

### Unit 3: Forces

#### 3A: Newton's Laws Overview

**balanced forces** - when the sum of the forces acting on an object are equal the object will remain at rest, or it will move at a constant velocity.

**force** - a push or pull.

**net force** - the sum of all of the forces acting on an object.

**Newton's 1st Law of Motion** - an object at rest remains at rest unless an external unbalanced force acts on it; an object in motion remains in motion unless an external unbalanced force acts on it.

**Newton's 2nd Law of Motion** - an object accelerates in the direction of the net force acting on it.

**Newton's 3rd Law of Motion** - for every action, there is an equal yet opposite reaction.

**unbalanced forces** - when the sum of the forces acting on an object are not equal, the object will accelerate or decelerate.

#### 3B: Free Body Diagrams

**balanced forces** - when the sum of the forces acting on an object are equal the object will remain at rest, or it will move at a constant velocity.

**force** - a push or a pull.

**free body diagram** - a figure used to visualize the forces acting on an object in a given condition.

**net force ( $F_{net}$ )** - the sum of all of the forces acting on an object.

**unbalanced forces** - when the sum of the forces acting on an object are not equal, the object will accelerate or decelerate.

#### 3C: Newton's Second Law Part 1

**contact force** - a push or pull transmitted across objects touching one another; examples are the applied force, spring force, and the normal force.

**field force** - pushes or pulls that occur between two objects without the objects touching one another; examples are gravity and the electrostatic force.

**friction** - a force that resists motion.

**gravity ( $F_g$ )** - one of the four fundamental forces of the universe; is exerted by anything that has mass on anything else that has mass.

**inverse-square law** - any law stating that a quantity decreases with the inverse square of a physical parameter such as distance.

**net force ( $F_{net}$ )** - the sum of all of the forces acting on an object.

**Unit 3: Forces**

**3C: Newton's Second Law Part 1 (continued)**

**newton (N)** - a derived unit of measurement for force; one newton is equal to one kilogram times meters divided by seconds squared ( $\text{kgm/s}^2$ ).

**Newton's 2nd Law of Motion** - an object accelerates in the direction of the net force acting on it.

**normal force ( $F_N$ )** - the support force exerted upon an object by a surface; is always perpendicular to the surface.

**weight (w)** - the force due to gravity acting on an object; equal to the mass of an object multiplied by the acceleration due to gravity on Earth.

**3D: Newton's Second Law Part 2**

**coefficient of friction ( $\mu$ )** - a ratio of the amount of resistance between two objects.

**friction** - the resistive force between an two objects.

**static friction ( $F_s$ )** - Friction that occurs when two objects are at rest relative to each other.

**kinetic friction ( $F_k$ )** - the slowing force between two objects moving past each other; one object, or both, can be moving.

**net force ( $F_{\text{net}}$ )** - the sum of all of the forces acting on an object.

**newton (N)** - a derived unit of measurement for force; one newton is equal to one kilogram times meters divided by seconds squared ( $\text{kgm/s}^2$ ).

**Newton's 2nd Law of Motion** - an object accelerates in the direction of the net force acting on it.

**normal force ( $F_N$ )** - the support force exerted upon an object by a surface; is always perpendicular to the surface.

**weight (w)** - the force due to gravity acting on an object; equal to the mass of an object multiplied by the acceleration due to gravity on Earth.

**3E: Newton's Third Law**

**action-reaction pairs** - pairs of objects in which one object exerts a force, known as the action, on another object, and the other object reacts to that action in a way in which the force is equal in magnitude but opposite in direction.

**Newton's 3rd Law of Motion** - for every action there is an equal and opposite reaction.

**Unit 3: Forces**

**3F: Gravity**

**air resistance** - the frictional force that air exerts on objects; also known as drag,  $F_D$ .

**gravity ( $F_g$ )** - one of the four fundamental forces of the universe; is exerted by anything that has mass on anything else that has mass.

**Newton's Universal Law of Gravitation** - the gravitational force between two objects increases with and is proportional to the increasing mass and decreases with the square of the distance between them.

**terminal velocity** - when the force due to gravity equals the force due to air resistance acting on a falling object and the object stops accelerating and moves at a constant velocity.

**weight ( $w$ )** - the force due to gravity acting on an object; equal to the mass of an object multiplied by the acceleration due to gravity on Earth.

**3G: Circular Motion**

**centripetal acceleration ( $a_c$ )** - the acceleration of an object moving in a circle that is directed toward the center of the circle.

**centripetal force ( $F_c$ )** - any force that causes an object to move in a circle.

**circular motion** - anytime an object moves in a way that traces out a circular path.

**period ( $T$ )** - the time it takes to go around a circle once.

**tangential velocity ( $v_T$ )** - the velocity of an object in its circular path that is directed tangent to the circle at that given point.