

Physics 1090 Homework #4

Due Thursday, September 24, 2:00 pm

1. As we've discussed, Archimedes found a lower bound to π by inscribing a succession of regular polygons in a circle. But he also found an upper bound by putting a circle inside a polygon.
 - (a) Draw a circle inside a square, touching each side at the midpoint. Prove from this that $\pi < 4$.
 - (b) What upper bound can you find by putting a circle similarly inside a hexagon?
2. Five years ago (June 8, 2004) Venus could be seen moving across the face of the Sun (it was easily visible from Charlottesville). This won't happen again until 2012.
 - (a) Since Venus is between us and the Sun, why are these transits so rare?
 - (b) They only ever occur in June or December. Can you suggest why they are not equally probable at any time of year?

3. Explain with a diagram the orbit of Venus in Ptolemy's model. If Ptolemy had had a telescope, and could see the phases (shadowing) of Venus, would that have given him any doubts about his model? Explain why or why not.

4. Mars in its path through the sky sometimes *loops backwards*.

Explain in your own words why this happens

- (a) using Ptolemy's model, and
- (b) with our present-day picture of the Solar System.

5. (a) Explain, with a diagram, what is meant by the "Ecliptic". What is the "Zodiac"?

(b) Find from a calendar the dates of the Winter Solstice, the Summer Solstice, the Spring Equinox and the Autumn Equinox. Draw a sketch of the Earth's path around the Sun, showing where it is on these four days, including an indication of the angle between the North Pole-South Pole axis and the direction to the Sun.

(c) Count the days exactly in the four quarters of the year between solstices and equinoxes. Are these periods all the same length? Would you expect them to be? Explain.