

**Donald P. Shiley School of Engineering**  
EGR 491 Telescope Design, Fall 2019  
Assignment 9 – The Sky and its Motion

Through student presentations, we have investigated many different types of objects commonly viewed by amateur astronomers. That's an easy thing to do in class. It is appropriate, since we are designing a telescope to view these sorts of objects.

Rhetorical question: So what's left for us?

My answer: ***an awareness of the night sky.***

This assignment is meant to help you achieve some familiarity with the summer-time night sky viewed from around 45<sup>th</sup> parallel (latitude) and how it changes from one night to the next – how heavenly bodies move through the sky.

- 1) What is the latitude of:
  - a) Portland
  - b) Seattle
  - c) Los Angeles
  - d) Your home town
- 2) What is meant by the *zenith* of the sky?
- 3) What is the meridian?

Slides posted on the course web page ([SummerTriangle.pptx](#)) are computer generated images of the night sky for mid-September around midnight looking towards the zenith. One slide shows the constellation outlines and names, the other does not. Use slide-show (F5 key) and toggle back and forth between them. Sketch the few brightest stars that make up the constellation's image (about 5-10 stars per constellation, generally) in the constellations listed below, and label each constellation you sketch. If you can recognize these constellations, you have a good start in knowing your way around the summer sky.

Cygnus, Aquila, Lyra, Hercules, Pegasus, Andromeda,

- 4) For Cygnus, Lyra and Aquila, label the brightest star (the  $\alpha$ -star) using 3-letter abbreviation and also include their common names for (for example:  $\alpha$ -Cyg, Deneb).
- 5) Draw straight lines connecting the stars for both the "Summer Triangle" and the "Great Square of Pegasus" asterisms. The Summer Triangle is composed of Deneb, Vega, and Altair. You should be able to identify "The Great Square" – it's pretty obvious and self-explanatory.
- 6) How far away (light years) are each of the three stars in the summer triangle?
- 7) On your sketch, identify the location of at least two of the following "deep sky" objects. Each of these was identified in a student presentation and the location given:
  - a) M13 Great Hercules Cluster (a globular cluster)
  - b) M27 Dumbbell nebula (a planetary nebula)
  - c) Veil Nebula (a supernova remnant)
  - d) M31 Great Andromeda Galaxy (yup, a galaxy)
- 8) It is obvious that the lights of Portland hide the night sky. To see how much is hidden by light pollution, see [PDX-light-nolight.pptx](#) (course page). To find a dark sky:

<http://darksitefinder.com/map/> and click on the Open Map button. There is nothing to turn in for this “question.”

- 9) What does the astronomical term “precession” refer to, and how long is earth’s precession? Include a sketch.
- 10) What is the relation between “precession” and “astrological age” (yes, “astrological” not “astronomical”)? Are we in the age of Aquarius or Pisces? While googling “astrological age” listen to the following for a possible hint (although possibly wrong) – and notice the quality of the 1960’s astronomical photos shown at the very beginning:  
<https://www.youtube.com/watch?v=kjxSCAalsBE>
- 11) Constellations are not real things – they are totally a human “creation.” What is a constellation, who defines them, and how many of them are there? Hint:  
<https://www.iau.org/public/themes/constellations/>
- 12) Where does the term “zodiac” derive from?
- 13) What is the “ecliptic” and what is its relationship to the zodiacal constellations?  
Hint: <https://www.space.com/5417-ecliptic-zodiac-work.html>
- 14) List the 12 zodiacal signs in monthly order, starting with Aries, the ram. Include both their “official” name and their “English” translation; for example, “Aries, the ram”.
- 15) What does the word “planet” mean? Hint: <https://www.space.com/5743-storied-history-word-planet.html>
- 16) List the eight or nine planets in order from the sun. (I’m avoiding the question “is Pluto a planet” – you decide. And by the way, there are periods where Pluto is closer to the sun than Neptune is). What is meant by planetary retrograde motion (view [retrograde.pptx](#))? Explain what causes it– use sketch(es). Do any of the planets not demonstrate retrograde motion – if so, which planets?
- 17) In 2018, Mars was in Capricornus and Saturn was in Sagittarius (view [retrograde.pptx](#)). Extrapolating, what constellation do you think they are now? After your educated guess, google it – were you close? How many zodiacal signs were you off by? (I don’t care how far off you were).

Time – what is it?

Our notion of time, and methods of measuring its passage are derived from astronomical events. What we call “a day” is technically referred to as “synodic day” or “solar day.” It is based on the amount of time it takes the sun to go from the meridian from one day to the next. The meridian is an imaginary line from due south to straight overhead. All astronomical objects will be at their highest point in the sky (furthest from the horizon) when it is on the meridian. 11:00 AM, means the sun has not yet reached the meridian; AM = anti-meridian or “before the meridian” (aka, before noon) and 1:00 PM = post-meridian or “after the meridian” (aka, afternoon). The length of a synodic day is precisely 24 hours. But the length of a “sidereal day” is not.

- 18) A “sidereal day” is the amount of time it takes the earth to rotate 360 degrees on its axis. Why is it not equal to a “synodic day”? How long is it – how many hours, minutes, and seconds? What is the time difference between a synodic day and a sidereal day on earth?
- 19) A “month” is related to the lunar cycle. How long is 1 moon synodic day? This is the same amount of time that it takes the moon to go from “full” to “full” again. How many lunar “days” are in 1 earth year? How long is a sidereal lunar day?

- 20) A year is the amount of time for earth to make one full orbit around the sun. However, due to the difference between sidereal and synodic days, stars are in slightly different locations from night to night. If some star (*we'll call it "Glinda"*) is on the meridian at 11:00PM on September 21, what time will *Glinda* be on the meridian the next night, September 22? To see how stars shift from night-to-night and month-to-month, see [nightly-sky-motion.pptx](#).
- 21) Just like the sun, stars and planets rise in the east and set in the west. Approximately, how fast do stars near the ecliptic move across the sky each night (degrees per minute)?
- 22) Seasons are based on the astronomical events as well. It is colder in winter for at least two good reasons: the length of daylight is less in winter and the angle that the sunlight strikes the ground is more oblique – in summer, the sun is more overhead. Assume earth is round (near spherical) – a good assumption, really! In Portland, how high in the sky (degrees above the horizon) does the sun reach when it is on the meridian (local noon) on June 21 and December 21? Estimate these values based on the latitude of Portland and earth's inclination. Then estimate how high a full moon when it is on the meridian on or near June 21 and December 21. DO THE CALCULATIONS – DO NOT JUST LOOK UP THE ANSWERS.