

Introduction

In class we looked at the difference between the solar day (defined as noon to noon) and the sidereal day (which is the true rotational period of the Earth. Numerically these are 24 h (exactly) for the former, and about 23 h 56 m for the latter.

The difference arises because the Earth moves in its orbit around the Sun during the time it takes to rotate once on its axis. In one day it moves about 1° in its orbit, and so has to rotate an extra 1° to reach the second noon. Since it rotates at 15° per hour to pick up that extra 1° takes 1/15th of an hour, or 4 minutes.

The same applies to the other planets in the Solar System, but for the outer planets it becomes a very small effect. However for the inner planets it is larger, partly because they orbit quickly, but also because they rotate slowly.

Let's look at this for two planets orbiting the Sun. I will use fictitious planets to make the arithmetic simpler.

Assignment

Please answer on a separate sheet of paper.

- Let's start with a (fictitious) inner planet. Being closer to the Sun than the Earth it orbits the Sun in only 180 (Earth) days, and has a solar day (noon to noon) of 120 (Earth) hours.
 - How long is the solar day in Earth days?
 - Through what angle does it move in its orbit around the Sun in 1 Earth day?
 - Through what angle does it move in its orbit around the Sun in 1 of the planet's solar days?
 - What is its rotational speed in degrees per (Earth) hour?
 - How long will it take to rotate through the angle from part c?
 - How long is the sidereal day on this planet?
- Now let's look at a (fictitious) outer planet. Being further from the Sun than the Earth it orbits the Sun in 3600 (Earth) days⁽¹⁾, and has a solar day (noon to noon) of 12 (Earth) hours.
 - How long is the solar day in Earth days?
 - Through what angle does it move in its orbit around the Sun in 1 Earth day?
 - Through what angle does it move in its orbit around the Sun in 1 of the planet's solar days?
 - What is its rotational speed in degrees per (Earth) hour?
 - How long will it take to rotate through the angle from part c?
 - How long is the sidereal day on this planet?
- Now look up the length of both the sidereal and solar day, and calculate their difference for the real inner planets
 - Mercury
 - Venus
- And do the same for a couple of the outer planets
 - Jupiter
 - Saturn

1 Approximately 10 years, and comparable to that of Jupiter (11.6 years)