

Physical Science

Chapter 2

Forces

The Nature of Force

- By definition, a **Force** is a *push* or a *pull*.



**A Push
Or
A Pull**

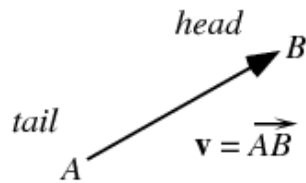


Just like **Velocity & Acceleration**
Forces have both
magnitude and direction
components

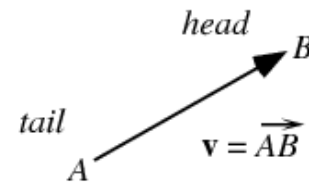
Balanced & Unbalanced Forces

- *With a Balanced force – opposite and equal forces acting on the same object result in NO motion of the object*
- **Unbalanced forces – two or more forces of unequal strength or direction acting upon on an object results in the motion of the object**

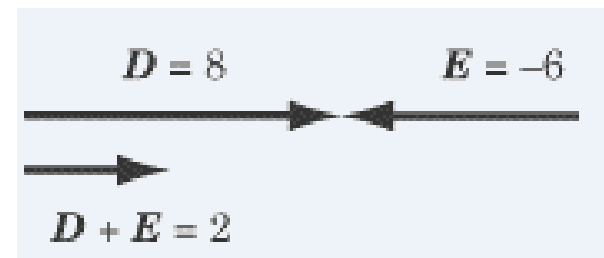
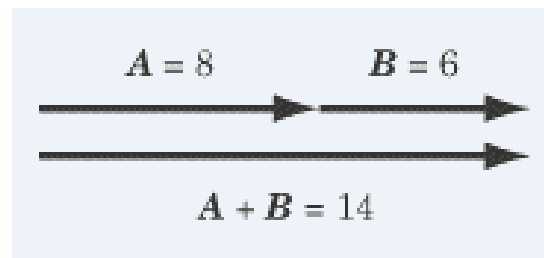




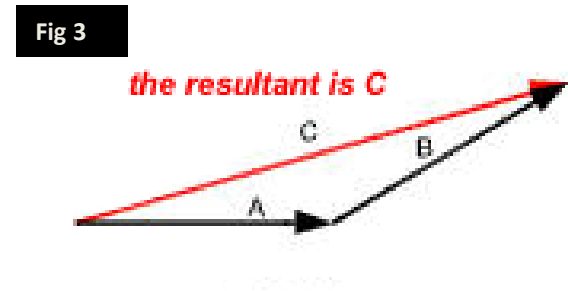
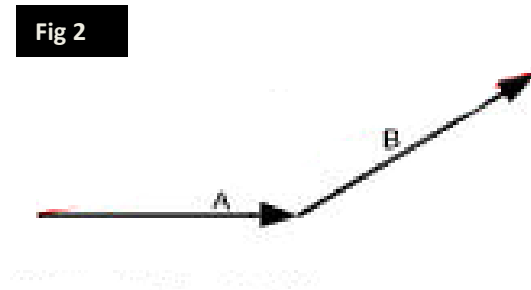
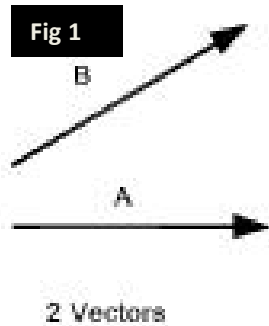
Vectors



- Vectors are a method used to visually show forces
- A vector is a quantity which has both magnitude (size) and direction.
 - The length of the arrow shows the **magnitude** of the vector.
 - The angle of the arrow shows the vector's **direction**.
- Just like numbers, we can add two or more vectors together and get a **net force** called the **resultant**



Adding 2 or More Vectors



- **Add vectors A and B to get the Resultant C**
 - $A + B = C$
- Fig 1 - shows the magnitude & direction of the 2 vectors we are adding
- Fig 2 – we move the beginning of vector B to the end of Vector A, making sure to keep the magnitude & direction exactly the same
- Fig 3 – Connect the beginning of Vector A to the end of Vector B, this is your “Resultant” C.

