PS1

1. The gravitational force between two electrons 1.00 m apart is 5.54 x 10^{-71} N. Find the mass of an electron.
2. The asteroid Ceres has a mass of 7 x 10^{20} kg and a radius of 500 km.
   a. What is the acceleration due to gravity on the surface of Ceres?
   b. How much would an 85-kg astronaut weigh on Ceres?
3. Two spherical balls are placed so that their centers are 2.6 m apart. The force between the two balls is 2.75 x 10^{-12} N. What is the mass of the each ball if one ball is twice the mass of the other ball?
4. When a falling meteoroid is at a distance above the Earth's surface of 3.00 times the Earth's radius, what is its acceleration due to gravity?
5. A 27-kg sphere is located at the origin. A 12-kg sphere is located at x = 10 m. Where could a third mass be placed between the two spheres and experience a net force of zero?
6. A force of 40.0 N is required to pull a 10.0-kg wooden block at a constant velocity across a smooth glass surface on Earth. What force would be required to pull the same wooden block across the same glass surface on the planet Jupiter?

PS2

1. The center-to-center distance between the Earth and the Moon is 384,400 km. The Moon completes an orbit in 27.3 days.
   a. Determine the Moon's orbital speed.
   b. What is the centripetal acceleration of the Moon?
2. Mimas, one of Saturn's moons, has an orbital radius of 1.87 x 10^8 m and an orbital period of about 23 hours. Use this data to determine the mass of Saturn.
3. Plaskett's binary system consists of two stars that revolve in a circular orbit about a center of mass midway between them. This means that the masses of the two stars are equal. If the orbital speed of each star is 220 km/s and the orbital period of each is 14.4 days, find the mass M of each star. (Hint: Solve for the orbital radius first, then realize that orbital radius is not the same as the separation between the stars.)
4. A 200-kg satellite is placed in an orbit around the Earth with a radius that is half the radius of the Moon's orbit.
   a. What is the satellite's orbital speed?
   b. How many days does it take the satellite to complete one revolution?

PS3

1. A 100-kg satellite orbits Earth 225 km above its surface. What is its orbital speed?
2. On July 19, 1969, *Apollo 11*'s orbit around the Moon was adjusted to an average orbit of 111 km above the surface of the Moon.
   a. How many minutes did *Apollo 11* take to orbit the Moon once?
   b. At what speed did it orbit the moon?
3. A communications satellite in geosynchronous orbit remains above a single point on the Earth's equator as the planet rotates on its axis.
   a. Calculate the radius of its orbit.
   b. The satellite relays a radio signal from a transmitter near the north pole to a receiver, also near the north pole. Traveling at the speed of light (3.00 x 10^8 m/s), how long is the radio wave in transit?
4. How high does a rocket have to go above the Earth's surface before its weight is half what it would be on Earth?
5. If a small planet were located 8.0 times as far from the sun as Earth is, how many years would it take the planet to orbit the sun? (Use a proportion to answer this question rather than doing a lot of unnecessary math.)

PS4

1. A satellite of the Earth has a mass of 100 kg and is at an altitude of 2.00 x 10^6 m.
   a. What is the potential energy of the satellite?
   b. What is the magnitude of the gravitational force exerted by the Earth on the satellite?
   c. What force does the satellite exert on the Earth?
2. After our Sun exhausts its nuclear fuel, its ultimate fate may be to collapse to a white-dwarf state, in which it has approximately the same mass it has now but a radius equal to the radius of the Earth.
   a. Calculate the average density of the white-dwarf.
   b. What is the acceleration due to gravity at its surface?
   c. What is the potential energy of a 5-kg object at its surface?
3. At the Earth's surface a projectile is launched straight up at a speed of 10.0 km/s. To what height will it rise? Ignore air resistance.
4. A 500-kg satellite is in a circular orbit at an altitude of 500 km above the Earth's surface. Because of air friction, the satellite is eventually brought to the Earth's surface, and it hits the Earth with a speed of 2.00 km/s.
   a. What is the energy of the satellite when it is in orbit?
   b. What is the kinetic energy of the satellite when it hits the Earth?
   c. What is the gravitational potential energy of the satellite when it is on the Earth's surface?
   d. How much mechanical energy was lost to friction?
5. A spaceship is fired from the Earth's surface with an initial speed of 2.00 x 10^4 m/s. What will be its speed when it is very far from the Earth? (Neglect friction.)