PHYS 2212

Look over
Chapter 21 sections 1, 2, 3, 4, 5, 6
examples 1, 2, 4

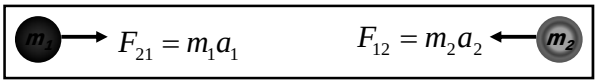
PHYS 1112

Look over
Chapter 16 sections 1, 2, 3, 5, 6
Examples 1, 3, 4, 5

Things to Know

1) What is a Coulomb.
2) What is the difference between Conductors, Insulators and Semi-Conductors.
3) How to use Coulombs Law to find the force between charged objects.

How Does Gravitational Force Depend on Mass?



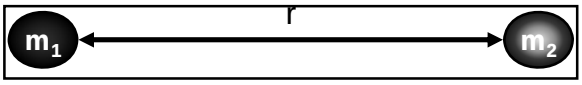
But by Newton's 2nd law:

$$F_{21} = F_{12}$$

So the gravitational must depend on both masses.

$$F_G \propto \frac{m_1 m_2}{r^2}$$

Newton's Law of Gravitation



The force between any two particles having masses $\mathbf{m_1}$ and $\mathbf{m_2}$ and separated by a distance **r** is an attraction acting along the line joining the particles and has the magnitude given by:

$$F_G = G\frac{m_1 m_2}{r^2}$$

Where **G** is a universal constant

"G"

To measure G we can use a Cavendish balance.

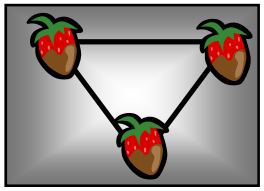
The value of G is:

$$G = 6.6726 \times 10^{-11}\left(\frac{m^2}{kg \cdot s^2}\right)$$

Center of Mass

The Gravitational between extended Spherical objects (like a planet) acts between the the center of the objects. The point at which the gravitational force acts is called the **Center of Gravity** or the Center of Mass.

Example 1



1)What is the magnitude and direction of the net gravitational force on the lower strawberry if each strawberry has a mass of *40 g* and the triangle has side *2.5 m* long?

Electromagnetism

The early Greek Philosophers knew that if you rubbed a piece of amber, it would attract bits of straw.

The Greeks also observed that some naturally occurring stones would attract Iron.

Electricity and Magnetism developed separately until 1820 when Han Christian Oersted found that a magnetic compass needle would be deflected by a electric current in a wire.

Electric Charge

"Charges with the same electrical sign repel each other, and charges with opposite electrical signs attract each other."

(+) and (-) Charge

The "Positive" and "Negative" labels and signs for electric charge were chosen arbitrarily by Benjamin Franklin.

The unit of charge we will be using is the Coulomb (C).

Conductors and Insulators

In some materials, such as metals, tap water and the human body, some of the negative charge can move rather freely. We call such materials Conductors.

In other materials, such as glass, chemically pure water, and plastic, none of the charge can move freely. We call these materials Nonconductors or Insulators.

Semi-Conductors

Semi-conductors, such as Silicon and Germanium, are materials that are intermediate between conductors and insulators.

Coulomb's Law

$$F = k\frac{|q_1||q_2|}{r^2}$$

If two charged particles (also called point charges) have charge magnitudes q_1 and q_2 and are separated by a distance r then the electrostatic force of attraction or repulsion between them has the magnitude:

The Force is Still a Vector

$$\vec{F}_{12} = -\vec{F}_{21}$$

$$\vec{F}_{12} = k\frac{q_1 q_2}{r_{12}^3}\vec{r}_{12} = k\frac{q_1 q_2}{r_{12}^2}\hat{r}_{12}$$

k or ε_0

The constant k in Coulomb's law is usually written as:

$$k = \frac{1}{4\pi\varepsilon_0} = 8.99\times10^{9}\ \frac{N\cdot m^2}{C^2}$$

The quantity ε_0, called the permittivity constant, which is equal to:

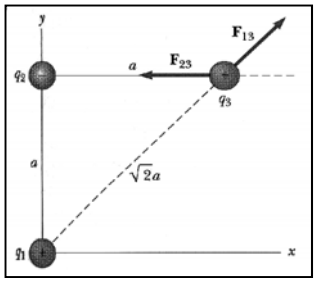
$$\varepsilon_0 = 8.85\times10^{-12}\ \frac{C^2}{N\cdot m^2}$$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{|q_1||q_2|}{r^2}$$

The Superposition Principle

If we have n charged particles, they interact independently in pairs, and the force on any one of them is the vector sum of the force that each particle exerts on that particle.

Example 2



2)Consider three point charges located at the corners of a right triangle as shown, where $q_1=q_3=5.0\ \mu C$, $q_2=-2.0\ \mu C$, and $a=0.10\ m$.
Find the resulting force exerted on q_3.

Charged is Quantized

Any positive or negative charge q that can be detected can be written as:

$$q = ne,\ n = \pm 1, \pm 2, \pm 3, \cdots,$$

In which e, the elementary charge, has a value of:

$$e = 1.60 \times 10^{-19}\ C$$

The Electron and Proton both have a charge of e.