ASTR 1031: Observing the Universe

Printable Course Packet

by

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with

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ASTR 1031: Observing the Universe
Sizes and Scales within the Universe
Lab #2

Name: _____ Lab Partners: _____

_____

Section: _____ Date: _____

II/III. Procedure/Results

A. The Sun-Earth System

1. Scale model Earth-Sun Sizes

The diameter of Earth is about **12,756 kilometers** (km), or about 8000 miles. The Sun is a huge ball of hot hydrogen gas **1,400,000 km** (1.4×10^6 km) in diameter (about 1 million miles).

Determine the **diameter** of the object representing your scale model Sun. Now compute how big the Earth would be if the Sun were this diameter. Draw an Earth that is approximately the correct size relative to the model used for the Sun.

Diameter of the scaled Sun _____ [in centimeters] Show ALL work!

Calculations:

$$\frac{\text{scaled size Sun}}{\text{REAL SIZE Sun}} = \frac{\text{scaled size Earth}}{\text{REAL SIZE Earth}}$$

Answer:
Scaled size Earth _____

Drawing of the scaled-size Earth →

2. Scale model Earth-Sun Distance

The Sun is **150,000,000 km** away from the Earth. **Using the same scale as part 1**, determine the distance that should be between your drawing of the Earth and the model Sun. Using a partner hold the Earth drawing and the model of the Sun the correct distance apart.

Show ALL work!

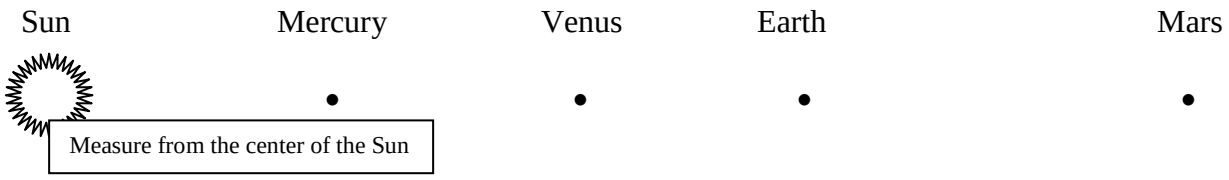
$$\frac{\text{scaled size Sun}}{\text{REAL SIZE Sun}} = \_\_\_\_\_$$

Scale model Earth-Sun Distance _____

Convert your answer to meters

B. The Solar System

Now we'll use a smaller scale to visualize the whole solar system (the Sun and all the planets). Below is a scaled drawing of the inner solar system: the Sun, Mercury, Venus, Earth and Mars. Astronomers often use a distance called the Astronomical Unit (AU) to represent the average distance between the Sun and the Earth (**1 AU = 1.5 x 10^8 km**). The outer planets are more distant from the Sun and would be located off the page. These planets and their approximate distances are: Jupiter (5 AU), Saturn (10 AU), Uranus (20 AU), and Neptune (30 AU).



1. Scale Size

If this drawing represents the "actual" size of the inner solar system, what is the scale of 1 AU (*i.e.*, how many centimeters represent the Earth-Sun distance above)?

Scaled size of this model = $\frac{\_\_\_\_\_\ \text{cm}}{1\ \text{A.U.}}$

2. Distances to the Outer Planets

On this scale, what would be the distance to Jupiter, Saturn, Uranus, and Neptune? Our ratio:

$$\frac{\_\_\_\ \text{cm}}{1\,\text{A.U.}} = \frac{\text{scaled distance to planet (cm)}}{\text{Real Distance to planet (A.U.)}}$$

Scaled distances to the outer planets Show your work!

Jupiter _____
Saturn _____
Uranus _____
Neptune _____

3. What is an everyday real object that is the scaled size of the distance to Neptune?

C. The Visible Stars

The star Vega is the brightest in the summer sky. Its distance is so great that light itself, which travels 300,000 km every second, takes 27 years to reach Earth. Thus the distance to Vega is **27 light-years** (l.y. = a unit of DISTANCE). The star Deneb appears almost as bright but is about **1,600 light-years** away. Astronomical distances are so huge that it takes light 8 minutes just to get from the Sun to the Earth (1 A.U.).

1. Star Distances in A.U. Convert the distances to Scientific Notation

Distance to Vega = 1,700,000 A.U. _____

Distance to Deneb = 100,000,000 A.U. _____

2. Scaled Star Distances

If the distances to all the stars we see in the sky were shrunk down to the same scale as in part C, what would be the scaled distances to Vega and Deneb? Think of it like this: if you place the inner solar system in part C on the ground, how many kilometers would you have to walk to get to Vega and Deneb?

Scaled size of this model = $\frac{10\,\text{cm}}{1\,\text{A.U.}}$ Show ALL work!

Convert your answers to kilometers.

Scaled distances Vega _____ Deneb _____

3. Name some Earthly distances that are the scaled size of each of these distances:

D. The Milky Way Galaxy

All of the stars we can see, which include all the constellations, are part of our Milky Way galaxy, a huge collection of stars having a diameter about **100,000 light-years**. All the stars in the Milky Way, including the Sun, are held together by mutual gravitational attraction. All these stars, as well as gas and dust, form a disk-shaped structure. The brighter stars form a nice spiral pattern when viewed from above. The Sun is located about 2/3 of the way out from the center toward one side of the disk. A sphere of radius **1600 light-years** (the distance to Deneb) would enclose most of the stars we can see with the unaided eye in the night sky.

1. <u>A Scale Model of the Milky Way</u>

This picture below is the Milky Way. Measure the diameter of the Milky Way below. What is your scale size (*i.e.*, how many centimeters represent 100,000 light-years)?

Scaled size of the Milky Way = $\frac{\text{\_\_\_\_ cm}}{100{,}000\ \text{l.y.}}$

2. <u>The Sphere of Stars Visible to the Unaided Eye</u>

Clearly place a dot where the Sun is located. **Set up the correct ratio, and compute** the size of a circle around the Sun whose *radius* is the correct scaled distance from the Sun to Deneb. Draw the circle around the Sun. This circle represents our local neighborhood of stars that can be seen with the unaided eye.

Show all your work!

Scaled distance to Deneb

_____

ASTR 1031: Observing the Universe
Spectroscopy: The Physics of Light
Lab #7

Name: _____ Lab Partners: _____

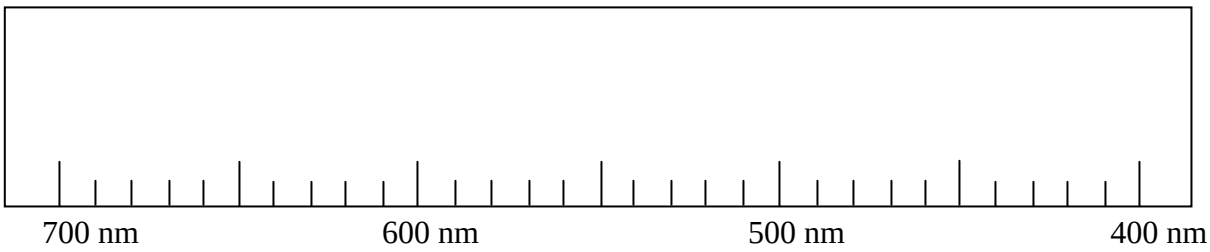
_____

Section: _____ Date: _____

II/III. Procedure/Results

E. The Spectrometer

a. Use the spectrometer and observe the spectrum of the bright incandescent light bulb. Draw the spectrum on the template below.
   - **i. Label all the colors**
   - **ii. Label the wavelength range for each of the colors**

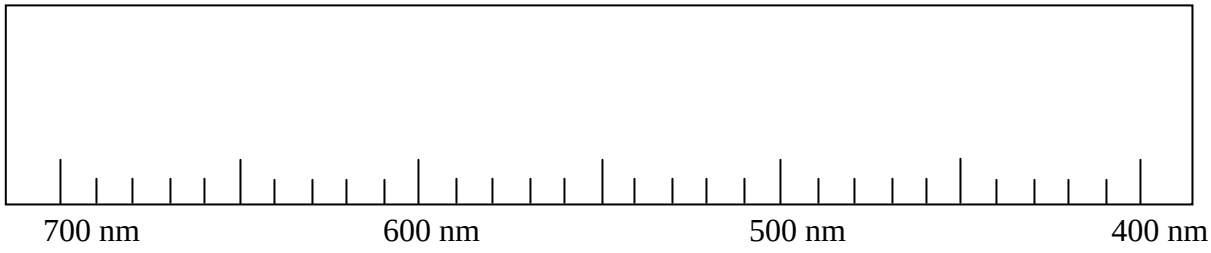


F. Gas Spectral Emission Tubes

1. Observe the Hydrogen Gas tube. **Please be very careful with the gas tubes and the power supplies. The gas tubes can get HOT.**

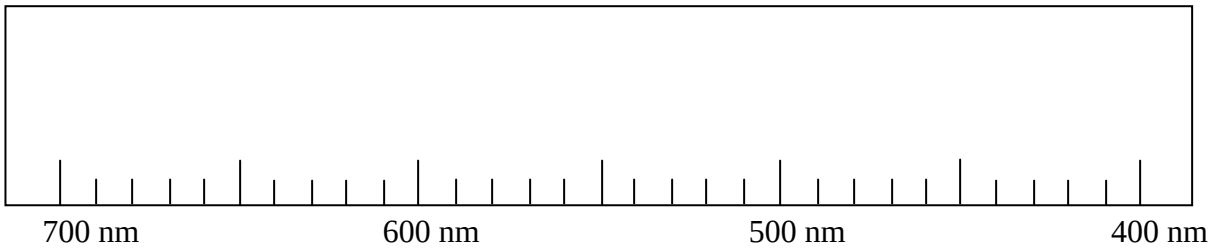
Label the colors and the wavelengths for each line you see on the template below.

Hydrogen Gas 'Star'

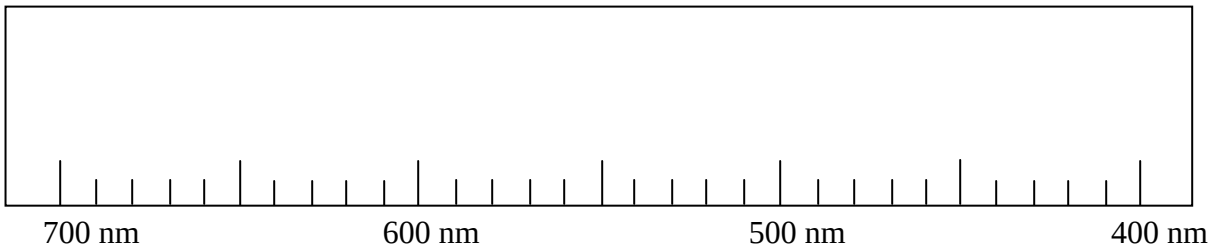


2. Observe the spectra for the three other unknown gaseous stars. Use the **Spectra of Gases** sheet to help you determine the gas composition of each star. Label the colors and the wavelengths for each of the lines you see.

