Lunar Eclipse Observations Name_____

Check the syllabus page for the dates and times of a lunar eclipse. If there is an event at DVC it will be listed there as well. But you can do this observation from your home. The reason to come to DVC would be for help and companionship

No other dates are possible and there is no make up for rain etc. If you want to use the eclipse observation for an Astro 128 observing project, make a back-up plan (like the museum visit or star tracking observation project). For in-person classes, there is no make up.

Materials: Paper, pencil, compass or string and a pin or another pencil.

Read through the entire exercise ahead of time. The eclipse goes too fast for you to figure things out while it is happening.

You will observe the Moon while it is in eclipse and as it enters or exits eclipse. If there is a total eclipse, make one observation while the Moon is entirely covered. You will draw the edge of he Earth's shadow on the Moon and will estimate the relative sizes of the Earth and the Moon, the time for the Moon to go through Earth's shadow and the darkness of the shadow.

The Danjon scale, described at the end of this write up, is a standard way to estimate the color of Earth's shadow. The shadow is not totally dark, because some sunlight comes through Earth's atmosphere and is bent so that it hits the Moon. The Earth's atmosphere and pollution remove much of the light, leaving rust color to dark gray light on the Moon. Since the amount of light differs for each eclipse, observers (like yourselves) are asked to estimate the color.

Record your values in the table provided and turn in the drawings of the Moon and Earth's shadow.

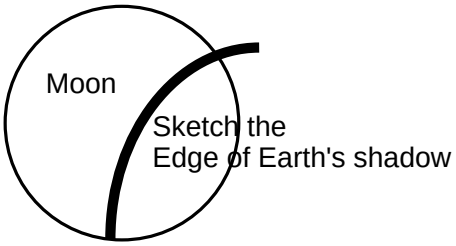
1) Observe the Moon while it is still entirely in eclipse, if it is a total eclipse. Use the Danjon scale described below to describe its appearance. Enter your data in the table. There is no way to see the edge of Earth's shadow.

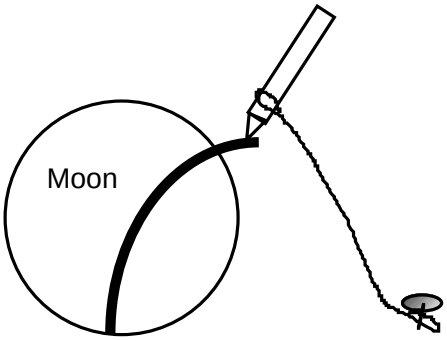
2) Sketch the Moon with the Earth's shadow edge at 3 different times as the Moon enters or exits the Earth's shadow. Make your observations at **least** 5 minutes apart. If only a tiny part of the shadow is on the Moon, it will be hard to detect the shadow. So don't make your observations at the very start or end of the eclipse. The circles below are meant to be the Moon. Sketch the shadow edge on the Moon. Be sure to put the date, time and direction toward the ground on each picture. ALSO record the information on the table.

3) The Earth's shadow is a circular (Why?)

4) Trace over the shadow edge with a compass and measure the radius of the Earth's shadow. If you do not own a compass, you may use a pencil with a string tied around it. Hold down the string where you think that the center of the shadow should be.

The shadow is quite a lot larger than the Moon. If you draw the Moon on a regular piece of 8.5 x 11 inch paper, the shadow probably will not fit. Don't recopy the sketch of the shadow. Make the paper bigger. Tape the paper with the Moon pictures onto a large piece of paper, such as a grocery bag or a newspaper, so it will not move. Then adjust BOTH the position of the center of the shadow circle, and the radius until you can get the circle to trace out the edge of the shadow.





To make a circle
Tie a string around a pencil
Pull the string taut and hold the end still
The pencil will make a circle.

Adjust the length of the string and the position of the end until the circle lies right on top of the shadow edge.

The string length is the radius of the shadow.

Do this for all three pictures of the Moon in the Earth's shadow

5) Neither the size of the Moon, nor the radius of the Earth's shadow is really changing during the eclipse. So average your values for the radius of Earth's shadow.

6) The radius of the picture of the Moon and the radius of the shadow represent the sizes of the Moon and the Earth. Divide the radius of the Moon picture by the average radius of the Earth shadow. This is roughly the ratio of their sizes

7) Find the ratio of the size of the Moon and the size of the Earth using their radii from your textbook. Your value is an approximation to this value.

8) Calculate the percentage error in your value of the ratio.

(The Earth's shadow is actually about 25% smaller than Earth, so don't expect your value of the ratio to be perfect).

9) Write an objective and a conclusion.

Turn in the table, the drawings, and an objective and conclusion (for lab).

Time	Shadow Brightness Danjon scale	Radius of Shadow (in centimeters)
		(during total eclipse if possible)
Average Radius of Earth's Shadow		
Ratio Moon Size/ Average Shadow Size based on your observations		
Ratio Moon Size/ Shadow Size using diameters from your textbook		
Percentage error in your ratio $\text{Percentage error} = \left(\frac{\text{your value} - \text{accepted value}}{\text{accepted value}} \right) \times 100$		

Danjon Scale of Lunar Eclipse Brightness

From Fred Espenak

The Moon's appearance during a total lunar eclipse can vary enormously from one eclipse to the next. Obviously, the geometry of the Moon's path through the umbra plays an important role. Not as apparent is the effect that Earth's atmosphere has on eclipses. Although the physical mass of Earth blocks off all direct sunlight from the umbra, the planet's atmosphere refracts some of the Sun's rays into the shadow. Earth's atmosphere contains varying amounts of water (clouds, mist, precipitation) and solid particles (dust, organic debris, volcanic ash). This material filters and attenuates the sunlight before it's refracted into the umbra. For instance, large or frequent volcanic eruptions dumping huge quantities of ash into the atmosphere are often followed by very dark, red eclipses for several years. Extensive cloud cover along Earth's limb also tends to

darken the eclipse by blocking sunlight. The French astronomer A. Danjon proposed a useful five point scale for evaluating the visual appearance and brightness of the Moon during total lunar eclipses. 'L' values for various luminosities are defined as follows:

L = 0 Very dark eclipse.
Moon almost invisible, especially at mid-totality.

