

Milestone: Keeping Time: Homework 4

Due: 25 September 2020

1 Pendulum versus verge and foliot clocks

Huygens' pendulum clock offered a vast improvement over the verge and foliot clocks that it replaced. Which piece/s of the verge and folio clock did the pendulum replace and what is the main reason for which this yielded a much better accuracy in timekeeping?

2 Anchor escapement

The anchor escapement was a development which further enhanced clock accuracy.

- a) Was the anchor escapement used in verge and foliot clocks or pendulum clocks?
- b) Why did the anchor escapement increase clock accuracy? What is the basic physical reason?

3 Clock accuracy

Consider a verge and foliot clock which loses 15 min of time every 24 hr.

- a) How much time does this clock lose in one hour?
- b) How many seconds does this clock lose in one minute?
- c) How many seconds does this clock lose in one second?

Now consider a pendulum clock which loses 15 s of time every 24 hr.

- d) How much time does this clock lose in one hour?
- e) How many seconds does this clock lose in one minute?
- f) How many seconds does this clock lose in one second?
- g) Imagine a sporting event which lasts for about three minutes and in which the winner is decided by 0.50 s. Which, if either, of these clocks would be accurate enough to time this race correctly?

4 Pendulum clocks

What is the main reason for which a pendulum cannot be used as a regulator in a wrist watch?

5 Earth's rotation and longitude

In the following "local noon" means the moment at which the Sun is highest in the sky at any particular location on Earth.

- a) The eastern border of Colorado is at longitude 102.05° W and the 109.05° W. How much time passes from the instant when the Sun is highest in the sky at the eastern border to when it is highest in the sky at the western border? Explain your answer.
- b) Grand Junction is located at 108.57° W. Look up the longitude of Glenwood Springs, CO and use this information to determine the amount of time that passes from local noon at Glenwood Springs to local noon at Grand Junction. Explain your answer.
- c) How far away in degrees of longitude is a location whose local noon is only one minute later than the local noon at Grand Junction? At this latitude one degree of longitude difference corresponds to a distance of about 54 miles. How far west would this location be? Explain your answers.