

ASTR 2310 General Astronomy I – Spring 2020, Brotherton

Homework #1, due in class Tuesday February 11, 2020

Instructions: Homework write-ups should be clean and clear. Illegible or hard to understand solutions may not earn credit. In addition to the solution, the steps leading to the solution are also important to earn full credit. You may need to use information from the internet to solve some of the problems, and you should clearly state your sources if you do so. Use appropriate units and significant figures for your solutions (or uncertainties if requested). It is permissible to work in groups, but everyone must hand in their own solutions that they have written themselves.

1. Slowing down to speed up...

Imagine you're an astronaut in a circular orbit 10,000 km from the center of the Earth. You do a burn to slow down to 6000 m/s, changing your circular orbit into an elliptical orbit. A) What was your initial speed in m/s? B) What is your minimum distance to the center of the Earth for the perigee of your new orbit in meters? C) What is your speed in m/s at the perigee of your new orbit? What percentage faster is it compared to your original circular orbit? D) What are the periods of the original circular orbit and the new elliptical orbit? Give your answers to three significant figures.

2. The masses of Pluto and Charon

Pluto and Charon represent a binary system, orbiting their common center of mass. Assume Charon is 8.2 times farther away from the center of mass than Pluto, their separation is 19,571 km, and the orbital period is 153 hours. What are their individual masses in kg? Give your answers to three significant figures.

3. Moonbase Alpha leaving the solar system!

In the old TV show Space 1999, there is an explosion on the moon resulting in our satellite achieving escape velocity from the solar system. A) What is escape velocity from the sun at 1AU in km/s? B) What is the moon's maximum speed in km/s relative to the sun? Draw a figure to indicate the geometry and the direction of the moon's motion relative to the sun and Earth. C) If the explosion provides a constant acceleration for 2.5 minutes, what is that acceleration in Earth gravities to achieve escape velocity in the easiest case? Give your answers to three significant figures.

4. Define / describe / explain:

- describe the virial theorem
- explain why Earth has two high tides each day
- what is the difference between perihelion and aphelion?
- what is the difference between apogee and aphelion?
- how many AUs are in a petameter? (use scientific notation)
- how is eccentricity defined? What range does it have?
- simply stated, what are Lagrangian points?