

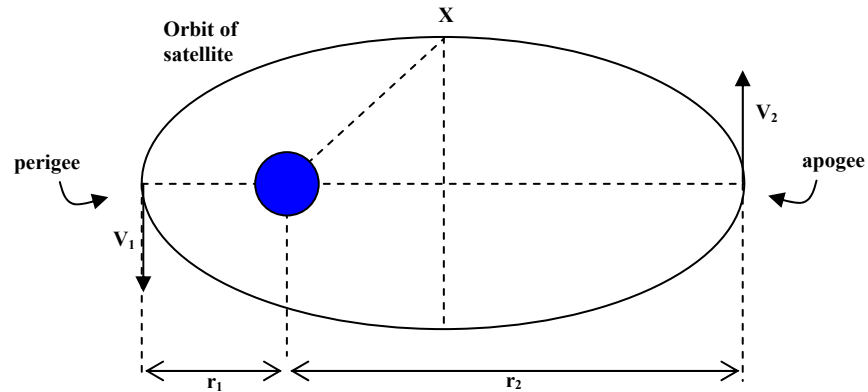
AP Physics C  
Review 10 Gravitation

1. If the distance between two point particles is doubled, what happens to the gravitational force between them?
2. At the surface of the earth, an object of mass  $m$  has a weight of  $w$ . If the object is transported to an altitude that's twice the radius of the earth, then, at the new location what is the weight compared to on the surface?
3. A moon of mass  $m$  orbits a planet of mass  $100m$ . Let the strength of the gravitational force exerted by the planet on the moon be denoted by  $F_1$ , and let the strength of the gravitational force exerted by the moon on the planet be  $F_2$ . How does  $F_1$  compare with  $F_2$ ?
4. The planet Pluto has  $1/500^{\text{th}}$  the mass and  $1/15^{\text{th}}$  the radius of Earth. What is the value of  $g$  on the surface of Pluto?
5. The mean distance from Saturn to the Sun is 9 times greater than the mean distance from Earth to the Sun. How long is a Saturn year?
6. Consider two uniform spherical bodies in deep space. Sphere 1 has mass  $m_1$ , and Sphere 2 has mass  $m_2$ . Starting from rest from a distance  $R$  apart, they are gravitationally attracted to each other.
  - a. Compute the acceleration of Sphere 1 when the spheres are a distance  $\frac{1}{2}R$  apart.
  - b. Compute the acceleration of Sphere 2 when the spheres are a distance  $\frac{1}{2}R$  apart.
  - c. Compute the speed of Sphere 1 when the spheres are a distance  $\frac{1}{2}R$  apart.
  - d. Compute the speed of Sphere 2 when the spheres are a distance  $\frac{1}{2}R$  apart.

Now assume that these spheres orbit their center of mass with the same orbit period,  $T$ .

- e. Determine the radii of their orbits. Write the answer in terms of  $m_1$ ,  $m_2$ ,  $T$ , and fundamental constants

7. A satellite of mass  $m$  is in the elliptical orbit shown below around Earth (radius  $r_E$ , mass  $M$ ). Assume that  $m \ll M$ .



- Determine  $v_1$ , the speed of the satellite at perigee. Write your answer in terms of  $r_1$ ,  $r_2$ ,  $M$ , and  $G$ .
- Determine  $v_2$ , the speed of the satellite at apogee. Write your answer in terms of  $r_1$ ,  $r_2$ ,  $M$ , and  $G$ .
- Express the ratio  $v_1/v_2$  in simplest terms.
- What is the satellite's angular momentum (with respect to Earth's center) when it's at apogee?
- Determine the speed of the satellite when it's at the point marked X in the figure.
- Determine the period of the satellite's orbit. Write your answer in terms of  $r_1$ ,  $r_2$ ,  $M$ , and fundamental constants.
- What is the eccentricity of the satellite's orbit? Write your answer in terms of  $r_1$  and  $r_2$ .