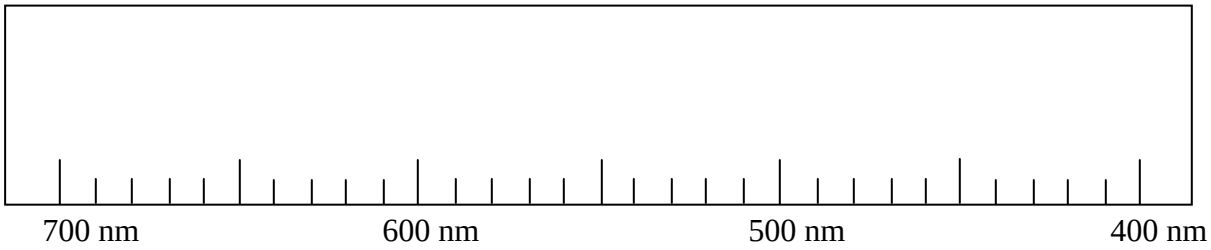
Unknown 'Star' #1: _____



Unknown 'Star' #2: _____

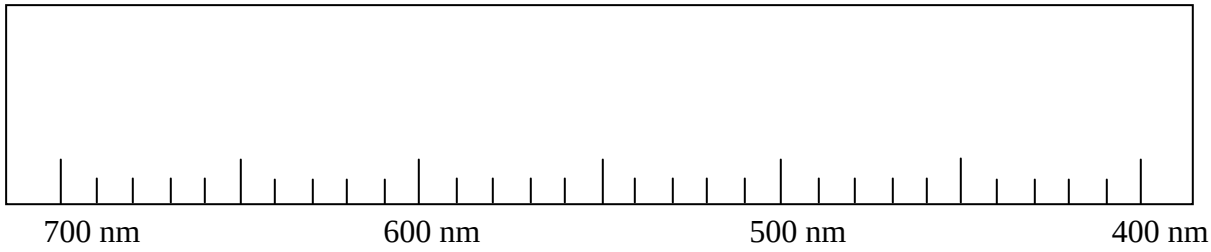


Unknown ‘Star’ #3: _____

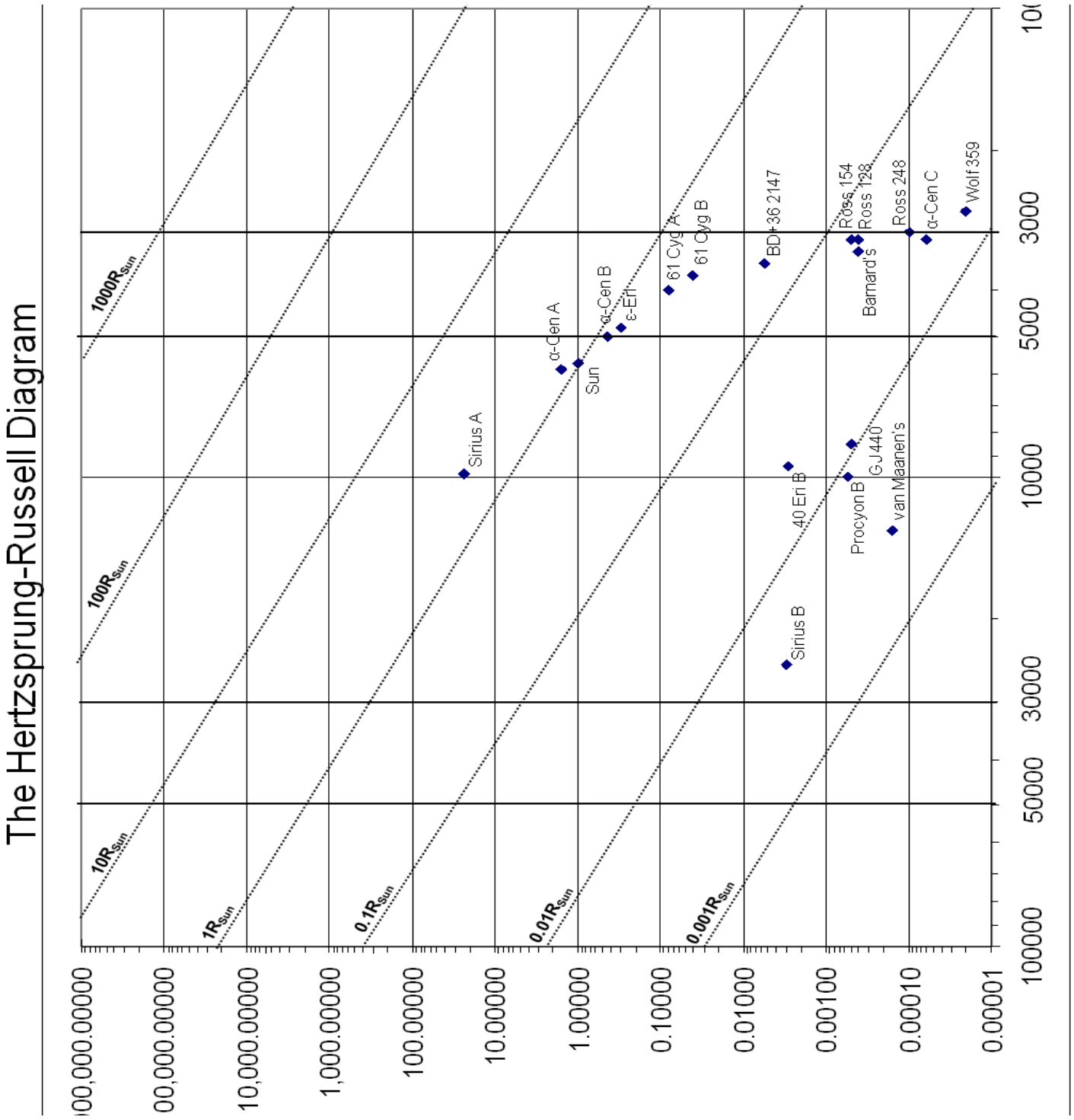


3. Examine the spectra of the fluorescent light very carefully and try to determine the predominant gas in the tube. There are several gases in a fluorescent light bulb, but one gas is fairly easily seen in the spectrometer. If a star were shining with fluorescent light, what is the composition of that star?

Fluorescent Light Bulb ‘Star’: _____



(Adapted, in part, from Astronomy 011, Fall 2000-Spring 2001 Laboratory material at Penn State University, Hayden McNeil Publishing, Inc. 2000. Used with permission.)



ASTR 1031: Observing the Universe
Hubble's Law
Lab #11

Name: _____ Lab Partners: _____

_____

Section: _____ Today's Date _____

III. Results

A. Calculating the Velocity of Recession for each Redshifted Galaxy

Table 11-1
Calculating the Recessional Velocities

	Galaxy 2			Galaxy 3			Galaxy 4		
	[O II]	H_β	[O III]	[O II]	H_β	[O III]	[O II]	H_β	[O III]
Redshifted λ (Angstroms)									
Calibration λ (Angstroms)	3727	4861	5007	3727	4861	5007	3727	4861	5007
Redshift									
Average Redshift									
Recession Velocity (km/s)									

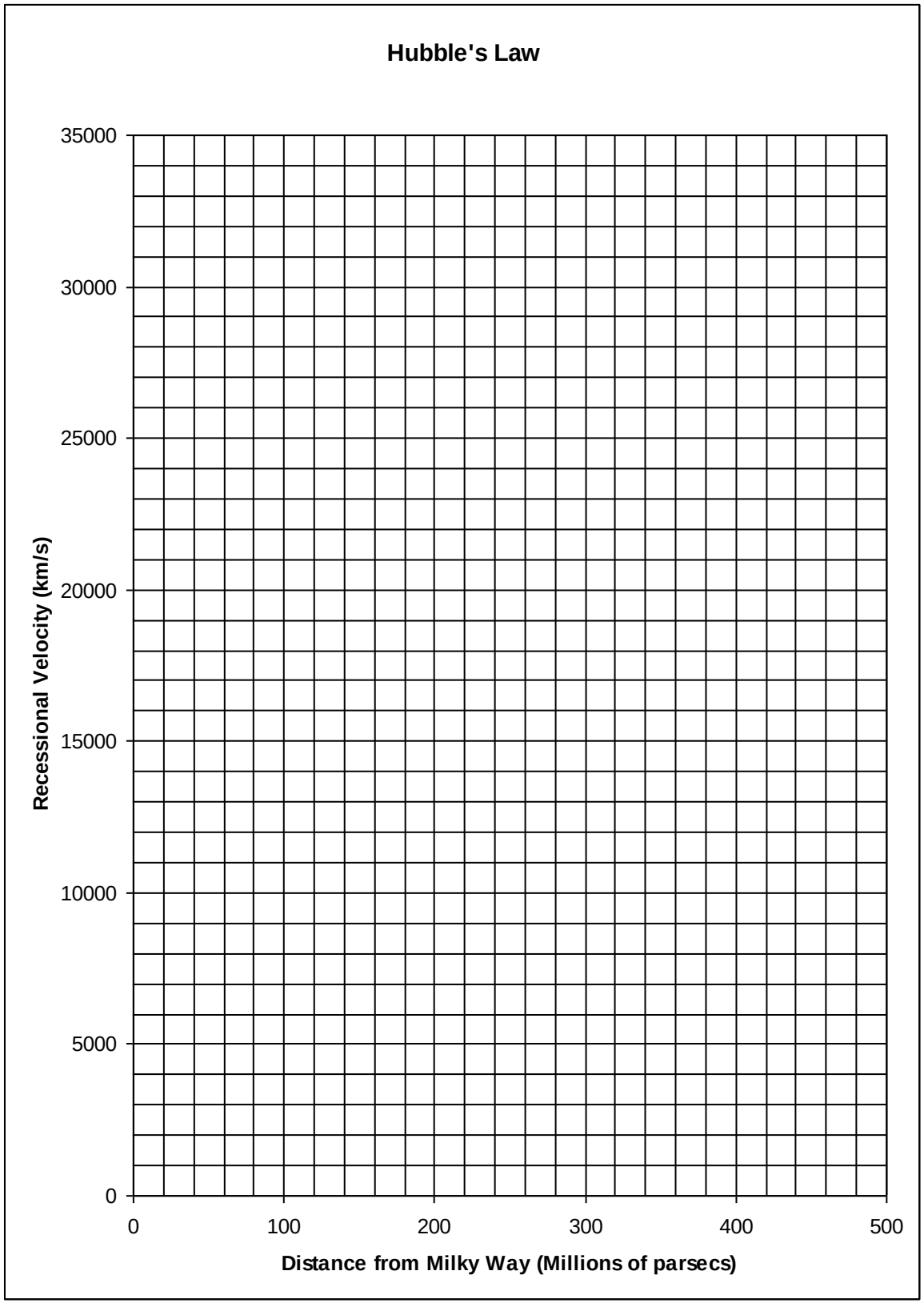
	Galaxy 5			Galaxy 6		
	[O II]	H_β	[O III]	[O II]	H_β	[O III]
Redshifted λ (Angstroms)						
Calibration λ (Angstroms)	3727	4861	5007	3727	4861	5007
Redshift						
Average Redshift						
Recession Velocity (km/s)						

B. Calculating Hubble's Constant

Table 11-2

Organizing the Data for Plotting

Hubble Velocity - Distance Relationship		
Galaxy Name	Velocity	Distance
	(km/s)	(Mpc)
1	0	0
2		103
3		164
4		281
5		347
6		435


Hubble's Law
35000
30000
25000
20000
15000
10000
5000
0
Recessional Velocity (km/s)
0
100
200
300
400
500
Distance from Milky Way (Millions of parsecs)

B. Calculating Hubble's Constant

Rise of my best-fit line= _____ (km/s)

Run of my best-fit line= _____ Mpc

H_o = *Rise/Run* = _____ (km/s)/Mpc

C. Calculating the Age of the Universe

$$Age = \left(\frac{1}{H_o}\right) \times (conversion\ \ factor\ 1) \times (conversion\ \ factor\ 2)$$

Conversion Factor 1 = _____ km/Mpc

Conversion Factor 2 = _____ billion years/sec

The age of the universe is about _____ billion years old.

