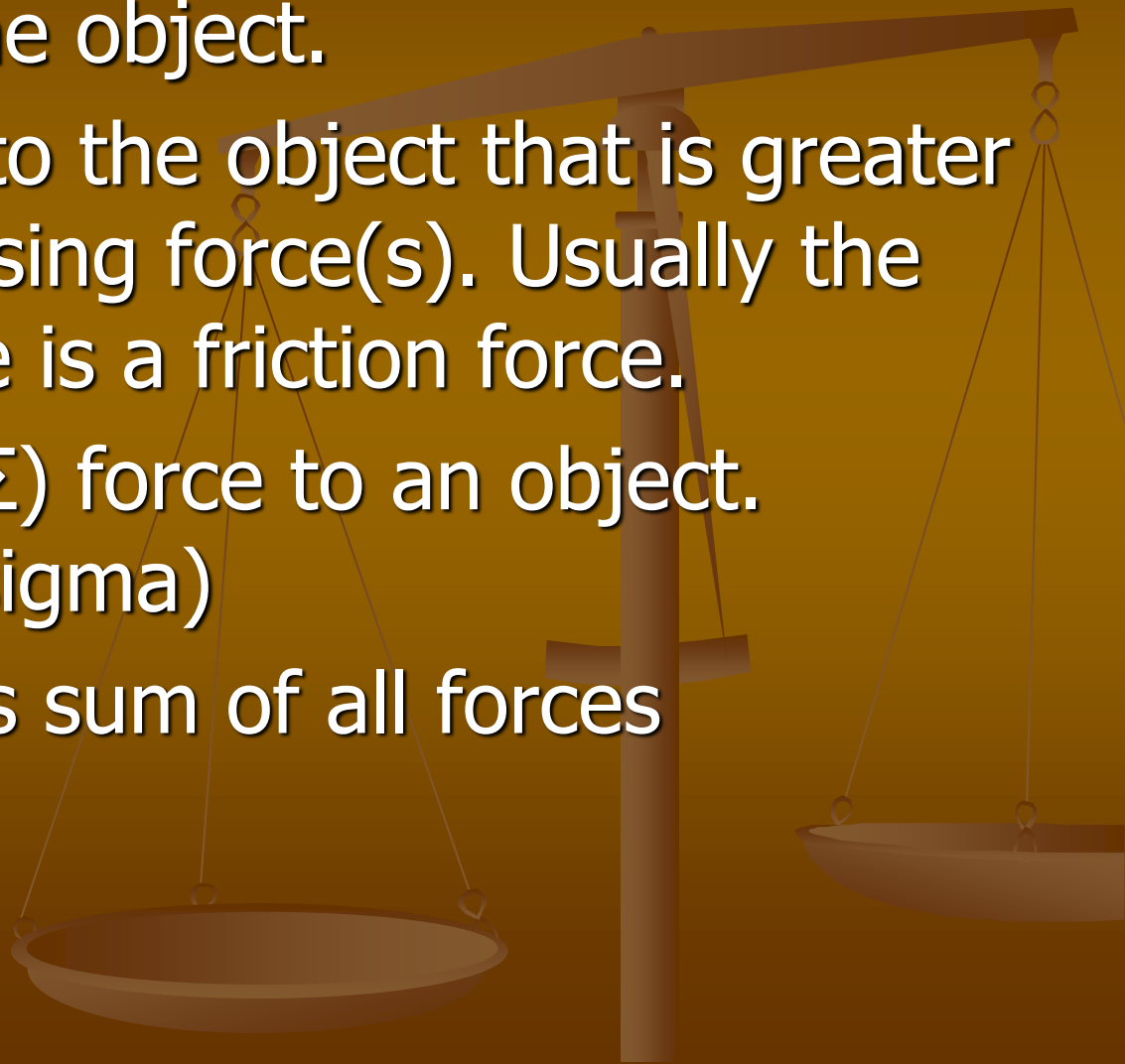
- In the previous unit a variety of ways by which motion can be ***described*** (words, graphs, diagrams, numbers, etc.) were discussed. In this unit (Newton's Laws of Motion), the ways in which motion can be ***explained*** will be discussed. Isaac Newton (a 17th century scientist) put forth a variety of laws which explain why objects move (or don't move) as they do. These three laws have become known as Newton's three laws of motion

What is acceleration?

