APPENDIX A

Also see Appendix 7 in Zeilik & Gregory

Physical constants:

Atomic mass unit (amu) = 1.66044×10^{-24} g = 1.6605×10^{-27} kg
Boltzmann constant, k = 1.384×10^{-16} erg/K = 8.61×10^{-5} ev/K = 1.384×10^{-23} joule/K
Electron mass, $m_e = 9.1091 \times 10^{-28}$ g = 9.1091×10^{-31} kg
Hydrogen mass, $m_H = 1.67343 \times 10^{-24}$ g (includes mass of electron and binding energy)
Gravitational constant = 6.67×10^{-8} dynes cm^2/g^2 = 6.67×10^{-11} N m^2/kg^2
Planck's constant, h = 6.6256×10^{-27} erg sec = 6.6256×10^{-34} J sec
Proton mass $m_p = 1.67252 \times 10^{-24}$ g = 1.67252×10^{-27} kg.
Solar mass $M_\odot = 1.989 \times 10^{33}$ g = 1.989×10^{-30} kg
Solar radius $R_\odot = 6.96 \times 10^{10}$ cm = 6.66×10^{8} m
Solar luminosity, $L_\odot = 3.89 \times 10^{33}$ erg/s
Speed of light, c = 2.99×10^{10} cm/s = 2.998×10^{8} m/s
Stefan-Boltzmann constant, $\sigma = 5.6697 \times 10^{-5}$ erg cm^{-2} sec^{-1} K^{-4} = 5.6697×10^{-8} W/m^2 K^{-4}.
Wien's Law constant, a = 2.898 x 107 Å K
1 joule = 10^7 ergs
1 ev = 1.602×10^{-12} ergs = 1.602×10^{-19} j

APPENDIX B

Running SKYLAB

SKYLAB dates back to 1990 and runs via a DOS emulator in Windows. If you are going to be printing screen images from SKYLAB, make sure the Snagit Icon is already on the bottom menu bar. If not, you will need to activate this software by clicking on the Snagit icon, which is found in the Physics Programs folder.

To run SKYLAB, click on the Skylab icon, which is also to be found in the Physics Programs folder. A menu then opens and you will need to click on the appropriate icon again. A screen then opens and you are instructed to press any key to open the main menu. SKYLAB is navigated by means of the keyboard only, the mouse will not work. Here are some key functions:

Spacebar: pause or stop animation
Enter: Continue or accept choice made in a menu.
Escape: return to the previous step or screen
Right cursor key: fast forward animation
Left cursor key: fast backward animation
Up/Down cursor keys: move up and down in a menu or change declination
Tab: move to the next field for entering data such time, date, angle, etc.

To select an item or program in a menu, you may type the number of the item, the first letter of the item in a menu, or move up and down in a menu using the Up/Down cursor keys. Then press Enter.

Most programs have a menu bar at the top and/or bottom of the screen. To select any item listed in the menu bar, type the first letter of the word. If another menu opens when you do this, you many navigate the menu in the way just described.

APPENDIX C

Obtaining Hardcopy of the Monitor Screen Image

1. Make sure the icon for the software, ***Snagit***, is on the bottom menu bar. If not, click on the ***Snagit*** icon in the Physics Programs folder. When the ***Snagit*** window opens, minimize it.
2. Run ***Skylab*** and obtain the chart that you want to print.
3. Press ALT & ENTER (a new, smaller window will open with your chart)
4. Press the PRINT SCREEN key (upper right on keyboard). Another window will open. Click to maximize this window in the usual way.
5. Set the mouse cursor (now a cross-hair) in the left corner under the white menu bar (not in the blue menu bar with the "**Dos Box**"), click, and then drag down to the right bottom to encapsulate the entire chart. To be sure that you have encapsulated the entire chart, you may drag down past the chart into the white area.
6. Now move the mouse cursor to the menu bar above the encapsulated image and click on "crop." The snagit window will now show what is to be printed.
7. Now click "Image" on the top menu bar,
   Then click on "Scale,"
   Click on "200%." This will make the chart fill the page. Do not print a chart that is not the size of an entire page.
8. Click "Colors" on menu bar
   Click on "Invert." This reverses white and black colors. Do not print out a chart with a black background; it will be useless and a waste of ink.
9. Click on "File," then
   Page setup, then
   Properties,
   Then click on the "Orientation" tab."
   Then click on landscape,
   Then click OK, and you return to the previous window.
   Click OK again in this window.
   It may only be necessary to do step 9 the first time when getting a hard copy.
10. Click on the menu bar button with the green check mark where it says "Finish." This sends the image to the printer.
11. Click on the light blue bar at the top of the window with your chart image where it says "DOSBOX." The bar will change to dark blue indicating the window is activated.
12. Press ALT & ENTER and the ***Skylab*** screen returns. If ***Skylab*** does not immediately return, you may have to do this twice.

