Chapter 1

23) *Which of the following correctly lists our "cosmic address" from small to large?*
a) Earth, solar system, Milky Way Galaxy, Local Group, Local Supercluster, universe. We are located on the planet Earth orbiting the Sun with the rest of the solar system, which includes 8 large planets. The Sun orbits in the plane of the Milky Way galaxy, which is part of the Local Group of galaxies including one other massive spiral Andromeda and numerous less massive galaxies. The Local Group is part of a system of other galaxy groups, which comprises the Local Supercluster. Finally, all the structure we know is contained in the universe.

25) *The star Betelgeuse is about 600 light-years away. If it explodes tonight*
c) we won't know about it until about 600 years from now. A light year is defined as the **distance** light travels in one year, therefore if an object is 600 light years away the light will take 600 years to arrive. This happens because the speed of light is not infinite (just look at the communication times of the New Horizon Mission around Pluto) ; however, nothing travels faster than the speed of light.

47)*Suppose you wanted to reach Alpha Centauri in 100 years.* **a** *How fast would you have to go, in km/hr?* **b** *How many times faster is the speed found in part a than the speeds of our fastest current spacecraft (around 50,000 km/hr)?*
a) This is a question of unit analysis, so think of the units of speed (distance per time). The question gives us the time (100 yr) and Table F.1 gives the distance (4.4 ly) to Alpha Centauri in light years. So we just plug in distance over time to get 4.4ly/100yr, which is .044 ly/yr. Now we know the light year is defined as the distance light travels in a year so a light year per year is just the speed of light, approximately $3.0 \cdot 10^8$m/s. Since a kilometer is 10^3 meters, converting to km/s the speed of light is $3.0 \cdot 10^5$ km/s. So now we have $.044 \cdot 3.0 \cdot 10^5$km/s, which is 13191.2 km/s. Finally, we need to convert km/s to km/hr. We know there are 60 seconds in a minute and 60 minutes in an hour, so we multiply 13191.2 (km/s) by 60(s/m) and 60(m/h). The units of seconds and minutes will cancel producing the answer 47,488,140 km/hr.
b) If you ever hear the words times, compare, or ratio know that your answer will not likely have units. Now we want to know how much faster the speed we would need to go to get to Alpha Centauri in 100 years (47,488,140 km/hr) is than the faster spacecraft known to man (50,000 km/hr). Therefore, we divide the two answers (desired speed/obtainable speed), the units cancel, and the answer is a current generation spacecraft would have to go 945 times faster (approx. 1000) to get to Alpha Centauri in 100 years.

Chapter 2

26)*This morning I saw the full Moon setting at about the same time the Sun was rising*
This statement make sense. The full Moon occurs when the entire side of the Moon facing the Sun is visible from Earth. This happens when the Sun, Earth, and Moon are all in a line when looking "down" on the plane of the solar system. Since the full Moon is at its highest point in the sky at midnight and the Moon is up for approximately 12 hours a day, the rotation of the Earth (west to east) causes a full Moon to rise six hours prior to midnight (6 p.m.) and set six hours later (6 a.m.). Like the Moon the Sun is up

approximately 12 hours a day and it is at is peak at noon, therefore the Sun rises at 6 a.m. on an "average" day. Thus, a full Moon would be setting at approximately the time the Sun would be rising (look at Figure 2.22).

32)*If the Sun rises precisely due east,*
b) it must be the of either the spring or fall equinox. During the first day of fall and spring the Earth is aligned such that its axis tilt is pointed perpendicular to the imaginary line connecting the Earth and the Sun. This means the Sun will be directly aligned with the equator (not slightly north or south of the equator as in summer and winter), thus when the sun rises it will be due east.

42)*Assume you live on the Moon, near the center of the face that looks towards Earth.* **a***Suppose you see a full earth in your sky. What phase of the Moon would people on Earth see?* **b** *Suppose people on Earth see a full Moon. What phase would you see for Earth?* **c** *Suppose people on Earth see a waxing gibbous Moon. What phase would you see for Earth?* **d** *Suppose people on Earth are viewing a total lunar eclipse. What would you see from your home on the Moon?*
a) New Moon because the alignment would be Sun, Moon, Earth in a line, therefore the side of the Moon facing the Earth would not be lit by the Sun.
b) New Earth because the alignment would be Sun, Earth, Moon in a line, therefore the side of the Earth facing the Moon would not be lit by the Sun.
c) Waning crescent Earth because as the Moon becomes more illuminated by the Sun as viewed from Earth (i.e. waxing) the view of the Earth from the Moon would become less illuminated (i.e. waning) by the Sun. Since the Moon is mostly lit at the gibbous Moon phase (i.e. the Moon is behind the Earth with respect to the Sun), the view of Earth from the Moon would only observe a crescent Earth.
d)A lunar eclipse occurs when the Earth's shadow is blocking sunlight from reaching the Moon, therefore the Moon would be experiencing a solar eclipse.

55) *The Moon's precise equatorial diameter is 3476 km, and its orbital distance from Earth varies between 356,400 km and 406,700 km. The Sun's diameter is 1,390,000 km and its distance from Earth ranges between 147.5 and 152.6 million km.* **a** *Find the Moon's angular size at minimum and maximum distances from Earth.* **b** *Find the Sun's angular size at its minimum and maximum distances from Earth.* **c** *Based on your answers to parts a and b, is it possible to have a total solar eclipse when the Sun and the Moon are both at their maximum distance?*

This question is just trigonometry. Using the small angle approximation $\theta/2 =$ diameter/(2distance)), therefore $\theta =$ diameter/distance

a) During the Moon's closest approach its angular diameter is 0.56° and its at its farthest distance 0.49°.

b) During the Sun's closest approach its angular diameter is 0.54° and its at its farthest distance 0.52°.

c) The angular size of the Moon is less than the angular size of the Sun when both are at their farthest distance from Earth. This means the Moon will be unable to completely block the Sun as viewed from Earth. Thus, a complete Solar Eclipse is impossible.