Name: _____ Lab # _____

DUE DATE: _____ Period: _____

LAB: *"Now You're Getting the Angle!"*

Introduction:

If you were on a ship in the middle of the ocean with no way to tell which direction was home, would you just give up and float adrift? Early sea explorers like Christopher Columbus did not accept this as an answer; they used a device called a **sextant**. The sextant measures the altitude, in angular degrees, of objects like stars in the night sky. By finding the **altitude**, or how high a star is above the horizon, navigators can map out their position on Earth.

In fact, knowing the *altitude* of the north star – Polaris, navigators not only know which direction 'north' is but they know exactly what latitude they are on Earth. This is because Polaris is a circumpolar star, meaning Polaris' position at the North Pole is 90^{o}N latitude or directly over your head. As you travel South toward the Equator, Polaris' altitude will decrease until you reach the Equator where Polaris is at 0^{o} altitude and your location is 0^{o}N latitude. Remember that **latitude** is the distance north or south of the equator you are.

This method of using stars like Polaris – the north star still used today; many true ship captains use Polaris' altitude to pinpoint their position at sea if their modem equipment fails them. Have you ever been told to find the North Star if you are lost?

Problem: How does a sextant (astrolabe) determine the altitude of a star like Polaris?

Objective: To measure the altitude in degrees of 5 stars from given distances

Materials:

- ☐ Paperclip
- ☐ String
- ☐ Tape
- ☐ Scissors
- ☐ Meter Stick
- ☐ Straw
- ☐ Cardboard Protractor cut-out
- ☐ Protractor (clear)/Ruler

Preparing your Sextant (astrolabe):

1. Obtain a cardboard protractor and cut it out.
2. Cut a length of string 20-25 cm long.
3. Tie the paperclip to one end of the string.
4. Turn the protractor toward you so it looks like the letter "D." Lay the straw across the center of the protractor (cutting the "D" in half).
5. Tape it in two places - on the side without the numbers on it. *See figure 1-1 to the right.*
6. Tape the other end of the string to the protractor just above the straw making sure the string lines up with 0^{o} on the front. *See figure 1-1 to the right.*
7. Calibrate your sextant, be sure the string reads zero degrees at start and can read 90^{o} when turned.

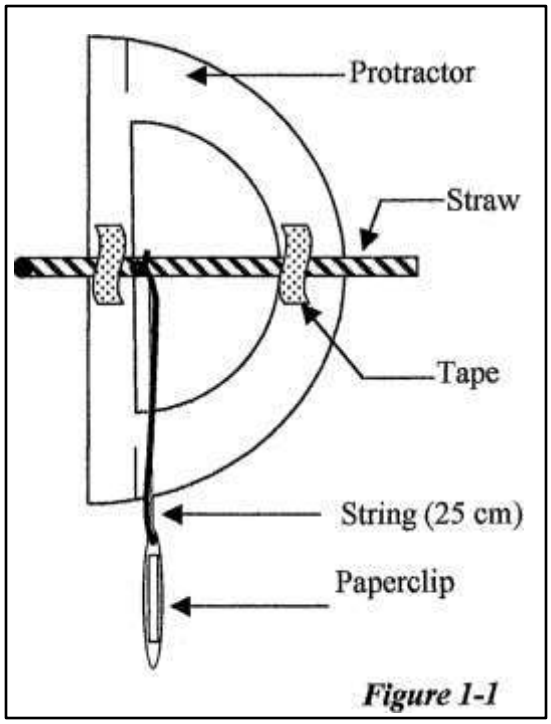


Figure 1-1

Procedure A: *Measuring with the Sextant (astrolabe) inside the classroom*

1. Locate **Star-A** on the wall in the classroom.
2. With a meter stick, measure **2 meters** away from the wall that **Star-A** is attached to.
2. Sight **Star-A** by looking into the straw from the side with the curved end of the protractor. *See figure 1-2 for proper star sighting.*
3. Carefully pinch the string against the paper protractor then read and record the angle on your data table.
4. Record your partner's data as well, then find the average angle from your collected data.
5. Repeat this procedure for **Stars-B** and **C.**

