

Answers will be put on angel at 12:01pm, Tues, 9/29. Late papers be accepted until noon, Tues.

Planet	Period (yr)	Semi-major axis (AU)	Eccentricity
Mercury	0.241	0.387	0.206
Venus	0.615	0.723	0.007
Earth	1.000	1.000	0.017
Mars	1.881	1.523	0.093
Jupiter	11.86	5.202	0.049
Saturn	29.46	9.539	0.056

1. **Earth's orbit.** The eccentricity of Earth's orbit is 0.017, and its semi major axis is 1 astronomical unit, 1AU. Recall that the eccentricity is (distance between foci)/(major axis).
 - a. (3 pts.) Draw a picture of the earth's orbit that shows the sun, two foci, the semi major axis, and eccentricity.
 - b. (2 pts.) Find the largest and smallest distance between the earth and sun. Express your answer in AU.

2. **Summer is long and winter is short.** More precisely, the length of time from the spring equinox in March to the fall equinox in September (186.4 days) is longer than the time from the fall equinox to the spring equinox (179.1 days). This fact is a consequence of the earth's elliptical orbit, the tilt of its spin axis, and the relationship between the tilt and the orbit. (Recall that the sun is north of the equator in summer and it is on the equator on the equinoxes.)

20 Mar 2004 06:49	186.4 days	179.1 days
22 Sept 2004 16:30		
20 Mar 2005 12:33		

- a. (6 pts.) Draw the earth's orbit and tilt that accounts for the longer summer.
 - b. (4 pts.) Explain why summer is longer than winter using the key features in your picture.

3. **Halley's Comet** has an orbital period of 76 years, and its eccentricity is 0.967.
 - a. (2 pts.) How far from the sun does it get? How close to the sun does it get? Give your answer in AU
 - b. (4 pts.) Explain how you found the answer from (a) from the information given.
 - c. (2 pts.) What the ratio between its fastest and slowest orbital speeds?

4. **A new planet** is found around the star X. Its period is 3.6 days or 0.01 year. Assume the star is exactly like the sun and assume the orbit is circular.
 - a. (4 pts.) Is its orbit smaller or larger than that of Mercury around the sun? Explain how you can answer this without computing a numerical answer.
 - b. (3 pts.) Show how to compute the radius of the orbit.
 - c. (1 pt.) Give a numerical answer for the radius of the orbit.