

## Milestone: Keeping Time: Homework 5

Due: 2 October 2020

### 1 Necessity of knowing longitude

Consider naval navigation in the period from the 15<sup>th</sup> to the 18<sup>th</sup> century. For which typical naval routes was the problem of knowing longitude more critical? For which routes was it less critical? Briefly explain your answer.

### 2 Determining longitude using time

A ship carries a clock that reads Greenwich time.

- a) Suppose that at some location in the open ocean local noon is observed from the ship and the clock states that Greenwich time is 3:20pm. Determine the longitude of the ship.
- b) Suppose that the sailors made an error in determining when local noon occurred and that they actually observed it half an hour after it truly did occur. Briefly explain what sort of error, if any, this would produce in the longitude that they calculate?

### 3 Determining Greenwich time

The crucial piece of information needed to determine longitude at any location on Earth is what Greenwich time at that moment. Using a synchronized clock provides one way to do this. What was the other possible way to determine Greenwich time at any location that could be used in the 18<sup>th</sup> century? Briefly explain how it worked.

### 4 Clock accuracy

At the equator 1° difference in longitude corresponds a distance of 69 mi.

- a) How much time passes between local noon at two points separated by 1° difference in longitude at the equator?
- b) How much time passes between local noon at two points separated by a distance of 69 mi at the equator?
- c) How much time passes between local noon at two points separated by a distance of 5.0 mi at the equator?

### 5 Harrison clocks

Did the Harrison clocks use a pendulum as a regulator? If so, why were they designed this way? If not, why did they not use a pendulum? Briefly explain your answer.

## **6 Research paper 2**

Provide the topic for your first research paper plus at least one possible source of information/evidence that might deal with the issue that your research paper considers. *This just seeks two pieces of information: the topic and the source. At this stage, you don't need to describe how the source might deal with the issue.*