

Name: _____

Date: _____

Section: _____

Astron 104 Laboratory #4

Phases of the Moon

Section 0.3

Introduction

In this lab, you'll investigate how the observed phase of the Moon depends on its positions relative to the Earth and Sun.

Learning Objectives

At the Completion of this lab, you should be able to:

1. Describe the geometry and scale of the Earth-Moon-Sun system.
2. Sketch the view of the Moon from Earth given its position relative to the Sun and Earth.
3. Estimate time of day/night for an observer given the position and rotation of Earth relative to the Sun.

Earth's Motion [30 pts total]

On the last page of this lab is the beginning of a drawing of the Earth-Moon-Sun system as viewed from above Earth's northern hemisphere. In addition to answering the questions, you will add details to your drawing as you go along.

1. Label Earth and the Moon and draw lines to indicate the orbit of each body (Earth's orbit doesn't need to be a complete circle, but the Moon's does) [5 pts].
2. At what position on Earth is it local noon in your sketch? Draw a stick figure of a person at that location on your drawing. [5 pts]

3. Which direction is West and which direction is East from where your stick figure is standing? (Remember, we're looking down on the North Pole.) Draw a "W" and an "E" for these directions. **[5 pts]**
4. The Sun appears to rise in the East and set in the West. Does Earth rotate clockwise or counterclockwise in your drawing? Draw an arrow to mark the rotation. **[5 pts]**
5. What time is it for an observer on the opposite side of the Earth from your stick figure? Label both times in your sketch. What time is it for observers halfway between the labeled times? (Hint: is the Sun rising or setting for a person in those locations?) Label those times as well. **[5 pts]**
6. Earth orbits the Sun in the same direction that it rotates. Indicate the direction of Earth's orbital motion with an arrow. Does the Earth orbit clockwise or counterclockwise in your sketch? **[5 pts]**

Moon's Motion [25 pts total]

The Moon orbits and rotates in the same direction as Earth.

1. Indicate these motions with arrows on your diagram. **[5 pts]**
2. In fact, the Moon's orbital and rotational periods are equal. So the Moon makes 1 rotation for every 1 orbit around the Earth. On your diagram, place an "X" on the side of the Moon facing Earth. Add three more Moons to your sketch, showing the Moon's location when it is one quarter, one half, and three quarters of the way through its orbit. How far has the Moon rotated in each position? Indicate where the "X" is located at each orbital position. **[20 pts]**

Illumination of the Moon [25 pts total]

1. Notice the arrows representing incoming sunlight on your diagram. Shade the parts of each Moon that are not illuminated by the Sun. **[5 pts]**
2. How much of the Moon's total surface is illuminated at each position? **[5 pts]**
3. Notice whether the "X" is illuminated at each position of the Moon. Is there a permanent "Dark Side of the Moon"? Why or why not? **[5 pts]**
4. The average distance between the Earth and the Moon is 384,399 km. The average distance between the Earth and the Sun is 149,598,261 km. How many times the average Earth-Moon distance is the average Earth-Sun distance? **[5 pts]**
5. How far away would the Sun be from the Earth in your scale diagram? Give this in cm. **[5 pts]**

Phases of the Moon [30 pts total]

1. Draw a line through the Moon at each position to separate the part that is visible to Earth from the part that is out of Earth's view. Sketch below the Moon's appearance to an observer on Earth at each position. [5 pts]
2. When you can see the Moon as a full bright circle, it is known as "Full Moon." When the Moon appears completely dark, it is known as "New Moon." The other two Moon positions in your diagram are known as "quarter" phases. Which position is first quarter and which position is last quarter? (Remember which direction the moon orbits the earth.) Label each phase with its name in your sketch above. [5 pts]
3. The Moon's positions between the four main phases also have names. The names are combinations of *waxing* or *waning* for when the Moon is "growing" or "shrinking" and *crescent* or *gibbous* for when the visible part of the Moon is less than half illuminated or more than half illuminated, respectively (e.g. "waxing crescent" or "waning gibbous"). Label the positions of these phases on your diagram using arrows between the main phases. [5 pts]

- Does everyone on Earth see the same phase of the Moon on a given day/night? Explain. **[5 pts]**
- A lunar eclipse occurs when the Moon passes through Earth's shadow. During what phase can lunar eclipses occur? **[5 pts]**
- A solar eclipse occurs when the Moon blocks the Sun as viewed from the Earth. During what phase can solar eclipses occur? **[5 pts]**

