Earth's Orbital Motion and Seasons - Exercise

Student Name: ______________________________

Step 1.

A. Start Stellarium. It should be in the default configuration you setup in the Using Stellarium exercise. You should be viewing to your South and set the program to full screen.
B. Bring up the Location Window and make sure you are set to your default location.
C. Bring up the Date/Time Window and set the time for 13:30:00 local time on 2010/3/21. This will be close to the March Equinox. Move the Date/Time Window to the upper right corner and leave it open.
D. Open the Sky/View Options Window and under the "Markings" heading, set the value for "Projection" to "Perspective". Set your latitude to 33 degrees north.
E. Set you view to the South with a FOV of about 100°.
F. Turn off the Equatorial grid off and turn on the Azimuthal grid and turn the atmosphere off.
G. Click on the Sun, but do not center it. Instead, drag the horizon down close to the bottom of the screen.

Step 2.

H. Let's examine the change in the maximum angle of the Sun from the horizon at each of the solstices and equinoxes.
I. While watching the movement of the Sun and the Sun's data in the upper left of the screen:

- **Question 1:** What is the Altitude of the Sun?

  __________° ________' __________"

J. Move the month to June (2010/6/21).

- **Question 2:** What is the Altitude of the Sun on this date/time?

  __________° ________' __________"

K. Move the month to September (2010/9/21).

- **<u>Question 3:</u>** What is the Altitude of the Sun on this date/time?

  __________° ________' __________"

L. Move the month to December (2010/12/21). Also, change the time to 12:32:00 (to compensate for the change from Daylight Savings time to Standard time)

- **<u>Question 4:</u>** What is the Altitude of the Sun on this date/time?

  __________° ________' __________"

M. Convert these altitudes to decimal degrees, place the answers in Table 1. and then complete the calculations in Table 1.

- **<u>Question 5:</u>** What is the average change in the Altitude? (average the absolute value of the three differences you calculated)

  ____________________ (Decimal Degrees)

- **<u>Question 6:</u>** What would you expect the average to be?

  ____________________ (Decimal Degrees)

- **<u>Question 7:</u>** What would explain the differences in your average and the value you expected?

  ____

Step 3.

N. It is often useful to examine the extremes. Let's look at the North Pole at the solstices and equinoxes.

O. Open the Location Window and change the Latitude to 90° 00' 00" and hit the enter key. Close the window.

P. Open the Sky and Viewing Window and under "Landscapes" select the "Ocean" landscape (this will give us a flat horizon to look at) and close the window. Turn the Landscape on.

Q. Make sure the atmosphere is on and use the Date/Time Window to set the date to 2010/6/21 and the time to 12:30:00. This will be the approximate **June Solstice**. Leave the window open and in the upper right hand corner.

R. Select the Sun and center it, and set the FOV to about 50 - 60 °

S. While watching the movement of the Sun and the Sun's data in the upper left of the screen, advance the time in one hour increments for 24 hours.

- **Question 8:** At what time does the Sun set?.

  ____

T. Move the time back and forth one whole day, in one hour increments, to determine the following: (you can turn off the atmosphere to help read the Sun's data in the upper left of the screen)

- **Question 9:** What is the lowest Altitude of the Sun during this 24 hour period?

  __________° ________' __________"

- **Question 10:** What is the highest Altitude of the Sun during this 24 hour period?

  __________° ________' __________"

- **Question 11:** What is the average of these two Altitudes?

  ________________° (decimal)

- **<u>Question 12:</u>** What does this number represent?

  ____

U. Now let's look at the approximate **March Equinox**. Move the date to (2010/3/20) and the time to 12:30:00. The Sun should be on the horizon.

V. Repeat Step 3.S above for the following questions.

- **<u>Question 13:</u>** Does the Sun ever get completely above the horizon? _________
- **<u>Question 14:</u>** Does the Sun ever get completely below the horizon? _________

W. Move the date to December (2010/12/21), at 12:00:00. This is the approximate **December Solstice**.

X. Again, repeat Step 3.S to answer the following:

- **<u>Question 15:</u>** What time does the Sun rise on this date?

  ____

- **<u>Question 16:</u>** What time does the Sun set on this date?

  ____

Date	Decimal Deg.	Diff. 3/31 6/21	Diff. 6/21 9/21	Diff. 9/21 12/21
3/21				
6/21				
9/21				
12/21				

Table 1.

Appendix: Calculating Decimal degrees from Degrees/Minutes/Seconds

Divide the Minutes by 60 and add the fraction to the Degrees.

Divide the Seconds by 3600 and add that fraction to the Degrees also.

This gives the Degrees in Decimal form.