1. In another solar system, a planet orbits the star at a distance 1 AU with a period of 2 earth-years.
   a. (5 pts.) Find the mass of the star. Express your answer in terms of the sun's mass.
   b. (0 pts.) Could Aristotle answer this question? (2 pts.) Explain your reasoning.
   c. (0 pts.) Could Kepler answer this question? (2 pts.) Explain your reasoning.
   d. (0 pts.) Could Newton answer this question? (2 pts.) Explain your reasoning.
2. **Halley's Comet** has an orbital period of 76 years, and its eccentricity is 0.967. Recall that the eccentricity is (distance between foci)/(major axis).
   a. (6 pts.) How far from the sun does it get? Give your answer in AU. (You must explain how you found this from the information given.)
   b. (2 pt.) How close to the sun does it get?
2. **First extra-solar planet.** On August 28, we discussed the observations of the motion of the star 51 Pegasi. You may read about it and other extrasolar planets in §9.6 of the textbook. The question that we address here is the mass of the planet. Assume that 51 Peg has the same mass as the sun and therefore Kepler's Third Law, $P^2=R^3$, is valid with the period in years and the radius in Astronomical Units.
   a. (5 pts.) Read parts b–e of this problem. Draw an "idea map" to show what information is needed to answer each part and where the information comes from.
   b. (5 pts.) How far does the star 51 Pegasi move in one orbit? What is the radius of the star's orbit in km?
   c. (5 pts.) Compute the radius of the planet's orbit in km. ($1AU=1.8\times10^8$ km.)
   d. (5 pts.) For a child and an adult to balance on a see-saw, they have to sit so that $R_{adult}\times M_{adult} = R_{child}\times M_{child}$, where R is the distance to the pivot and M is the mass. The same is true for 51 Peg and its planet. The pivot is the center of the orbits. Find the mass of the planet compared to that of the sun.
   e. (3 pts.) Is the mass of the planet similar to the Earth's or Jupiter's? The mass of the sun is 330,000 times that of the earth and 1,000 times that of Jupiter.

Starting in 1994, Michel Mayor & Didier Queloz of the Geneva Observatory have been observing the motion of the star 51 Pegasi. They found that it is moving towards us and then away from us and then toward us and then away and so on. It repeats every 4 days and 5 hours. The fastest it moves is 60 meters in a second, or 120 miles per hour. This is unusually slow for an astronomical object. The earth moves around the sun 5000 times faster. What could cause the star 51 Pegasi to move in this manner?