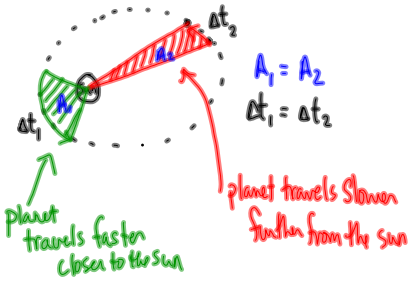
Chapter 12 - Universal Gravitation

§12-1 Newton's Law of Universal Gravitation

Groundwork for Newton → Kepler

Kepler's Laws

1. Planets move in elliptical orbits (the Sun is the focus at one end)
2. An imaginary line joining the Sun and a planet sweeps equal areas in equal times.



3. The quotient of the cube of the orbital radius and the square of the orbital period is constant for all planets.

$$\frac{R^3}{T^2} = K \quad \text{(Kepler's Constant - Sun)}$$

Central body

A and B are two planets.

$$\frac{R_A^3}{T_A^2} = \frac{R_B^3}{T_B^2}$$

So what about Newton + Gravitation?

$$F_g \propto m_1$$
$$F_g \propto m_2$$
$$F_g \propto \frac{1}{r^2}$$

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

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

Newton's Law of Universal Gravitation

where F_g is the force of gravity between m_1 and m_2 (N)
m_1 and m_2 are the masses of the objects (kg)
r is the separation (centre to centre) (m)

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

Consider you + the earth:

$F_g = mg$ ← your mass

$F_g = G\frac{m_1 m_2}{r^2}$ ← your mass, g

$g = 9.8\ m/s^2$ (near the Earth's surface)

TO DO

① Scientific Models: Gravity
② Centripetal force
③ [illegible] } class.