

Midterm - INTD290

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

February 19, 2021

1 How to Submit this Final

1. Complete your work on this midterm.
2. Scan it into PDF form using a smartphone app, scanner, or digital picture
3. Alternatively you can type up your answers in a separate file, but it still must be a PDF
4. Submit it using the link on Moodle

2 Kepler's Laws and The Venus Transit

1. **Kepler's First Law** Given that the *eccentricity* of most planetary orbits is small, we often treat them as a circle. (a) Why is Pluto different? (b) Suppose we call the radius of the orbit of the Earth around the Sun 1 AU, and 1 AU is 1.5×10^8 km. What is the orbital radius of Jupiter in km, if we determine it is 5.2 AU?

2. **Kepler's Third Law** Using Kepler's Second Law, fill in the table in Fig. 1. Compare to the data points in Fig. 1 (right).

Planet	Radius (AU)	Period (years)
Earth	1.0	1.0
Venus	0.72	
Mars		1.88
Jupiter	5.2	
Neptune		165

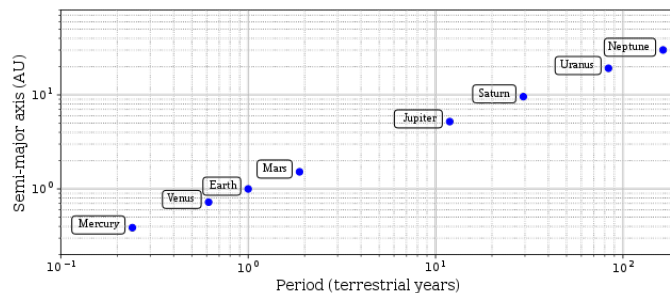


Figure 1: Fill in the table using Kepler's Third Law.

3. Recently, the European Southern Observatory in the Andes mountains of Chile released results regarding two exoplanets, obtained with the SPHERE instrument on the Very Large Telescope (VLT). Explain the significance of this result.

3 Navigation

1. Suppose we sail down a river, and use a Cartesian coordinate system to track our progress, in which the positive x-coordinate represents East and the positive y-coordinate represents North. (a) If we sail from $(1.1, 1.5)$ km to $(-2.1, 1.5)$ km, what distance did we cover? (b) In what direction are we heading?
2. Suppose we start at the origin of a coordinate system just like the one in the previous problem. We sail 2 km North, then 2 km East, then 1 km South, then 0.5 km East. (a) What is our final location? (b) How far are we away from the origin?
3. Recall that distance is equal to velocity multiplied by time duration. Suppose that our little boat travels 5 km per hour with the current. How long is the journey in the previous problem?