Kepler's Laws

1. Use the planet Uranus to calculate Kepler's constant for bodies that orbit the Sun. (3.38×10^{18} m^3/s^2)
2. What would be the period of a planet that orbits the Sun in an orbit of radius 3.20×10^{14} m? How many Earth years would this be? (3.11×10^{12} s, 9.85×10^4 y)
3. Calculate the radius of orbit of a planet orbiting the Sun if it has a period of 1.13×10^5 s. (3.50×10^9 m)
4. Calculate the speed of the planets mentioned in Problems 2 and 3. (646 $\frac{m}{s}$, 1.93×10^5 $\frac{m}{s}$)
5. Tethys is one of the moons of the planet Saturn. Using this moon, calculate Kepler's constant for bodies that orbit Saturn. (9.56×10^{14} m^3/s^2)
6. Using the constant determined in problem # 5, find the speed of a satellite that orbits Saturn at an altitude of 600 kilometres. (2.48×10^4 $\frac{m}{s}$)
7. For a satellite which orbits Mars with a period of 1.70×10^5 s find
   (a) the orbital radius. (3.14×10^7 m)
   (b) its centripetal acceleration. (4.29×10^{-2} $\frac{m}{s^2}$)
8. Calculate Kepler's constant for the planet Neptune by using the data for its moon, Nereid. (1.76×10^{14} m^3/s^2)
9. A satellite orbits Mars in 3.00 hours. Find
   (a) its orbital radius. (5.00×10^6 m)
   (b) its speed. (2.91×10^3 $\frac{m}{s}$)
10. (a) Calculate the value for Kepler's constant for the moon in orbit around the Earth. (1.00×10^{13} m^3/s^2)
    (b) A T.V. satellite is in orbit around the Earth at an altitude of 900 km. Find the period of this satellite in seconds. (6.21×10^3 s)
11. How long will it take a satellite to orbit Earth if it is at an altitude of 4.0×10^4 km? (9.99×10^4 s)
12. A satellite around the Sun has an orbital radius of 1.3×10^{11} m. Find
    (a) the satellite's period, (2.56×10^7 s)
    (b) the circumference of its orbit in metres, (8.16×10^{11} m)
    (c) the average speed of the satellite. (3.19×10^4 $\frac{m}{s}$)
13. The radius of the moon is 1.74×10^6 m. During the 1972 Apollo 16 moon flight, the Command Module manoeuvred into a nearly circular orbit 100 km above the lunar surface. The period of this spacecraft was measured to be 2.0 hours. During one of its orbits the Command Ship launched a small satellite into a circular orbit 1900 km above the lunar surface.
    (a) What was the period of this small satellite? (2.00×10^4 s)
    (b) What was the speed of the small satellite? (1.14×10^3 $\frac{m}{s}$)
14. A telecommunications satellite is in geostationary orbit around Earth (a period of 24 h). Find
    (a) the average radius of its orbit. (4.21×10^7 m)
    (b) its altitude above Earth's surface, (3.57×10^7 m)
    (c) its average orbital speed. (3.06×10^3 $\frac{m}{s}$)
15. Calculate the speed with which Pluto orbits the Sun in km/h. (1.83×10^4 km/h)