For Objects in a Circular Orbit:

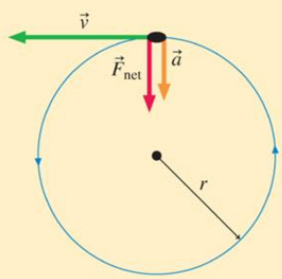
Recall the following facts:

Uniform Circular Motion

An object moving in a circular path is in uniform circular motion if v is constant.

- The speed is constant, but the direction of motion is constantly changing.
- The **centripetal acceleration** is directed toward the center of the circle and has magnitude

$$a = \frac{v^2}{r}$$



- This acceleration requires a net force directed toward the center of the circle. Newton's second law for circular motion is

$$\vec{F}_{net} = m\vec{a} = \left(\frac{mv^2}{r}, \text{toward center of circle}\right)$$

Universal Gravitation

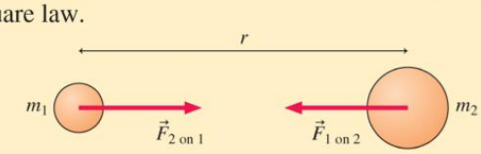
Two objects with masses m_1 and m_2 that are distance r apart exert attractive gravitational forces on each other of magnitude

$$F_{1\,on\,2} = F_{2\,on\,1} = \frac{Gm_1m_2}{r^2}$$

where the gravitational constant is

$$G = 6.67 \times 10^{-11}\ \text{N} \cdot \text{m}^2/\text{kg}^2$$

This is **Newton's law of gravity.** Gravity is an inverse-square law.



Now consider if an object is orbiting another in a **circular** path then:

1. It has a centripetal force. $\frac{mv^2}{r}$

2. Gravity is that centripetal force $\frac{GMm}{r^2}$

Therefore, for objects that orbit in a **circular path** it must be true that:

$$\frac{GMm}{r^2} = \frac{mv^2}{r}.$$