Show all work here

ASTR 1031: Observing the Universe
The Planisphere
Night Lab #1

I. Objectives

The night sky is a beautiful and wondrous thing to see; unfortunately, many people are not very familiar with the sky and the positions, patterns, and motions of the Sun, Moon, stars, and planets. A planisphere is a very simple and effective tool for understanding the stars in the night sky.

The objectives for this lab:

- Learn how to operate a planisphere
- Understand the concept of a celestial sphere
- Observe the night sky and learn the names and locations of various stars and constellations
- Define the Horizon coordinate system: Altitude and Azimuth
- Determine rising and setting times of stars and constellations for different dates
- Understand the diurnal and annual motions of the stars

II. Procedure

G. Using the Planisphere

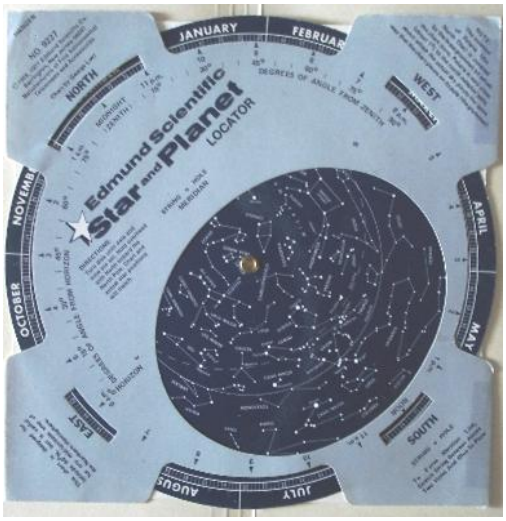


Figure 1. A Planisphere

1. Identify North, South, East, and West on the planisphere. Note that East and West are reversed because a planisphere is meant to be held over your head.

2. The oval shape to the sky represents the hemisphere of the sky rendered flat on the disk. The **Zenith** is at the very CENTER of the oval and represents the point in the sky directly overhead. The **Horizon** is located around the perimeter of the oval. The disk rotates about the star Polaris (i.e. the "North Pole Star").

3. The months and days of the year are located at the edge of the rotating circular disk. The times of day are located in a circular pattern on the front of a card. Rotate the disk until today's date aligns with the current time of night.

4. Hold the planisphere overhead with the North point on the planisphere pointing towards the North Pole on Earth and the star positions will align with your view of the sky. This works well if you are lying down on the ground.

5. If you are standing, a useful tip is to hold the planisphere in front of you with the direction you wish to look at the BOTTOM. The lower part of the oval within the planisphere will give a good representation of the sky. For example, if you are facing north then turn the planisphere upside-down with "North" at the bottom of the card. The northern stars and constellations will be seen at the bottom of the oval.

H. Details of a planisphere

a. The **Meridian** – the meridian is an imaginary line running from the North Pole to the South Pole; therefore, the meridian cuts the sky into eastern and western halves.

b. **Altitude** – the angular measure of an object measured perpendicular to and above the horizon. By definition the altitude of the horizon is 0° and the altitude of the zenith is 90°. The range of values for altitude is 0° to 90°.

c. **Azimuth** – the angular measure of an object along the horizon measured eastward from North. By definition north has an azimuth angle of 0°. The range of values for azimuth is 0° to 360°.

ASTR 1031: Observing the Universe
The Planisphere
Night Lab #1

Name: _____ Lab Partners: _____

_____

Lab Section #: _____ Date: _____

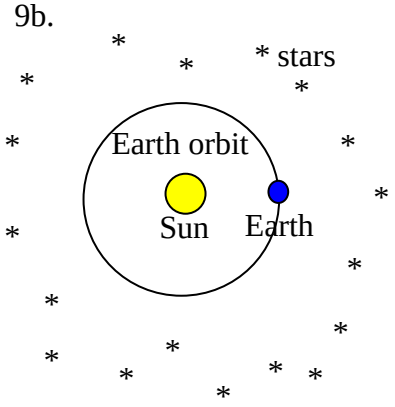
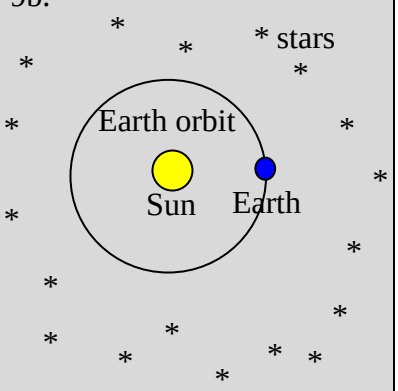
III. Results

A. Using the Planisphere

For Spring Observations **Set the planisphere for February 15 at 8:00 PM local standard time.**	**For Fall Observations** **Set the planisphere for September 15 at 9:00 PM local daylight saving time.**

	Spring	**Fall**
1. Name 3 constellations on (or near) the meridian	1a. _____ 1b. _____ 1c. _____	1a. _____ 1b. _____ 1c. _____
2. Name a constellation on or near the Horizon in each of the four cardinal directions (N, E, S, W).	2. North _____ East _____ South _____ West _____	2. North _____ East _____ South _____ West _____
3. Find the constellation Ursa Major and the Big Dipper within it. What direction in the sky are you looking to see the Big Dipper?	N, NE, E, SE, S, SW, W, or NW 3. _____	N, NE, E, SE, S, SW, W, or NW 3. _____
4. Find the "pointer" stars of the Big Dipper. To what star are they pointing?	4. _____	4. _____
5. What star is at the center rivet "hole" in the planisphere?	5. _____	5. _____

	Spring	Fall
6. What time does the *center* of constellation Orion RISE on February 15 (for Fall: Aquila on Sept. 15)? In which direction does it rise? Be specific.	6a. Time _____ 6b. Direction _____	6a. Time _____ 6b. Direction _____
7. What time does the *center* of constellation Orion cross the meridian on February 15 (for Fall: Aquila on Sept. 15)?	7. _____	7. _____
8. What time does the *center* of constellation Orion SET on February 15 (for Fall: Aquila on Sept. 15)? In which direction does it set?	8a. Time _____ 8b. Direction _____	8a. Time _____ 8b. Direction _____

9a. On what date is (Spring: Orion; Fall: Aquila) above the horizon all night? That is, on what date does the *center* of Orion (Aquila) cross the meridian at midnight. [This is the BEST date to see Orion (Aquila) in the night sky.] 9b. On this BEST observing date, circle the star position of Orion (Aquila) relative to the Earth and Sun in the figure to the right.	9a. _____ 9b.  Not to scale	9a. _____ 9b.  Not to scale
10. During which months will Orion (Aquila) NOT be visible in the night sky, 6:00 pm – 6:00 am? [Hint: Orion (Aquila) IS visible in the night sky during the range of dates when it rises at 6:00 pm and sets at 6:00 am.]	10. _____	10. _____

	Spring	Fall
11. Using your knowledge from the last few questions, what is the BEST date to view the constellation Leo in Spring (for Fall: Hercules)?	11. _____	11. _____
12. Spring: Find the two dog constellations Canis Major and Canis Minor. What are the names of the bright stars in each? (Fall: Find the constellations Cygnus, Aquila, and Lyra. What are the names of the brightest stars in each?)	12a. _____ 12b. _____ 12c. _____	12a. _____ 12b. _____ 12c. _____
13. Spring: on February 15 at 8:00 PM, which direction would you look to see the constellation Leo? (Fall: on Sept. 15 at 9:00 PM where would you look to see Bootes?) What are the approximate Altitude and Azimuth angles of this constellation?	Use the center of the constellation for your measurements. 13a. _____ 13b. Altitude _____ 13c. Azimuth _____	Use the center of the constellation for your measurements. 13a. _____ 13b. Altitude _____ 13c. Azimuth _____
14. On Feb. 15 at 8:00 PM (Fall: on Sept. 15 at 9:00 PM), list all of constellations of the zodiac that are visible. Also name any bright stars in each of them.	14. _____ _____ _____ _____ _____ _____	14. _____ _____ _____ _____ _____ _____
15. On February 15 at 8:00 PM (Fall: on Sept. 15 at 9:00 PM), find the Milky Way. What direction does it follow across the sky?	15. _____	15. _____

B. Observing the Night Sky

Spring Observing: February 1 – March 1
Go outside and observe the night sky between 7:00 PM and 11:00 PM. Use your planisphere to help you. Use your closed fist held at arms-length to approximate an angle of 10° in the sky.

Fall Observing: September 1 – October 1
Go outside and observe the night sky between 8:00 PM and 12:00 AM. Use your planisphere to help you. Use your closed fist held at arms-length to approximate an angle of 10° in the sky.

	Spring	**Fall**
Spring or Fall: Find the constellation Cassiopeia. What are the approximate Altitude and Azimuth angles of Cassiopeia? How many stars can you see in Cassiopeia? What is the approximate angular size of Cassiopeia?	16a. Altitude _____ 16b. Azimuth _____ 16c. # of stars visible ____ 16d. Angular Size _____	16a. Altitude _____ 16b. Azimuth _____ 16c. # of stars visible ____ 16d. Angular Size _____
Spring or Fall: Find the constellation Ursa Minor. What are the approximate Altitude and Azimuth angles of Ursa Minor? How many stars can you see in Ursa Minor? What is the approximate angular size of Ursa Minor?	17a. Altitude _____ 17b. Azimuth _____ 17c. # of stars visible ____ 17d. Angular Size _____	17a. Altitude _____ 17b. Azimuth _____ 17c. # of stars visible ____ 17d. Angular Size _____
Spring: Find the constellation Orion. What are the approximate Altitude and Azimuth angles of Orion? How many stars can you see in Orion? What is the approximate angular size of Orion? Fall: Use the constellation Pegasus.	18a. Altitude _____ 18b. Azimuth _____ 18c. # of stars visible ____ 18d. Angular Size _____	18a. Altitude _____ 18b. Azimuth _____ 18c. # of stars visible ____ 18d. Angular Size _____

Use the Observing Sheets on the following pages and sketch the night sky in two different directions. For example, while facing South look up at a 45° angle and sketch the sky as you see it. Repeat for another direction.

