The Rotating Sky – Student Guide

Don't write your answers on here!

III. Horizon Coordinates

1.) Complete the following table involving the horizon coordinate system. You should predict the answers and then use the simulator to check them. Place your location at the given latitude. Remember that you can measure coordinates by adding a star and then dragging the star to that location. *(Hint: You find your answers by adding stars to the simulation and finding the coordinates of those stars.)*

Description	Latitude	Azimuth	Altitude
West point on the horizon	Any		
Zenith	Any	Any	
NCP	20ºN		
NCP	61ºN		
SCP	58ºS		
SCP	Tropic of Capricorn		
Intersection of CE and Meridian	30ºN		
Intersection of CE and Meridian		0º	55º

2.) You have from your teacher a diagram known as a "fish-eye" view of the sky. Note that it is drawn like a sky-chart which is held up above your head and mimics the sky in that perspective. You should convince yourself that the east and west directions are shown correctly.

Star	Azimuth	Altitude
A	0°	20°
B	90°	0°
C	180°	-5°

Assume that you are at a northern mid-latitude of 40° N. You will be asked to create 3 stars, A, B, and C at specified azimuths and altitudes (the table above). You will then be asked to make predictions about the locations and motions of the stars as time advances. After drawing in your predictions you should use the simulator to check your answer. If your original prediction was in error, redraw your star paths to reflect the correct motion.

a) Draw in the location of the North Celestial Pole. Note that since this location is directly above the Earth's North Pole it will not move in the sky as Earth rotates.

b) Draw in star A (from table above) at the specified coordinates and assume that this is time t = 0 hrs. What will be the coordinates of star A at t = 6 hours?

At t = 6 hours?

Az:	Alt:

At t = 12 hours?

Az:	Alt:

At t = 24 hours?

Az:	Alt:

Draw in each of these locations and connect the path between the stars. For what fraction of the day is star A visible? _____

c) Draw in B at the specified coordinates and assume that this is time t = 0 hrs.

What will be the location of star B at t = 3 hours?

Az:	Alt:

At t = 6 hours?

Az:	Alt:

At t = 12 hours?

Az:	Alt:

Draw in each of these locations and connect the path between the stars. For what fraction of the day is star B visible? _____

d) Draw in C at the specified coordinates (as best you can) and assume that this is time t = 0 hrs.

Estimate the coordinates of the star at t = 6 hours?

Az:	Alt:

At t = 12 hours?

Az:	Alt:

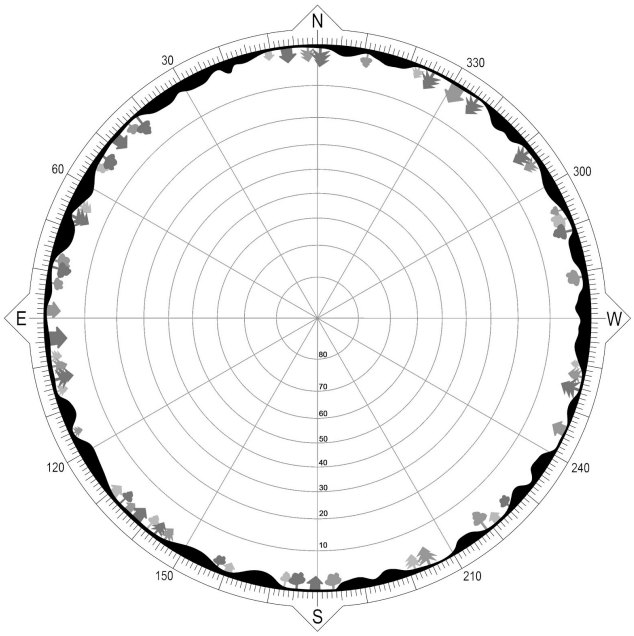
At t = 24 hours?

Az:	Alt:

For what fraction of the day is star C visible? _____

3.) Think about the characteristics of a star that passes through your zenith point (still at 40° N). Use the simulator to determine the following characteristics of this star. (start with a star at your zenith)

Rising Azimuth (where on the horizon the star rises) = _____



Setting Azimuth (where on the horizon the star sets) = _____

Declination = _____

IV. Declination Ranges

4.) The two end stars of the Big Dipper are known as the "pointer stars" since a line drawn through them points toward Polaris (a very important marker in the sky since it is located very near the NCP). Use the **constellations** control to add the Big Dipper to the celestial sphere. Now manipulate the observer's location to estimate where on the Earth the Big Dipper can always be seen, where it sometimes can be seen, and where it never can be seen. (Hint: you will need to use the **start animation** control since the Big Dipper can be either above or below the NCP.) Repeat with Orion and the Southern Cross.

