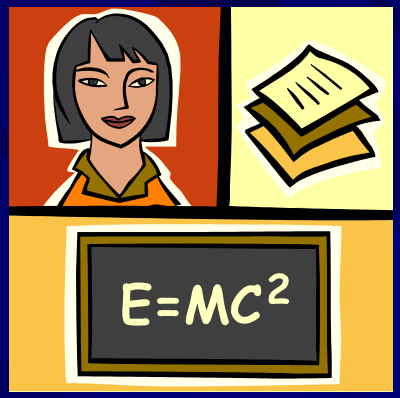
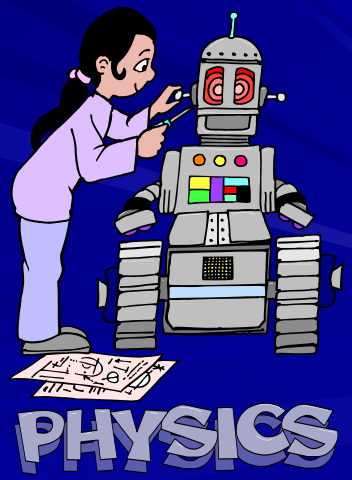


Conceptual Physics

Notes on Chapter 4-5-6

ewton's Laws



Newton's 1st Law of Motion

Inertia

Aristotle

Galileo

Copernicus

THE GREAT THINKERS!

Newton's 1st Law of Motion
Inertia

Aristotle thought of motion in two terms:

- Violent Motion
- Natural Motion

Natural Motion is motion in the vertical direction.

Examples: A tree leaf falls to Earth.

Rain falls to Earth

Smoke rises into the air

Violent Motion is motion in the horizontal direction.

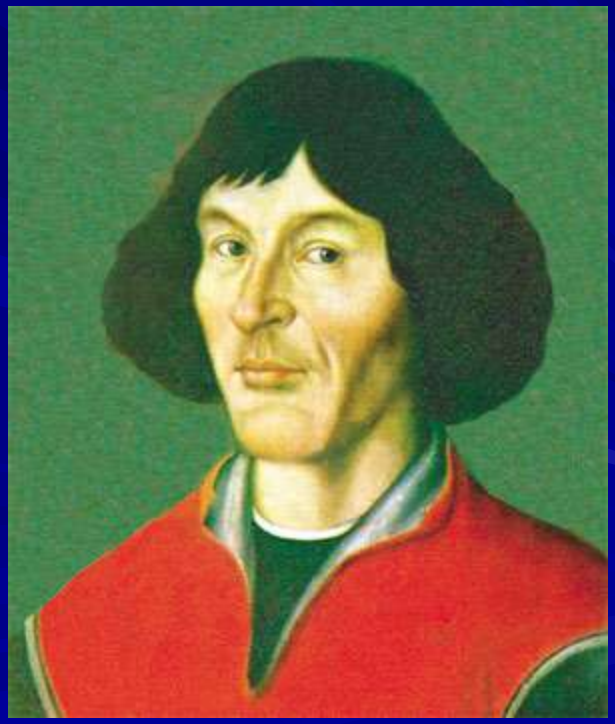
Examples: Horse pulling a cart

Pushing a rock

Newton's 1st Law of Motion
Inertia

Aristotle thought that if there was NO FORCE, then there was no movement, except for Natural motion

Copernicus, looking at astronomical data, reasoned that the Earth was moving around the sun. This went against the church which said Earth was the center of the universe.



Newton's 1st Law of Motion
Inertia

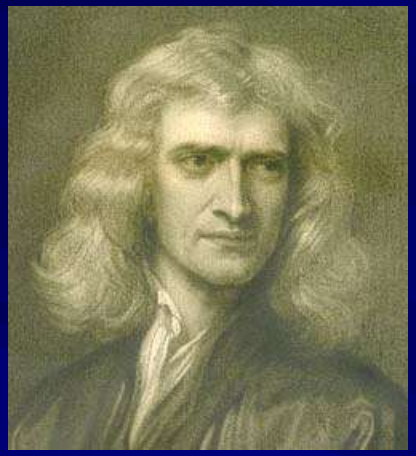
Galileo came up with the definitions of **FORCE** and **FRICTION**.

