Newton's Law of Universal Gravitation (SwiftStudy Printable)

Law of Gravitation

$$F = \frac{Gm_1m_2}{r^2}$$

F	gravitational force	N
G	universal gravitation constant = 6.67 × 10^{-11} N·m^2/kg^2	
m_1, m_2	masses of objects	kg
r	distance between objects	m

Acceleration Due to Gravity

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

g	acceleration due to gravity	m/s^2
G	universal gravitation constant = 6.67 × 10^{-11} N·m^2/kg^2	
m_p	mass of planet	kg
r	radius of planet	m

Tips to Remember

- Always remember that r is the **center to center** distance between the two objects. For instance, if an astronaut is 2000 km above the earth—which has radius 6400 km—then the center of the astronaut is 2000 km + 6400 km from the center of the earth. That means that r is 8400 km, or 8.4 × 10^6 m.
- In the formula for the acceleration due to gravity on a planet, r actually is the radius of the planet. That's because the center to center distance, which is what r measures, is from the center of the planet to the surface, i.e., the planet's radius.
- When you calculate the force between two objects on earth, expect the answer to be small. Gravity is reallly a very wimpy force; you notice it only because you're standing on something the size of a planet. You shouldn't expect to notice the gravitational force between yourself and an object next to you.