Lab 2
The Origin of the Seasons

Names: _____

Exercise #1

1. Do you think this change in distance is big enough to cause the seasons? Explain your logic. **(3pts)**

2. Take the ratio of the aphelion to perihelion distances: _____ **(1pt)**

   Sun diameter in January image = _____ mm

   Sun diameter in July image = _____ mm

3. Take the ratio of bigger diameter / smaller diameter, this = _____. **(1pt)**

4. How does this ratio compare to the ratio you calculated in question #2? **(2pts)**

5. So, if an object appears bigger when we get closer to it, in what month is the Earth closest to the Sun? **(2pts)**

6. At that time of year, what season is it in Las Cruces? What do you conclude about the statement "the seasons are caused by the changing distance between the Earth and the Sun"? **(4pts)**

7. Thus, for Las Cruces, the Sun is "up? longer in July than in January. Is the same thing true for all cities with northern latitudes? Yes or No ? **(1pt)**

   Ok, let's compare Las Cruces with Fairbanks, Alaska. Answer these questions by filling in the blanks:

8. Fairbanks is (closer to / further from) the North Pole than Las Cruces. **(1pt)**

9. In January, there are more daylight hours in _____. **(1pt)**

10. In July, there are more daylight hours in _____. **(1pt)**

    Now let's compare Las Cruces with Sydney, Australia (fill in the blanks).

11. While the latitudes of Las Cruces and Sydney are similar, Las Cruces is _____ of the Equator, and Sydney is _____ of the Equator. **(2pts)**

12. In January, there are more daylight hours in _____. **(1pt)**

13. In July, there are more daylight hours in _____. **(1pt)**

14. **Summarizing:** During the Wintertime (January) in both Las Cruces and Fairbanks there are fewer daylight hours, *and* it's colder. During July, it is warmer in both Fairbanks and Las Cruces, *and* there are more daylight hours. Is this also true for Sydney?: _____ **(1pt)**

15. In fact, it is wintertime in Sydney during _____, and summertime during _____. **(2pts)**

16. From Table 2.1, I conclude that the times of the seasons in the Northern hemisphere are exactly _____ to those in the Southern hemisphere. **(1pt)**

The Spinning, Revolving Earth
Experiment #1:

Table 2.2: Position #1: Equinox Data Table **(4pts)**

Latitiude	**Length of Daylight Arc**	**Length of Nighttime Arc**
Equator		
45° N		
Arctic Circle		
Antartic Circle		

Table 2.3: Position #1: Length of Day and Night **(2pts)**

Latitiude	**Daylight Hours**	**Nighttime Hours**
Equator		
45° N		
Arctic Circle		
Antartic Circle		

17. The caption for Table 2.2 was "Equinox data". The word Equinox means "equal nights", as the length of the nighttime is the same as the daytime. While your numbers in Table 2.3 may not be exactly perfect, what do you conclude about the length of the nights and days for *all*

latitudes on Earth in this experiment? Is this result consistent with the term Equinox? **(3pts)**

Experiment #2:

Table 2.4: Position #2: Solstice Data Table **(2pts)**

Latitiude	**Length of Daylight Arc**	**Length of Nighttime Arc**
Equator		
45° N		
Arctic Circle		
Antartic Circle		

Table 2.5: Position #2: Length of Day and Night **(2pts)**

Latitiude	**Daylight Hours**	**Nighttime Hours**
Equator		
45° N		
Arctic Circle		
Antartic Circle		

18. Compare your results in Table 2.5 for +45° latitude with those for Minneapolis in Table 2.1. Since Minneapolis is at a latitude of +45° , what season does this orientation of the globe correspond to? **(2pts)**

19. What about near the poles? In this orientation what is the length of the nighttime at the North pole, and what is the length of the daytime at the South pole? Is this consistent with the trends in Table 2.1, such as what is happening at Fairbanks or in Ushuaia? **(4pts)**

Experiment #3:

Table 2.6: Position #3: Solstice Data Table **(2pts)**

Latitiude	**Length of Daylight Arc**	**Length of Nighttime Arc**
Equator		
45° N		
Arctic Circle		
Antartic Circle		

Table 2.7: Position #3: Length of Night and Day **(2pts)**

Latitiude	**Daylight Hours**	**Nighttime Hours**
Equator		
45° N		
Arctic Circle		
Antartic Circle		

20. As in question #19, compare the results found here for the length of daytime and nighttime for the +45° latitude with that for Minneapolis. What season does this appear to be? **(2pts)**

21. What about near the poles? In this orientation, how long is the daylight at the North pole, and what is the length of the nighttime at the South pole? Is this consistent with the trends in Table 2.1, such as what is happening at Fairbanks or in Ushuaia? **(2pts)**

22. Using your results for all three positions (Experiments #1, #2, and #3) can you explain what is happening at the Equator? Does the data for Quito in Table 2.1 make sense? Why? Explain. **(3pts)**

Exercise #4:

23. Turn on the flashlight and move the arm to lower and higher angles. How does the illumination pattern change? Does the illuminated pattern appear to change in brightness as you change angles? Explain. **(2pts)**

24. The diameter of the illuminated circle is _____ cm.

    The area of the circle of light at an elevation angle of 90° is _____ cm^2. **(1pt)**

25. The major axis has a length of $a =$ _____ cm, while the minor axis has a length of $b =$

_____ cm. The area of an ellipse is simply ($\pi \times a \times b$)/4. So, the area of the ellipse at an elevation angle of 45°: _____ cm^2. **(1pt)**

26. At 90°, the amount of light per centimeter is 100 divided by the area of circle = _____ units of light per cm^2. **(1pt)**

27. At 45°, the amount of light per centimeter is 100 divided by the area of the ellipse = _____ units of light per cm^2. **(1pt)**

28. Since light is a form of energy, at which elevation angle is there more energy per square centimeter? Since the Sun is our source of light, what happens when the Sun is higher in the sky? Is its energy more concentrated, or less concentrated? How about when it is low in the sky? Can you tell this by looking at how bright the ellipse appears versus the circle? **(4pts)**