Physics 513 Name:
Gravitation and Orbital Problems Date:

1) For this question, you will need the following information:
Mass of Sun – 1.99×10^{30} kg
Distance between Sun and Earth – 1.50×10^{11} m
Mass of Earth – 5.98×10^{24} kg
Distance between Earth and Moon – 3.84×10^{8} m
Mass of Moon – 7.36×10^{22} kg
Distance between Sun and Mars – 2.28×10^{11} m
Mass of Mars – 6.42×10^{23} kg
a) What is the gravitational attraction between the moon and Earth?
b) What is the gravitational attraction between the sun and Earth?
c) What is the gravitational attraction between the sun and Mars?

2) A 4000 kg satellite orbits the earth at a distance of 9.55×10^{6} m from the center of the earth.
a) What is the gravitational attraction experienced by the satellite?
b) What is the orbital speed of the satellite?
c) What is the orbital period of the satellite?

3) A satellite is orbiting Earth at 5430 m/s. What is the altitude of the satellite?

4) You are a space traveler and have just landed on the planet Humperdink. As you were approaching planet Humperdink, you were able to find the radius of the planet to be 2000 km and it's mass to be 6×10^{23} kg.
a) What is the gravitational field constant on the surface of this planet?
b) If you have a mass of 70 kg, what is your weight on Humperdink?

5) On Planet Y, the acceleration due to gravity is 7.5 m/s^2. The diameter of the planet is 3000 km.
a) What is the planet's mass?
b) What is the orbit speed of a satellite, which orbits 200 km from the planet's surface?

6) A star has three planets, Huey, Dewey and Louie. The innermost planet, Huey has an orbital period of 2 earth years and a mean orbital radius of 4.5×10^{5}m.
a) If Dewey has a mean orbital radius of 1.29×10^{6}m, what is its period?
b) Louie has an orbital period of 25 years, what is the mean orbital radius?
c) What is the mass of the star? (Hint: we discovered what the constant in Kepler's 3rd law was)
d) If I doubled the mass of Huey, what would happen to its period?
e) If I doubled the mass of Louie, what would happen to the force that the star exerts on it?
f) Calculate the average orbital speed of Huey in m/s.
g) Calculate the centripetal acceleration of Huey.

7) Planet X has two satellites, Bob and Mary. Bob has a period of 10 earth days and an orbital radius of 5×10^8 m. Mary has an orbital period of 18 earth days.
a) Find Mary's orbital radius
b) Find the mass of planet x
c) If the radius of Planet X is 9×10^5 m, find the acceleration due to gravity at the surface.

8) An asteroid is 5.6 times as far from the sun as the Earth. What is its orbital period in earth years?

9) A satellite takes 34 earth years to orbit the sun. How far from the sun is it?