Name		
Partner(s)		
Date		
Grade		
Category	**Max Points**	**Points Received**
On Time	5	
Printed Copy	5	
Lab Work	90	
Total	100	

Using Star Charts

1. Introduction

Star charts are literally maps of the sky. We use them for a number of purposes, such as telling us what time of night certain stars and constellations will be visible, plotting the positions of the Sun, Moon, and planets against the background stars, and locating non-stellar objects such as nebulae and galaxies in the sky. In this week's activity, we will become familiar with star charts and how to use them. You will use three types of star charts, all available from the **Sky Publishing Corporation** (http://www.skyandtelescope.com). These chart types are

- Sky and Telescope Star Wheel
- The SC1 Constellation Chart
- The Pocket Sky Atlas

Today in lab, you will use each of these charts to answer a set of astronomical questions. Later in the Semester, you may also be asked to use them in a nighttime observing exercise designed to help learn features of the sky.

Students may keep the SC1 chart for use throughout the semester. The star wheels and Pocket Sky Atlases should be returned to your teaching assistant at the end of the lab period or observing period.

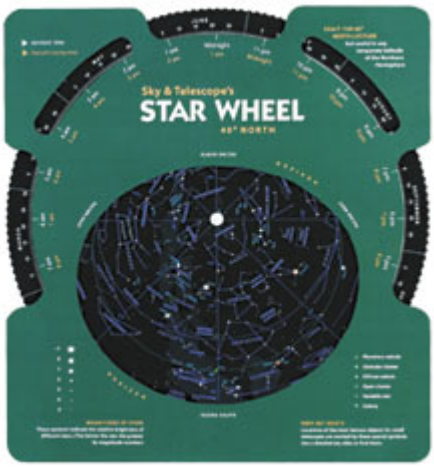
A Digression on Star Names

We will be spending a lot of time this semester finding stars and using them as points of reference. It is worthwhile to learn about how they are named.

- The brightest stars have commonly used names which come from Greek (Antares), Latin (Regulus, Castor, Pollux), and most commonly Arabic (Betelgeuse, Deneb, Algol)
- Second-ranked stars (less bright) also have Arabic names (Algenib, Na'ir al Saif, etc), but they typically don't appear in scientific use.
- The most common way of naming reasonably bright stars (even the brightest ones) is by a Greek letter, followed by the name of the constellation. Examples are Alpha Lyrae (α Lyr), Delta Scorpii (δ Sco), Beta Cygni (β Cyg). The choice of Greek letter indicates the relative brightness of the star compared to other stats in the constellation. Relative brightness follows the order of the Greek alphabet (α,β,γ,δ, etc.).
- You may also notice that the names of the constellations have changed a little, i.e. Lyra goes to Lyrae, Scorpius to Scorpii, and Cygnus to Cygni. Those who have studied Latin will recognize the latter form is the genitive, or possessive of the first form. Don't worry about the Latin grammar; just write them down as best you can.

2. The Star Wheel

The Star Wheel is an analog computer for calculating the **HORIZON SYSTEM** positions of stars, based on their celestial coordinates, the date, and the time of day. Star wheels are specific to the latitude at which observations are made. Rotate the wheel until the date of interest lines up with the time of day you want. Notice that you can choose either **DAYLIGHT SAVINGS TIME** (Yellow) or **STANDARD TIME** (White). The oval region shows you the stars that are above the horizon, and also shows the different directions. This oval region is a reasonably accurate picture of the sky above the horizon. It allows a good estimate of the azimuth and altitude angles of any star at the specified date and time. If you flip the star wheel over, you have an alternative (and in some ways superior) representation of the stars close to the horizon in the south and southwest.



2.1. Exercise

Use the star wheel provided to answer the following questions about the evening sky. Make sure to use the correct times (standard time vs. daylight-savings time) when answering the questions. Ask your lab instructor if you are unsure which time mode you are in. Each question is worth

Q1. Dial up 9PM for tonight. What constellation has just risen?

Q2. Which has just set?

Rise? _____

Set? _____

Q3. In what part of the sky at 9PM would you find the constellation of Ursa Major, otherwise known as **"The Big Dipper"**?

Part of Sky? _____

Q4. What bright star is close to the MERIDIAN and about halfway up the sky from due south?

Star Name? _____

Q5. The constellation Orion is a favorite nighttime object for many observers. What months is Orion visible in the early evening? For the purpose of this question, let "the early evening" be 7 PM.

Months? _____

Q6. The brightest star in the sky is Sirius, in the constellation of Canis Major (**"The Big Dog"**). On approximately what date will it be rising just before 5 AM standard time?

Date? _____

Interesting Note: This corresponded to the time of year when the Nile River flooded; the ancient Egyptians made a supernatural connection between the rising of this bright star, and the annual flood which brought life to Egyptian civilization.)

3. The SC1 COnstellation Chart

The SC1 chart is a flat, long strip of paper that resembles maps of the world. Instead of the surface of the Earth, however, the SC1 shows the surface of the celestial sphere. The two coordinates on the SC1 are the celestial coordinates of Right Ascension and Declination. The SC1 is useful for showing the coordinates and names

of a large number of stars. It can be used by itself for learning the constellations, although it is not quite as convenient as the star wheel.