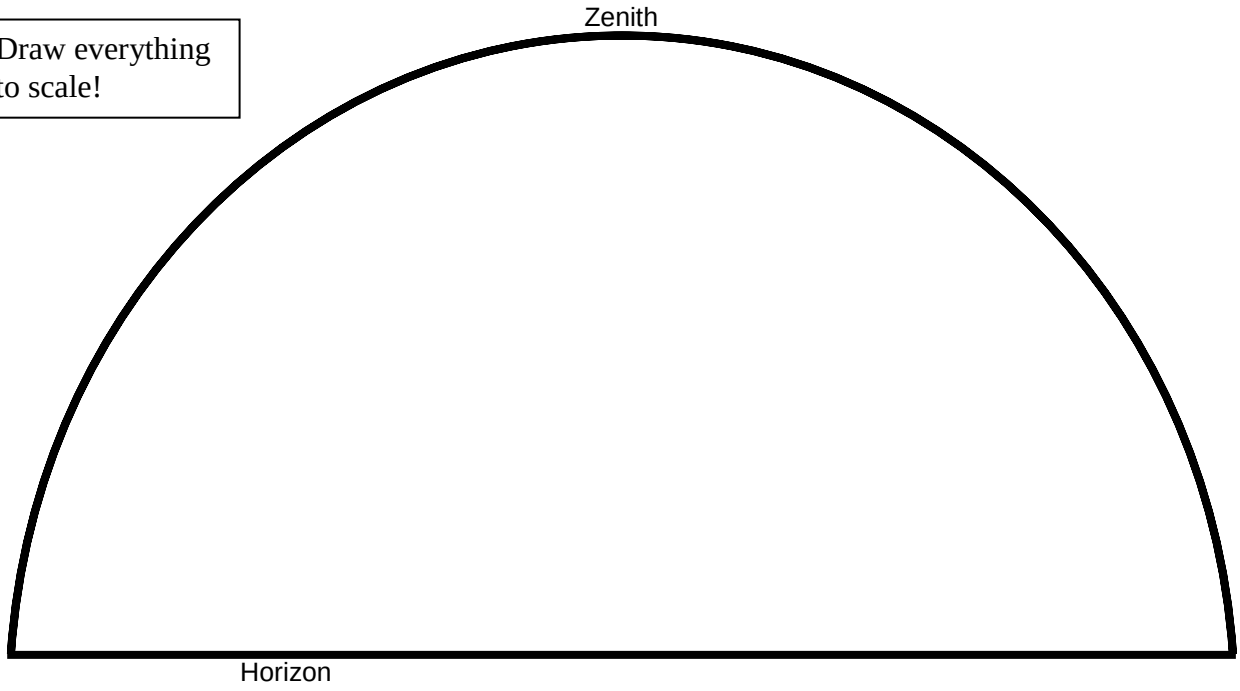
Name_____

Observing Sheet

Title: _____ Date and Time: _____

Sky Condition: _____ Observing Site: _____

Draw everything to scale!



Label Directions on Horizon

Description of the objects:

_____
_____
_____
_____
_____
_____
_____

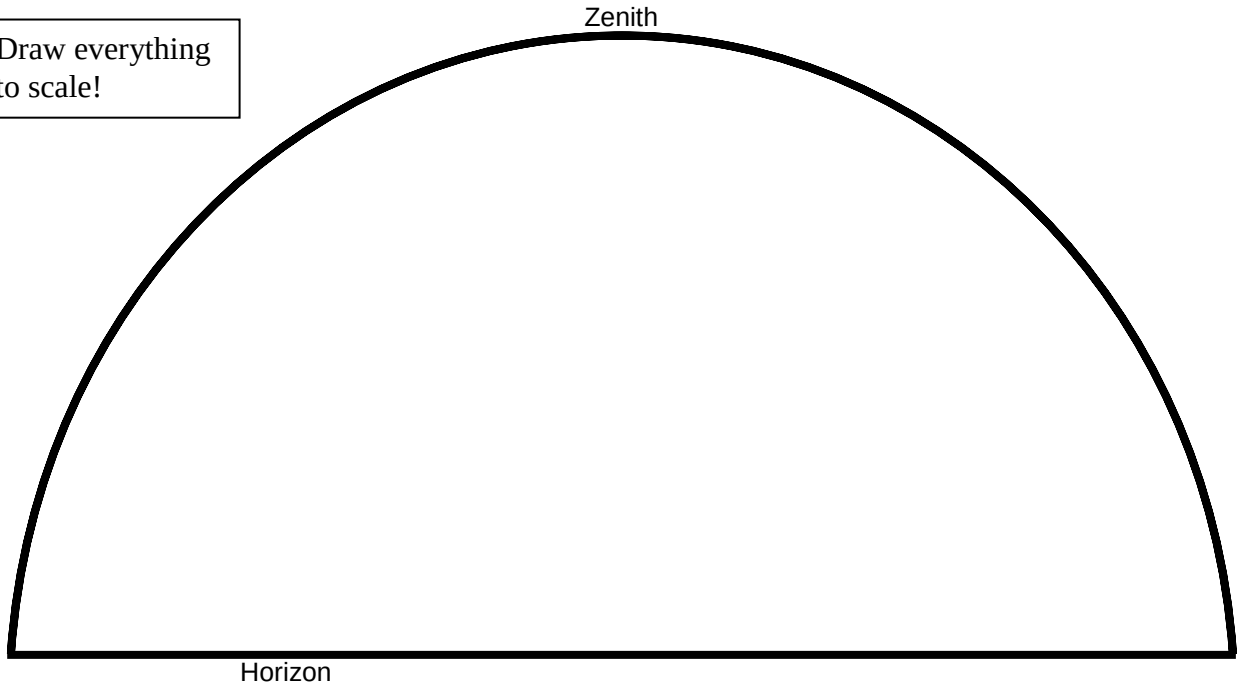
Name_____

Observing Sheet

Title: _____ Date and Time: _____

Sky Condition: _____ Observing Site: _____

Draw everything to scale!



Label Directions on Horizon

Description of the objects:

_____
_____
_____
_____
_____
_____
_____

Conclusions

Summarize your results, your conclusions, and any additional questions you have. What are the uses of a planisphere? Explain why the planisphere is not useful for locating the Moon. Will your planisphere work anywhere on Earth? Explain why or why not? Pay careful attention to legibility, spelling, grammar, punctuation, and continuity of thought. Be thorough!!!!

Please sign the Academic Honesty Form on the last page.

Statement on Academic Honesty

Academic Standards of Conduct (from ***MTSU Student Handbook***):

Middle Tennessee State University strives to promote values and attitudes that are reflective of solid academic character and integrity. For this reason, MTSU expects each student to complete assignments that are original and reflective of that individual student. Academic integrity is an essential component of a quality education. When students participate in behavior that is considered to be academic misconduct, the scholarly value of their education is lessened.

Academic misconduct is defined as follows:
1. **Plagiarism.** The adoption or reproduction of ideas, words, statements, images, of works of another person's as one's own without proper acknowledgment.
2. **Cheating.** Using or attempting to use unauthorized materials, information, or study aids in any academic exercise. The term academic exercise includes all forms of work submitted for credit or hours.
3. **Fabrication.** This is unauthorized falsification or invention of any information or citation in an academic exercise.
4. **Facilitation.** Helping or attempting to help another to violate a provision of the institutional code of academic misconduct.
For more information: The Office of the Assistant Dean for Judicial Affairs and Mediation Services, KUC 326S, 898-5812.

The Honor Statement

Middle Tennessee State University is committed high intellectual integrity and academic honesty. As a student of MTSU, I pledge that I will conduct work in this course to uphold the Academic Standards of conduct as stated above.

Pledged:

_____

Student Name (printed)

_____ _____

Student Signature date

ASTR 1031: Observing the Universe
Night Observing Session II – Moon and Planets
Night Lab #2a

I. Objectives

Astronomy is the science of understanding the physical universe outside Earth's atmosphere. Almost all astronomers gather information by observing the universe, and, therefore, you must also observe the universe to help you better understand it. Our objectives tonight are:

- use your eyes to observe the Moon and a planet (if visible), or another interesting object
- use telescopes to observe the Moon and a planet (if visible), or another interesting object
- draw the objects as you see them to make a record of your observation
- Describe the objects and answer questions and make inferences

Hopefully this will enrich your already curious mind about the makeup of our universe.

II. Procedure

A. Observing the Moon, a Planet, or another object

The observing project consists of observing the Moon and a planet (if visible) with the naked eye AND by using telescopes. Use the Observation Sheets provided to record your observations and make your descriptions.

Notes about observations:

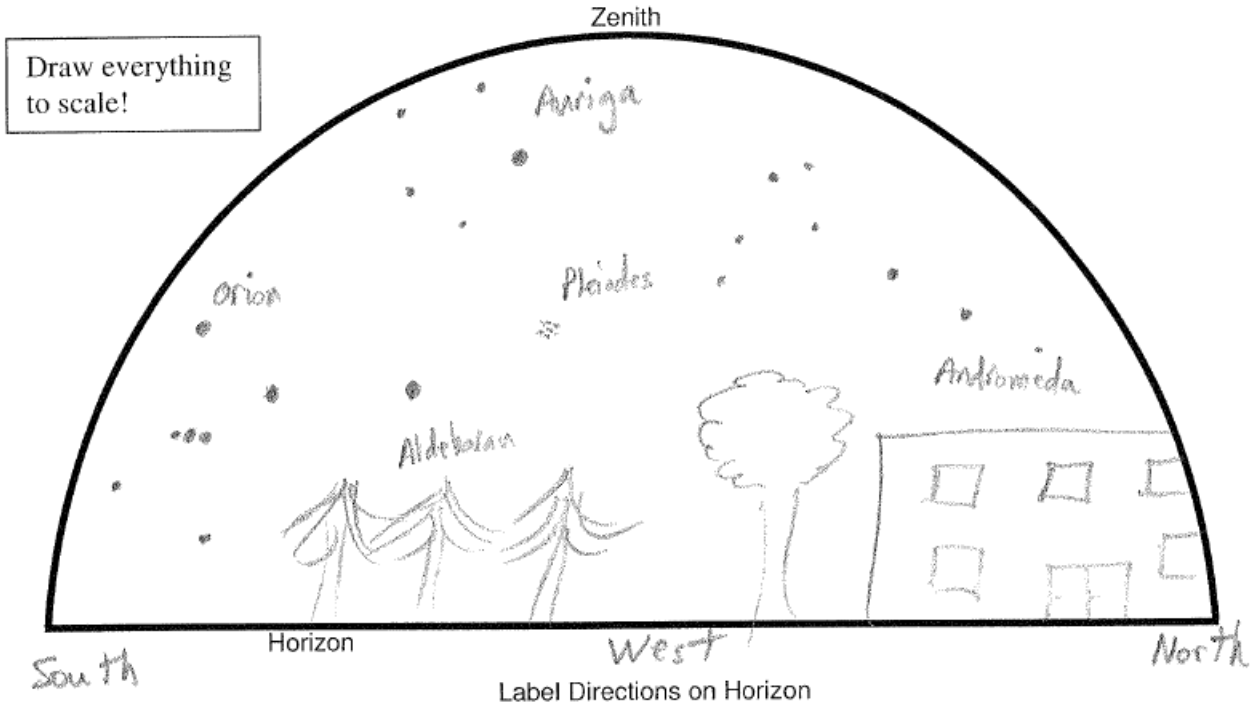
1. Make ALL drawings using a **PENCIL**!
2. Record the date, time, and location on all observations
3. Determine the Magnification. $Magnification = \frac{Telescope\_Focal\_Length}{Eyepiece\_Focal\_Length} = \frac{2000mm}{x}$
4. Record the directions on your drawing (N, S, E, W, NE, NW, etc.)
5. Record the weather conditions (briefly)
6. Label what you are drawing
7. Only draw what you see (not what you don't see). All observations are unique and you can be as detailed as you wish when making your drawings. Drawing skills are not judged, but do the best you can. Be conscientious.
8. Write a short description of the object you are viewing. Make some comments on the following, if appropriate:
   a. Size b. Shape c. Brightness (compare with other objects)
   d. Color e. Features

   Any other curious details or comments (be creative!)