Star Pattern	Latitudes where it Can Always Be Seen (circumpolar)	Latitudes Where it Can Sometimes Be Seen (rise and set)	Latitudes Where it Can Never Be Seen (never rise)
Big Dipper			
Orion			
Southern Cross			

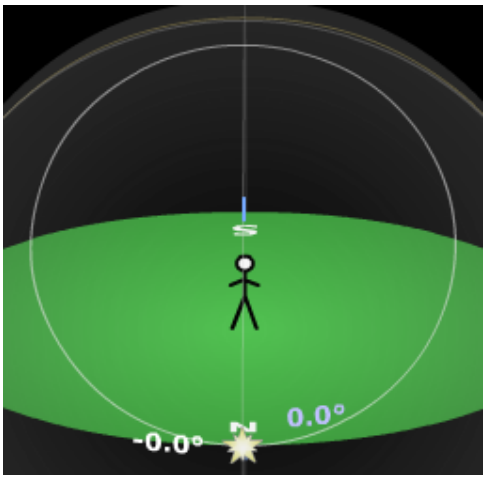
5.) In which of the 3 declination ranges (circumpolar, rise and set, or never rise) are stars A, star B, and star C found?

Star A: _____

Star B: _____

Star A: _____

Star	Azimuth	Altitude
A	0°	20°
B	90°	0°
C	180°	-5°



6.) Let's explore the boundaries of these 3 regions. Make sure you are still at a latitude of 40º N, create a star, select the long trails option for star trails, and animate for 24 hours so that a complete parallel of declination is made for the star. Now drag this active star so that it is at the north point of the horizon. (Make sure the star is active so you can read off its coordinates.) Note that a star with a slightly smaller declination would dip below the north point while a star that is closer to the NCP would obviously be circumpolar. Thus, this star's declination is a limiting value for the circumpolar declination range. Move the star to each of the following latitudes and Complete columns 2 and 3 on the next page for each of the given latitudes.

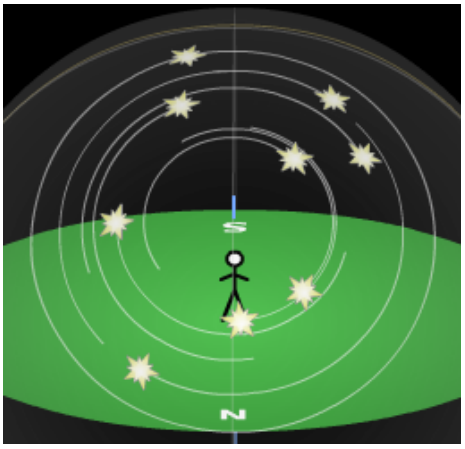
Column 1	Column 2	Column 3	Column 4	Column 5
Latitude	**North Point Declination**	**Circumpolar Range**	**South Point Declination**	**Rise & Set Range**
10º N				
25º N				
40º N	+50º	+50º to +90º		
55º N				
70º N				

Now drag the star to the south point on the horizon and read off the star's declination. This is a limiting value for the never rise declination range. You should now be able to complete columns four and five in the table above.

7.)

- Set the simulator up for an observer on the equator. Create some stars (~20) in the simulator and click animate continuously. Describe the circumpolar stars seen from the equator.
- Set the simulator up for an observer at the south pole. Make sure that there are still stars (~20) in the simulator and click animate continuously. Describe the circumpolar stars seen from the south pole.
- Use your experiences from questions 6, 7, and 8 to help you state a general rule for identifying the three declination ranges given the observer's latitude.

V. Star Trails



Visualizing star trails is an important skill that is very closely related to declination ranges. Again set up the simulator for a latitude of 40º N, create about 20 stars randomly in the sky, turn on long star trails, and click animate continuously. The view to the right illustrates the region around the north celestial pole. Realize that we need to imagine what these trails would look like from the stick figure's perspective.

8.) Move the horizon diagram so that you can see what the stick figure would see. Sketch the star trails from the observer's perspective for each of the following latitudes and directions. You should indicate the position of a pole when looking N or S.

9.) Note that the simulator has a display option that illustrates the angle that the celestial equator makes with the horizon. The angle will be nearly the same for other parallels of declination (i.e. star trails) near the east or west point. Use the table on the following page to record the star trail angle for rise and set stars at various latitudes.

Latitude	Direction	Star Trail Angle
10º N	E	
25º N	E	
40º N	E	
55º N	E	
70º N	E	

10.) Describe a general rule for determining your latitude from looking at star trails.