

MATH 392: Seminar in Celestial Mechanics

Homework Assignment #3

DUE DATE: Thurs., Feb. 7, start of class.

Homework should be turned in at the BEGINNING OF CLASS. You should write up solutions neatly to all problems, making sure to show all your work. You are strongly encouraged to work on these problems with other classmates, although the solutions you turn in should be your **own** work. Please cite any references (web based or text) that you may have used for assistance with the assignment.

Note: Please list the names of any students or faculty who you worked with on the top of the assignment.

1. Read Chapter 3 of *Celestial Mechanics: The Waltz of the Planets*, by Celletti and Perozzi. What was Bepi Colombo's big insight that aided the Mariner-Venus-Mercury mission and how does it relate to the featured topic of the chapter?
2. Consider the Kepler problem with gravitational constant $\mu = 3$ and mass $m = 1$. Suppose that at time $t = 0$, a planet has initial position and velocity given by the vectors $\mathbf{q}_0 = (1, 2, 2)$ and $\mathbf{v}_0 = (1, 0, -1)$, respectively.
 - a) Find the values of h and e and determine what type of path the planet traces out.
 - b) Find the vectors \mathbf{c} and \mathbf{e} .
 - c) At what time does the particle pass through pericenter?
 - d) Find the precise location (in rectangular coordinates) of the particle at time $t = 2$. This may require the use of a computer algebra system such as Maple.
3. Do the following exercises from Pollard's text: **7.2, 7.3, 8.3, 8.4**.
Some hints: For **7.2**, try using L'Hôpital's rule or Taylor series.