Adding Vectors

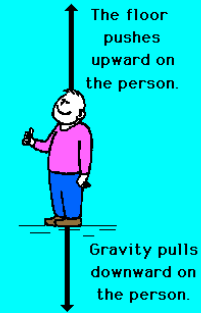


Click the icon to
run java script
game that
allows you to
add vectors

Newton's 3 Laws of Motion

- **Newton's 1st Law of Motion:**
- **AKA The Law of Inertia**
 - **which states** an object at rest will remain object in motion will remain in motion at a constant velocity until acted on by another force.

The forces on the person are balanced.



Remember:

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



Newton's 3 Laws of Motion

- **Newton's Second Law of Motion** aka **$F=ma$**
- Force = mass x acceleration
 - Can be written as:
 - $F=ma$; $a= F/m$; $m= F/a$
- What is the basic unit for mass? **Kilogram**
- What is the basic unit for acceleration? **Meter/sec/sec**
- Therefore the basic unit for Force is
(kilogram)(meter/sec/sec)
- An object with a mass of 1 kg accelerating at 1 m/s/s has a force of 1 Newton



$$1\text{N} = \frac{\text{kg m}}{\text{s}^2}$$

Ding-a-ling!!

Newton's 2nd Law & Force of Gravity

- Everyone has heard of the FORCE of gravity
- ❑ So far, we know only of four types of **fundamental forces** in nature:

- ❑ Gravity, Electromagnetic, Weak, and Strong

- Gravity: the force that pulls objects towards each other
- Since gravity is a force it also obeys Newton's second law

$$F=ma$$

Since objects fall at the same speed, their acceleration is the same.

All objects accelerate at the rate.

Here on Earth the rate is:

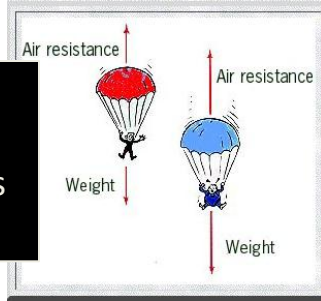
$$A_g = 9.8 \text{ m/s}^2$$

Or

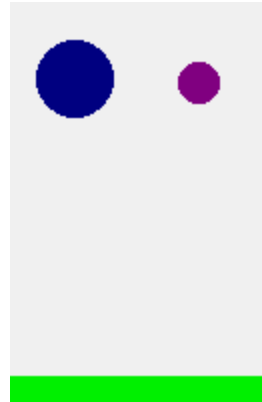
$$\Delta = 32 \text{ ft/s}^2$$

Air resistance keeps things from falling

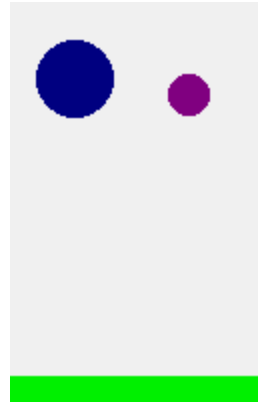
equally



The way Aristotle believed objects to fall on the Earth



The way objects actually fall to Earth



With this experiment, Galileo proved Aristotle wrong

Feather and ball bearing dropped at atmospheric pressure.



