Making a Sunset Calendar

Due Date: _____

INTRODUTION:
Many ancient civilizations kept time with the Sun. They used the Sun's position to determine the hours of the day as well as the days of the year. Across Asia, Europe, Africa and the Americas people tracked the seasons by looking at the location of the rising or setting Sun. Predicting the seasons was very important to people whose food depended on planting crops or predicting migrations. Some peoples built observatories which had markings to determine the date from the position of the sun. This lab allows us to check the technique to see if we can use the position of sunset to keep a calendar.

PROCEDURE:
You will observe sunset over an extended period from the same location and record what you see.

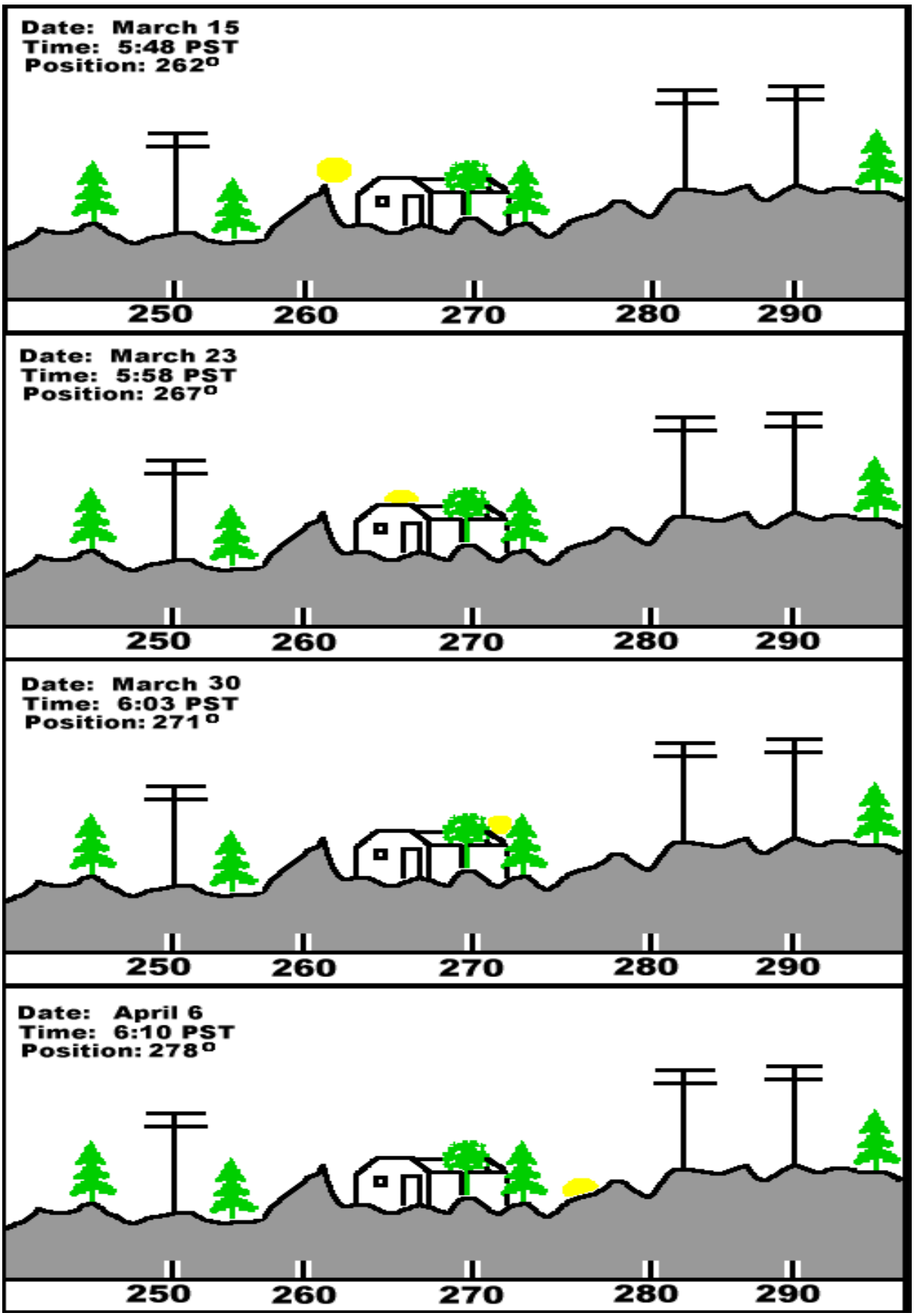
1 **Picking a good spot**. This is important: it must offer a wide view of the western horizon, so you can see the Sun set over the next few months. Having distinctive landmarks, such as trees, fences, posts or buildings makes measuring the position of sunset easier(see figures). Also, be sure that you can find due West easily. Parks, schools and large parking lots are often good places. Find a specific place to stand (you must stand in the same spot for each measurement) and look due West, using your hands make sure that you can see the horizon (or close to it) for 30^o to the North and the South. There are two common methods of finding West.

