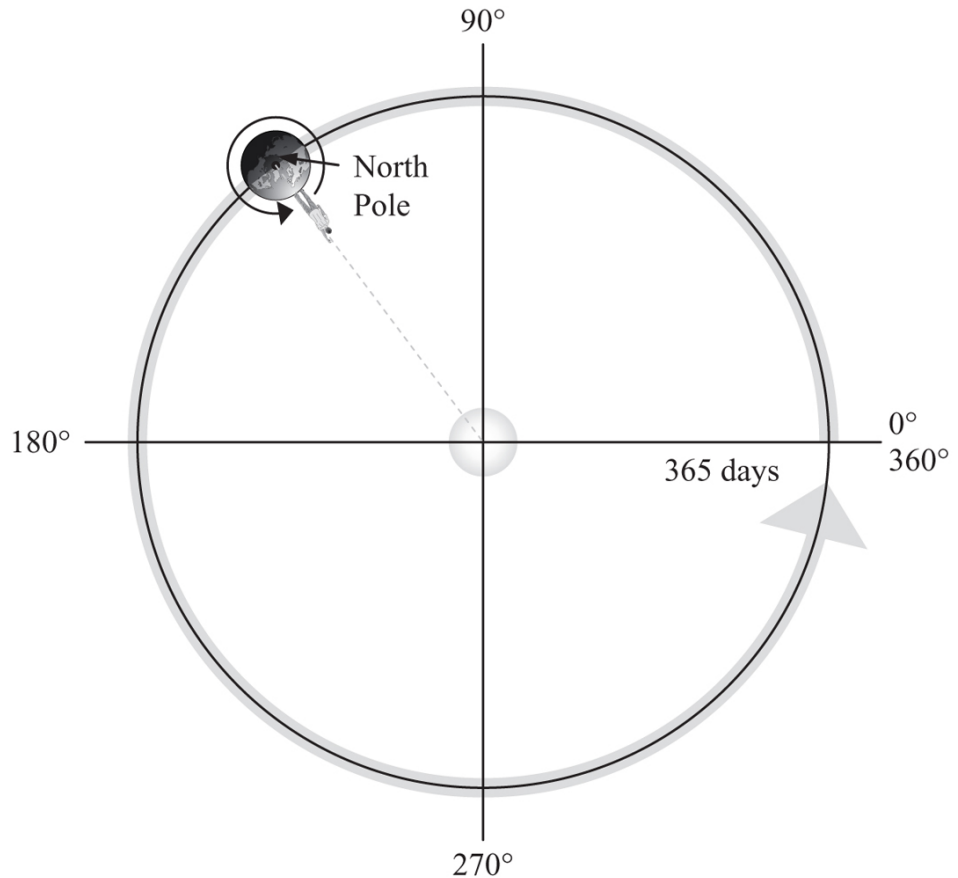


Part I: Solar Day

Figure 1 shows a top-down view of the Earth–Sun system. Arrows indicate the directions of the rotational and orbital motions of Earth. For the observer shown, the Sun is highest in the sky at 12 noon.



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- 1) Earth orbits the Sun in a counterclockwise direction once every 365 days. Approximately how many degrees does Earth move along its orbit in one day?
- 2) As Earth orbits the Sun, it also rotates in a counterclockwise direction about its axis as shown in Figure 1. We define 24 hours as the time from when the Sun is highest in the sky one day to when it is highest in the sky the next day. How many degrees does Earth rotate about its axis in exactly 24 hours: 360°, slightly less than 360°, or slightly more than 360°?
- 3) How long does it take Earth to rotate exactly 360°: slightly less than 24 hours, 24 hours, or slightly more than 24 hours?
- 4) Two students are discussing their answer to Questions 2 and 3.

Student 1: *Earth rotates about its axis once every 24 hours, and one rotation equals 360°.*

Student 2: *No. When Earth has gone around 360° it has also moved a small amount counterclockwise around the Sun, which means the Sun is not yet at its highest point. Earth must spin a little bit more for the Sun to reach its highest point.*

Do you agree or disagree with either or both of the students? Explain your reasoning.

Solar vs. Sidereal Day

Part II: Sidereal Day

We define a **solar day** as the time it takes for the Sun to go from its highest point in the sky on one day to its highest point in the sky on the next day, and we divide that time into 24 hours.

A **sidereal day** is defined as the time it takes for Earth to rotate *exactly* 360° about its axis with respect to the distant stars.

- 5) When does Earth rotate a greater amount, during a solar day or during a sidereal day?
- 6) Which takes a shorter amount of time, a solar day or a sidereal day?

Note: Since Earth rotates more than 360° in a solar day, a sidereal day is about 4 minutes shorter than a solar day.

Imagine that at some time in the future the direction that Earth orbits the Sun is somehow reversed so that Earth now orbits the Sun approximately 1° *clockwise* each day. However, the rotation about its own axis remains counterclockwise at the same rate.

- 7) In the space below, create a sketch similar to Figure 1 to depict this imaginary situation.

- 8) Through how many degrees will Earth now rotate in a *sidereal* day?
- 9) Through how many degrees will Earth now rotate in a *solar* day?
- 10) Which is now longer, the solar or the sidereal day?
- 11) Is a sidereal day now longer, shorter, or the same length as a sidereal day was before we changed Earth's orbital direction?
- 12) Is a solar day now longer, shorter, or the same length as a solar day was before we changed Earth's orbital direction?