Physics 109: Homework #2 Solutions

2.1 There would need to be at least two spheres: one to account for the diurnal motion and one to account for the monthly motion of the moon. The former would require a sphere carrying the moon westward once per day. The latter would rotate once per sidereal month (27.3 days) eastward about an axis tilted with respect to the axis of the diurnal motion. (A third sphere completing one rotation in 18.6 yrs also tilted with respect to both previous spheres would be required to account for the movement of the Moon's nodes.)

2.2 The Greeks could not prove that either the Sun or the Earth was at the center of the solar system. Both possibilities were consistent with the observations that they had. The lack of stellar parallax (or, equivalently, the lack of changes in the sizes of the constellations during the year) argued that the Earth was stationary. But, the Earth could still be moving if the stars are very far away. The Sun being larger than the Earth, deduced by Aristarchus, argues that the Sun ought to be at the center. But, of course, this is not proof. The complete cycle of lunar phases proves that the Moon goes around the Earth (rather than the Sun). The occurrence of both solar and lunar eclipses also proves this.

2.3 The sound reasons for rejecting Aristarchus' heliocentric model were that during the course of a year (1) the stars did not appear to change in brightness and (2) the constellations remained unchanged in size and shape. These observations are, in fact, true and they imply that the stars are very distant, an idea that the Greeks were unprepared to accept. On the other hand, reasons having to do with the lack of great winds rushing across the Earth, the behavior of falling stones, or the Earth being too heavy to move are inconsistent with modern ideas of motion.

2.4 Mars: superior conjunction, opposition, quadrature. Venus: inferior conjunction.

2.5 The Greeks are believed to the first civilization that approached the study of astronomy with the goal of explaining and understanding what they observed. They laid down the foundations of astronomical study, i.e., observation, model building, and mathematical analysis, that remain an important part of modern astronomy.