The SC1 shows the MAGNITUDES of stars by the size of the dot representing the star. The correspondence between the magnitude of a star and the size of its plotted symbol is shown in the scale on the lower right edge of the chart. Note that the brightest stars like Arcturus and Vega have magnitude 0, while the faintest ones visible to the eye have magnitudes of about 5-6. The stars in the Big Dipper are "second magnitude", meaning magnitudes between 1 and 2.

The SC1 Chart can be used to tell which stars are up at any time of the day or night, although it is not as easy as with the star wheel. Along the bottom edge of the chart, just below the numbers corresponding to the RIGHT ASCENSION, are dates. A ruler placed vertically at that point shows the location of the meridian at 8PM standard time on that date. The location of the meridian at later times on that date can be found simply by moving the ruler 1 hour of Right Ascension to the left for each hour of time. Note the heavy double line running horizontally through the middle of the chart. This line represents the CELESTIAL EQUATOR. This is the line that defines a value of 0 degrees for the DECLINATION. The curved line that looks like the sine function from trigonometry represents the ECLIPTIC, which is an extremely important imaginary line in astronomy. This is the path along which the Sun, Moon, and planets move.
The dates along the ecliptic show you the location of the Sun on that date. From this chart, you can see that the Sun reaches its highest declination on about June 21.

With the data from Part 1.2, you can make a rough estimate of the length of today's day. First, use the measurements in Table 2 to calculate the angular distance θ the sun traveled between the two observations you made during lab. Next, divide this distance by the change in time between the measurements (in hours) to obtain the solar rate in deg/hour. Now consult Table 5 to estimate the total angular distance the sun will travel for today's date. Use the solar path length from the table and the solar rate you calculated to estimate the length of today's day. Do your calculations in the space provided below in Table 6.

3.1. Exercise

Answer the following questions using your SC1 Chart.

Q1. The celestial coordinates for M44 (**"The Beehive Cluster"**) are Right Ascension (RA) = 8h40m, Declination (Dec) = 20d. What constellation is M44 in?

Constellation? _____

Q2. What bright star has the following coordinates: RA = 19h51m, Dec = +8d51m?

Star Name? _____

Q3. Find the location of the meridian at 8PM tonight. Is the star you found above east of the meridian, on the meridian, or to the west of the meridian?

Location?

Q4.At 9PM Time tonight, where in the sky would you look to find the constellation Perseus?

Location?

Q5.What is the RA and Dec of the sun on the following days? March 21st?
Q6.June 21st?
Q7.August 21st?
Q8.December 21st?

Mar 21st

June 21st

Aug 21st

Dec 21st

4. "Sky and Telescope" Pocket Sky Atlas

The Pocket Sky Atlas is a detailed map of the sky in which each page shows a region about the size of a constellation, and which plots stars as faint as 7th magnitude. This is considerably fainter than can be seen with the unaided eye, but easily visible with binoculars. The Pocket Sky Atlas is useful for finding fainter stars, locating planets and asteroids that cannot be seen with the naked eye, and observing non-stellar objects such as nebulae and galaxies. We will use the Pocket Sky Atlas for this last purpose later in the semester.

An analogy can make the function of the Pocket Sky Atlas clearer. The star wheel and SC1 Chart are similar in function to a map of the entire world. The Pocket Sky Atlas is however more like an atlas which has a map of each state on a single page, with similar detail for the rest of the world.

The legend for the atlas is given just before Map 1, and shows the scale for the magnitudes of stars, the symbols used for star clusters and galaxies, etc. The maps are organized in sets of 10, with 10 maps being used to cover 3 hours of Right Ascension. For example, maps 1 - 10 cover the Right Ascension range 0h – 3h, charts 31 - 40 cover the range 9h – 12h, etc.

Each map shows the grid of celestial coordinates, allowing measurement of a position to fraction of a degree, the outline of constellations in that part of the sky, and the locations of galaxies, nebulae, and star clusters. Note that the smaller dots represent fainter stars. The location of the ecliptic is also indicated.

The Pocket Sky Atlas is a powerful aid to the sky, but it is best used together with the Star Wheel or SC1 to get oriented.

4.1. Exercise

Use any of the charts you like to answer the questions below.

Q1. An object of great interest in astronomy, which we will discuss later in the semester, has the following coordinates: RA = 0h43m, Dec = +41d16m. What is the name of this object?

Q2. What kind of astronomical object is it?

Name?	
Type?	

Q3. Give the name of a star located within a degree or two of this object which would help you find it in the night sky.

Q4. Give the name of a second star.

Star 1?	
Star 2?	

In the space provided below, draw a map that would help you find this object when observing it through the eyepiece of a low magnification telescope or a pair of binoculars. This sort of map is called a **FINDING CHART**. Keep in mind that the **FIELD OF VIEW** (the region of the sky you can see) with a small telescope is ~ 3-5 degrees. A good finding chart contains the brightest stars in the region and notes indicating where the object is situated relative to the pattern the stars make in the sky. Label the galaxy and bright stars and try to identify one geometric pattern (triangle, square) that will help you to better locate your object.