

**HOMEWORK #2**  
**Due date: Sep 2, 2020**

1. Re-derive all the three alt-az equations (all spherical, of course). Be pedantic, use color, impress me. Above all, make sure you fully understand where all the angles and all the sides are, and why.
2. Derive a general expression for the angle  $\psi$  between the horizon and the path of the rising star.
3. Observing from Villanova, what is the declination of stars that we can observe for 16 hours? At what angle w.r.t. north do we see them when they are  $20^\circ$  above the horizon on the eastern sky? Stars with what declination are visible 20 hours? At what azimuth do they set/rise? Geographic coordinates of Villanova are  $40^\circ 2' 14.3963''$  N,  $75^\circ 20' 56.6768''$  W.
4. 4 hours after its culmination we see a star precisely due west. At that time the star is at a  $40^\circ$  altitude. From which geographic latitude are we observing this star? Was this a superior or an inferior culmination?
5. At 7:32pm local Villanova time we observe a star precisely in the eastward direction 2 hours after it rose. It is  $20^\circ$  above the horizon. When will the star culminate? When will it set? What azimuth will it have as it culminates? As it sets? At which altitude and azimuth will it be at midnight?
6. *Extra credit:* Derive culmination, rise/set and visibility criteria for the stars observed from the southern hemisphere.