

Ch. 10-1

- Force is any push/pull.
- Force can be described by strength and direction which can be shown by means of an arrow. The width of the arrow shows the strength and the tip of the arrow shows the direction.
- Unbalanced forces: net force makes object move, stop, or change direction.
- Balanced forces: net force is zero; there is no change in object's motion.
- Newton's First Law of Motion: an object at rest will remain at rest and an object which is moving will keep moving at constant velocity until an unbalanced force acts on it.
- Inertia: property of an object; tendency of an object to resist motion change; inertia and mass are directly proportional.
- Mass is the measure of the inertia of an object.
- Newton's First Law of Motion is called Law of Inertia.

Ch. 10-2

Newton's Second Law of Motion: net force on an object depends on acceleration and mass.

$$F = m \times a$$

Newton = meter per second squared x kilogram

For the same mass, as the force increases, so does the acceleration; for the same acceleration, as the mass increases so does the force.

Ch. 10-3

- Friction: force exerted by one surface on another when they rub together.
- Friction depends on:
 - type of surface: rougher creates more friction
 - how hard the surfaces push : the harder the more friction
- Friction can be useful, ex. while walking. It can be bad, ex. when moving parts of machines wear out; putting oil will decrease the friction.
- Types of friction:
 - sliding: ex. skiing
 - rolling: ex. tires on ground
 - fluid: through air/water

Sliding needs the most force to overcome because of most contact between surfaces; next is rolling, and then fluid.

- Gravity: force that pulls objects towards the Earth's center.
- Free Fall: the only force on the object is gravity; an unbalanced force will accelerate the object at the same rate of 9.8 m/second squared called the acceleration due to gravity.
- Air resistance increases with speed and surface area.
- With air resistance the object with the more mass (and therefore more weight) will fall faster before reaching terminal velocity. As the object falls, its speed and therefore air resistance increase. When air resistance is so large that it balances with the gravity force, than acceleration is zero and object reaches terminal velocity (balanced forces).
- Weight: measurement of the force of gravity on an object.
 $W = m \times a$
- The force of gravity between 2 objects depends on
 - mass: more mass more gravity
 - distance between them: more distance less gravity
- Universal Law of Gravitation: gravity acts between all objects in the Universe.

Ch. 10-4

- Newton's 3rd Law of Motion: if one object exerts a force on another object, then the second object exerts a force of equal strength in the opposite direction on the first object.
- Ex. a skater pushes on another; both move but the skater who pushed is pushed back with an equal but opposite force.
The speed with which the 2 move depend on mass. Same mass means same speed. Different masses means the one with greater mass will move back more slowly. Although action/reaction forces are equal but opposite, the same force on a greater mass results in a smaller acceleration.
- This law refers to 2 different objects. The action/reaction forces cannot add together and therefore can't cancel out even if they are equal and opposite.
- Momentum (M) = mass (m) x velocity (v) or $\text{Kg.m/s} = \text{Kg} \times \text{m/s}$
Like velocity and acceleration, momentum is described by direction and quantity.
- The more momentum the harder to stop the object.
Ex. you can catch a baseball at 20 m/s speed but not stop a car moving at 20 m/s. The car has more mass and therefore more momentum.
Ex. a bullet shot from a rifle has a very small mass but high momentum because of its high speed.
- Study Fig. 19. In all 3 cases the total momentum of the group of objects is conserved. The Law of Conservation of Momentum: total momentum of any group of objects remains the same unless outside forces act on them.

10-5

How do rockets lift off? The lift off against the force of gravity can be explained using Newton's 3rd Law of Motion. A rocket can rise into the air because the gases it expels with a downward force exert an equal but opposite force on the rocket. As long as this upward pushing force, called thrust, is greater than the downward pull of gravity, there is a net force in the upward direction. As a result, the rocket accelerates upward.

Satellite: any object that travels around another object in space.

- * An artificial satellite is a device that is launched into orbit around Earth designed for use in space research, communication, military intelligence, weather analysis, and geographical surveys.

- * These satellites orbit Earth in an almost circular path. The force that causes it to move in a circle is called a centripetal force. In this case it is the gravitational force that pulls the satellite toward the center of the Earth.

- * A satellite doesn't fall because they don't travel straight up into the air. They move around Earth.

At a certain speed, the path of an object that orbits Earth would match the curve of the Earth. The satellites continually fall toward Earth,, but because Earth is curved they travel around it.

- * A satellite does not need fuel because it continues to move ahead due to its inertia. But gravity changes its direction continuously.

- * Satellites sent into higher orbits circle Earth once every 24 hours. Since Earth rotates once every 24 hours, a satellite above the equator always stays above the same point on Earth as it orbits.