EXAMPLE Observing Sheet

Title: _Orion + Pleiades___ Date and Time: _March 15, 1997 18:00:01__

Sky Condition: __Clear_____ Observing Site: __MTSU Campus, TN _____



Description of Object(s):

_____Beautiful view of the western sky - the Pleaides is to the West and very fuzzy and faint. Orion is also to the southwest. Most of the stars are blue-whitish is color, but Betelgeuse is reddish is color. I can see Aldebaran in the constellation Taurus; it is also reddish in color. I see a few stars of Perseus and Andromeda in the northwest.

Instructor's Signature _____

ASTR 1031: Observing the Universe
Night Observing Session II – Moon and Planets
Night Lab #2a

Name: _____ Lab Partners: _____

_____

Section: _____ Date: _____

III. Results

A. Naked eye drawings of the Moon, a Planet, or another astronomical object

Complete the Observing pages

B. Telescope Drawings of the Moon, a Planet, or another astronomical object

1. Complete the Observing pages

2. Observe one of the planets and answer the associated question.
Mars or Saturn --- determine what season it is experiencing in its northern hemisphere. Explain.
Jupiter --- use a data sheet and label the name of each moon you seen on your drawing.
Venus --- what is its phase?

_____

_____

_____

_____

_____

3. If you observed the Moon, identify three (3) features by their proper name. Record these names below and label these on your telescope drawings. Use the Moon maps in the classroom if you need help.

Lunar Feature 1 _____

Lunar Feature 2 _____

Lunar Feature 3 _____

Conclusions

Summarize your results, your conclusions, and any additional questions you have. If you observed an object outside the solar system, use your skymap, your textbook, or the Internet and find the distance to this object. Write one complete paragraph explaining which object you saw made the biggest impression on you. Please write well!

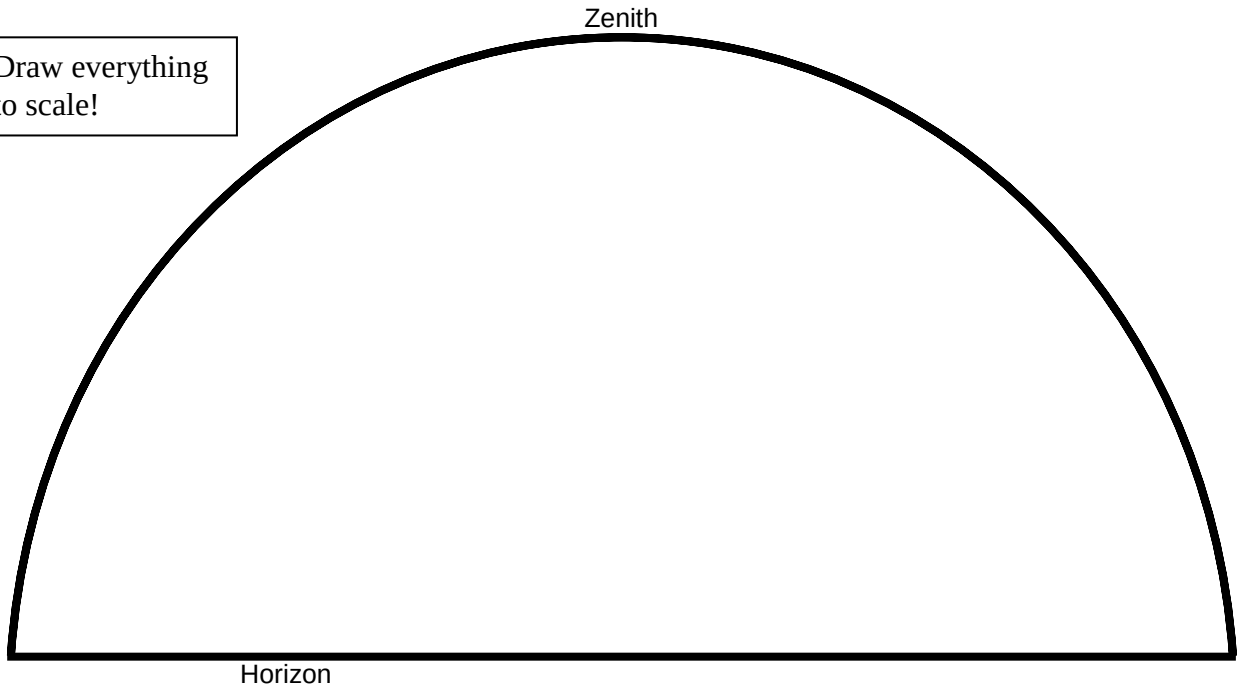
Name_____

Moon Observing Sheet

Title: _____ Date and Time: _____

Sky Condition: _____ Observing Site: _____

Draw everything to scale!



Label Directions on Horizon

Description of the Moon:

_____
_____
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What is the phase of the Moon?_____

In what constellation is the Moon located? _____

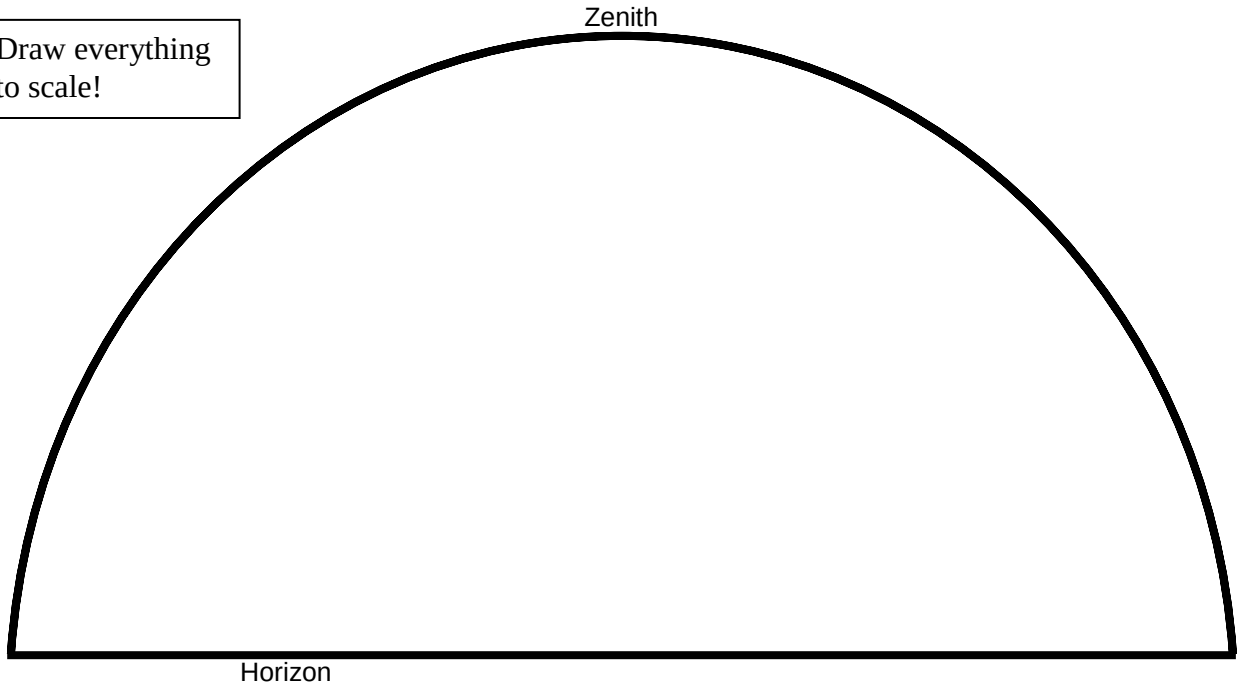
Name_____

Observing Sheet (use if necessary)

Title: _____ Date and Time: _____

Sky Condition: _____ Observing Site: _____

Draw everything to scale!



Label Directions on Horizon

Description of the object:

_____
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In what constellation is the object located?

_____

Telescope Observing Sheet Name_____

Date: _____ Time: _____

Sky Conditions: _____ Observing Site: _____

MAGNIFICATION = _____

Title:_____

Description of Object:

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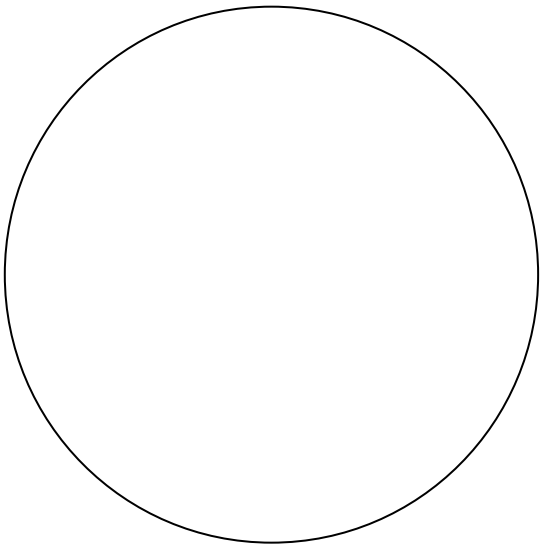

Field of view of telescope

MAGNIFICATION = _____

Title:_____

Description of Object:

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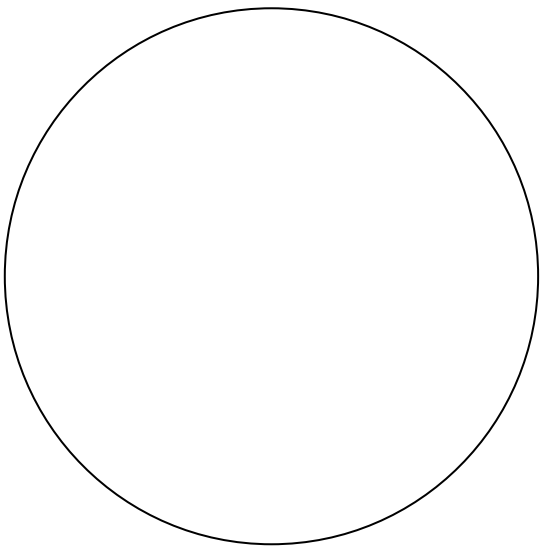

