

Ch 8 HW: Rev Con 6,7,17,18,20 Pro 36 67
 Sec 8.1a Obj: Describing the Law of Universal Gravitation.

Universal Gravitation

- Newton proposed two ideas that led to gravity from Kepler's Laws and his own Laws of motion.

1) Using Kepler's Law, the Force acting on the planet in its orbit is inversely related to the square of the distance btw the planet + the sun.

$F \propto \frac{1}{d^2} \Rightarrow$ Inverse square Law.

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2) Using his own Law's Newton hypothesized that the force acting on an object must be proportional to its mass + because of his Third Law the object also applies a force on the earth therefore the force must also be proportional to earth's mass

$F \propto m_1 m_2$

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- This force of attraction is called the gravitation force (F_g).

* Newton assumed that the same force of attraction will exist btw any two masses.

* Law of Universal Gravitation

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

- Newton was also able to connect his gravitational Law to Kepler's 3rd Law.

* By using his 2nd Law of Motion + circular motion Newton showed

$$\left(\frac{1}{T}\right)^2 = \left(\frac{4\pi^2}{G m_s}\right) r^3$$

$$\underline{\underline{T^2 \propto r^3}}$$

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- Newton did not know the value of G .

* Henry Cavendish develop an apparatus which allow him to calculate G , 100 yrs after Newton. (Cavendish Experiment)

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

- Once G was determine, we were then able to determine the mass of the earth as well as any other planet.

$$F_g = G \frac{m_1 m_2}{d^2} \quad F_g = mg$$

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

$$g = \frac{G m_1}{d^2}$$

$$m_1 = \frac{g d^2}{G}$$

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