Module #5 Newton’s Laws

* Sir Isaac Newton
	+ 1642-1727
	+ Accomplishments
		- Discovered three laws of motion
		- Developed a theory describing gravity
		- Showed that white light is composed of many colors with prism experiment
		- Developed calculus
		- Built the first reflecting telescope
	+ Not an orthodox Christian, but held many standard Christian beliefs
		- Studied the Bible
		- God is creator
		- Christ is mediator between man and God
		- Did not see Christ as divine, only as a man
	+ Believed that studying science was a way of learning about creation, and learning about creation was a way of learning about God.
* Newton’s First Law
	+ Aristotle (4th century BC)
		- Concluded that matter “wants” to be at rest, and it will stay at rest until acted on by some outside force.
		- The “natural” state of matter is for it to be at rest
	+ Galileo Galilei (1564-1642)
		- Italian physicist
		- In the late 1500s, he began doing experiments that contradicted Aristotle’s views.
		- Many of his discoveries also contradicted the Roman Catholic church’s beliefs about the universe
		- Showed by experiment that when two surfaces come into contact with one another, the surfaces grad onto each other, resulting in a force that inhibits motion
			* Friction = a force that opposes motion, resulting from the contact of two surfaces
		- Galileo’s experiments and reason led Newton to his first law
	+ Newton’s First Law (The Law of Inertia) = an object in motion (or at rest) will tend to stay in motion (or at rest) until it is acted upon by an outside force.
		- Matter has no preferred state
		- There are many examples in nature that illustrate this law
			* When riding in a car, your body lurches forward when the driver slams on the brakes because of inertia – your body wants to continue moving forward
* Newton’s Second Law
	+ States that when an object is acted on by one or more outside forces, the vector sum of those forces is equal to the mass of the object times the resulting acceleration vector.
	+ Expressed in an equation: ∑F = ma
		- ∑ symbol is the capital Greek letter sigma and means “sum of”
		- ∑F means the sum of the forces
		- M represents the mass of the object
		- A stands for the resulting acceleration
	+ A force is essentially a push or a pull exerted on an object in an effort to change that object’s velocity
	+ The units for force are (kg \* m) / s2 which we define as the Newton.
	+ The dyne (g\*cm/s2) is a very small force
	+ Force is a vector quantity
	+ The magnitude of the acceleration depends on both the magnitude of the force and the mass of the object.
		- Massive objects take a lot of force to achieve even a little acceleration
		- Objects that have little mass need only a little force to achieve a large acceleration
	+ Example 5.1 (p.147)
	+ OYO 5.3-5.4 (p.148)
* Mass and Weight
	+ One important application of Newton’s Second Law involves distinguishing mass from weight.
	+ Mass is a measure of how much matter is in an object
		- Scalar quantity
	+ Weight is a measure of how hard gravity is pulling on an object
		- Depends on location
		- A vector quantity
		- Is a force
		- W = mg
	+ When a measurement is referred to in slugs, grams, or any prefix unit based on grams (mg, kg, etc.), the mass of the object is being reported
	+ When a measurement is given in Newtons, dynes, or pounds, the weight of the object is being reported.
	+ Example 5.2 p.150
	+ How a scale works
		- Composed of a spring or a flexible needle that is sensitive to the force that it exerts
		- Gravity pulls the object down and the spring or needle pushes the object up with an equal force.
		- The scale can read the force exerted by the spring or needle, reading the weight,
		- The scale takes the weight and divides it by the acceleration due to gravity, turning a weight scale into a mass scale
	+ Example 5.3 p.151
	+ OYO p.152
* The Normal Force
	+ A scale will push up against an object with the same force that gravity is using to pull down on the object. This cancels out the gravitational force and keeps the object from falling to the center of the earth.
		- As long as the scale and object are at rest (or moving with a constant velocity), the two forces will be equal.
	+ Normal force is a force that results from the contact of two bodies and is perpendicular to the surface of contact
		- In geometry “normal” means “perpendicular”
	+ Example 5.4 p.154
	+ OYO 5.7 p.154
* Friction
	+ Brought about by the fact that matter is made up of atoms or molecules
	+ All surfaces have grooves and bumps in them which determine how close the molecules (or atoms) or one surface can get to the molecules (or atoms) of the other surface.
		- The closer the molecules are, the more they attract each other and the more they will be able to resist motion
	+ Experiment 5.2 p.156-157
	+ Static friction = friction that opposes the initiation of motion
		- Static frictional force can increase to counteract an increasing force which attempts to cause motion
		- There is a maximum value that the static frictional force can reach
		- If a force greater than the maximum static frictional force is applied to an object, the object will move
	+ Kinetic friction = friction that opposes motion once the motion has already started
		- The kinetic frictional force between a given object and the surface upon which it moves is less than the maximum static friction force between the object and the surface.
			* It takes less force to keep it moving (1st law of motion)
	+ The frictional force between two surfaces is strongly dependent on the molecules which make up those surfaces.
		- The force of friction depends on the attraction between the molecules of the two surfaces as well
* An Equation for the Frictional Force
	+ Two things affect the strength of the frictional force between an object and a surface:
		- The nature of the object and the surface
		- The normal force that the surface exerts on the object
	+ f = μFn
		- “f” stands for the magnitude of the frictional force
		- “Fn” represents the normal force
		- The symbol μ (lower case Greek letter mu) is called the coefficient of friction
			* If a surface holds on to an object well, the coefficient of friction is large
			* If the surface foes not hold onto an object well, the coefficient of friction is small
			* Coefficient of static friction (μs) if the object is stationary
			* Coefficient of kinetic friction (μk) is the object is moving
			* There is no way to know the values of the coefficients for a given surface (unless you are told or determine it experimentally)
			* For a given object and surface, the coefficient of static friction is more than the coefficient of kinetic friction
	+ Example 5.5 p.161-165
	+ OYO p.165-166 #5.8-5.11
* Newton’s Third Law
	+ Newton’s Third Law = for every action, there is an equal and opposite reaction
	+ Diagram:
	+ 
	+ OYO p.167 #5.12