PROBLEM SET 4
Physics 2021

1. What is the orbital semi-major axis of a planet with a sidereal period of 25 years?

2. An asteroid is 2 AU from the Sun at perihelion and 6 AU from the Sun at aphelion. (a) Find the semi-major axis of the asteroid's orbit. (b) Find the sidereal period of the orbit.

3. A comet orbits the Sun with a sidereal period of 64.0 years. (a) Find the semi-major axis of the orbit. (b) At aphelion, the comet is 31.5 AU from the Sun. How far is it from the Sun at perihelion?

4. Suppose that you traveled to a planet with 4 times the mass and 4 times the diameter of the Earth. Would you weigh more or less on that planet than on Earth? By what factor?

5. The mass of Saturn is approximately 100 times that of Earth, and the semimajor axis of Saturn's orbit is approximately 10 AU. To this approximation, how does the gravitational force that the Sun exerts on Saturn compare to the gravitational force that the Sun exerts on the Earth?

6. A satellite is said to be in a "geosynchronous" orbit if it appears always to remain over the exact same spot on Earth. (a) What is the period of this orbit? (b) At what distance from the center of the Earth must such a satellite be placed into orbit?

7. Suppose a newly discovered asteroid is in a circular orbit with synodic period 1.25 years. The asteroid lies between the orbits of Mars and Jupiter. (a) Find the sidereal period of the orbit. (b) Find the distance from the asteroid to the Sun.

8. An asteroid is three times as far from the Sun at aphelion than at perihelion. At perihelion its orbital speed is 25 km/s. What is the orbital speed of the asteroid at aphelion?

9. Suppose the distance between two stars doubled while the mass of each star doubled as well. What would happen to the orbital period of the two stars?

10. If the Sun was suddenly twice as massive and its distance did not change, then what would be the orbital period of the Earth?