With this experiment, Apollo 15 astronauts proved Galileo right. (link to YouTube)

Newton's 2nd Law & Weight

- **$F=ma$**

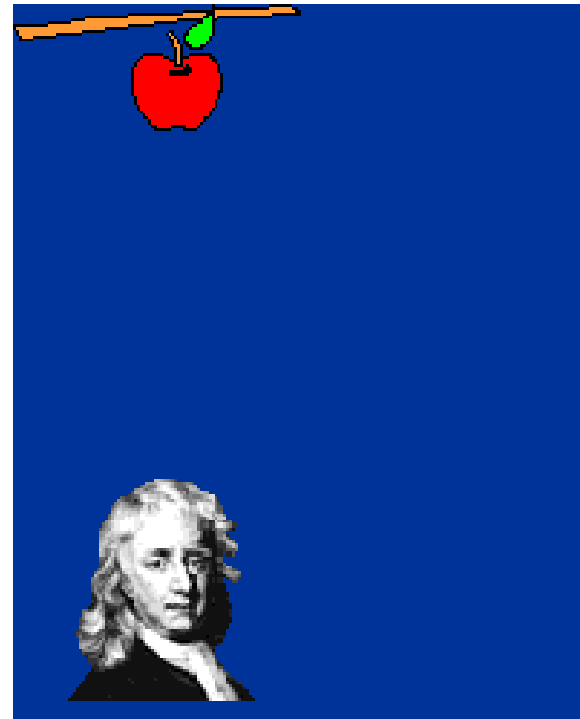
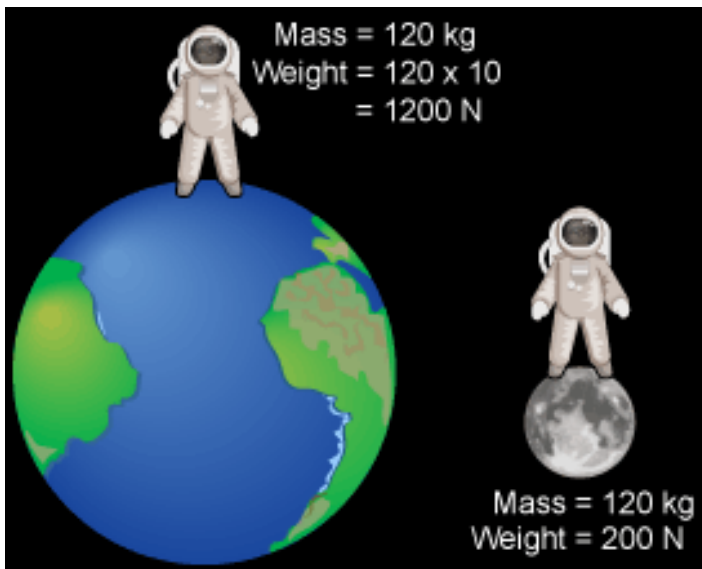
- Weight is the force of gravity acting on an object's mass.
- Therefore weight is a type of Force
- The formula for weight: $\text{Weight} = \text{mass} \times A_g$
- Since **$A_g = 9.8 \text{ m/s}^2$** then

$\text{Weight} = \text{mass} \times 9.8 \text{ m/s}^2$

- Got it? I hope so... it's a ding-a-ling!

Remember:

