Chp 3-Review Questions. Analyzing Scales and Motions of the Universe

1. Write the following numbers using powers-of-ten notation:
   a) 10 million
   b) 60 thousand
   c) four one-thousandths
   d) 38 billion
   e) your age in months
2. How is an astronomical unit (AU) defined? Give an example of a situation in which this unit of measure would be convenient to use.
3. Give the word or phrase that corresponds to the following standard abbreviations:
   a) km
   b) cm
   c) s
   d) km/s
   e) mi/h
   f) m
   g) m/s
   h) h
   i) ly
   j) g
   k) kg

Which of these are units of speed? (*Hint: You may have to refer to a dictionary. All of these abbreviations should be part of your working vocabulary.*)

4. A reporter once described a light-year as "the time it takes light to reach us traveling at the speed of light." How would you correct this statement?
5. When the *Voyager 2* spacecraft sent back pictures of Neptune during its flyby of that planet in 1989, the spacecraft's radio signals traveled for 4 hours at the speed of light to reach Earth. How far away was the spacecraft? Give your answer in kilometers, using powers-of-ten notation. (Hint: See the preceding question.)
6. How did the ancient Greeks explain why the Sun and the Moon slowly change their positions relative to the background stars?
7. In what direction does a planet move relative to the stars when it is in direct motion? When it is in retrograde motion? How do these compare with the direction in which we see the Sun move relative to the stars?
8. (a) In what direction does a planet move relative to the horizon over the course of one night? (b) The answer to (a) is the same whether the planet is in direct motion or retrograde motion. What does this tell you about the speed at which planets move on the celestial sphere?
9. What is the significance of Occam's razor as a tool for analyzing theories?
10. How did the models of Aristarchus and Copernicus explain the retrograde motion of the planets?
11. At what configuration (for example, superior conjunction, greatest eastern elongation, and so on) would it be best to observe Mercury or Venus with an Earth-based telescope? At what configuration would it be best to observe Mars, Jupiter, or Saturn? Explain your answers.
12. Which planets can never be seen at opposition? Which planets can never be seen at inferior conjunction? Explain your answers.

13. What is the difference between the synodic period and the sidereal period of a planet?
14. What are the foci of an ellipse? If the Sun is at one focus of a planet's orbit, what is at the other focus?
15. What are Kepler's three laws? Why are they important?
16. At what point in a planet's elliptical orbit does it move fastest? At what point does it move slowest? At what point does it sweep out an area at the fastest rate?
17. The orbit of a spacecraft about the Sun has a perihelion distance of 0.1 AU and an aphelion distance of 0.4 AU. What is the semimajor axis of the spacecraft's orbit? What is its orbital period?
18. A comet with a period of 125 years moves in a highly elongated orbit about the Sun. At perihelion, the comet comes very close to the Sun's surface. What is the comet's average distance from the Sun? What is the farthest it can get from the Sun?
19. What observations did Galileo make that reinforced the heliocentric model? Why could these observations not have been made before Galileo's time?
20. Why does Venus have its largest angular diameter when it is new and its smallest angular diameter when it is full?
21. What are Newton's three laws? Give an everyday example of each law.
22. How much force do you have to exert on a 3-kg brick to give it an acceleration of 2 m/s^2? If you double this force, what is the brick's acceleration? Explain your answer.
23. Suppose that Earth were moved to a distance of 3.0 AU from the Sun. How much stronger or weaker would the Sun's gravitational pull be on Earth? Explain your answer.
24. In 2006, Mercury was at greatest western elongation on April 8, August 7, and November 25. It was at greatest eastern elongation on February 24, June 20, and October 17. Does Mercury take longer to go from eastern to western elongation, or vice versa? Explain why, using Figure 3-8.
25. The mass of the Moon is 7.35×10^{22} kg, while that of Earth is 5.98×10^{24} kg. The average distance from the center of the Moon to the center of Earth is 384,400 km. What is the size of the gravitational force that Earth exerts on the Moon?
26. What is the size of the gravitational force that the Moon exerts on Earth? How do your answers compare with the force between the Sun and Earth calculated in the text?

<u>Chp 3-Discussion Questions. Analyzing Scales and Motions of the Universe</u>

1. Which planet would you expect to exhibit the greatest variation in apparent brightness as seen from Earth? Which planet would you expect to exhibit the greatest variation in angular diameter? Explain your answers.
2. What do you believe to be Galileo's single most important astronomical observation, and why it was most important?

<u>Chp 3-Collaborative Group Exercises. Analyzing Scales and Motions of the Universe</u>

1. Use two thumbtacks, a loop of string, and a pencil to draw several ellipses. Describe how the shape of an ellipse varies as the distance between the thumbtacks changes.
2. Use data from the appendix to determine how many Martian years old each member of your group would be if they were born on Mars.
3. Considering where your group is sitting right now, how many times dimmer would an imaginary, super-deluxe, ultrabright flashlight be if it were located at the front door of the group member who lives farthest away as compared to if it were at the front door of the group member who lives closest. Explain your reasoning.

4. Galileo's *Dialogue Concerning the Two World Chief Systems* described fictional conversations between three people. Create a short play using this style, describing Kepler's laws of planetary motion using each person in your group.

5. Astronomers use powers of ten to describe the distances to objects. List an object or place that is located at very roughly each of the following distances from you: 10^{-2} m, 100 m, 10^{1} m, 10^{3} m, 10^{7} m, 10^{10} m, and 10^{20} m.