## Homework \#3

## Due Tuesday, October 30 in class

## Instructions

This handout is your worksheet. Please write your answers in the spaces provided. In cases where a calculation is called for, please show your work including any sketches, so we can evaluate your answer and assign partial credit as appropriate. We will only accept homework on this worksheet.

1. Eris is the largest-known Pluto-like dwarf planet in the outer Solar System. It has an elongated elliptical orbit with an aphelion distance of 98 AU . If you were standing on the surface of Eris when it is at aphelion, how much fainter would the Sun appear to be compared to what we see here on Earth?
2. How far do you have to be from the Sun in AU in order for the gravitational force from the Sun on you to be 100 times smaller than the Sun's gravitational force on you right now?
3. Two identical robotic spacecraft are launched by NASA. The first is inserted into a circular orbit 20000 km from the center of the Earth, while the second flies to the planet Mongo and is inserted into a circular orbit that is also 20000 km from the center of Mongo. However, the spacecraft orbiting around Mongo has an orbital period of exactly $\mathbf{1} / 4^{\text {th }}$ the period of its sister spacecraft orbiting the Earth. What is the mass of Mongo in units of the mass of the Earth?

Note: you do not need to know G or the mass of Earth to do this problem, and you can assume that the masses of the both spacecraft negligibly small compared to the masses of Earth and Mongo.
4. You seal a sample of pure radioactive Unobtainium-123 into a jar and leave it alone for 24 years. After 24 years you open the jar and find that $3 / 4$ of the Unobtainium has decayed into a stable isotope of Illudium. What is the half-life of Unobtainium-123?
5. A new comet has been discovered far out in the Solar System. The semimajor axis of its long elliptical orbit around the Sun is 100 AU. Its perihelion distance is 1 AU. Answer the following questions:
a. On the figure below, label perihelion, aphelion, and the semi-major axis:

b. What is the comet's aphelion distance in AU?
c. How long will this comet take to complete one orbit around the Sun?
d. How much faster does the comet move at perihelion compared to when it is at aphelion (hint: use Newton's version of Kepler's n $^{\text {nd }}$ Law)?