1 newton = 0.22 pounds



ENTER YOUR WEIGHT HERE →

150

Calculate

The Planets

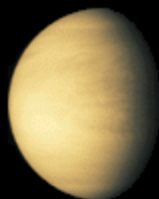
MERCURY



Your weight is

56.7

VENUS



Your weight is

136

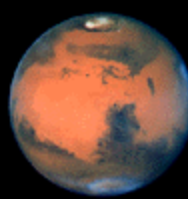
THE MOON



Your weight is

24.9

MARS



Your weight is

56.5

JUPITER



Your weight is

354.6

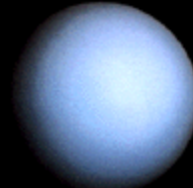
SATURN



Your weight is

159.6

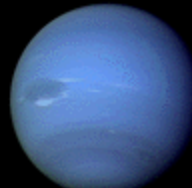
URANUS



Your weight is

133.3

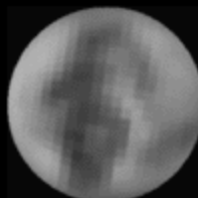
NEPTUNE



Your weight is

168.7

PLUTO



Your weight is

10

THE SUN



Your weight is

4060.8

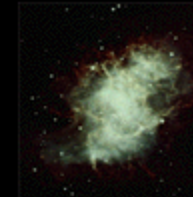
A WHITE DWARF



Your weight is

195000000

A NEUTRON STAR



Your weight is

210000000000000

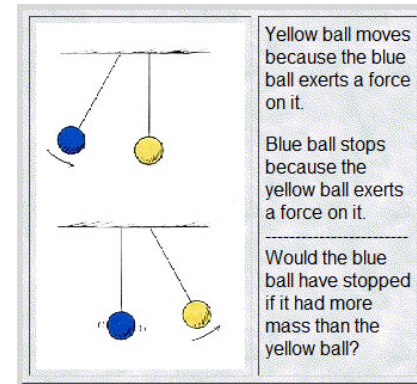
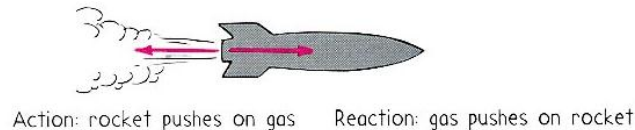
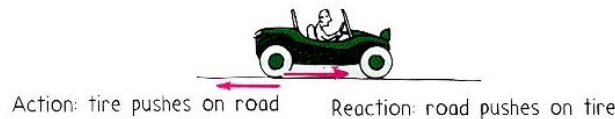
Newton's 3 Laws of Motion

- **Newton's 3rd Law of Motion:**

- For every action there is an equal & opposite reaction.



- If an object is not in motion, then all forces acting on it are balanced and the net force is zero!
- Friction – the force that one surface exerts on another when the two rub against each other.



