

Practice Problems

Introduction to Astronomy PHS-151
Kirkwood Community College
Iowa City Campus

Kepler's Third Law of Planetary Motion

1. A newly discovered dwarf planet is found to have an orbital semi-major axis of 57 A.U. What is the orbital period of this object?
2. Saturn's average distance from the Sun is 9.58 A.U. What is the length of the ringed planet's year?
3. Our sun's nearest neighbor, Proxima Centauri, is thought to orbit the two larger stars in the Alpha Centauri system every 2,000,000 years. What is its average distance from the two other members of the system?
4. A sun-grazing comet will narrowly escape plunging directly into the Sun. If the comet's orbital period is 108 years, what is its *aphelion* distance from the Sun?

Solutions

Kepler's Third Law of Planetary Motion

1. A newly discovered dwarf planet is found to have an orbital semi-major axis of 57 A.U. What is the orbital period of this object?

$$P^2 = a^3$$

$$P^2 = (57)^3 = 57 \times 57 \times 57 = 185,193$$

$$P^2 = 180,000$$

$$P = (180,000)^{\frac{1}{2}} = \sqrt{180,000}$$

$$P = 420 \text{ yrs}$$

2. Saturn's average distance from the Sun is 9.58 A.U. What is the length of the ringed planet's year?

$$P^2 = a^3$$

$$P^2 = (9.58)^3 = 9.58 \times 9.58 \times 9.58 = 879$$

$$P = (879)^{\frac{1}{2}} = \sqrt{879}$$

$$P = 29.6 \text{ yrs}$$

3. Our sun's nearest neighbor, Proxima Centauri, is thought to orbit the two larger stars in the Alpha Centauri system every 2,000,000 years. What is its average distance from the two other members of the system?

$$P^2 = a^3$$

$$a^3 = (2,000,000)^2 = (2 \times 10^6)^2 = 4.0 \times 10^{12}$$

$$a = (4.0 \times 10^{12})^{\frac{1}{3}} = \sqrt[3]{4.0 \times 10^{\frac{12}{3}}} = 1.6 \times 10^4$$

$$a = 16,000 \text{ A.U.}$$

4. A sun-grazing comet will narrowly escape plunging directly into the Sun. If the comet's orbital period is 108 years, what is its *aphelion* distance from the Sun?

$$P^2 = a^3$$

$$a^3 = (108)^2 = 108 \times 108 = 11,664$$

$$a = (11,700)^{\frac{1}{3}} = (11,700)^{0.3333} = \sqrt[3]{11,700}$$

$$a = 22.7 \text{ A.U.}$$

$$2a = 45.4 \text{ A.U.}$$