# **Force and Motion Notes**

**I. Forces**

A. **Force** – a push or pull exerted by one object on another.

-Measured in Newtons (N).

B. **Net force** – the result of 2 or more forces acting on an object at the same time.

-In the same direction, they’re added

-In opposite directions, they’re subtracted

C. **Balanced forces** – forces acting on an object that have a net force of zero. Ex.- equal but opposite forces.

-**Unbalanced forces** – forces that have a net force > 0 and result in a change in velocity (acceleration).

D. **Normal Force** – FN – The force that a surface exerts on an object resting on it.

1) It is always perpendicular to and away from the surface.

E. **Contact Forces** – forces that touch an object to exert a force -Ex. (friction, air resistance, applied forces)

-**Non-contact** (long-range) **Forces** – forces that can be exerted on an object without touching it.

-Ex. (magnetism, gravity, electricity)

F. **Tension Forces** – forces exerted on object using a rope, chain or other material stretched tight (under tension)

1) always a pull, not a push

**II. Newton's First Law of Motion (Law of inertia)**

A. Objects in motion stay in motion at a constant velocity, and objects at rest remain at rest unless an unbalanced (net) force acts on them to cause a change in motion.

B. Inertia - the tendency of an object to resist any change in its motion.

- The greater the mass of an object the greater its inertia

**III. Newton's Second Law of Motion (F=MA)**

A. Acceleration = net force

mass

-Acceleration is directly proportional to the force applied.

-Acceleration is inversely proportional to the mass of the object.

-Fnet = 0, either constant speed or at rest, Fnet > 0, it accelerates

-Show [Rocket Sledder](http://www.physicsclassroom.com/Physics-Interactives/Newtons-Laws/Rocket-Sledder/Rocket-Sledder-Interactive) Demo

IV. **Friction** – the force that opposes motion between two touching surfaces.

B. Amount of friction depends on:

1. Type or kind of surfaces

- µ = **Coefficient of friction** – measures the smoothness of a surface

-The larger µ is, the more friction, the less µ is, the less friction

2. Amount of forces pressing the surfaces together.

3. Amount of surface area

-Formula for the friction force

Ffriction (Ff) = FN • µ

C. Types of friction

1. **Static friction**- the friction between two surfaces that are not moving

- increases as you push harder on an unmoving object, until the object begins to move. Once the object moves it becomes…

2. **Sliding friction** – the force that opposes the surfaces of two sliding objects caused by **microwelds** breaking and reforming.

**3. Rolling friction** – the friction between the wheels of an object and the ground.

D. **Fluid resistance** – the friction between the fluid’s molecules and the object moving through them.

1. Amount of fluid resistance depends on:

a) an object’s speed,

b) an object’s frontal surface area,

and c) the density of the fluid.

E. **Terminal velocity** – Velocity reached when the force of air

resistance equals the force of gravity, so that a falling object no

longer accelerates.

-Ex. – parachutes

## V. Gravity

A. **Law of gravitation** - any two masses (objects) exert an attractive force on each other.

B. Amount of attraction depends on:

1. Mass of objects – the greater the mass, the greater the pull of gravity and vice versa

-The masses are directly proportional to the force of gravity.

2. Distance b/w objects - the greater the distance, the pull of gravity is exponentially less.

-The distance is exponentially & inversely proportional.

C. On earth, the distance to the center of the earth and the mass is constant, so acceleration due to gravity (g) = 9.8 m/s2

-technically in Paradise g = 9.79472 m/s2

D. Mass vs. Weight

**1. Weight** is the measure of the force of gravity on an object.

a. Measured in **N (Newtons)**

Weight (force of gravity) = mass • g (9.8 m/s2)

N= \_\_\_\_ kg • 9.8 m/s2

Wt in N = Wt. in # x4.45

# 2. Mass is the amount of matter that something is made of.

# 3. Weight is measured with a scale and changes as gravity changes.

-Mass is measured with a balance and does not change

Do heavier objects fall faster than lighter objects?

4. **Freefall** – when the only force acting on an object is gravity

5. **Apparent Weight** – when other contact forces besides gravity act on an object.

6. **Weightlessness** – when no contact forces are acting on an object

**VII. Newton’s Third Law (Action-Reaction)**

A. Forces occur in pairs.

B. For every action force, there is an equal and opposite reaction force.

Which is which?

They are exerted on different objects.

Effects of forces on the acceleration of two objects may be very different

Tug of War – scale examples

C. You cannot hit an object more force than it can exert back on you