Chp 6: Lect 7: Newton's Second Law of Motion

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Acceleration & Force

Newton's Second Law of Motion: Newton's first law says that a force is needed to change an object's motion. What kind of change happens? ______________________! What is acceleration? The rate at which _____________ changes over _____________.

Predict whether the following are true or false.

- If you slow down on your bike, you are accelerating. __________
- If you ride your bike at constant speed, you cannot accelerate. __________
- Changing the speed and changing the direction of your bike are both examples of acceleration. __________

Acceleration: going fast??? This is where it gets tricky… we typically think of acceleration as going fast. Remember that a change in *velocity* could be a change in speed, a change in direction, or both. So if you are accelerating, it means you are changing speed (going faster or slower) or direction. A decrease in speed is called __________________________.

Think about it this way… What happens when you coast down a long hill on your bike or board? At the top of the hill, you move slowly. As you go down the hill, you move faster & faster - you accelerate! If your speed increases by 1 mph each second, then your acceleration is 1 mph per second.

Example of Acceleration	How Velocity Changes
A plane taking off	
A car stopping at a stop sign	
Driving around a corner	

$$\text{Acceleration} = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$

Change in Speed (m/s)

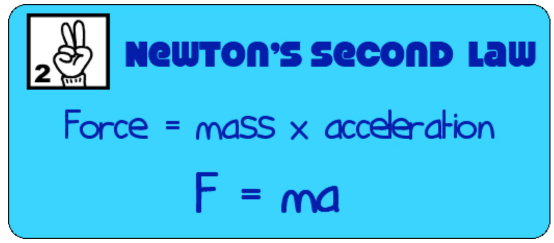
Acceleration (m/s^2) $\rightarrow$ $$A = \frac{V_f - V_i}{t}$$ $\leftarrow$ Time (s)

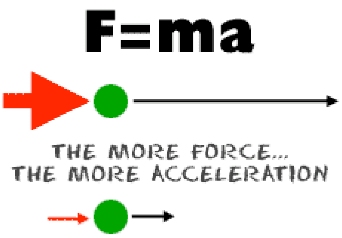
How do you calculate acceleration?

Example #1: In a summer storm, the wind is blowing with a velocity of 8 m/s north. Suddenly, in 3 seconds, the wind's velocity is 23 m/s north. What is the acceleration in the wind?	**Example #2:** You are riding your bike downhill at a speed of 15 m/s west. Five seconds later, you find yourself traveling 25 m/s west. What is your acceleration	**Example #3**: At point A, a runner is jogging at 3 m/s. Twenty seconds later, at point B on a hill, the jogger's velocity is now 1 m/s. What is the jogger's acceleration from point A to point B?

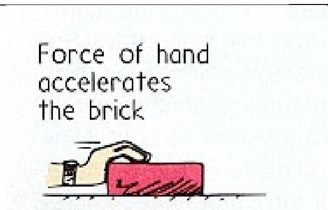
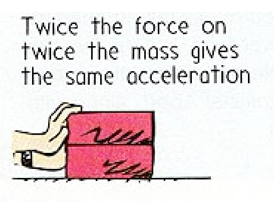
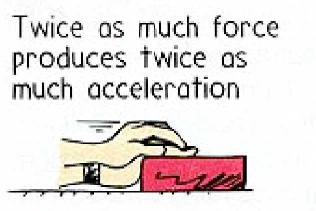
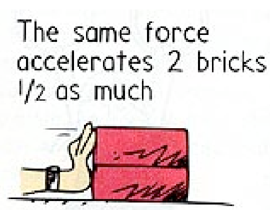
Newton's Second Law of Motion: The second law says that the acceleration of an object produced by a force is directly proportional to the magnitude of the force, the same direction as the force, and inversely proportional to the mass of the object. What the heck????

Newton's Law #2: Another way to phrase it: force ____________ acceleration, & mass ______________ acceleration. As mass or acceleration increases, force _________________. As mass or acceleration decrease, force _________________.





What does this mean, really? Picture a trip to Costco. After grabbing a hot dog or piece of pizza, you grab a cart & start shopping. At first, the cart is nice & light, and fun to drive around & pretend to race people. By the time you're done shopping, what does the cart look like? FULL!!!! How does it feel to move it? HARD! It takes ____________ force to accelerate ____________ mass.

	»It takes one hand to push the brick. »		»If you have twice the mass, it takes twice the force to move it at the same acceleration. »
	»If you apply twice the force by using two hands, the acceleration increases by two. »		»But if you push two bricks with the same force, they accelerate half as fast. »

Newton's Law #2 & Falling Objects: Remember what you learned about the rate of acceleration for falling objects? All falling objects fall to the Earth with the same acceleration… 9.8 m/s/s. Does more mass make an object fall faster? No, the acceleration is *always* ___________________. So let's see how this works… An object is in free fall if it is accelerating due to the force of gravity & no other objects are acting on it. A ball dropped off a cliff is in free fall until it hits the ground. Objects in free fall accelerate at 9.8 m/s^2 on Earth.