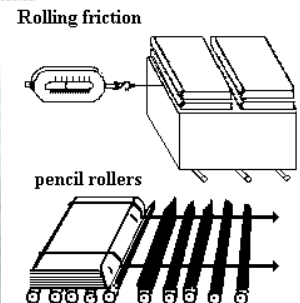
Sliding friction



Fluid friction



Rolling friction

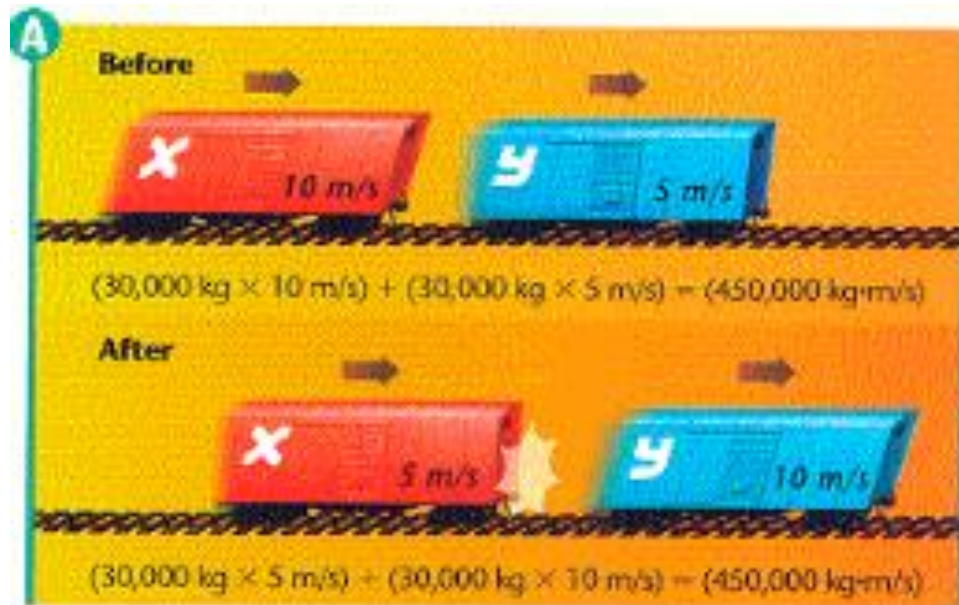


Momentum

- An object's momentum is directly related to both its mass and velocity.
- **Momentum = mass x velocity**
- For some reason, maybe because mass is designated as “m” in formulas, momentum is designated as “p”.
- Therefore: **$p = mv$**
- The unit for **mass is kg**, the unit for **velocity is meter/second**, therefore the unit for **momentum is kg m/sec**
- **Conservation of Momentum:**
 - When two or more objects interact (collide) the total momentum before the collision is equal to the total momentum after the collision

Momentum – 2 moving objects

- During this collision the speed of both box cars changes. The total momentum remains constant before & after the collision. The masses of both cars is the same so the velocity of the red car is transferred to the blue car.



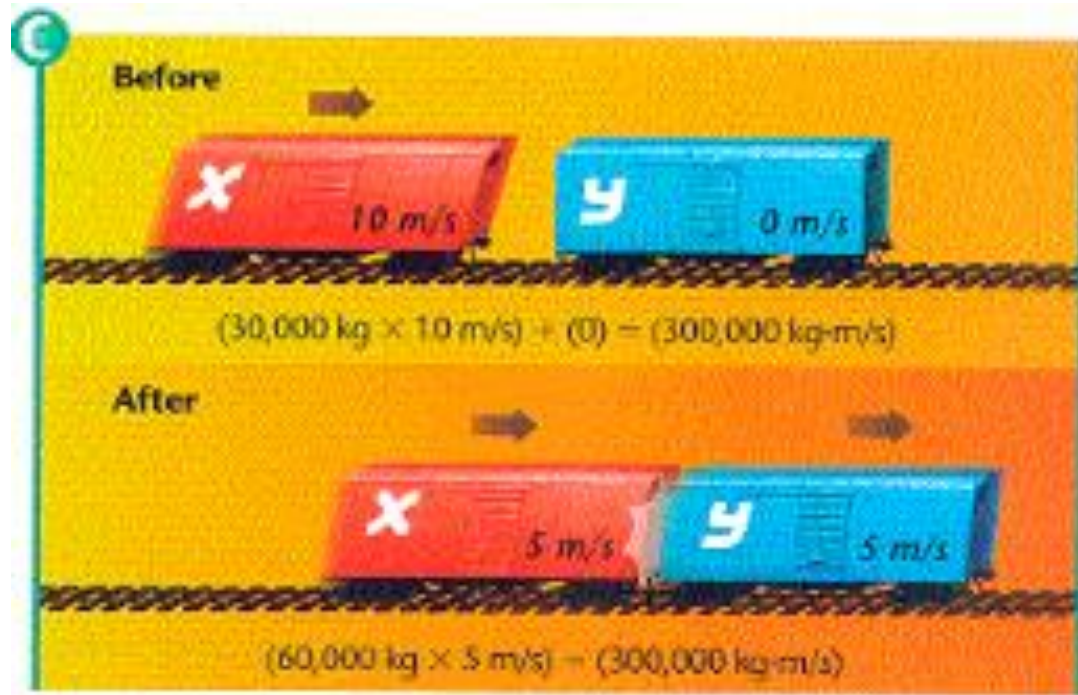
Momentum – 1 moving object

- During this collision the speed red car is transferred to the blue car. The total momentum remains constant before & after the collision. The masses of both cars is the same so the velocity of the red car is transferred to the blue car.



Momentum – 2 connected objects

- After this collision, the coupled cars make one object w/ a total mass of 60,000 kg. Since the momentum after the collision must equal the momentum before, the velocity must change. In this case the velocity is reduced from 10 m/sec. to 5 m/sec.



Let's call it a night....

Take a break.

Cya Later!