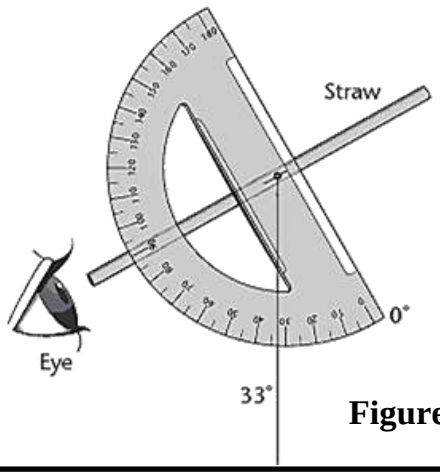


Figure 1-2

Procedure B: *Measuring with the Sextant (astrolabe) outside the school*

1. Locate **Star-D** on the school building window.
2. With a meter stick, measure **7 meters** away from the wall that **Star-D** is attached to.
2. Sight **Star-D** by looking into the straw from the side with the curved end of the protractor. *See figure 1-2 for proper star sighting.*
3. Carefully pinch the string against the paper protractor then read and record the angle on your data table.
4. Record your partner's data as well, then find the average angle from your collected data.
5. Repeat this procedure for **Stars-E** and **the top of the flag pole.** ***See figure 1-3 for flag pole.***

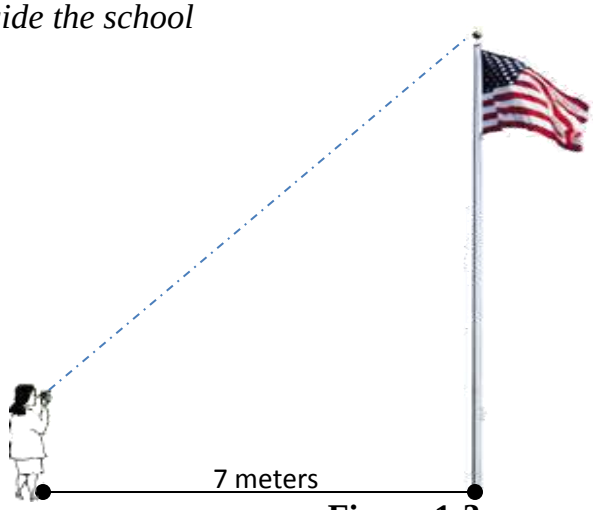


Figure 1-3

Procedure C: *Where is Polaris?*

1. Complete this procedure for extra-credit once your lab is graded and returned to you!
2. Bring home your sextant, and on a clear night find the north star – Polaris. Look to the north sky!
3. Aim your sextant at the North Star – Polaris, and record its altitude in degrees on your data table.
4. Return to school and re-submit your lab for points.

Data Table: *Altitude of Stars*

Star Name	Distance (away from wall)	Person Measuring (list names)	Angle (in degrees °) of altitude (from horizon)	Average
A	2 meters	*you:*	o	o
			o	
			o	
B	2 meters	*you:*	o	o
			o	
			o	
C	2 meters	*you:*	o	o
			o	
			o	
D	7 meters	*you:*	o	o
			o	
			o	
E	7 meters	*you:*	o	o
			o	
			o	
Top of flagpole	7 meters	*you:*	o	o
			o	
			o	
Polaris	Extra Credit	*yourself*		

Conclusion Questions:

1. a. What is a **sextant** used for? [1 point] _____

_____

b. What explorer used a sextant?[1 point] _____

2. Explain how you used your sextant [2 points]: _____

_____

_____

3. Define the following: [2 points]

a. **altitude**: _____

_____

b. **latitude**: _____

_____

4. How does the **altitude** of Polaris (the North Star) help determine your **latitude** on Earth? [2 points]

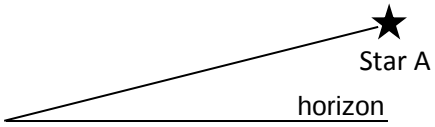
_____

_____

_____

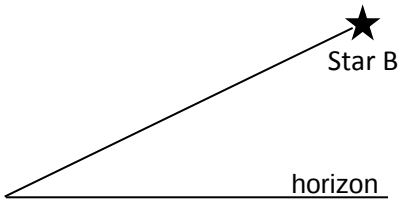
5. Use a protractor to measure the angles for the stars pictured below to the nearest degree. [3 points]

a.



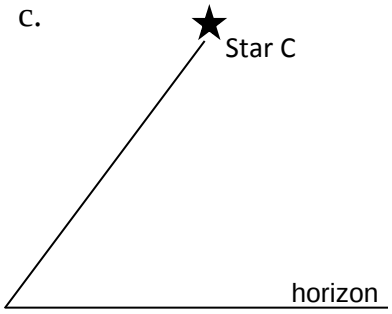
a) Star A = _____ ^{o}

b.



b) Star B = _____ ^{o}

c.



c) Star C = _____ ^{o}

6. Use a protractor to draw in stars for the given angles (use the line given as a start point) [3 points]

horizon

a. **Star D = 30^{o}**

horizon

b) **Star E = 43^{o}**

horizon

c) **Star F = 75^{o}**