Field of view of telescope

Telescope Observing Sheet Name_____

Date: _____ Time: _____

Sky Conditions: _____ Observing Site: _____

MAGNIFICATION = _____

Title:_____

Description of Object:

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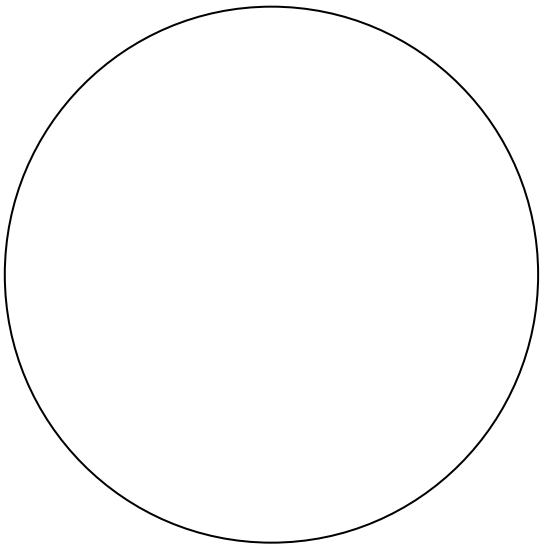

Field of view of telescope

MAGNIFICATION = _____

Title:_____

Description of Object:

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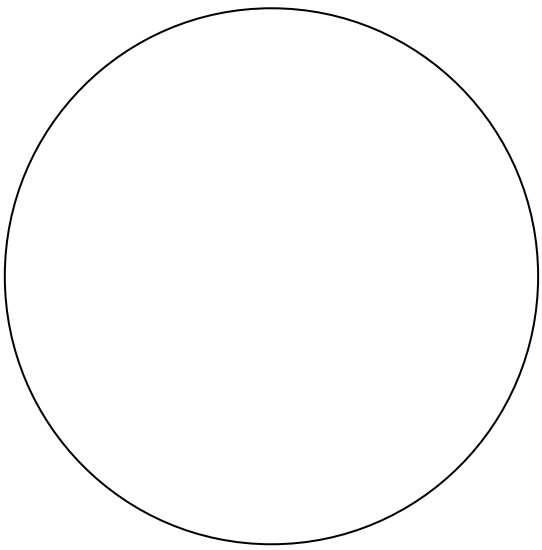


Field of view of telescope

ASTR 1031: Observing the Universe
Night Observing Session III – Deep Sky Objects
Night Lab #3a

I. Objectives

Astronomy is the science of understanding the physical universe outside Earth's atmosphere. Almost all astronomers gather information by observing the universe, and, therefore, you must also observe the universe to help you better understand it. Our objectives tonight are:

- use your eyes to observe the constellations
- use telescopes to observe a variety of astronomical objects
- draw the objects as you see them to make a record of your observation
- Describe the objects and answer questions and make inferences

Hopefully this will enrich your already curious mind about the makeup of our universe.

II. Procedure

A. Observing with the Naked Eye and with Telescopes

The observing project consists of observing three (3) constellations with the naked eye AND three (3) different astronomical objects using telescopes. Use the Observation Sheets provided to record your observations and make your descriptions.

Notes about observations:

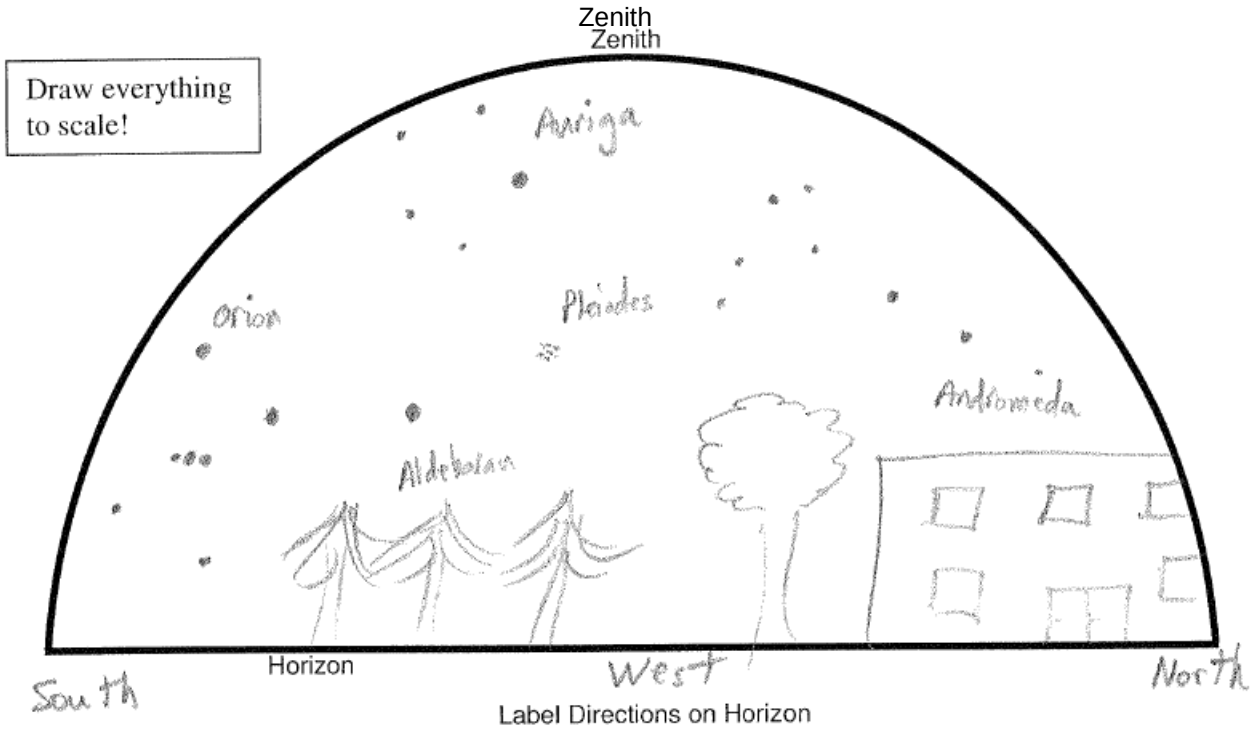
9. Make ALL drawings using a **PENCIL**!
10. Record the date, time, and location on all observations
11. Determine the Magnification. $Magnification = \frac{Telescope\_Focal\_Length}{Eyepiece\_Focal\_Length} = \frac{2000mm}{x}$
12. Record the directions on your drawing (N, S, E, W, NE, NW, etc.)
13. Record the weather conditions (briefly)
14. Label what you are drawing
15. Only draw what you see (not what you don't see). All observations are unique and you can be as detailed as you wish when making your drawings. Drawing skills are not judged, but do the best you can. Be conscientious.
16. Write a short description of the object you are viewing. Make some comments on the following, if appropriate:
    a. Size b. Shape c. Brightness (compare with other objects)
    e. Color e. Features

    Any other curious details or comments (be creative!)

SAMPLE Observing Sheet

Title: _Orion + Pleiades___ Date and Time: _March 15, 1997 18:00:01__

Sky Condition: __Clear_____ Observing Site: __MTSU Campus, TN _____



Description of Object(s):

_____Beautiful view of the western sky - the Pleaides is to the West and very fuzzy and faint. Orion is also to the southwest. Most of the stars are blue-whitish is color, but Betelgeuse is reddish is color. I can see Aldebaran in the constellation Taurus; it is also reddish in color. I see a few stars of Perseus and Andromeda in the northwest.

Instructor's Signature _____

ASTR 1031: Observing the Universe
Night Observing Session III
Night Lab #3a

Name: _____ Lab Partners: _____

_____

Section: _____ Date: _____

III. Results

A. At Least Three Constellation Drawings

Constellation 1 _____ Constellation 2 _____

Constellation 3 _____ Others _____

B. Three Telescope Drawings

Telescope Object 1 _____ Telescope Object 2 _____

Telescope Object 3 _____

What are some of the incredible distances to the objects you viewed in the telescopes? List one or two of them here and describe how many years it would take light to travel from that object to your eyeball.

_____

_____

_____

_____

_____

_____

Would a telescope be useful for viewing an entire constellation? Why or why not?

Conclusions

Summarize your results, your conclusions, and any additional questions you have. Write one paragraph describing your telescope observing experience.

Constellation Observing Sheet

Title: _____

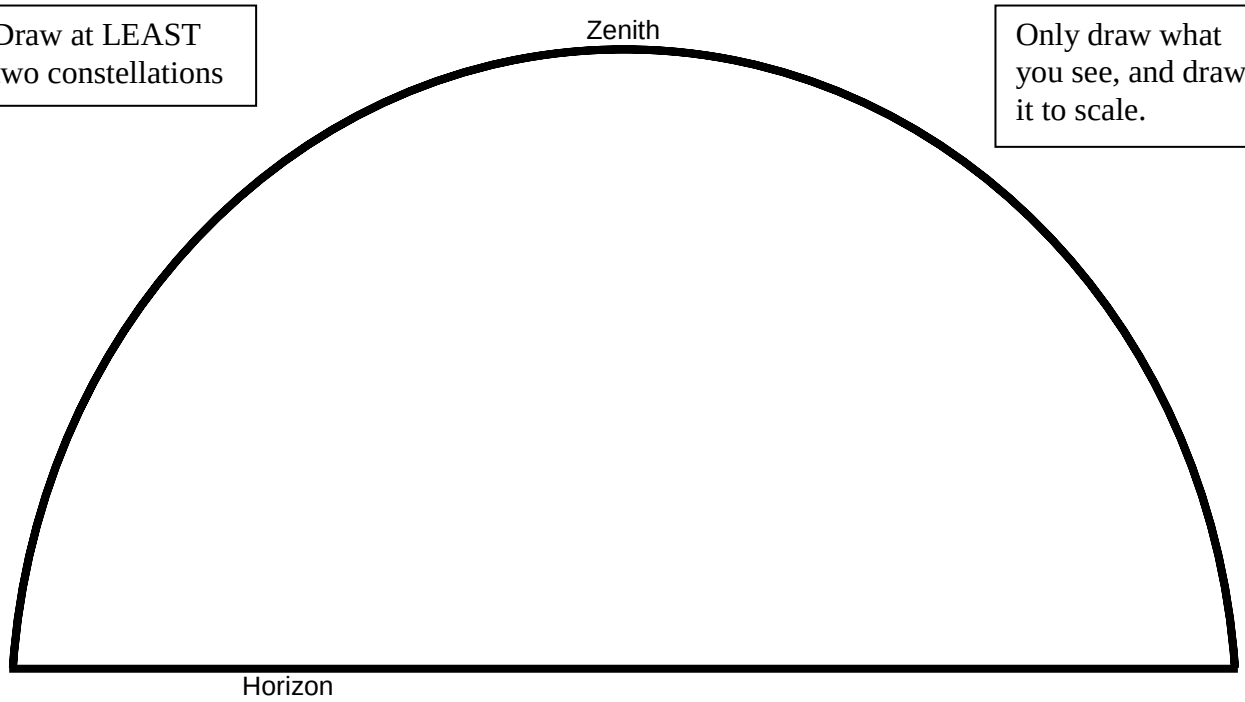
Date and Time: _____

Sky Condition: _____

Observing Site: _____

Draw at LEAST two constellations

Only draw what you see, and draw it to scale.



