

Practice Problems

1. Saturn's moon Titan has an orbital radius of 1.22×10^6 km and an orbital period of 15.9 days. Find the mass of Saturn.
2. A rocket is launched into space with an initial speed of 2.00×10^4 m/s. What will its speed be when it is very far from the Earth? Ignore friction and the rotation of Earth.
3. Two stars are nearly at rest when they are an infinite distance apart. Due to their gravitational attraction, they begin to move towards each other. Assume their masses are m_1 and m_2 and that their radii are r_1 and r_2 , respectively.
 - a. Once they are a distance d apart (from center of mass to center of mass), what is the speed of each planet and their relative speed?
 - b. What is the kinetic energy of each planet just before they collide? (Assume energy and momentum are conserved.)
4. Four particles of mass m are placed at the corners of a square of side $3d$. If the particles are brought together to form a square of side d , what is the change in gravitational potential energy of the system?
5. The position of a particle is given by $x(t) = (2.00 \text{ m}) \cos(5.00\pi t + \pi)$, where x is in meters, and t is in seconds.
 - a. Find the frequency and period of the motion.
 - b. Find the amplitude of the motion.
 - c. Find the phase constant.
 - d. Find the position of the particle at $t = 0.125$ s.
6. A 3.00-kg mass is hung from the bottom end of a vertical spring fastened to an the ceiling. the object is set into simple harmonic motion with a period of 9.30 s. Find the force constant of the spring.
7. An oddly shaped two-dimensional pendulum moves in simple harmonic motion with a frequency of 0.450 s^{-1} . The center of mass lies 0.350 m from the pivot point, and the pendulum has a mass of 2.20 kg. Find the moment of inertia of the pendulum about the pivot point.
8. An object of mass m is attached to a horizontal spring with force constant k on a frictionless surface. The system is displaced from equilibrium a distance ℓ and released with an initial velocity of v_0 back toward the equilibrium position.
 - a. What is the frequency of the SHO?
 - b. What is the initial potential energy of the mass and spring system?
 - c. What is the initial kinetic energy?
 - d. What is the motion's amplitude?