- Force is any push or pull.
- *Friction is the name given to the force that acts between materials that touch as they move past each other.*

Galileo was concerned with *how* things move rather than *why* they move. Galileo stated that every material resists change --- **INERTIA**

Newton's 1st Law of Motion

Inertia



Newton

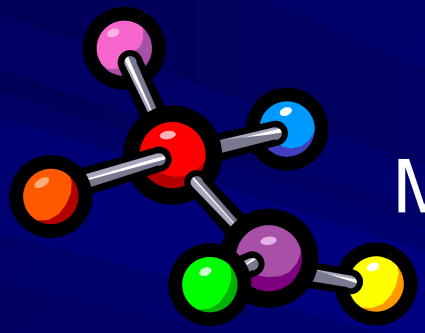
Newton's First Law --- INERTIA

Every object continues in a state of rest, or of motion in a straight line at constant speed, unless it is compelled to change that state by forces exerted upon it.

Newton's 1st Law of Motion

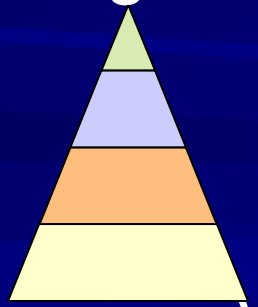
Inertia

Mass, Volume and Weight — NOT the same



Mass is the amount of matter a object has.

Weight is the force of gravity on an object



Volume is the amount of space a object takes up.

Newton's 1st Law of Motion

Inertia

Units

Mass / Weight is measured in KILOGRAMS (Kg)

Volume is measured in CUBIC units (m^3, cm^3, mm^3)

Force is measured in NEWTONS (N)

One Kg is equal to 9.8 N

Or

9.8 N is equal to 1 Kg

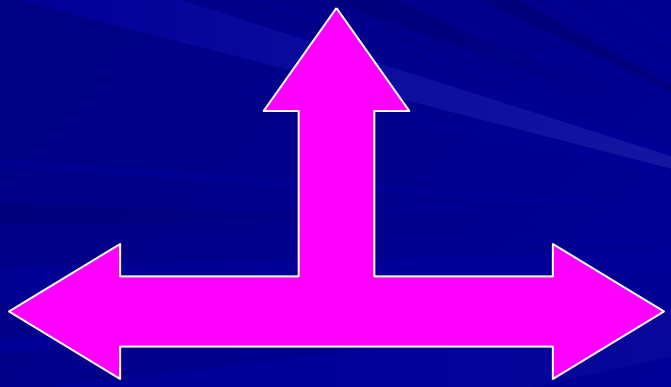
Newton's 1st Law of Motion

Inertia

Net Force

Like vectors we can add and subtract Forces. Net force is equal to the combination of all the forces on a object.

(See figure 2.1 pg 13,)



Newton's 1st Law of Motion
Inertia

When all the force on a object are equal, then the object is said to be in equilibrium. Any object in equilibrium is moving at constant speed and direction, or not moving.

Newton's 2nd Law of Motion
Forces and Motion

When a FORCE is applied to a object, that object experiences a acceleration during the applied force

