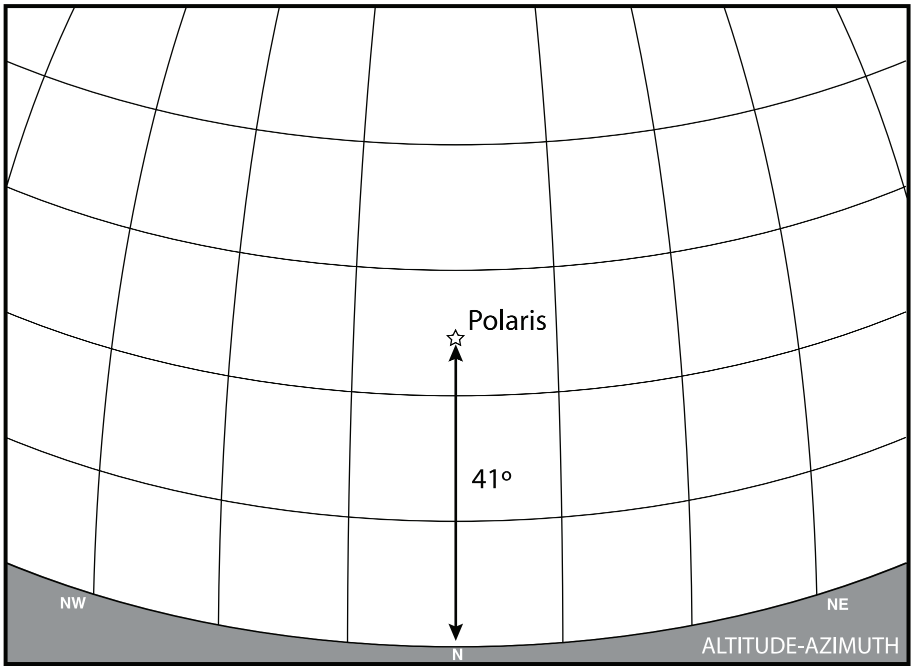
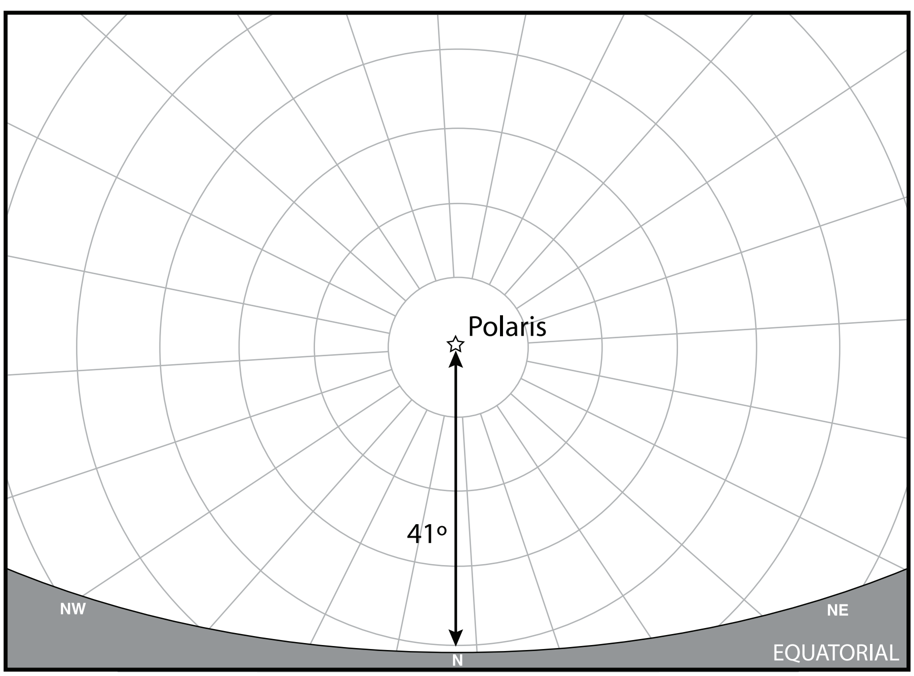
PHYS 1040: Solution
Assignment #1, Spring 2008

