For Problem 2, it is helpful to use a celestial sphere. There is one in 3260 BMPS.

1. Erathosthenes noticed that the sun lit the bottom of a well in Syene at noon on one day and that in Alexandria the sun cast a shadow that was 7° from vertical. The distance from Alexandria to Syene is 500km.

   a. (5 pts.) Suppose Herathosthenes lived on Hearth that is 3000km in radius. Herathosthenes noticed that the sun lit the bottom of a well in Hsyene at noon on one day. What is the angle of the shadow of a vertical stick in Halexandria. The distance from Halexandria to Hsyene is 500km.

      Picture Hsyene, Halexandria, and the center of Hearth. The distance between Hsyene and Halexandria is a fraction 500km/(2π 3000km) of the circumference. It is also (x °)/360°, where x is the angle of the shadow in Halexandria. Therefore x=360°500km/(2π 3000km)=9.5°.

2. The coordinates of the center of the Milky Way galaxy are $17^{hr}39^{min}$ right ascension and –29° declination.

   a. (5 pts.) When is the best time of year to observe it? Explain how you can figure this out from knowing that the right ascension of the sun is $0^{hr}0^{min}$ on the vernal equinox.

      You want to observe for the longest part of the night, which means it rises at sunset and sets at sunrise. In the figure for question 3, left is 0hr. Therefore the galactic center (18hr) is up. On 6/21, the sun is setting when 18hr is rising.

   b. (2 pts.) Is it better to observe it from Michigan or from Chile in South America? Explain your reasoning.

      It is better to observe in Chile. Because the declination is –29°, it passes overhead at latitude –29°, which is in Chile. In Michigan, at +44° latitude, it is at best only 17° above the horizon, which is very low in the sky.

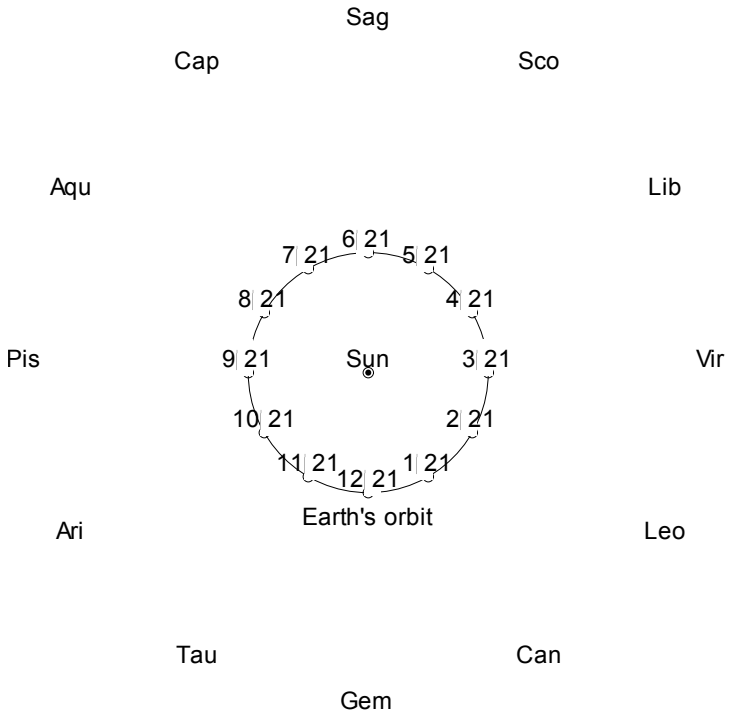


Figure 1 As given in the problem

3. **A mental model of the sky,** which we introduced in class.

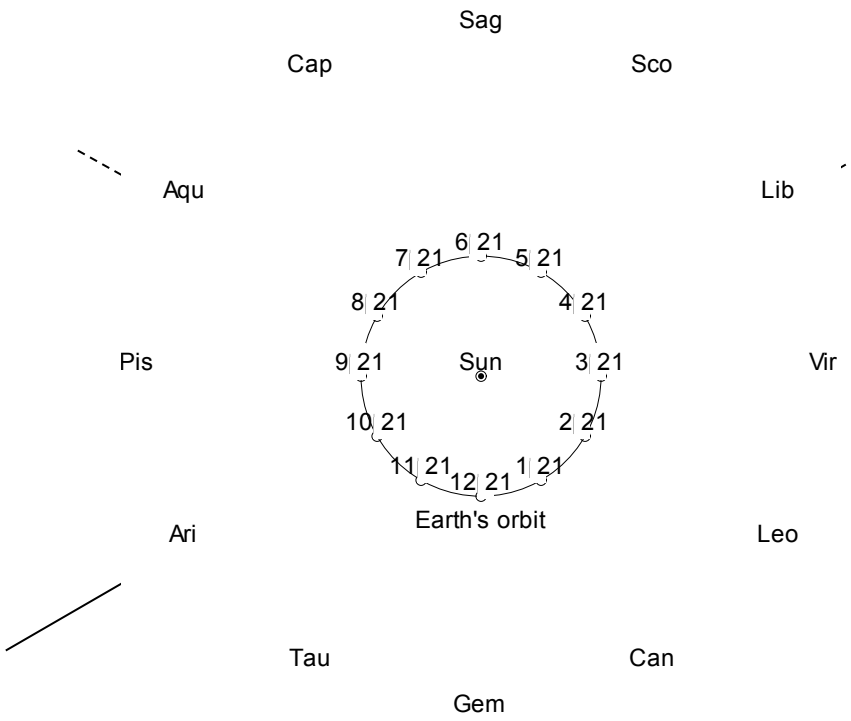
   a. (5 pts.) A star rises at 8 pm. When does it rise two months from now? Explain how you deduced the answer.

      Today is close to 9/21. The arrow on the figure is you at 8pm, and the line is the horizon. (Note that because the constellations are many, many times as far from us as the sun, that to see what is somewhere in relation to the earth you have to shrink the earth's orbit

essentially down to where the sun is.) The horizon turns counterclockwise with the earth. Therefore Aries is rising.

The dashed line is the horizon at noon on 11/21. (Aquarius is rising at noon.) Two hours later, Pisces is rising, and at 4pm, Aries is rising. (Every two hours, a new constellation of the zodiac is rising.)

Alternatively, you can reason this way: 2 months = 4 hours of right ascension. As time goes by, stars rise earlier. Therefore it will rise 4 hours sooner at 4pm.



b. (5 pts.) Which constellation of the Zodiac is high in the sky at sunset tonight? Explain how you deduced the answer.

Today is nearest to 9/21. Draw the horizon, which runs from Pisces to Virgo. The sun is on the horizon. The upper half of the sky is visible. A little later, the horizon turns counterclockwise and the sun goes below the horizon. Therefore Sagittarius will be highest at sunrise.

Figure 2 For answer

(Note that if you said your sunset was at 8pm, then Cap would be high in the sky)