If I double a force .... I double the acceleration

If I triple a force .... I triple the acceleration

Newton's 2nd Law of Motion
Forces and Motion

THEREFORE Force ~ acceleration

Mass resists acceleration

The larger the mass .... the less the acceleration

THEREFORE acceleration ~ 1 / mass

Newton's 2nd Law of Motion
Forces and Motion

Newton's Second Law

acceleration = force / mass

Or

F = ma

Newton's 2nd Law of Motion
Forces and Motion

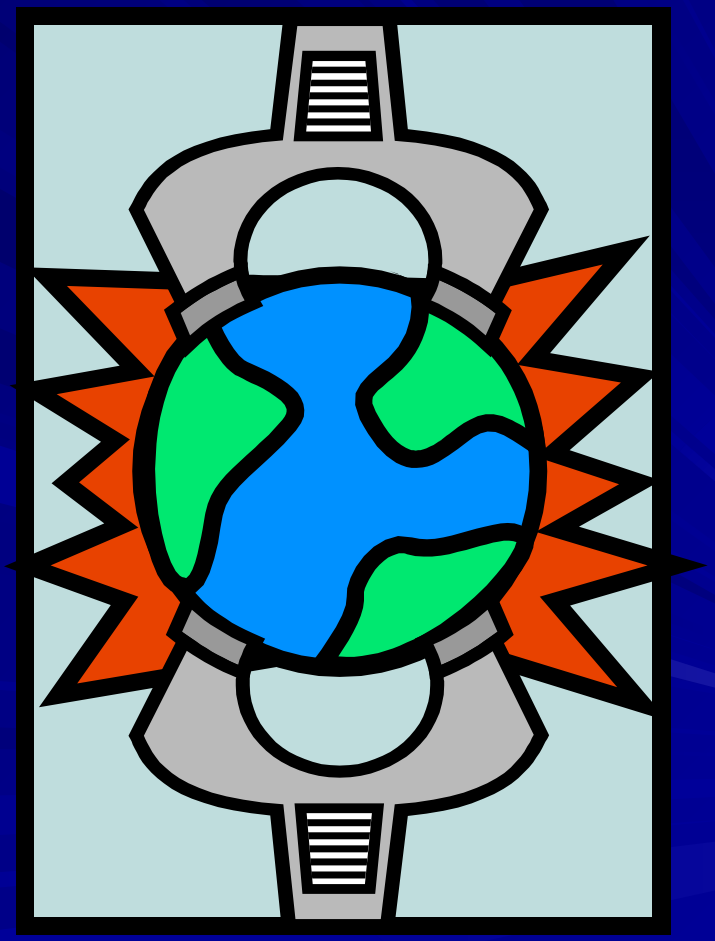
How I apply a force is

PRESSURE

Pressure is force per area.

Units are Pa ...

Pascal's



Newton's 2nd Law of Motion
Forces and Motion

Free Fall AGAIN

Why do heavy and light objects fall with the same velocity? If you answer *g*, how do you explain your answer.

Newton's Second Law is $a = F / m$

$a = g$

$g = F/m$

Newton's 2nd Law of Motion
Forces and Motion

A *heavy* object has large Force and large Mass

F / M

A *light* object has small Force and small Mass

F / M

then .....

F / M = F / M

Notice that the ratio of both equal g

Newton's 2nd Law of Motion

Forces and Motion

What about Air Resistance?

a = F / m Force = weight - air resistance (R)

a = weight - air resistance / m (Weight = mg)

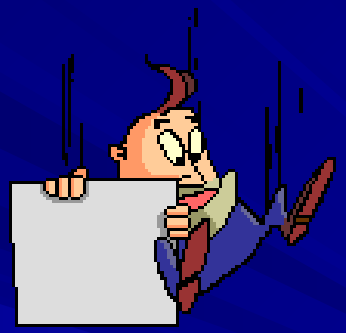
a = mg - R / m (NOTE: m and m are the same)

a = g - R (Note that with air resistance the acceleration WILL always be LESS then g)

Newton's 2nd Law of Motion
Forces and Motion

THEREFORE .... a skydiver will always fall less than g.

This is known as *terminal velocity*.



Terminal Velocity for

- **a human is about 150 - 200 km/h**

a baseball about 45 km/h

- **a tennis ball about 33 km/h**

Newton's 3rd Law of Motion

Action and Reaction

Forces always occur in pairs ...

action – reaction

Object *A* exerts a force on object *B*

Object *B* exerts a force back on object *A*

Newton's 3rd Law of Motion
Action and Reaction

Action and reaction forces are equal in strength and opposite in direction

Example:

The earth pulls on a ball

The ball pulls on the earth

Newton's 3rd Law of Motion

Action and Reaction

Question:

How does a rocket in outer space move?