APPENDIX D

Drawing Diurnal Circles

Follow the directions below to help you draw diurnal circles on the answer diagram. For your first try; draw lightly with a pencil using the computer animation in ***Skylab 2*** to help you. When you have finished for all the declinations, draw your final rendition. **Use only a pencil,** so that you can erase any mistakes; you might want to color code the circles by declination. While drawing diurnal circles, proceed as follows:

1. First use a protractor and locate the positions of the celestial poles, if they are not already drawn on the answer diagram. The latter are to be placed on the local celestial meridian

(LCM) using the latitude angle.

2. Now draw a line connecting the poles. This line should pass through the center of the celestial sphere. This is the axis of rotation of the celestial sphere. Label it as such.
3. Now use the protractor and the latitude angle to find the two points where the celestial equator intersects the celestial meridian (LCM). Label the point on the upper LCM as **Σ** and the point on the lower LCM as **Σ′**.

   Warning: If your protractor is larger than the drawing of the celestial sphere, you will need to make marks that are off the **LCM** to indicate any angle you measure. To find where these marks should be on the **LCM**, lay a ruler along your mark and the center of the celestial sphere, then make a mark where the ruler crosses the **LCM**. This mark then indicates the actual point of upper or lower transit.

   Draw a faint line connecting the **Σ** and **Σ′** points. Do not extend the line beyond these points.
4. Now draw the celestial equator as an ellipse passing through these two points and the **E**ast and **W**est points. Make the half of the ellipse on the back of the celestial sphere to be a **dashed curve**. Check with Fig. 3-1. This is the diurnal circle of the Sun on the days of the equinoxes.
5. Indicate somewhere along the celestial equator that the declination is 0^o and draw 2 short, bold arrows along the circle, one on the back and one on the front, indicating the direction of diurnal motion.
6. When drawing the other diurnal circles for the Sun, look up the declination of the Sun when it as at the summer solstice or winter solstice, or use the declination given to you by your instructor. Use the declination of the object and your protractor to locate the upper transit (**UT**) and lower transit (**LT**) points on the local celestial meridian (LCM). To do this, set the zero line of the protractor along the line connecting the two points where the celestial equator crosses the LCM and measure the declination angle from those points. Make sure your marks are on the LCM, and then connect them with a faint straight line. For the Sun, label these points as **SUT** and **SLT**.
7. Once the points of upper and lower transit have been properly located on the **LCM,** connect these two points with a faint pencil line.
8. Through the point where the above line intersects the north-south (**N-S**) line, draw another faint guideline parallel to the east-west (**E-W**) line from horizon to horizon. The two points where this last line touches the horizon are the points where the Sun (or any object) rises and sets. Label them as **SSR** and **SSS**.
9. Draw a solid, concave curve from the upper transit (UT) point to the lower transit (LT) point and through the **rise-point** to represent the half of the diurnal circle on the front (east) side of the celestial sphere. Try to keep this curve symmetrical about the axis of rotation (the line connecting the celestial poles).
10. Now draw a dashed, concave curve from upper transit (UT) to lower transit (LT) and through the **set-point** to represent the half of the diurnal circle on the backside of the celestial sphere.
11. Indicate the direction of diurnal motion with a short arrow on the front half of the diurnal circle and another on the back half of the diurnal circle.
12. Indicate the declination of the diurnal circle somewhere along the circle like this $\delta = -45^o$.

In general your diurnal circles should adhere to the following properties:

1. They are circles centered on the axis of rotation.
2. They are circles lying in planes parallel to the plane of the celestial equator.
3. The points of upper and lower transit must be on the celestial meridian and symmetrically positioned on either side of the celestial poles.
4. The rise and set points must lie along a line parallel to the east-west line and in the plane of the celestial horizon.