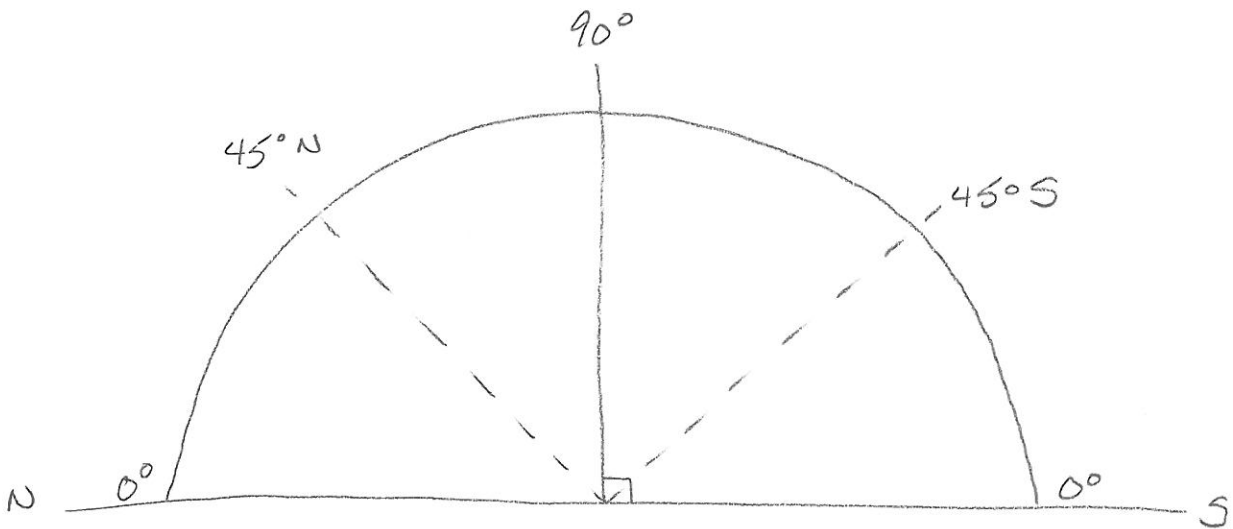
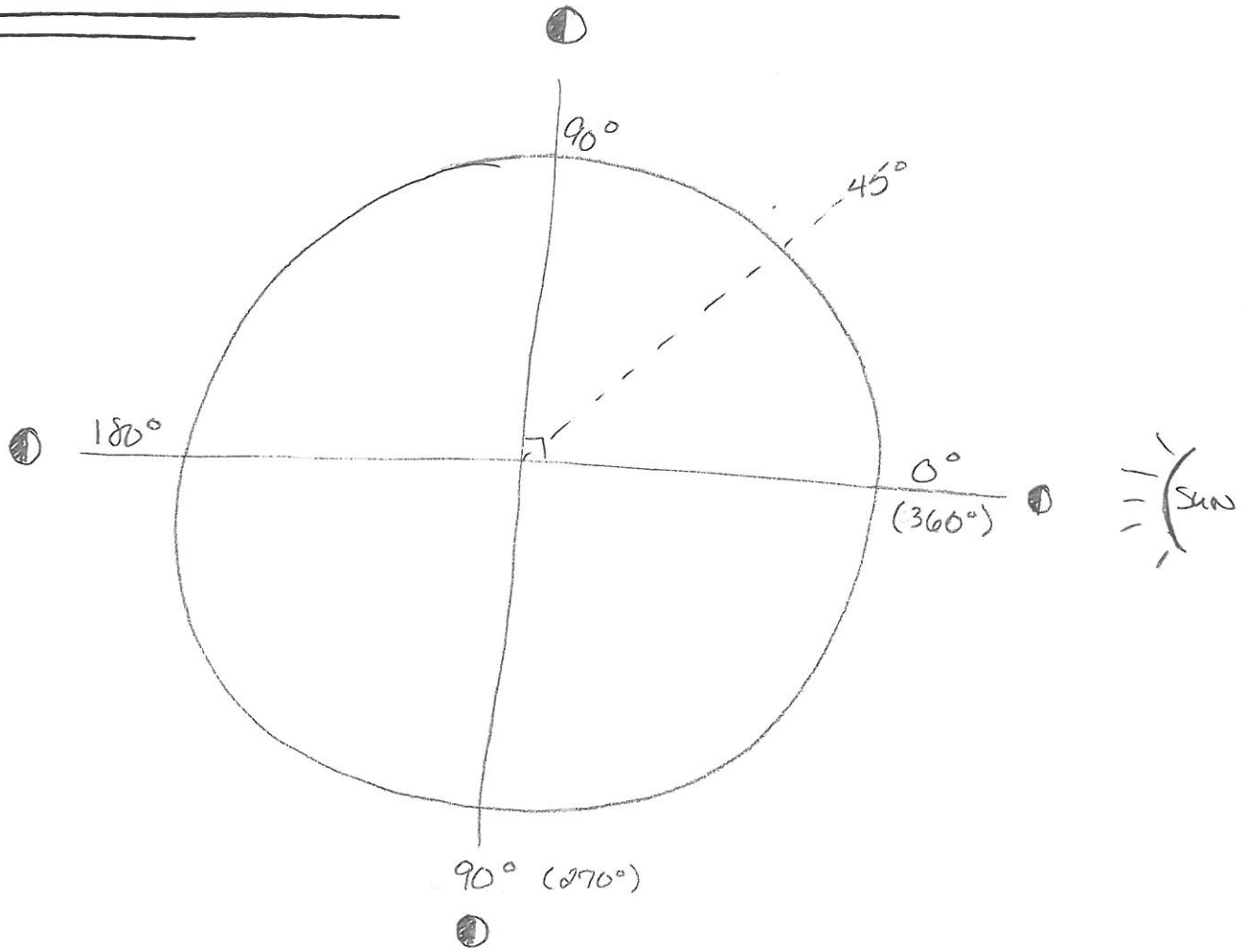


