Milestone: Timekeeping: Homework 2

Due: 6 September 2021

1 Simple vertical sundial

Consider a simple sundial consisting of a vertical stick that casts a shadow. Suppose that one one day the Sun passes directly overhead. On this day sunrise would be at 6:00am and sunset at 6:00pm. The length of the shadow cast by the stick changes during the day.

a) What is the time when the Sun makes an angle of 40° from the zenith and is West of the zenith?

b) Consider the *change* in length of the shadow from 7:00am to 8:00am versus the *change* in length of the shadow from 10:00am to 11:00am? Would the change in length from 10:00am to 11:00am be smaller than, larger than or the same as that from 7:00am to 8:00am? Explain your answer (a diagram may be useful).

c) Suppose that one tried to record the hours with marks spaced equally distant from each other to indicate the hours. Would this work correctly? Explain your answer.

2 Sundial location

Would a sundial designed to tell time correctly in Grand Junction, CO work equally well if it were moved to Mexico City? Explain your answer.

3 Temporal hours in Fairbanks, AK

The city of Fairbanks, AK is sufficiently far north that its shortest day is much shorter than its longest day. Suppose that the system of temporal hours was used in Fairbanks. For each of the following days determine the duration of one temporal hour.

a) Midwinter, with sunrise at 10:58am and sunset at 2:40pm

b) Midsummer, with sunrise at 2:57am and sunset at 12:47am (the following day).

4 Ancient Roman sundial

There is an animation of a moving shadow on an ancient sundial from Pompeii (at the time part of the Roman Empire) available on the website

https://jitp.commons.gc.cuny.edu/4836-2/

The website shows various animations of the shadow produced by the Sun on various days of the year.

a) Sketch the lines of the dial as accurately as you possible can (ignore the inscriptions).

b) Indicate on your sketch the line along which the shadow moves during the winter solstice.

c) Indicate the line along which the shadow moves during the spring equinox.

d) Indicate the line along which the shadow moves during the summer solstice.

e) Indicate the lines which mark the hours on the various days. Do these appear to be conventional equal hours or temporal hours?

5 History of sundials

There is not much literature available that describes the broader history of sundials. The following article sketches out some of the issues: A. J. Turner, Sun-Dials: History and Classification, History of Science, Vol. 27 Issue 3, pp 303-318 (September 1, 1989). Obtain this article via D2L and answer the following questions based on what you read. *Note: This is a fairly dense article and you can probably skip sections that have to do with arguments between various scholars. You may have to jump back and forth in this, but that is part of reading such articles.*

a) The author sketches issues about the known literature about sundials in the introductory paragraph. On what aspects of understanding sundials does he say most work has focused? Which aspects does he say have received little attention?

b) The author eventually describes what is known in the 20^{th} century about the history of sundials. According to him where and when were the earliest known sundials?

c) According to the author, what is strong evidence for widespread use of sundials in ancient Greece (also called the Hellenistic world)?

d) According the the author, is there much evidence for use on sundials in Europe in the few centuries after the fall of Rome in the 5^{th} century. After this, when did sundials eventually become more commonplace in Europe? Where were they usually found?