Primer for the Position of the Sun

We are going to transfer the key information from the diagram below to your Lenart spheres.

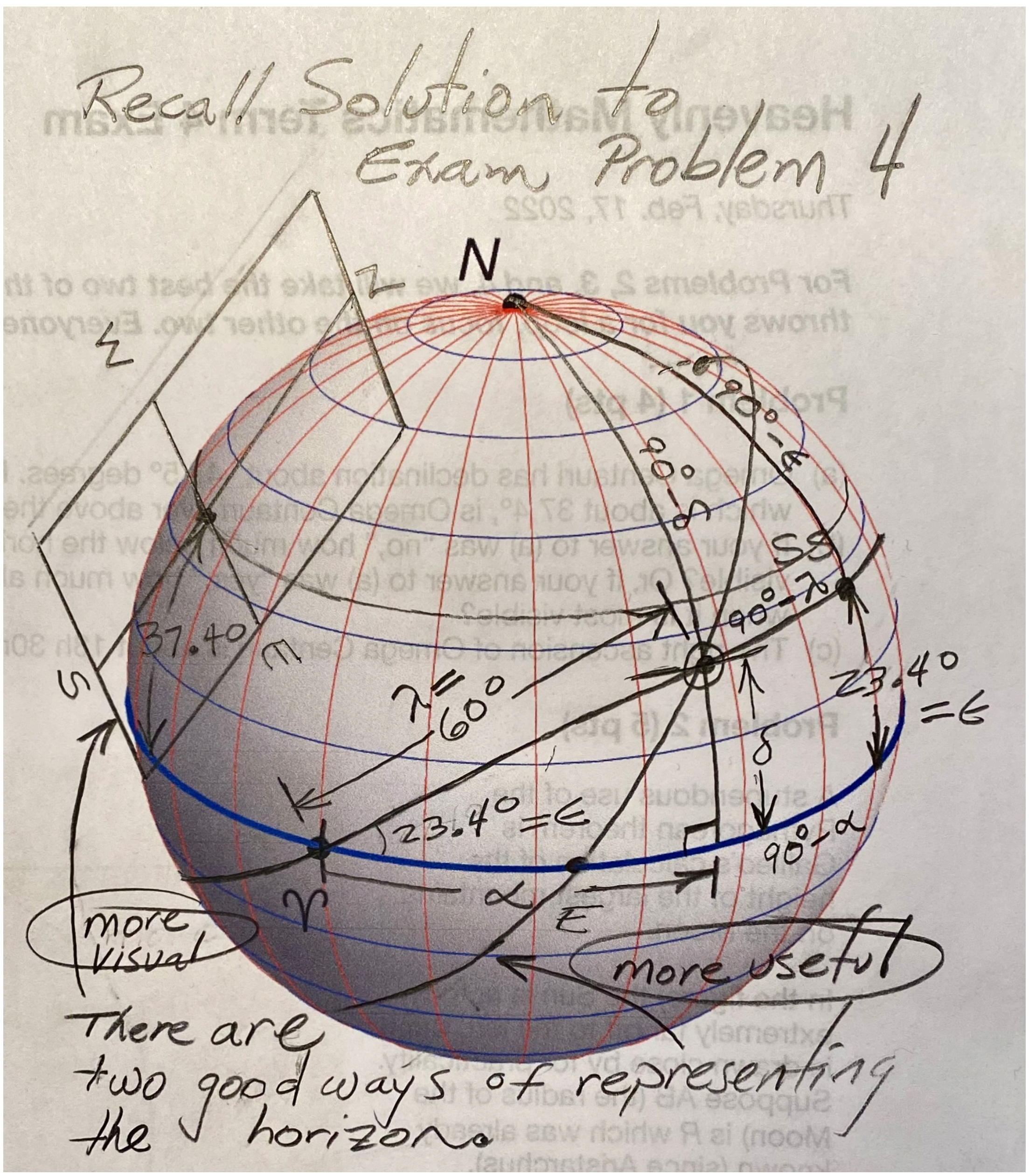
Step 1: Mark the Celestial North Pole and the Celestial Equator.

Step 2: Choose any point on the Celestial Equator and label that point ♈.

Step 3: Find the Point 90º to the east of that point and mark it with a dot.

Step 4: Measure 23.4º degrees toward the Celestial North Pole from the dot you made in Step 3 and make another dot.

Step 5: Connect the dots you made in Steps 3 and 4 with the Celestial North Pole. Label the dot you made in Step 4 SS.



Step 6: Make the great circle that is the Ecliptic. It needs to pass through ♈ and through SS.

Step 7: Measure 60° along the Ecliptic. Make a dot and circle it. This represents the position of the Sun on the Celestial Sphere on May 20th, 2022 (or May 22nd according to Ptolemy and Van Brummelen Appendix A). Mark the line that goes straight south from the Celestial North Pole through the Sun and hits the equator at a 90° angle.