1.1 Using a map. Examine the location you wish to use (such as a park or a school) and find two landmarks which are directly East and West of each other. Stand at the Eastern one and find the other landmark!

1.2 Using a compass. (It is easier to show this than to describe it)

2 **Drawing and calibrating the horizon.** Refer to the figures. Draw the western horizon from about 30^o South of West to about 30^o North of West. Unless you are a very good artist your drawing will only be a crude representation – but that is O.K. We are about to calibrate your drawing! Indicate on your drawing where on the horizon is due West as 270^o. Then picking the most prominent landmarks, measure (using your hand) the azimuth of each.

3 **Making the observations.** Once a week you will need to go to your observation spot at sunset and record the time and position of sunset. You may just draw the position that the Sun contacts the horizon (and note the time) and then later determine what the azimuth is. Note the time, date and azimuth of the Sun for each observation. By looking up the time of sunset in your newspaper (or on-line) you can be sure to get to your spot before the Sun sets. You will need to make a total of _____ observations.


Date: March 15
Time: 5:48 PST
Position: 262°
250
260
270
280
290
Date: March 23
Time: 5:58 PST
Position: 267°
250
260
270
280
290
Date: March 30
Time: 6:03 PST
Position: 271°
250
260
270
280
290
Date: April 6
Time: 6:10 PST
Position: 278°
250
260
270
280
290

LAB REPORT:

You must turn in all of your observations along with a lab report answering these questions.

[Under Data Description]

1. Describe where you observed sunset, why you chose that spot and any difficulties you had during the course of observations (e.g. Did a landmark fall down? Did the police ask you why you are drawing the sunset? Were you unable to find your spot each time?). Any data point which seems unusual should have an explanatory comment.

[Under Analysis]

2. Plot the azimuth of sunset calculated from the included equations. Draw a smooth line connecting these points [You may use supplied plots]. What is the shape of this curve?

3. On the same graph, plot the observed azimuth of sunset for the year. How well do your data match the calculated values? How do you explain any discrepancy?

4. Plot the calculated time of sunset from the included formula [You may use supplied plots]. Draw a smooth curve connecting the points. What is this shape of this curve?

5. On the same graph, plot the observed times of sunset. How do your observations compare to the calculation? How do you explain any discrepancy?

6. On a copy of a Horizon diagram, indicate the position of sunset for both Solstices and Equinoxes. Describe how this information would help keep a calendar. Is the Azimuth of sunset sufficient information to know the date? Why or why not?

7. How would you use this to create a sunset based calendar? What additional information would you need to make your calendar as accurate as possible?

8. Is there a correlation between the time of sunset and the azimuth of sunset?

Equations for Calculations:

Note the following variables:

Az= Azimuth, D = Declination of Sun,
L= Latitude of observer H= Hours of daylight
JD = Julian Day (Day of the year)

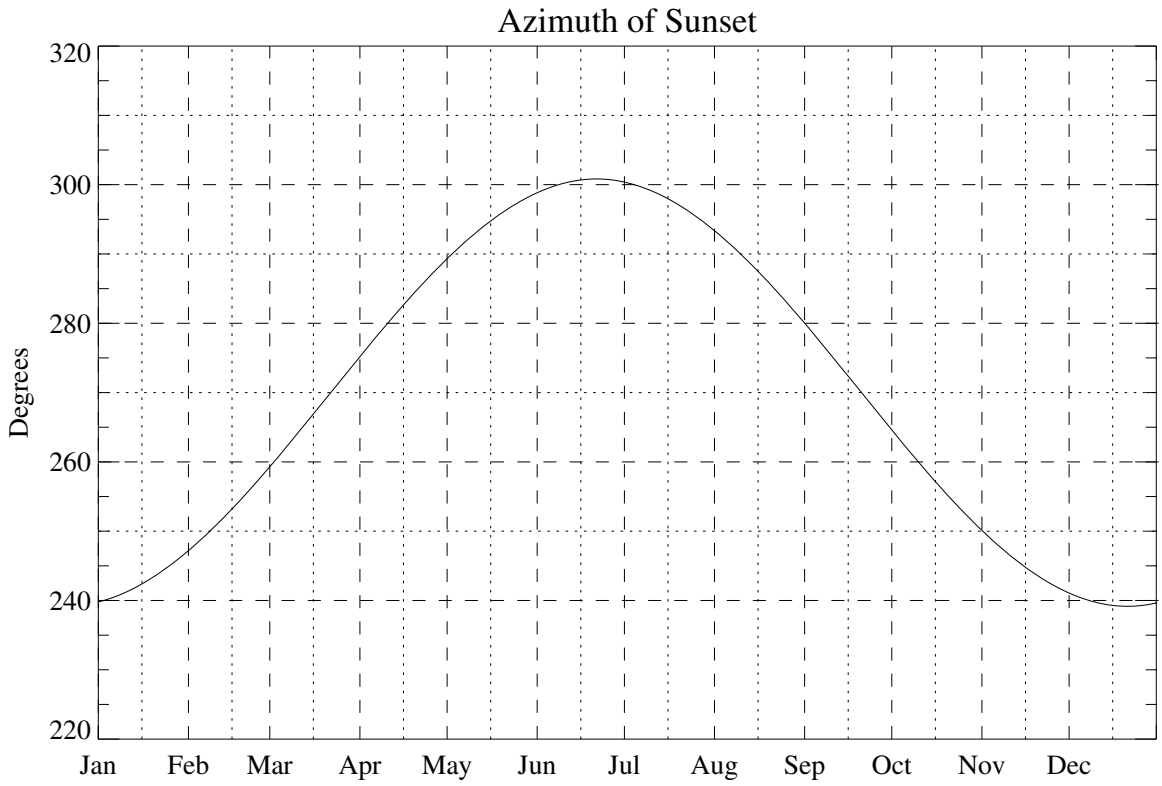
Azimuth of Sunset: $Az = 360 - \cos^{-1}(\sin(D) / \cos(L))$

