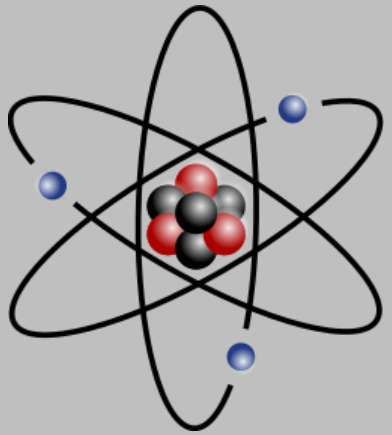
International House Tashkent
Subject: Physics
Department: ES, Course 1
Lesson 7. Newton's law of universal gravitation



Newton's Law of Universal Gravitation

- The force of gravity between two masses in the universe is directly proportional to the product of the masses and inversely proportional to the square of the distance between their centres

- Sounds complicated right?

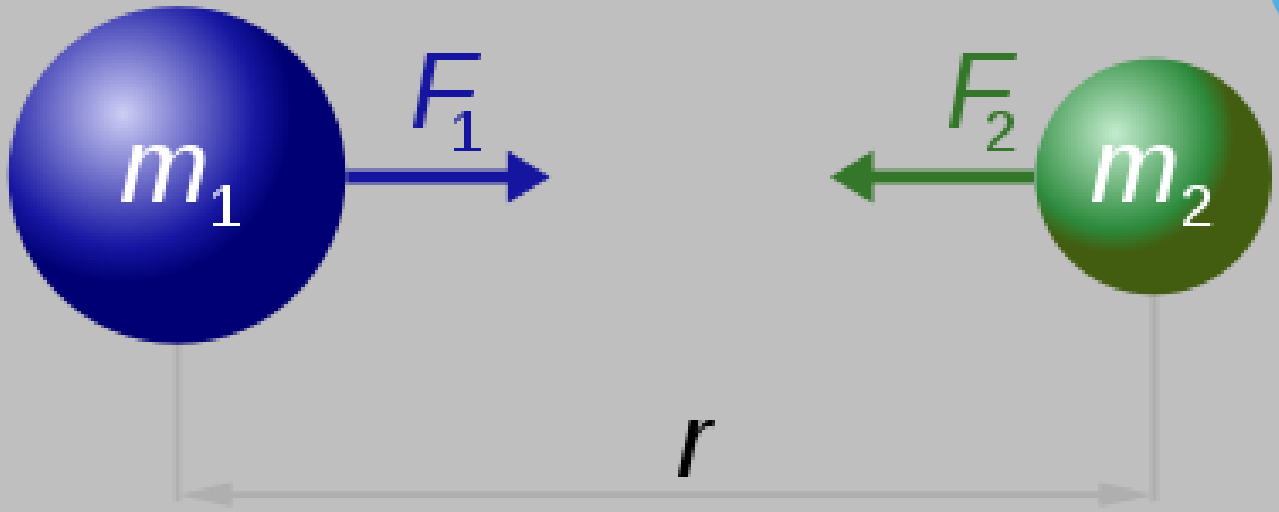
In summary,

- The heavier the two objects are, the greater the force of attraction
- The forces of attraction decreases rapidly as objects move apart
- No matter how large the distance is, the force of attraction will NEVER BE ZERO
- Every object in the universe exerts a force of attraction on all other objects near or far

In Mathematical Terms,

$$F = \frac{GM_1M_2}{r^2}$$

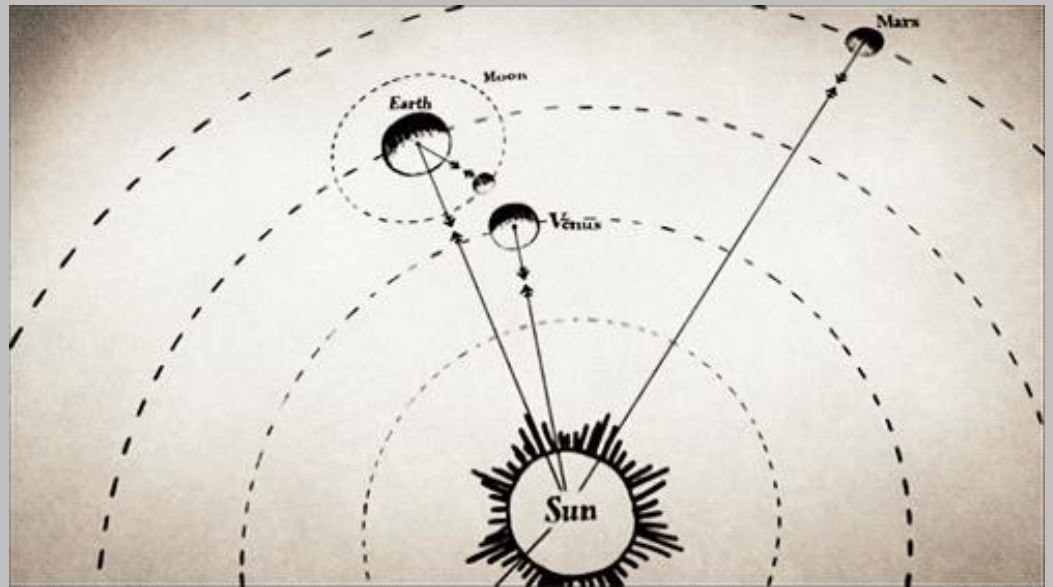
- F_G = the magnitude of the force of gravitational attraction between 2 objects (N)
- G – **BIG G** - universal gravitational constant
  - G = 6.67 x 10^{-11} N·m^2/kg^2
- m_1 & m_2 – mass of each object (kg)
- r = distance between the 2 objects centres (m)



$$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$$

Limits to the Equation

- Cannot be applied to all shapes
- The equation is valid for:
  - 2 spheres (i.e. the earth and sun)
  - a particle/object and a sphere (i.e. a person and the earth)
  - 2 objects/particles whose sizes are much smaller than the distance between them (2 people 2 km away from each other)



Gravitational Field Strength

- We can simplify this equation to find a planet specific value to calculate gravitational force
- In this formula:
  - G is constant
  - M is the mass of the planet
  - R is the radius of the planet
- g represents the gravitational

$$g = \frac{GM}{r^2}$$

field strength **OR** acceleration due to gravity on the planet's surface!!!