

Astr2100 Descriptive Astronomy
Fall 2017 Test 1A
September 27th 2017

Definitions

1. Define the following:
 - a. circumpolar *Any star which never sets*
 - b. azimuth *The angular position of a star around the horizon*
 - c. the motion of one object around another (for example, the Earth around the Sun). *Orbit*
 - d. Astronomical Units *The mean distance from the Earth to the Sun*
 - e. The day when the declination of the Sun is $23\frac{1}{2}^\circ$ *The Summer Solstice.*

2. What are the terms for the following:
 - a. the line around the Celestial Sphere which divides the northern and southern portions of the sky. *The Celestial Equator*
 - b. The day on which the declination of the Sun is equal to $+23\frac{1}{2}^\circ$. *The Summer Solstice.*
 - c. The angular measurement of the position of any object in the sky, above the local horizon. *Altitude*
 - d. The distance covered by light in 365 days. *A light year*
 - e. The point in the sky with an altitude of 90° . *Your zenith*

Concepts/Short Answer

3. From night to night, the position of the Moon in the sky moves to the east by 12° . What causes this? *The orbit of the Moon around the Earth*
4. Why does the Earth have seasons? *Because of the tilt of the Earth's rotational axis relative to the ecliptic (its orbital plane)*
5. Why is there a difference between the solar and sidereal days? *Because during the course of a day the Earth moves roughly 1° in its orbit around the Sun.* Which represents the rotational period of the Earth. *The sidereal day*
6. We live in the northern hemisphere. Can we see stars which are located in the southern half of the Celestial Sphere. Briefly explain your answer. *Yes. Only stars with a declination more negative than $-(90 - \text{our latitude})$ can never be seen.*
7. A star is directly above the point on the horizon which is exactly southeast of you. What is its azimuth? *Southeast is half way between east ($\text{az} = 90^\circ$) and south ($\text{az} = 180^\circ$) and so its azimuth is 135°*
8. 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.*
9. If you stand on the equator, whereabouts in the sky would you find the North Celestial Pole? *At the northern point of the horizon.*

Conversions

10. Convert 86 AU to meters $86 \text{ AU} * \frac{1.5 \times 10^{11} \text{ meters}}{1 \text{ AU}} = 1.29 \times 10^{13} \text{ m}$

11. Convert 4×10^{16} miles to light years $4 \times 10^{16} \text{ miles} * \frac{1 \text{ light year}}{5.88 \times 10^{12} \text{ miles}} = 6800 \text{ light years}$

Numerical

12. The latitude of Cairo, Egypt is 30.1° N. For an observer there
- What is the altitude of Polaris? **Altitude = latitude = 30.1°**
 - What is the altitude of the Sun on the day of the winter solstice?
 - Altitude = $90 - \text{latitude} - \text{tilt}$**
 - Altitude = $90 - 30.1 - 23\frac{1}{2} = 36.4^\circ$**
 - 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° sometimes visible**
 - Capella declination = 46° sometimes visible**
 - Dubhe declination = 62° always visible**
 - Hadar declination = -60° never visible**
 - Kocab declination = 74° always visible**
 - Sirius declination = -17° sometimes visible**
 - Subhail declination = -43° sometimes visible**
13. If a 3rd quarter Moon is on the Meridian, what time is it?
 - A 3rd quarter Moon is always 90° ahead of the Sun.**
 - With the Moon on the meridian the Sun must be on eastern horizon**
 - It is sunrise (6 am)**
14. If a star is 660 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 660 years to travel 660 light years.**
15. If it is 9×10^{14} miles (about 153 light years) to a star, and you can travel at 5×10^4 mph, how many years would it take you to get there?
 - Distance = speed * time**
 - $9 \times 10^{14} \text{ miles} = 5 \times 10^4 \text{ mph} * \text{time}$**
 - $\text{time} = 9 \times 10^{14} / 5 \times 10^4 = 1.8 * 10^{10} \text{ hours}$**
 - $\text{time} = 1.8 \times 10^{10} \text{ hours} / 24 \text{ hours per day} / 365 \text{ days per year} = 2.05 \text{ million years}$**
16. 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 eighteen minutes?
 - Angular speed = $360^\circ / 24 \text{ hours} = 15^\circ \text{ per hour}$**
 - $\text{time} = 18 \text{ minutes} = 18/60 = 0.3 \text{ hours}$**
 - $\text{angle} = 15^\circ \text{ per hour} * 0.3 \text{ hours} = 4.5^\circ$**
17. 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.

- a. What is the latitude of the Arctic Circle?
 - i. If the sun touches the horizon at noon, then its altitude must be 0°
 - ii. On the Winter Solstice the altitude = $90 - \text{latitude} - \text{tilt}$
 - iii. $0 = 90 - \text{latitude} - 23\frac{1}{2}$
 - iv. Solving, latitude = $90 - 23\frac{1}{2} = 66\frac{1}{2}^\circ \text{ N}$
 - b. Is there any part of the US where the Sun doesn't rise during some, or all, of the winter?
 - i. Only on or close to the north coast of Alaska. Everywhere else (including most of the state of Alaska) has a latitude less than $66\frac{1}{2}^\circ \text{ N}$
18. If you see a full Moon on the eastern horizon, what time is it?
- a. A full Moon is always directly opposite the Sun.
 - b. With the Moon on the eastern horizon the Sun must be on the western horizon
 - c. It is sunset, 6 pm.