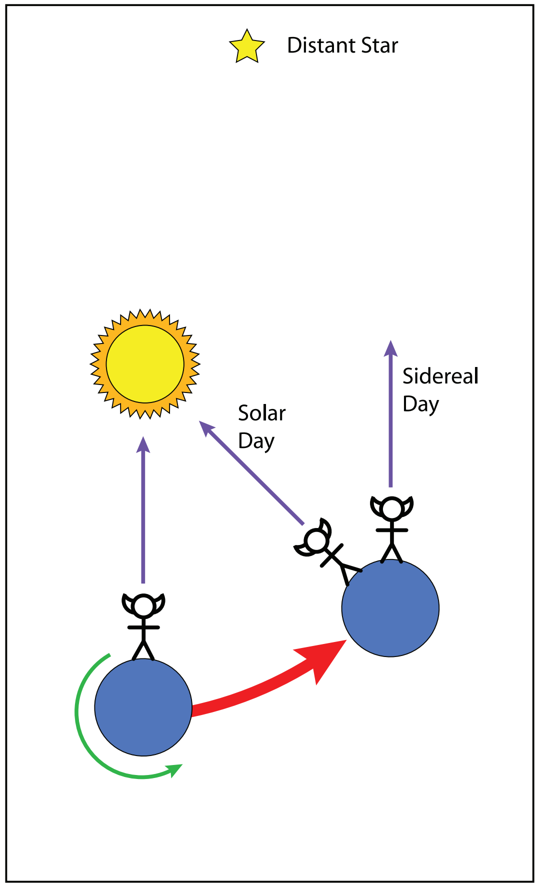
1: I love coordinate systems!





2: If only I had a sidereal watch

A sidereal day is *SHORTER* than a solar day. The reason is shown in the figure below.



The Earth not only rotates but also moves along its orbit. The Sun is relatively close to the Earth, compared to the stars which are very distant. This close proximity means that small changes in the Earth's position changes the direction you have to look to see the Sun[1].

A sidereal day is the time it takes a star to go from overhead to overhead again. Since the star is very far away, the orbital motion of the Earth does not change the direction I have to look (see figure). A solar day is the time it takes the Sun to go from overhead to overhead again. Since the Sun is much closer, as the Earth moves in its orbit, it has to spin farther than 360° to bring the Sun back to overhead.

3: The Stars to Navigate By

The altitude of Polaris above the northern horizon is equivalent to my latitude.

A mental exercise to convince yourself this answer is true is to consider two special cases. From the equator (latitude 0°) Polaris is on the northern horizon (altitude 0°). From the North Pole (latitude 90°) Polaris is directly overhead (altitude 90°).

[1] This is a familiar property of close objects versus distant objects. Consider a simple example here on Earth. Imagine you have two friends, Calvin and Hobbes, standing in a row with you. Calvin is one meter to your left, and Hobbes is 1 kilometer to your right. If you take two steps forward, you have to look behind you to your left to see Calvin, but still only have to look to your right to see Hobbes.

4: Recording astronomical data
Every astronomical observation must contain: *your name*, *the date*, *the time of the observations* and *the location from which the observations were made*. This is the minmum information needed to compare your observations to those of other observers around the world. Other useful information includes *sky conditions* and what *astronomical equipment* was used.

5: The Rising Constellations
Each night the constellations rise slightly earlier than they did the night before. The reason is that the Earth has moved around the Sun slightly in its orbit, and so the direction you are facing at sunset is slightly different (farther to the east on the Celestial sphere) than it was the night before.

6: The Southern Skies
There is nothing special comparing the Southern Hemisphere to the North. The same rules apply: (1) The Celestial Pole is above the horizon by an altitude equal to your latitude, and (2) You can see $90° - Lat$ into the opposing hemisphere.

Since $Lat = 38°$ in Melbourne, the altitude of the South Celestial Pole is 38°, and my friend can see $90° - 38° = 52°$ into the Northern skies (about the declination of the bottom of the Big Dipper).

7: The Mr. Spock Observatory for Discovery of the Cosmos
If I want to see as much of the sky as possible, I will build my observatory close to the Equator of the Earth. From such a vantage point, I can see both the North and South Celestial Poles, and all the stars in between. I can't see all the stars all the time, because some are behind the Sun, but over the course of an entire year, the Sun will move and I will be able to see all of the stars for some period of time.