Label Directions on Horizon

Description of Object(s):

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Constellation Observing Sheet

Title: _____

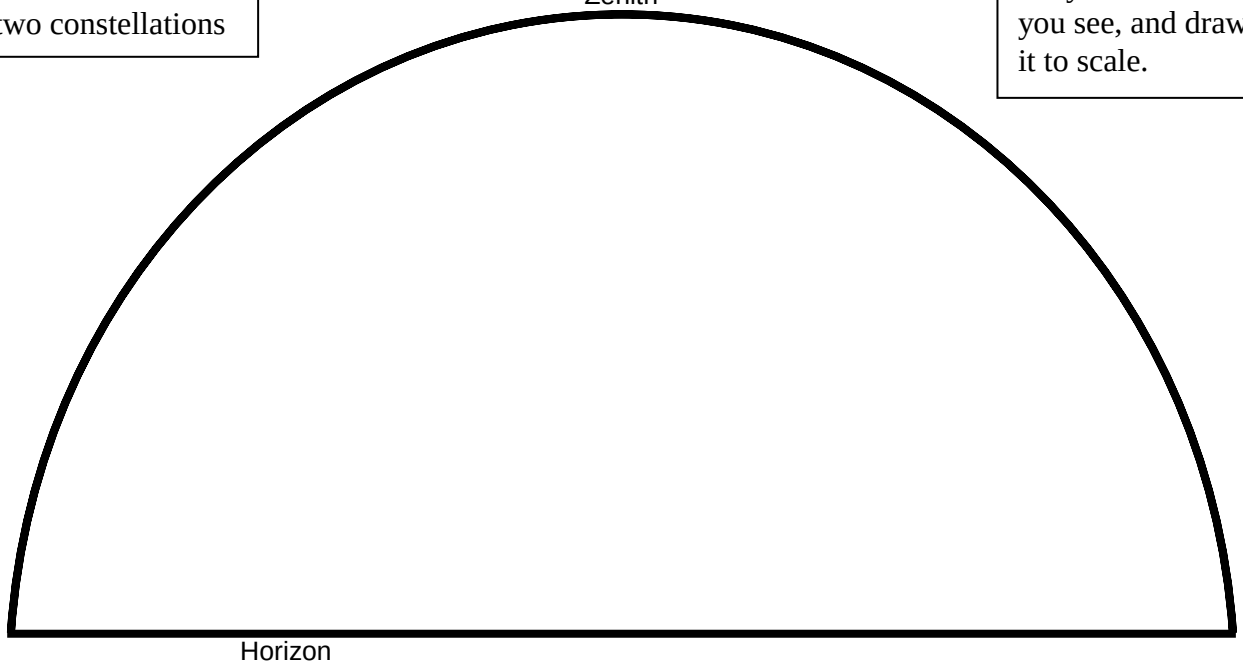
Date and Time: _____

Sky Condition: _____

Observing Site: _____

Draw at LEAST two constellations

Only draw what you see, and draw it to scale.



Label Directions on Horizon

Description of Object(s):

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Telescope Observing Sheet

Date: _____ Time: _____

Sky Conditions: _____ Observing Site: _____

Title:_____

Magnification = _____

Description of Object:

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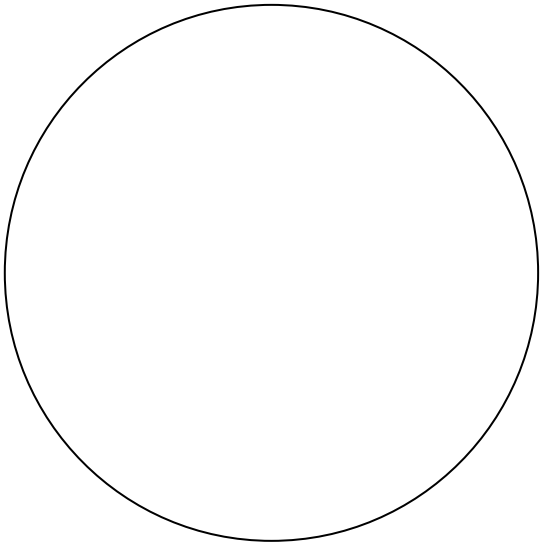

Field of view of telescope

Title:_____

Magnification = _____

Description of Object:

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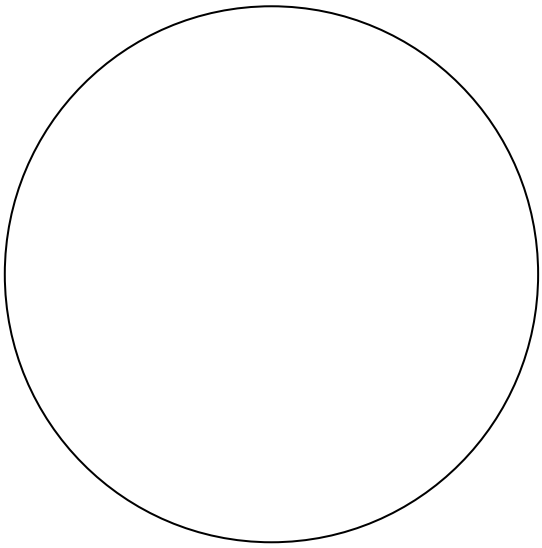

Field of view of telescope

Telescope Observing Sheet

Date: _____ Time: _____

Sky Conditions: _____ Observing Site: _____

Title:_____

Magnification = _____

Description of Object:

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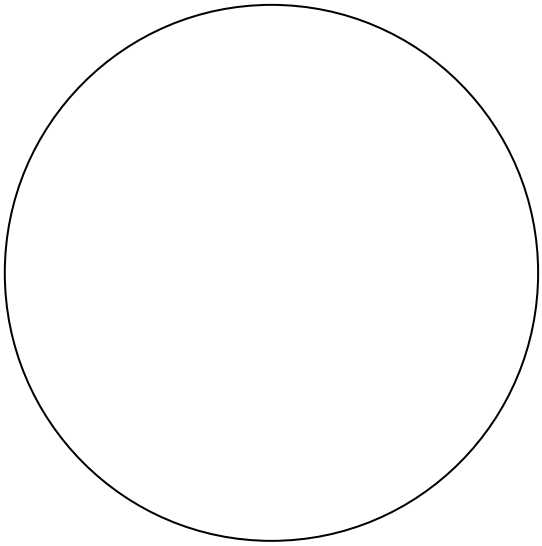

Field of view of telescope

Title:_____

Magnification = _____

Description of Object:

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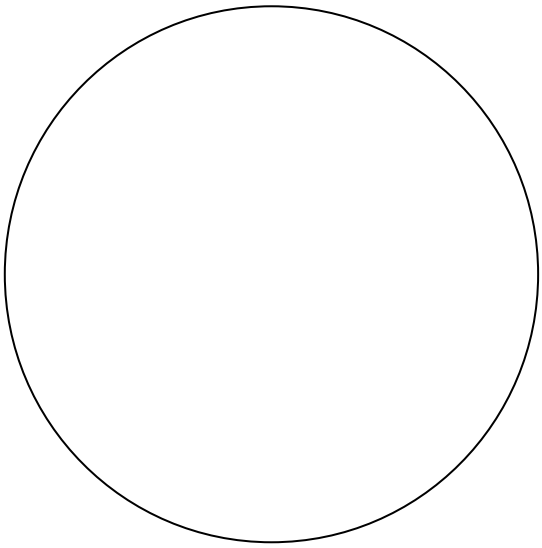


Field of view of telescope

ASTR 1031: Observing the Universe
Kepler's Laws
Cloudy Night Lab #2b

Name: _____ Lab Partners: _____

_____

Section: _____ Today's Date _____

Night Instructor's Signature: _____

III. Results

B. Plotting the Data

See 2 pages forward.

C. Testing Kepler's 1st Law

Table for Testing Kepler's 1st Law

	Distance from Sun	Distance from "F"	Total Distance
30 Year Point			
50 Year Point			
80 Year Point			

Conclusion: Comet JAK obeys Kepler's 1st law. _____ (yes) _____ (no)

D. Testing Kepler's 2nd Law

Table for Testing Kepler's 2nd Law

	Number of Squares
From 0 to 5 Years	
From 55 to 60 Years	
From 80 to 85 Years	

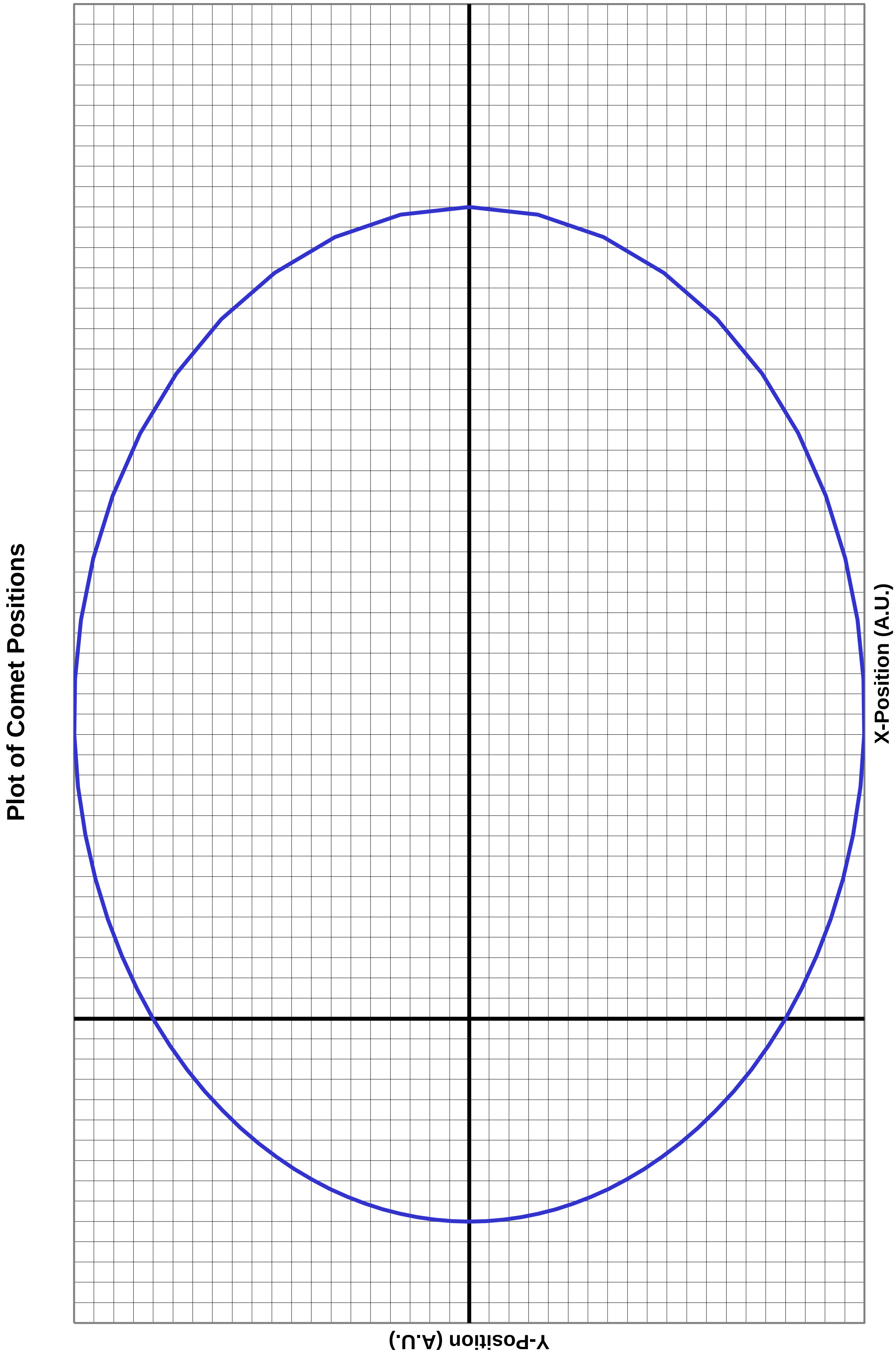
Conclusion: Comet JAK obeys Kepler's 2nd law. _____ (yes) _____ (no)

