

Astr2100 Descriptive Astronomy
Fall 2017 Test 1B Answers

Definitions

1. Define the following:
 - a. altitude **The angular position of any object above the horizon**
 - b. declination **The angular position of any object on the Celestial Sphere, north or south of the equator**
 - c. zenith **The point on the Celestial Sphere which is directly above you**
 - d. light year (definition, not the number) **The distance which light travels in a year**
 - e. any of the days when the declination of the Sun is 0° **The Vernal and Autumnal Equinoxes**
2. What are the terms for the following:
 - a. the line whose declination is 0° **Celestial Equator**
 - b. the point whose declination is -90° **The South Celestial Pole**
 - c. any star which never sets **A circumpolar star**
 - d. the mean distance from the Earth to the Sun (name, not the number) **Astronomical Unit**
 - e. Any point with an altitude of 0° **A point on the horizon**

Concepts/Short Answer

3. Within the period of one hour everything moves across the sky at a rate of 15°/hour. What causes this? **The rotation of the Earth in the opposite direction (west to east)**
4. For your zenith what are
 - a. the altitude? **90°**
 - b. the declination? **Your latitude**
5. Why is there a difference between the solar and sidereal months? **Because during the course of a month the Earth moves roughly 30° in its orbit around the Sun.** Which represents the orbital period of the Moon around the Earth. **The sidereal month**
6. Why do we get the seasons? **Because of the tilt of the Earth's rotational axis relative to the ecliptic (its orbital plane)**
7. A star is directly above the point on the horizon which is exactly northeast of you. What is its azimuth? **North east is half way between north (az = 0°) and east (az = 90°) and so its azimuth is 45°**
8. If you stand on the equator, whereabouts in the sky would you find the South Celestial Pole? **At the southern point of the horizon.**
9. Since the celestial coordinates are relatively difficult to use (as opposed to using the local or horizontal coordinates) why are they used at all? **Because they pinpoint the position of any star in the sky with angles which are the same for all observers on the Earth, and at any time. The local coordinates depend on the location of the observer, and the time of the day/night.**

Conversions

10. Convert 120 AU to miles $120 \text{ AU} * \frac{93,000,000 \text{ miles}}{1 \text{ AU}} = 1.16 \times 10^{10} \text{ miles}$

11. Convert 3.4×10^{19} meters to light years $3.4 \times 10^{19} \text{ meters} * \frac{1 \text{ light year}}{9.46 \times 10^{15} \text{ m}} = 3600 \text{ light years}$

Numerical

12. The latitude of Warsaw, Poland is 52.2° N. For an observer there
- What is the altitude of Polaris? **Altitude = latitude = 52.2°**
 - What is the altitude of the Sun on the day of the winter solstice?
 - Altitude = $90 - \text{latitude} - \text{tilt}$**
 - Altitude = $90 - 52.2 - 23\frac{1}{2} = 14.3^\circ$**
 - For each of the following stars, is it visible every night, only visible on some nights, or is it never visible?
 - Always visible if declination $> 90 - \text{latitude} = 90 - 52.2 = 37.8^\circ$**
 - Never visible if declination $< -(90 - \text{latitude}) = -(90 - 52.2) = -37.8^\circ$**
 - Visible some nights if the declination is between these values**
 - Alnath declination = 29° **sometimes visible**
 - Archenar declination = -57° **never visible**
 - Capella declination = 46° **always visible**
 - Dubhe declination = 62° **always visible**
 - Hadar declination = -60° **never visible**
 - Kocab declination = 74° **always visible**
 - Sirius declination = -17° **sometimes visible**
 - Subhail declination = -43° **never visible**
13. If a 1st quarter Moon is on the eastern horizon, what time is it?
- A 1st quarter Moon is always 90° behind the Sun.**
 - With the Moon on the eastern horizon the Sun must be on the Meridian, south of you**
 - It is noon**
14. The Arctic Circle is defined as being the latitude on which the Sun will reach the horizon but not actually rise on one day of the year, the Winter Solstice.
- What is the latitude of the Arctic Circle?
 - If the sun touches the horizon at noon, then its altitude must be 0°**
 - On the Winter Solstice the altitude = $90 - \text{latitude} - \text{tilt}$**
 - $0 = 90 - \text{latitude} - 23\frac{1}{2}$**
 - Solving, latitude = $90 - 23\frac{1}{2} = 66\frac{1}{2}^\circ$ N**
 - Is there any part of the US where the Sun doesn't rise during some, or all, of the winter?
 - Only on or close to the north coast of Alaska. Everywhere else (including most of the state of Alaska) has a latitude less than $66\frac{1}{2}^\circ$ N**
15. If a star is 450 light years from us, how long does it take light to get from this star to us? **Since light travels 1 light year in a time of 1 year, it will take 450 years to travel 450 light years.**
16. If it is 8×10^{15} miles (about 1360 light years) to a star, and you can travel at 8×10^5 mph, how many years would it take you to get there?
- Distance = speed * time**
 - $8 \times 10^{15} \text{ miles} = 8 \times 10^5 \text{ mph} * \text{time}$**
 - time = $8 \times 10^{15} / 8 \times 10^5 = 10^{10}$ hours**
 - time = $10^{10} \text{ hours} / 24 \text{ hours per day} / 365 \text{ days per year} = 1.14 \text{ million years}$**
17. Because of the rotation of the Earth once every 24 hours any star in the sky appears to move from east to west. By what angle does it move in 42 minutes?

- a. Angular speed = $360^\circ / 24 \text{ hours} = 15^\circ \text{ per hour}$
 - b. time = 42 minutes = $42/60 = 0.7 \text{ hours}$
 - c. angle = $15^\circ \text{ per hour} * 0.7 \text{ hours} = 10.5^\circ$
18. If you see a 3rd quarter Moon on the western horizon, what time is it?
- a. A 3rd quarter Moon is always 90° ahead of the Sun.
 - b. With the Moon on the western horizon the Sun must be on the Meridian, south of you
 - c. It is noon