Name: _____

Date: _____

Section: _____

Astron 104 Laboratory #4
The Celestial Sphere

Basic Setup

Once the celestial sphere is properly setup, it will serve as an exact model of the heavens relative to your location on Earth. To achieve this, three basic steps are required.

1. **Set the Sun's location in the sky.**
   The small moveable Sun between the celestial sphere and the world globe can be adjusted based upon the time of year to show its location relative to Earth for any date and time.

   (a) The large outer sphere detaches from the base. Carefully remove it.

   (b) Using the calendar scale on the ecliptic of the celestial sphere as a reference, rotate the small white knurled knob to move the Sun around the ecliptic until it is positioned against the sky for the correct date.

2. **Set the orientation of the sphere.**
   The goal is to place the observer "on top of the world."

   (a) Now reinstall the metal circle so that the North Celestial Pole (NCP) is aligned in the general direction of the northern cardinal point (N) on the plastic base.

   (b) Orient the metal meridian so that the 24-hour time wheel "MIDN" mark points toward the zenith.

   (c) Using the angular scale on the metal meridian as a guide, rotate the celestial sphere so that the observer's latitude and corresponding declination are at the top of the sphere.

   (d) Using the large white knurled knob at the Celestial South Pole (CSP), rotate the earth so that the observer's longitude is at the top of the small globe.

3. **Set the time of observation.**
   Encircling the NCP of the celestial sphere is a calendar wheel with a scale that lines up with a fixed 24-hour time wheel.

(a) Set the time of observation by rotating the celestial sphere until the date marker aligns with the time marker.

(b) During daylight savings time (DST) use the hour that is 1 hour earlier on the fixed time wheel.

(c) Verify that the small world globe still has your observation point directly below the zenith.

Altitude and Azimuth

To locate a star in the sky, we can use the horizon of the observer as a reference. **Azimuth** is the equivalent of a compass direction, with 0° pointing North and 90° pointing East. **Altitude** is an indication of how far above (+) or below (−) the horizon an object is.

Your Relationship to the Universe

Once the Globe has been set for the place and time as outlined above, it becomes an actual model of the sky showing the stars and constellations in their correct positions. If you look through the transparent Celestial Globe, you will see the positions of the stars as seen from your location. For example, set the Globe for Milwaukee (latitude 43° N) at 10 pm on October 15. Then look through the Globe from the South toward the North Pole. Note that the Big Dipper is lying along the North Horizon, and Cassiopeia is above the North Star (Polaris is very close to the North Celestial Pole). *If you don't see these constellations in these locations, please ask for assistance.* Now rotate the Celestial Globe to 11 pm and notice that the stars appear to move in a counter-clockwise direction around the North Star.

Stars below the horizon are not visible. For a northern observer, the stars near the North Star will *never* go below the horizon while stars near the South Celestial Pole will *never* rise above the horizon. Other stars are visible between their rise and set times.

Apparent Motion

Our field of view as we look into the sky is determined by the time of day, the time of year, and your location on Earth. To demonstrate the fact that different stars are visible from different times and places, set the Globe for your location at 10 pm on December 15. Notice the *constellations* visible at that time. Then set the Globe for 10 pm on March 15, June 15 (DST), and September 15 (DST). Notice the seasonal changes. Record the constellation nearest the zenith for each of those dates [**5 pts each**]:

Date	Dec 15, 10pm	Mar 15, 10pm	Jun 15, 10pm	Sep 15, 10pm
Constellation nearest zenith				

Now rotate the Earth Globe from West to East one complete rotation with the knob at the South Celestial Pole. Notice that different sections of the sky are visible from your location throughout the day and night. When looking at the night sky, the stars appear to move from East to West. However, it is the rotation of the Earth from West to East that causes this apparent motion of the stars.

1. Determine what bright stars are visible from the North Pole, the equator, and the South Pole. [**10 pts**]

2. Find the location of Ursa Major (containing the Big Dipper) for 10pm on July 15 (DST) and 10pm on January 15 from your location. Double check that midnight on the hour dial is pointing toward the zenith. To indicate the location you should record the altitude and azimuth of Ursa Major on those dates. [**5 pts each**]

Date	Jul 15, 10pm	Jan 15, 10pm
Azimuth		
Altitude		

3. Where will the star Vega (in Lyra) be at 10 pm on January 15? Will it be visible from your location? [**5 pts**]

4. What constellations are never visible from your location? And which bright stars are always visible in the evening and do not rise or set? **[10 pts]**

5. Find the time of sunrise and sunset for December 23 and June 5 (DST) at your location. Determine the length of the day for each date. **[5 pts each]**

Date	Dec 23	Jun 5 (DST)
Sunrise		
Sunset		
Length of day		

6. What is the Sun's highest altitude above the horizon in Milwaukee for today? **[5 pts]**

7. Set the Globe for 0° (equator) and find the times of sunrise and sunset for December 23 and June 5. **[5 pts each]**

Date	Dec 23	Jun 5
Sunrise		
Sunset		

8. Set the Globe for Sydney, Australia (-35°) and determine whether or not it will be dark at 6pm on November 2. **[10 pts]**