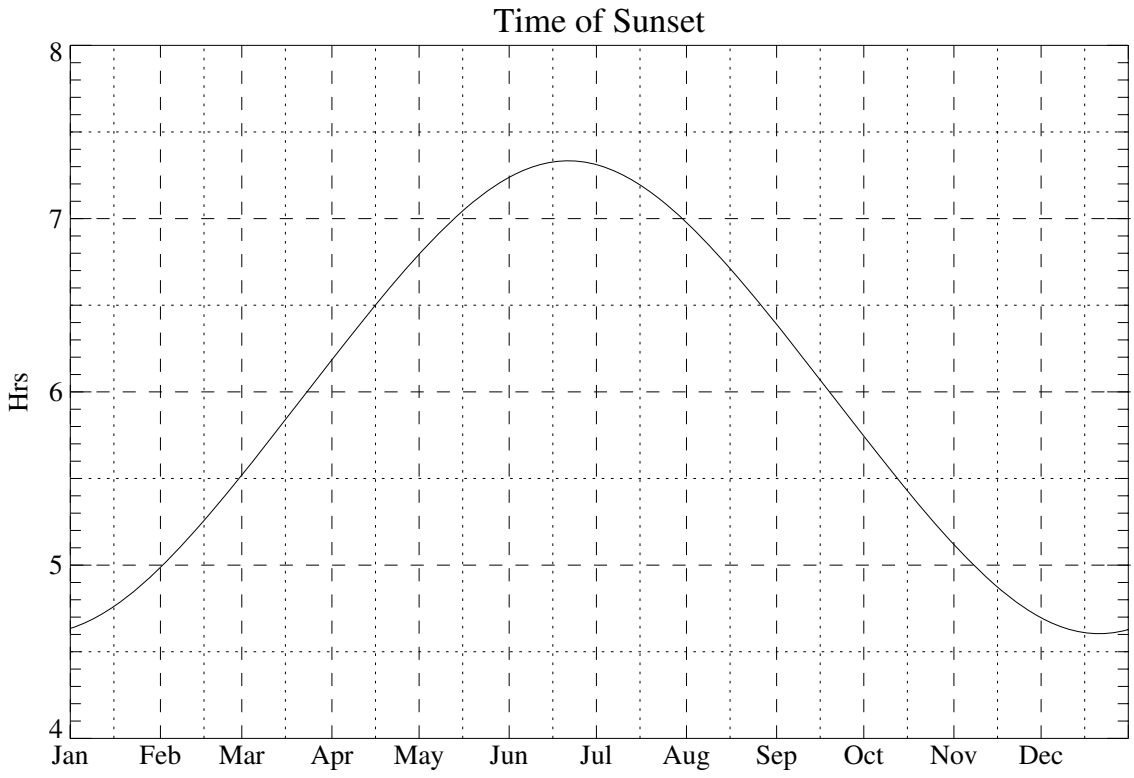
Hours of Daylight: $H = (2/15) \times \cos^{-1}(-\tan(D)\tan(L))$

Time of Sunset is nominally H/2 – why?

Declination of the Sun: $D = 23.46 \sin((JD-80) \times 360/365.25))$

If you observe sunset from Middlefield Campus, you can use this aerial view to help find the azimuth of sunset





Note: Vertical dashed lines are the first of the month and Vertical dotted lines are the fifteenth of the month