BASIC ANGLE RELATIONS

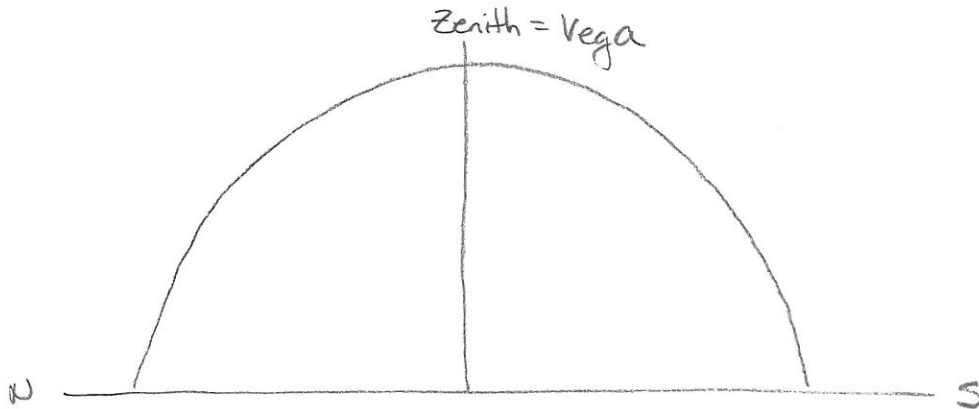


EXAMPLE CALCULATIONS

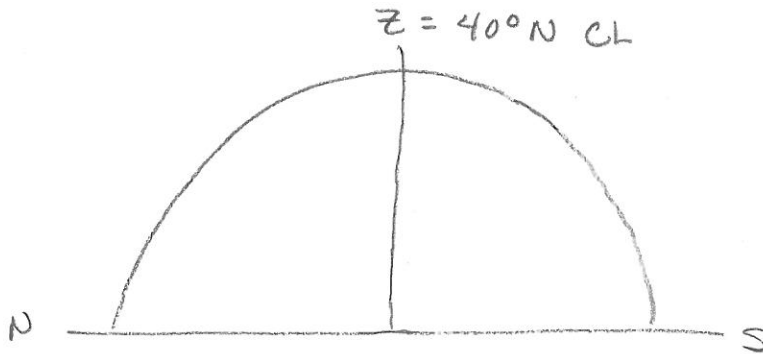
- Zenith Angle of Arcturus at Boulder

Start by setting up your sky.

