(Orbits)

1) A 1 500 kg satellite is in a stable circular orbit at an altitude of 4.0×10^5 m above the Earth's surface. At what speed is the satellite travelling?

2) The moon Titan orbits the planet Saturn with a period of 1.4×10^6 s. The average radius of this orbit is 1.2×109 m.
a) What is Titan's centripetal acceleration?
b) What is Saturn's mass?

3) A satellite orbits Earth at a velocity of 3.1×10^3 m/s. What is the radius of this orbit?

4) Pluto has a mass of 1.31×10^{22} kg. Charon, Pluto's largest moon, has an orbital radius of 17 500 km.
a) What is Charon's orbital speed?
b) What is Charon's orbital period?

5) A satellite is in a circular orbit around a planet of mass 4.44×10^{23} kg. If the period of revolution 6.0×10^5 s, how far away is the satellite from the planet?

6) A satellite of mass m orbits Earth at a distance R with a period T and speed v. What will the period and speed be of a satellite…
a) of mass 2m (at the same distance, R)
b) orbiting at a distance 3R
c) orbiting at a distance ½R

(Gravitational Potential Energy)

7) How much work is required to lift a 1 200 kg object from the surface of Earth to an altitude of 9.6×10^5 m?

8) A 2.0×10^3 kg satellite travels in a stable circular orbit around the Earth. The orbital radius is 4.2×107 m.
a) What is the satellite's potential energy?
b) What is the satellite's kinetic energy?
c) What is the total energy of the satellite?

9) A 1 500 kg satellite is in a stable circular orbit at an altitude of 4.0×10^5 m. What is the satellite's total energy in this orbit?

10) A 3 500 kg object is at rest on the surface of Earth.
a) How much work is required to lift it to an altitude of 4.0×10^5 m?
b) How much work is required to lift it to infinity?
c) What is the escape velocity?

11) Show that ET = ½Ep for a body in a circular orbit around a planet where ET is the total mechanical energy of the orbiting body.

12) A ball is thrown vertically upwards from the surface of an asteroid of mass 4.60×10^{15} kg and radius of 8.30 km.
a) What height above the surface of the asteroid does the ball reach if it has an initial velocity of 5.0 m/s?
b) At what speed must the ball be thrown to escape the gravitational field of the asteroid?

13) A 6 540 kg satellite travels in a stable circular orbit around the earth. The orbital radius is 1.23×107 m. How much work is required to increase the orbital radius to 4.56×107 m?

14) Two planets, X and Y, are separated by a distance of 4.3×10^{11} m. Planet X has a mass of 6.6×10^{22} kg and Planet Y has a mass of 1.3×10^{23} kg.
a) At what point between the two planets would an astronaut have to be in order to feel no net force?
b) What is the gravitational potential energy of a 75 kg astronaut at this point?