

Introduction to Physics : Notes/W.S.-50

Gravity is the force of attraction between any two masses.

The **Law of Universal Gravitation** was discovered by Sir Isaac Newton.

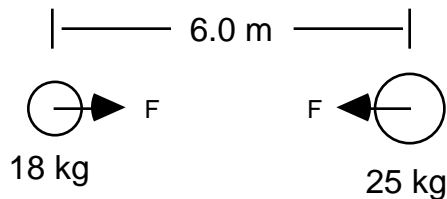
This law states that any two masses will exert an attractive force on each other. This force is called the force of gravity. This force decreases as the distance between the centers of the two masses increases according to Newton's law of gravity.

The Law of Gravity is:

$$F = \frac{G \cdot m_1 \cdot m_2}{d^2}$$

The force of gravity is F . The center to center distance between the masses is d . The two masses are, m_1 and m_2 . The gravitational constant is G . $G = 6.7 \times 10^{-11}$.

Examples: Suppose we have two masses separated by a distance of 6.0 meters. Find the force between them.



$$F = 6.7 \times 10^{-11} \times 18 \times 25 / 6.0^2 = 8.4 \times 10^{-10} \text{ N}$$

The force will decrease as the distance between the two masses increases, according to the equation:

$$\frac{F_2}{F_1} = \left[\frac{d_1}{d_2} \right]^2$$

If the force between two masses is 16.0 N when they are separated by a distance of 2.0 m, the force between them when they are separated by a distance of 4.0 m is given by; $F_2/16 = (2.0/4.0)^2$. $F_2 = 4.0$ N.

Problems:

- 1)a) What is the "Law of Universal Gravitation"?
- b) What is the numerical value of the gravitational constant G?
- c) Find the force of gravity between a 65 kg man and a 950 kg car if the distance (center to center) between them is 3.0 m.
- d) If the distance between them is increased to 6.0 m, find the force of gravity between them.

2) Find the force of gravity between the Earth and the Sun

Mass of Earth is 6.0×10^{24} kg

Mass of Sun is 2.0×10^{30} kg

Distance to Sun is 1.5×10^{11} m

3) Two objects have a force of gravity between them of 32 N when the distance between them is 8.0 m. Find the forces and distances in the table below.

force of gravity (N)	distance (m)
<u>32</u>	<u>8</u>
---	4
<u>512</u>	---
---	<u>16</u>
<u>2.0</u>	---

Answers: 1)a) Any two masses have an attractive force between them. b) 6.7×10^{-11} , c) 4.6×10^{-7} N, d) 1.1×10^{-7} N, 2) 3.6×10^{22} N, 3) 128, 2.0, 8.0, 32.