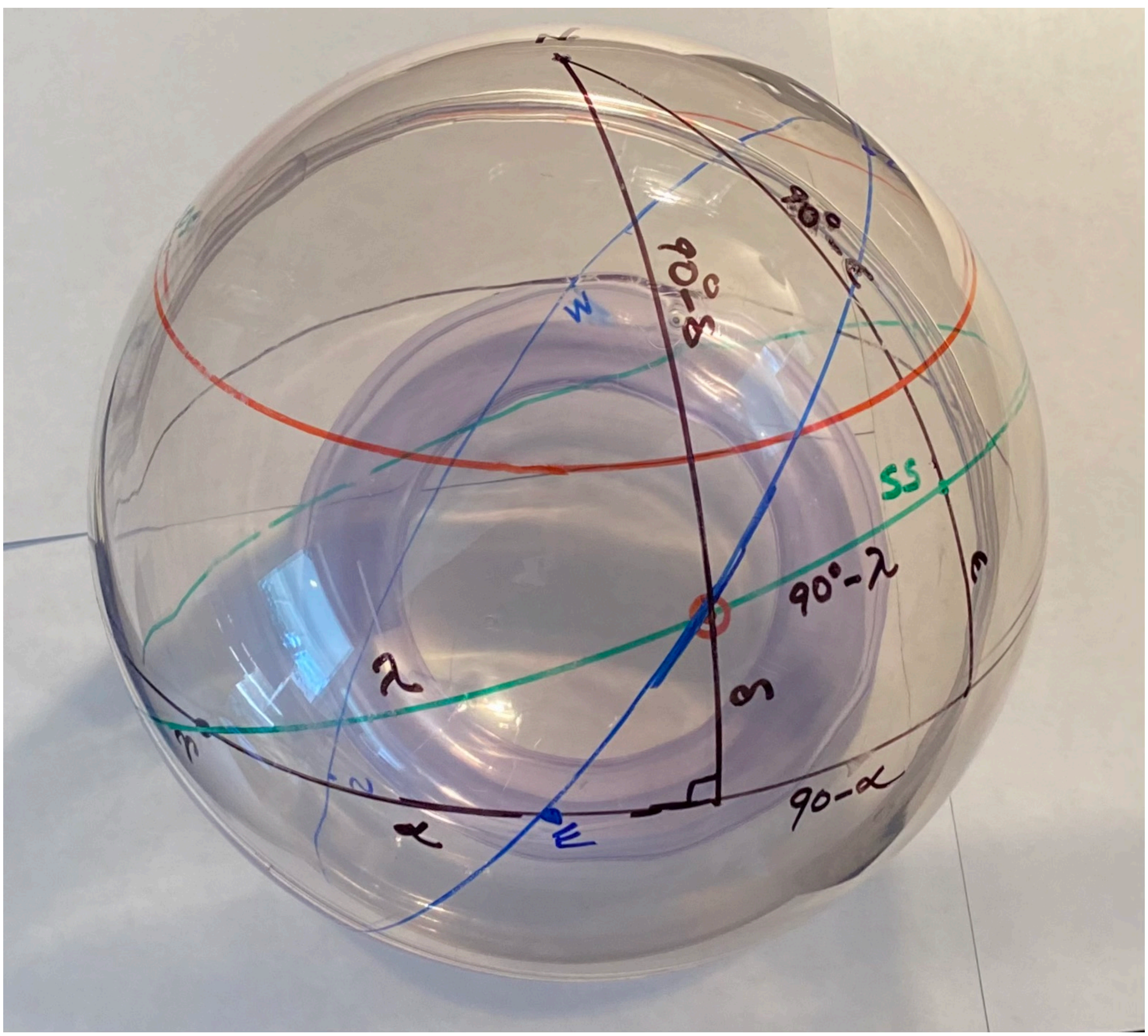
Step 8: Deep Springs has latitude 37.4°. Mark this circle with a compass planted at the celestial north pole. The compass will need to be extended to a radius of 90°-37.4=52.6°. VERY TRICKY: Find the place on this line of latitude that is 90° in the westward direction from the Sun. This is where Deep Springs will be under the Celestial Sphere AT SUNSET on May 20th. Label this point DS.

Step 9: Mark the great circle corresponding to Deep Springs's horizon and mark N, E, S, and W on this circle. ALSO TRICKY!

Step 10: Label λ, ε, α, and δ on your sphere. Also label the segments that are 90°-λ, 90°-ε, 90°-α, and 90°-δ.

The Result

After following these directions, your Lenart sphere should look quite like this:



Ptolemy's Whacky Model

In Problem Set 3, we calculated some properties of the position of the Sun using Ptolemy's whacky model. Ptolemy's model is not one of those theories that is close to right in a deep sense. It was just an approximation that kind of worked, and embellishing it got astronomers further and further off in the weeds. The bottom line, that Kepler's Laws forced upon the Ptolemaians, is that circles are not ellipses and the Sun (or more precisely the Earth) does not move at a constant speed (it moves faster at perigee and slower apogee). However, we are pursuing the ancient approach, so let us continue with their perfect and brilliant work as well as their imperfect concepts.

In Problem Set 3, Problem 1(a), we found OA = 0.017 and OB = 0.038. That gives sqrt(OA*OA + OB*OB) = 0.0416.

In Problem Set 3, Problem 1(b), we found the Sun's position along the ecliptic at apogee. We got 68º.

In Appendix A, Van Brummelen got 0.041367 and 65.429º for these numbers. Hopefully the discrepancies are just rounding errors — not some conceptual error on our part.

The point of Appendix A is that we can use Ptolemy's model to predict where the Sun is along the Ecliptic. We just count the days since the Spring Equinox and put them into some equations. Van Brummelen has the results of the model tabulated on pp. 175-178. We only need the results; there isn't much reason to dive further into the model.

Small Additional Results for Applying the Theorems of Menelaus

In the drawing on your sphere, some of the important arcs are 90º. Some of the other important arcs are 90º-ψ where ψ is one of the angles λ, ε, α, and δ. Because the Menelaus Theorems involve sines of the arcs, it will be handy to know that sin (90º-ψ) = cos ψ.

Finally, you need to recall the definition of tan ψ. It is opposite over adjacent. But it can also be written in terms of sin ψ and cos ψ. tan ψ = sin ψ / cos ψ.