L = 1 Dark Eclipse, gray or brownish in coloration.
Details distinguishable only with difficulty.

L = 2 Deep red or rust-colored eclipse.
Very dark central shadow, while outer edge of umbra is relatively bright.

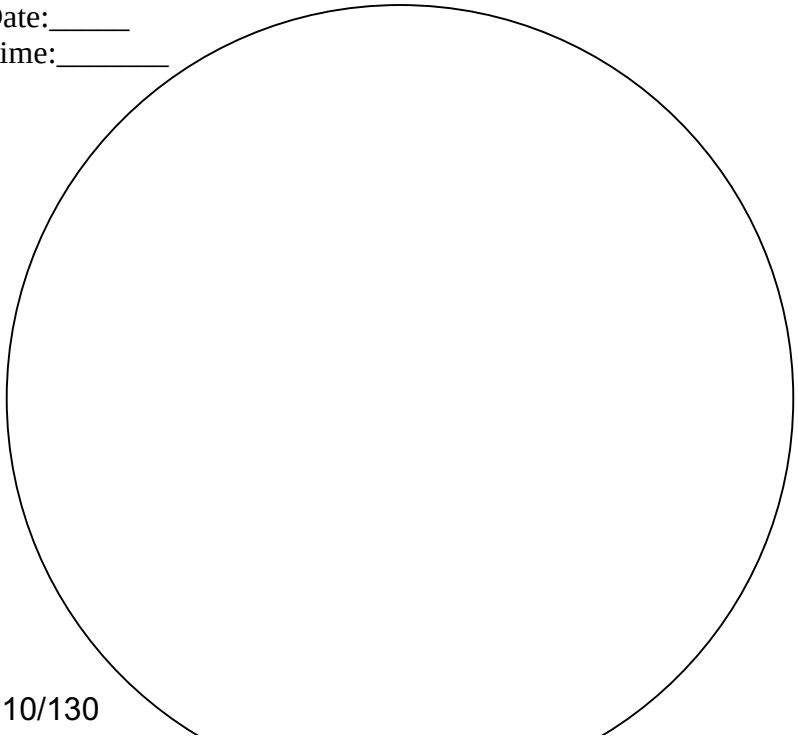
L = 3 Brick-red eclipse.
Umbral shadow usually has a bright or yellow rim.

L = 4 Very bright copper-red or orange eclipse.
Umbral shadow has a bluish, very bright rim.

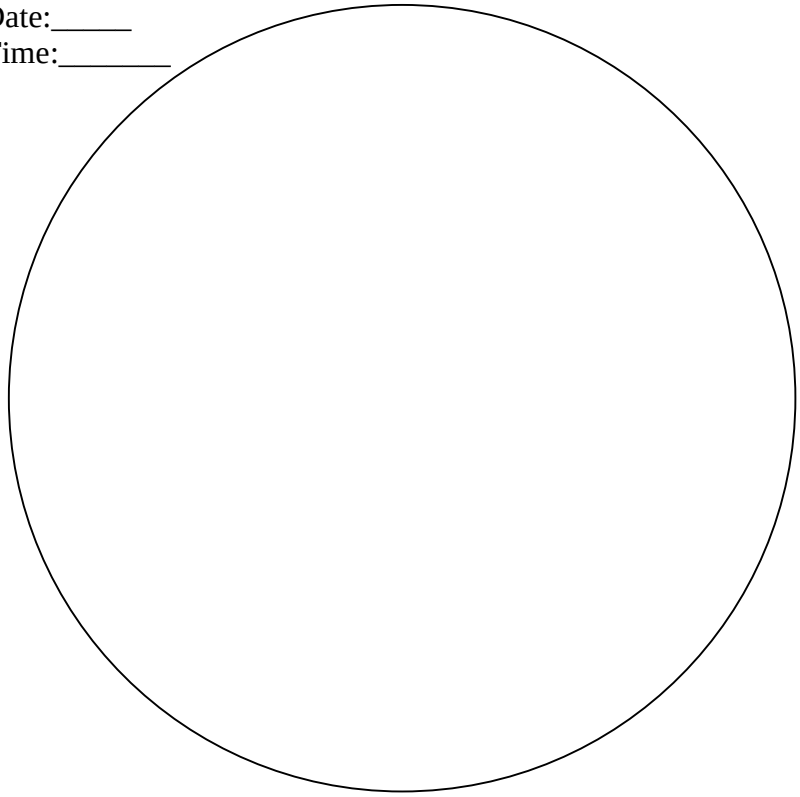
The assignment of an 'L' value to lunar eclipses is best done with the naked eye, binoculars or a small telescope near the time of mid-totality. It's also useful to examine the Moon's appearance just after the beginning and before the end of totality. The Moon is then near the edge of the shadow and provides an opportunity to assign an 'L' value to the outer umbra. In making any evaluations, you should record both the instrumentation and the time. Also note any variations in color and brightness in different parts of the umbra, as well as the apparent sharpness of the shadow's edge. Pay attention to the visibility of lunar features within the umbra. Notes and sketches made during the eclipse are invaluable in recalling details, events and impressions.

Observers are encouraged to make Dajon brightness estimates and to report them to Sky and Telescope.

Date:_____
Time:_____



Date:_____
Time:_____



Date:_____
Time:_____