E. Testing Kepler's 3rd Law

Table for Testing Kepler's 3rd Law

	Orbital Period (Years)	(Orbital Period)^2	Semimajor Axis (A.U.)	(Semimajor Axis)^3
Mercury	0.241		0.387	
Earth	1.00		1.00	
Jupiter	11.9		5.20	
Neptune	165		30.1	
JAK	125		25.0	

Conclusion: Comet JAK obeys Kepler's 3rd law. _____ (yes) _____ (no)


Plot of Comet Positions
X-Position (A.U.)
Y-Position (A.U.)

Conclusions

Comets are very different from planets. They are smaller, they are mostly composed of ice, and their orbits are not even close to being circular. Write one paragraph (at least 5 sentences) explaining why one would expect comets to obey Kepler's Laws of ***planetary*** motion. Your paragraph should be written in such a way that someone who is new to astronomy could understand what you are trying to say. Pay careful attention to legibility, spelling, grammar, punctuation, and continuity of thought.

Instructor's Signature _____

ASTR 1031: Observing the Universe
Stellarium Night Observing Session III
Cloudy Night Lab #3

Name: _____ Lab Partners: _____

_____

Section: _____ Date: _____

III. Results

C. At Least 4 Constellation Drawings

Viewing Direction _____

Constellation 1 _____ Constellation 2 _____

Constellation 3 _____ Constellation 4 _____

Others _____

D. Four Telescope Drawings

Telescope Object 1 _____ Telescope Object 2 _____

Telescope Object 3 _____ Telescope Object 4 _____

Questions

1. What are some of the incredible distances to the objects you saw with Stellarium? Give two examples of them here and describe how many years it would take light to travel from that object to your eyeball.

2. Would a telescope be useful for viewing an entire constellation? Why or why not?

Go to the Astronomy Picture of the Day website: http://apod.nasa.gov/apod/

3. What is the picture today? Give a short summary of the image.

Conclusions

Summarize your results, your conclusions, and any additional questions you have. Write one paragraph explaining something you learned in today's lab that you never knew before. Please write well! Pay attention to spelling, grammar and continuity of thought.

Constellation Observing Sheet

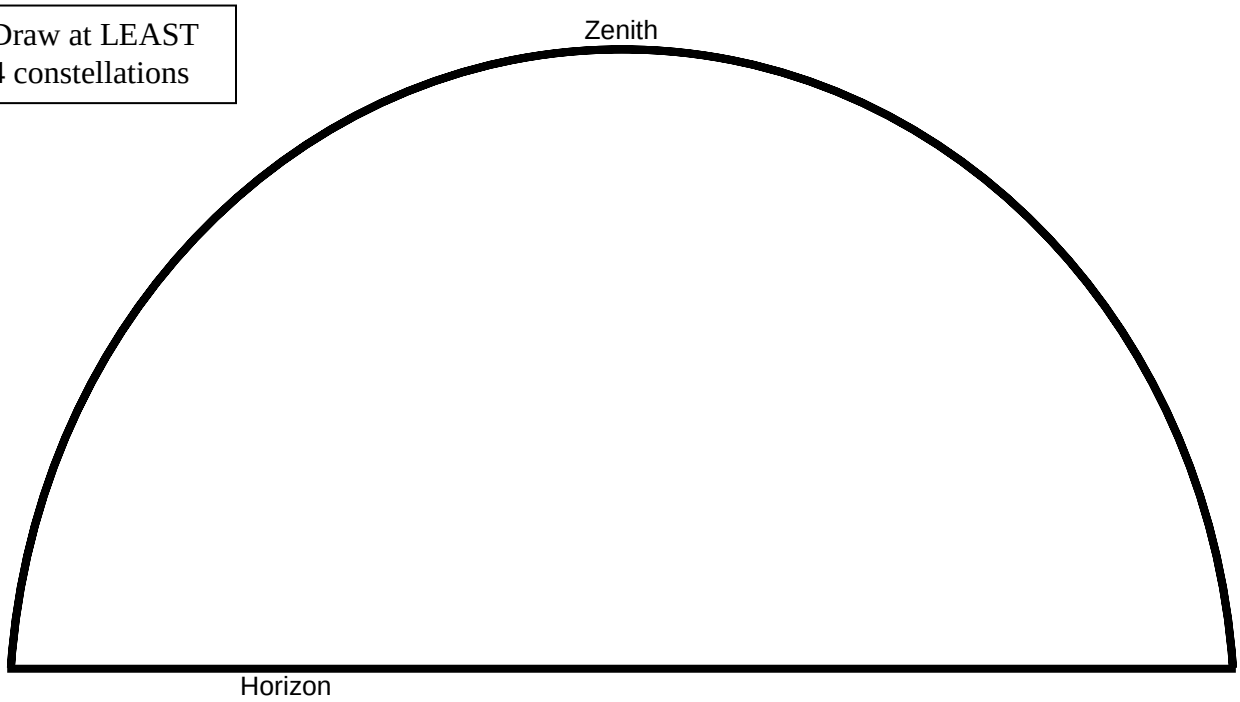
Title: _____

Date and Time: _____

Sky Condition: _____

Observing Site: _____

Draw at LEAST
4 constellations



Label Directions on Horizon

Description of Object(s):

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Telescope Observing Sheet

Date: _____ Time: _____

Sky Conditions: _____ Observing Site: _____

Object :_____

Magnification = _____

Description of Object:

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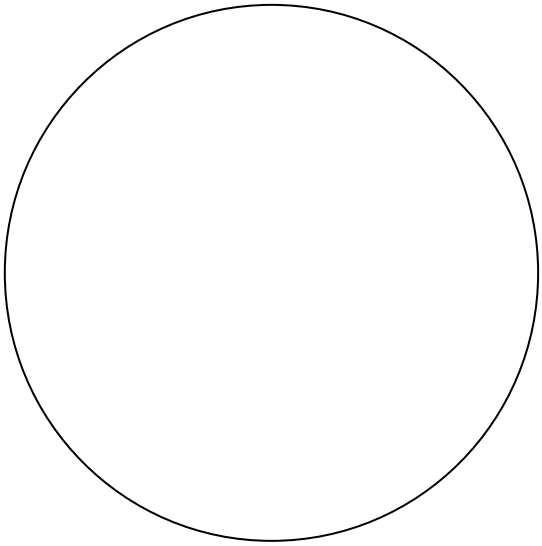

Field of view =

Object :_____

Magnification = _____

Description of Object:

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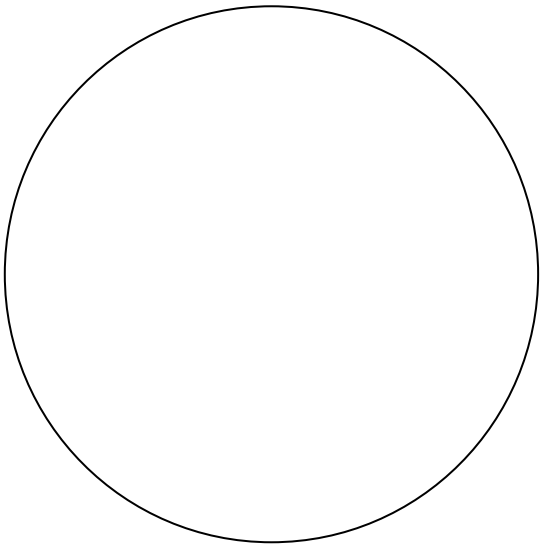

Field of view =

Telescope Observing Sheet

Date: _____ Time: _____

Sky Conditions: _____ Observing Site: _____

Object :_____

Magnification = _____

Description of Object:

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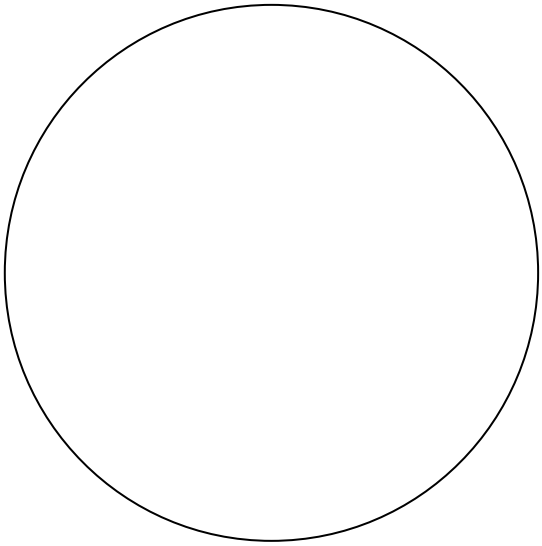

Field of view =

Object :_____

Magnification = _____

Description of Object:

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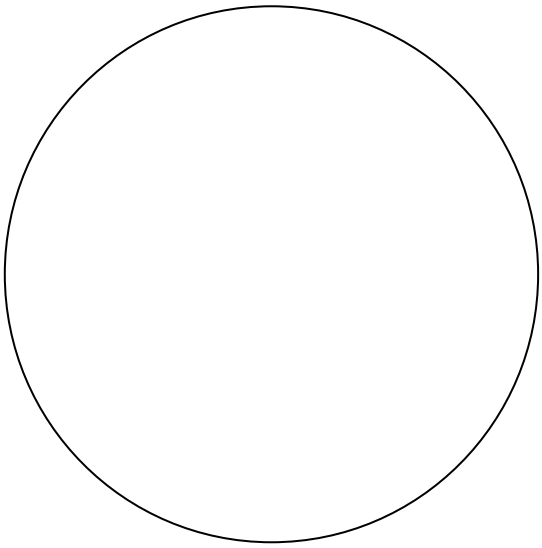

Field of view =