

Physical Science

Physics

Motion & Force

I. Need to Know Formulas for this unit:

Speed = distance / time

$$S = D/T$$

Distance = Speed x Time

$$D = ST$$

Acceleration = $\frac{\text{Final Velocity} - \text{Initial Velocity}}{\text{Time}}$

$$A = \frac{V_f - V_i}{T}$$

Acceleration of gravity = $A_g = 9.8 \text{ m/s}^2$

Force = Mass x Acceleration

$$F = MA$$

Weight = Mass x Acceleration of gravity

Momentum = Mass x Velocity

Pressure = Force / Area

II. Motion

A. **Motion** occurs when the distance between the object and a reference point is changing

B. **Reference point**- place or point used to determine if an object is in motion

C. **SI**

1. International System of Units: The metric system

2. Length – measured in meters

3. Mass – grams

4. Volume – liters

a) $1 \text{ ml} = 1 \text{ cm}^3$

5. Weight – Newtons

6. Density – mass / volume

D. **Speed** – the distance an object travels in one unit of time

1. **a magnitude only**: it only tells us “how much”

2. 75 miles per hour, 18 meters per second

E. **Velocity** – when the speed and the direction is known then the velocity can be described

1. Specifies a **magnitude AND a direction**

2. 75 miles per hour in a northern direction, 18 meters per second east

F. Graphing motion

1. x axis – the horizontal units

2. y axis – the vertical axis

3. **slope** of the line = $\frac{\text{rise}}{\text{run}}$ (the vertical change)
(the horizontal change)

G. **Acceleration** – the change in speed or the change in direction of an object

III. Forces

A. Force is measured in the units of Newtons (N): $1 \text{ N} = 1 \text{ kg} \times 1 \text{ m/s}^2$

B. **Force**- a force is simply a push or a pull on an object

1. Like velocity and acceleration Force shows a magnitude AND direction

2. Arrows called “**Vectors**”

3. **Balanced force** – opposite and equal forces acting on the same object result in NO motion of the object

4. **Unbalanced forces** – two or more forces of unequal strength acting upon an object results in the motion of the object.

5. **Newton’s 1st Law of Motion**: The Law of Inertia - an object at rest will remain at rest, and an object in motion will remain in motion and at a constant velocity until acted on by another force.

a) The greater the mass of an object the greater the **inertia**

C. **Force = mass x acceleration**

1. **Newton's Second Law of Motion** – The net force on an object is equal to the product of its acceleration and its mass:
2. $\text{mass} = \text{Force} / \text{acceleration}$
3. $\text{acceleration} = \text{force} / \text{mass}$

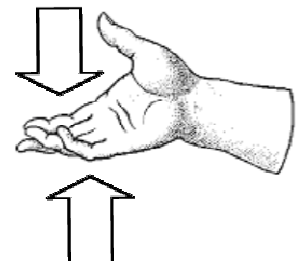
D. Friction & Gravity

1. **Friction:** the force of friction is the force that one surface exerts on another one when they are rubbed together.
 - a) The strength of the force of friction depends on
 - (1) The type of surfaces
 - (2) How hard they push against each other
2. **Gravity:** the force that pulls objects towards each other
 - a) **Earth's Gravity pulls objects at 32 ft / s / s**
 - b) Earth's Gravity pulls objects down at **9.8 m/s²**
 - (1) Velocity after one second: 9.8 m/s
 - (2) Velocity after two seconds: 19.6 m/s
 - (3) Velocity after three seconds: 29.4 m/s
 - (4) Velocity after four seconds: 39.2 m/s
3. **Weight** – Force of gravity acting on an object
 - a) **Weight = Mass x Acceleration of gravity**
4. **Newton's Third Law of Motion:** For every action there is an equal and opposite reaction.
 - a) AKA: if one object exerts a force on another object, then the second object exerts a force of equal magnitude in the opposite direction of the first object.
5. **Momentum = Mass x Velocity**
 - a) Conservation of Momentum: The total of any group of objects remains the same unless outside forces act on the objects

IV. Forces in Fluids

A. **Pressure: a force pushing on a surface**

1. $\text{Pressure} = \text{Force} / \text{Area}$
2. Unit of measure for Pressure is the Pascal
 - a) 1 Pascal = 1 N / meter²
 - b) Remember that 1 N = 1 Newton = 1kg x 1 meter / 1 second²
 - c) When surface area is smaller than meter² then the unit used is N/cm²
3. Fluid Pressure
 - a) Fluid is a substance that can flow easily. Therefore gas can be classified as a "fluid".
 - b) In fluids, molecules are constantly moving in all directions.
 - c) As a molecule moves and collides w/ a surface, it exerts a force on that surface.
 - d) All of the forces exerted by the individual molecules are added together to make up the pressure exerted by the fluid.
 - e) Fluid Pressure is the total force exerted by the fluid divided by the area over which the force is exerted: $\text{Pressure} = \text{Force} / \text{Area}$
4. Air Pressure
 - a) At sea level air exerts a pressure of about 14 lbs / inch² in the American system
 - b) In the metric system, air pressure at sea level is about



10.13 N/cm²

- c) 1 cubic meter of air at sea level weighs about 1 kilogram
- d) Balanced force when fluid is **NOT** moving: the pressure pushing down on your hand is balanced by the pressure pushing up on your hand

5. Variations in Fluid Pressure

- a) Air pressure decreases as elevation increases
- b) Water pressure increases as depth increases

B. Pascal's Principle

- 1. When force is applied to a **CONFINED FLUID**, an increase in pressure is transmitted equally to **ALL** parts of the fluid.
- 2. Hydraulic lift, hydraulic brakes and starfish tube feet

C. Archimede's Principle

- 1. The buoyant force on an object is equal to the weight of the fluid displaced by the object.
- 2. The buoyant force is opposite (pushes up) to the force of gravity (pulls down)
- 3. Archimede's Principle is why boats float
- 4. Density of water is 1 gm /ml
 - a) If an object has a density greater than water: it sinks, less than water: it floats

D. Bernoulli's Principle

- 1. The pressure exerted by a moving stream of a fluid is less than the pressure of the surrounding fluid.
- 2. The faster the fluid moves, the less pressure it exerts on the surface of the object
- 3. Bernoulli's principle is why planes fly!