- An increase or decrease in speed, or a change in direction of an object's motion.
- (change in velocity) / (time) $\frac{\Delta V}{\Delta t}$
- units = m/s/s = m/s^2
- Most people would say 10 m/s^2 is a fast acceleration and 1 m/s^2 is a slow acceleration but it is more correct to say "large" or "small" in place of the words fast and slow because acceleration is not a "speed". Acceleration is the rate at which velocity changes.

How do we produce acceleration in an object?

- Push or pull the object.
- Apply a force to the object that is greater than the opposing force(s). Usually the opposing force is a friction force.
- Apply a *net* (Σ) force to an object. (Greek letter sigma)
- *net* (Σ) means sum of all forces



What is a *net force*?

- A net force is the "left over" or UNBALANCED force that accelerates an object.
- If all of the forces on an object are balanced, then the object will not accelerate. Consider an object falling at its' terminal velocity…
- 3N  3N
- acceleration = ?
- Acceleration = **ZERO** since there is no net force to accelerate the object….
- The forces balance each other out.
- Unbalanced (net) force produces acceleration.

What is the relationship between acceleration and net force?

- (direct)Net (left over) force causes acceleration.
- The more net force applied to an object, the more it will accelerate.
- If you increase the net force, then acceleration will increase.
- If there is NO net force the object will NOT accelerate. *

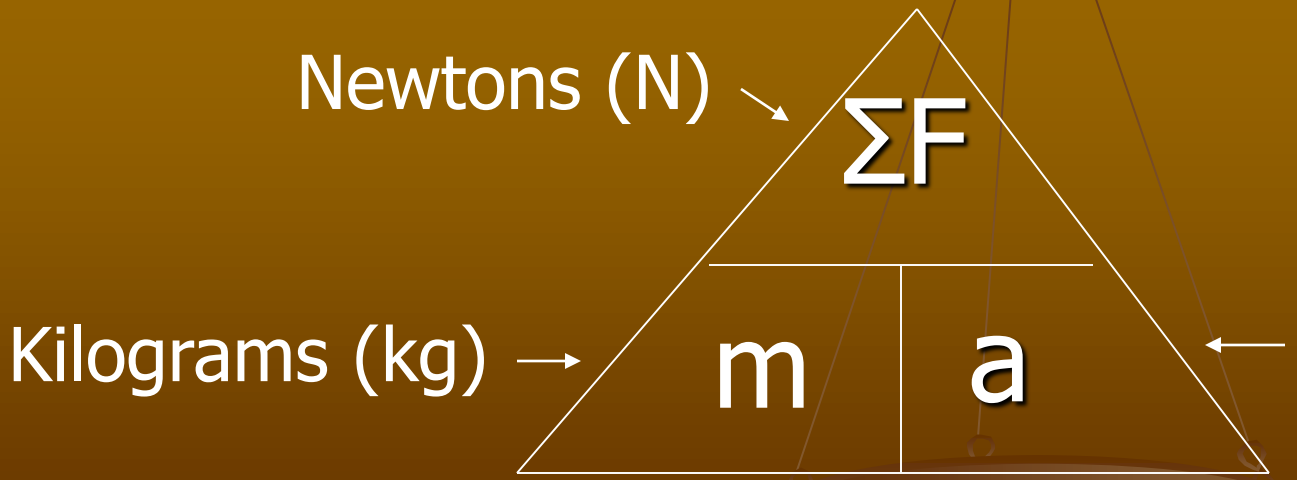
*** The OBJECT CAN BE EITHER STATIONARY OR MOVING AT A CONSTANT VELOCITY IN THIS SITUATION!!!!! SOOOOOOO important to remember!!!!**

Newton's Second Law:

- The acceleration produced by a net force on an object is directly proportional to the magnitude of the net force, is in the same direction as the net force, and is inversely (oppositely) proportional to the mass of the object.
- As a formula, Newton's second law is written as:

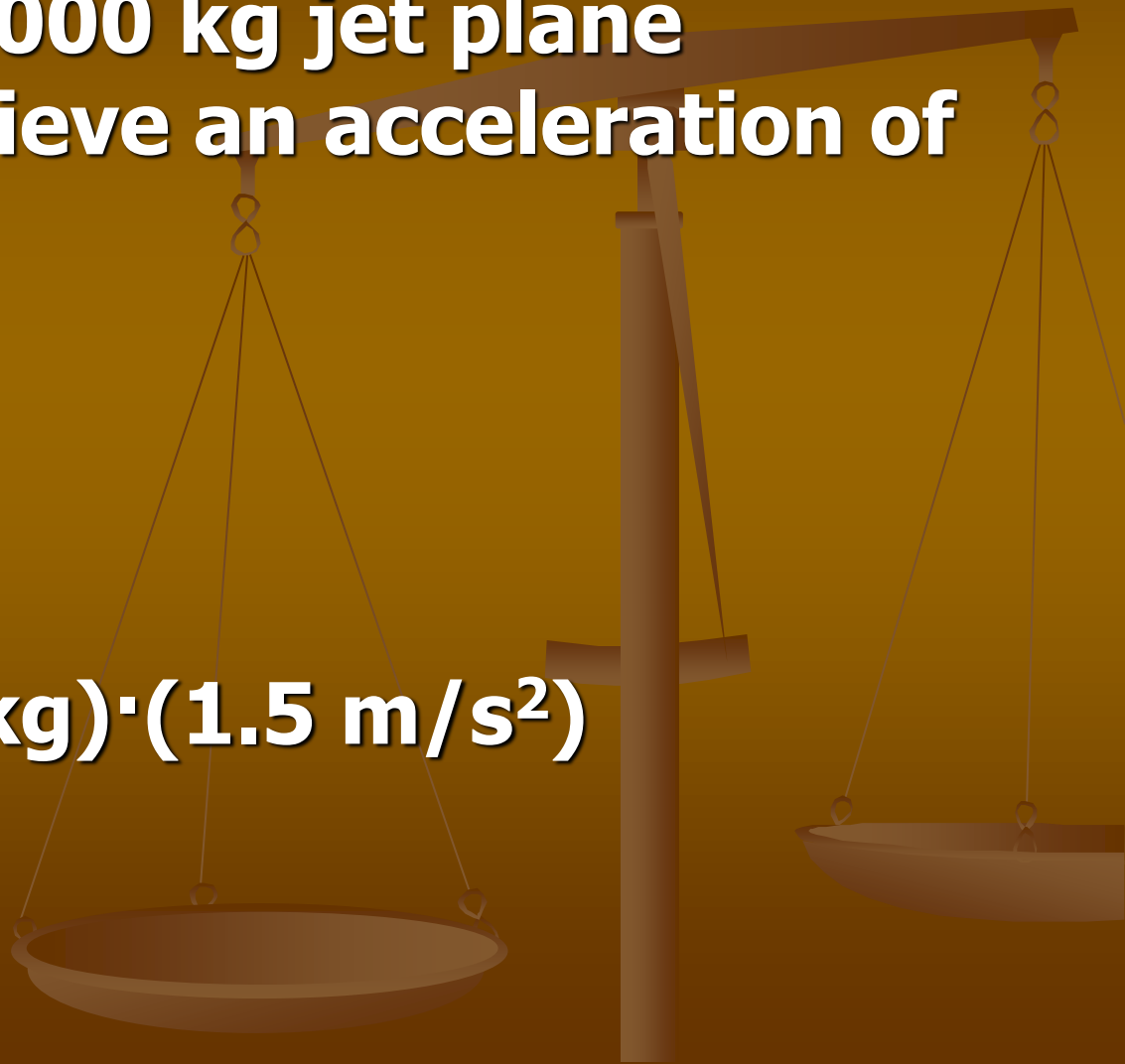
Newton's 2nd Law:

- $a = \frac{\Sigma F}{m}$ $\Sigma F = ma$



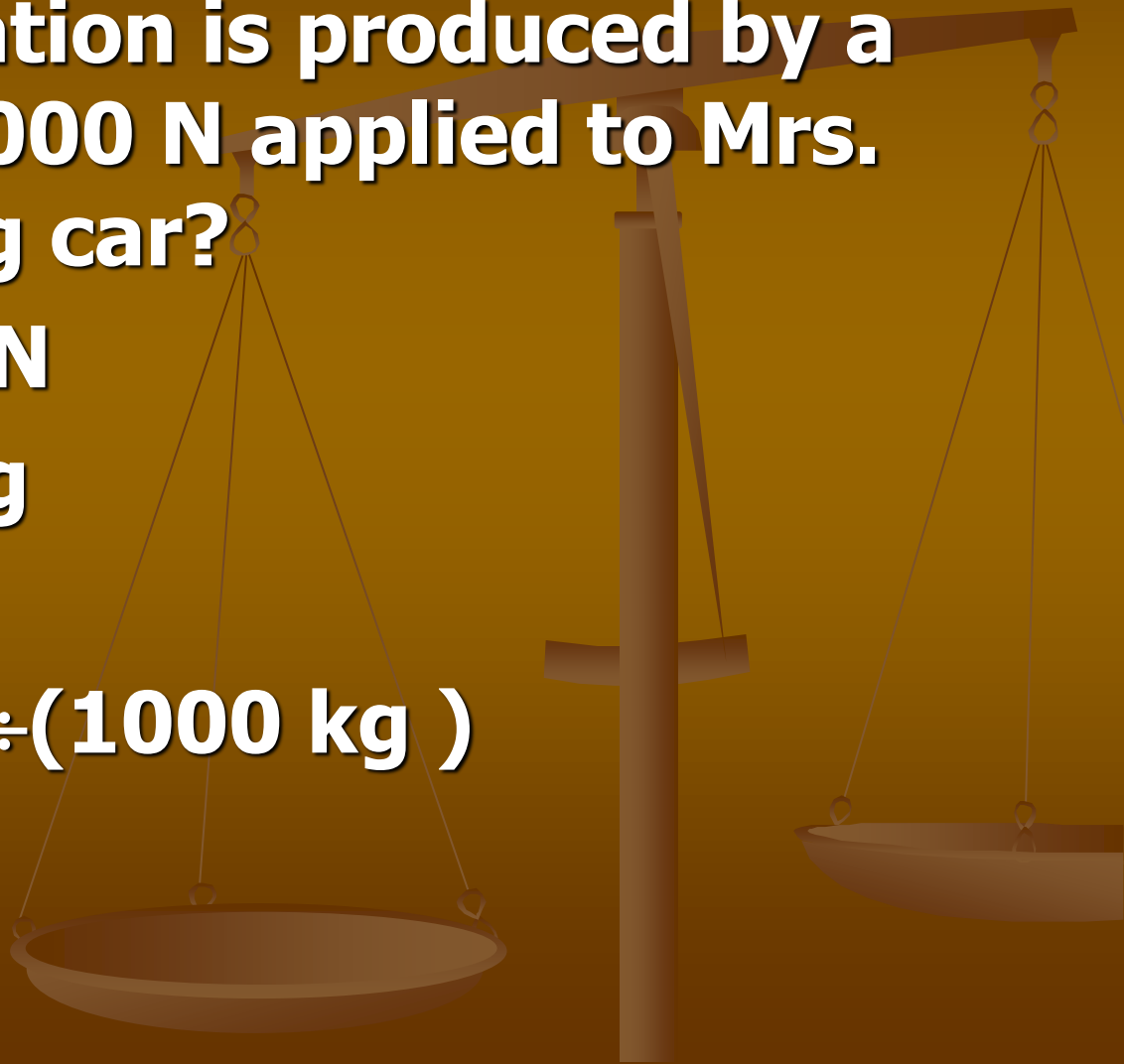
Example 1:

- How much net force, or thrust, must Mrs. McD's 30,000 kg jet plane develop to achieve an acceleration of 1.5 m/s^2?
- m = 30,000 kg
- a= 1.5 m/s^2
- F_{net} = ?
- $F_{net} = (30{,}000kg)\cdot(1.5\ m/s^2)$
- F_{net} = 45000 N



Example 2:

- **What acceleration is produced by a net force of 2000 N applied to Mrs. McD's 1000 kg car?**
- **F_{net} = 2000.0 N**
- **m = 1000.0 kg**
- **a=?**
- **a = (2000 N)÷(1000 kg)**
- **a = 2 m/s^2**



Example 3:

- If Mrs. McD applies a net force of 60 N to a barbell and causes the barbell to accelerate up at a rate of 3 m/s^2, then what is the mass of this barbell?
- $\Sigma F = 60.0\ N$
- $a = 3.00\ m/s^2$
- $m = ?$
- $m = (60\ N) \div (3\ m/s^2)$
- $m = 20.0\ kg$