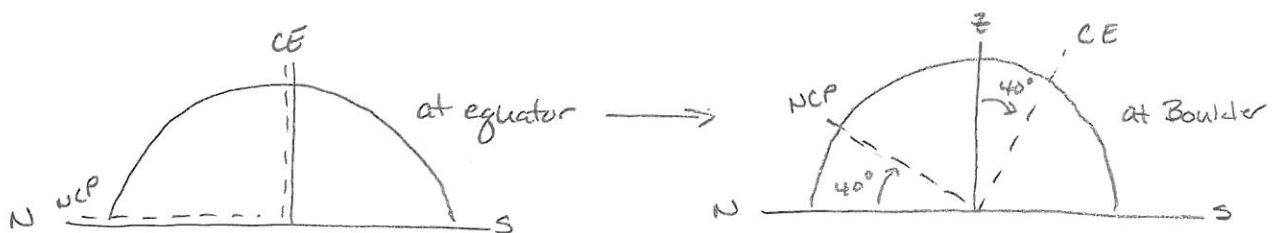
① At Boulder, the zenith star is Vega



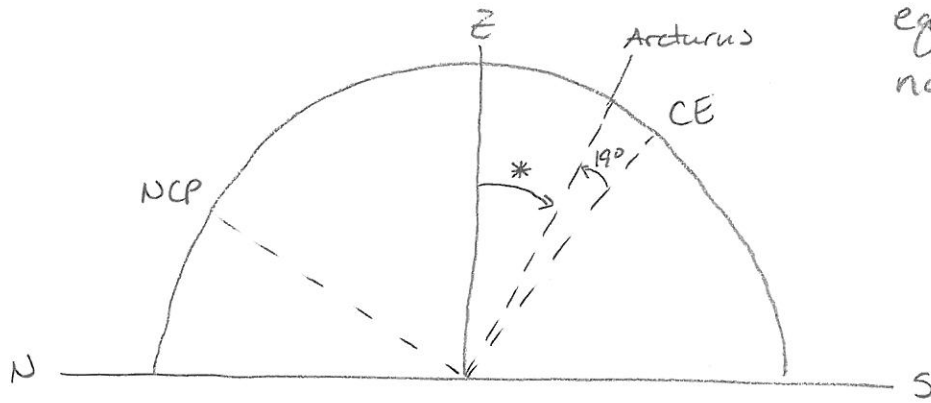
② This means that at your (local) zenith, the celestial latitude is the celestial latitude of Vega = 40° N



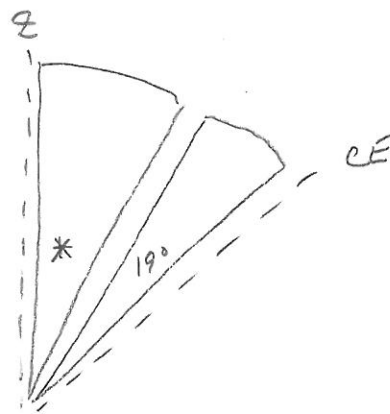
③ This means the celestial equator is tilted south of the zenith by 40° , and the north celestial pole is tilted of the north horizon by 40° as well.



Now locate Arcturus relative to the celestial equator. Arcturus' celestial latitude is 19° N. So it's 19° up from the celestial equator towards the north.



For the zenith angle, we want the angle labeled *, measured from the zenith downwards. So you have this picture:



where the two pie slices add up to 40° , the amount the celestial equator was tilted off (or down) from zenith. The calculation then goes as follows:

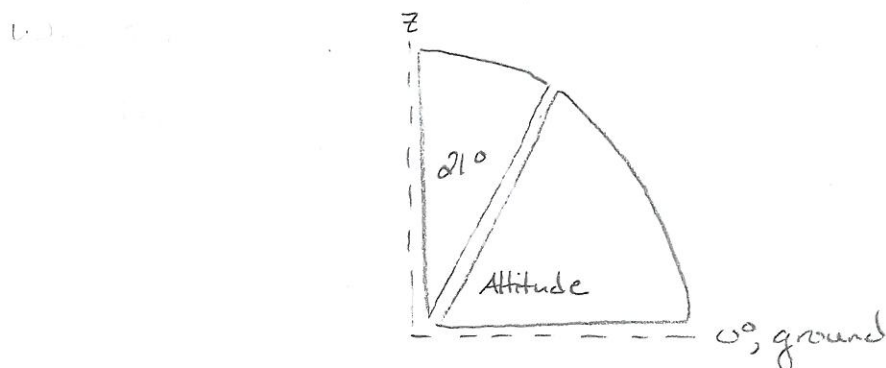
$$\begin{aligned} ZA &= 40^\circ - 19^\circ \\ &= 21^\circ \end{aligned}$$

And Arcturus is south of zenith on the meridian so the final answer is

$$ZA = 21^\circ S$$

- Altitude of Arcturus at Boulder

Altitude is measured upwards from the ground, and the highest altitude possible is at the zenith, which is 90° (see diagram on page 1). So the picture looks like this:



So the calculation goes as follows:

$$\begin{aligned}\text{Altitude} &= 90^\circ - 21^\circ S \\ &= 69^\circ S\end{aligned}$$

<p>* <u>Basic Rule of Thumb</u></p> <p>$ZA + \text{Altitude} = 90^\circ$</p>

- Multiplication and Division with Units

Any time you want to know how many somethings make up another thing, it's best to start by looking at the units.

For example, if you want to know how many blueberries per pie, you would divide the total number of blueberries by the total number of pies:

$$\# \text{ of blueberries / pie} = \frac{\# \text{ blueberries}}{\# \text{ pies}}$$

If you want to know how many blueberries to buy to make some number of pies, you reverse this calculation and multiply instead.

$$\# \text{ of blueberries needed} = (\# \text{ blueberries / pie}) \times (\# \text{ of pies wanted})$$

So if you want to know the number of miles in 1 degree, you would divide miles by degrees:

$$\# \text{ of miles in 1 degree} = \frac{\# \text{ miles}}{\# \text{ degrees}}$$

Basic rules of thumb:

- "in", "per" = divide

- the thing you want to know "how much" of goes on top
- the thing that "contains" it goes on bottom

- "how many necessary for", "to make", "total" = multiply