Homework #1 - Solutions

1. Which of the following has your "address" in the correct order?

A) you, Earth, solar system, Local Group, Local Supercluster, Milky Way
B) you, Earth, solar system, Milky Way, Local Supercluster, Local Group
C) you, Earth, solar system, Local Group, Milky Way, Local Supercluster
D) you, Earth, Local Group, Local Supercluster, solar system, Milky Way
E) you, Earth, solar system, Milky Way, Local Group, Local Supercluster

Answer: E – see Ch1_pt2 slide 15 for summary.

2. Which of the following statements does *not* use the term *light-year* in an appropriate way?

A) It's about 4 light-years from here to Alpha Centauri.
B) It will take me light-years to complete this homework assignment.
C) A light-year is about 10 trillion kilometers.
D) It will take the Voyager spacecraft about 20,000 years to travel just 1 light-year.
E) The Milky Way Galaxy is about 100,000 light-years in diameter.

Answer: B – Every other answer is correctly describing a *distance*, whereas option B) is talking about an amount of time.

3. One *light-hour* is the distance that light travels in an hour. How far is this, in kilometers? (Recall that the speed of light is 300,000 km/s.)

A) 300,000 km
B) 18 million km
C) 100 million km
D) 1.08 billion km
E) 9.46 trillion km

Answer: D – See the midterm review notes (Wed 7th Feb lecture), slide 12. Briefly, the speed of light is 3×10^8 m/s, and we know that we are looking for what distance light would cover in an hour. An hour is 3600 seconds (60 seconds in one minute, 60 minutes in one hour). Therefore, we multiply these two numbers together to get 1.08×10^{12} m/s, which is the same as 1.08 billion km.

4. Approximately how fast are you moving with the rotation of Earth?

A) 13,000 km/hr
B) 1,300 km/hr
C) 130 km/hr
D) 13 km/hr
E) not moving at all

Answer: B - See the midterm review notes (Wed 7th Feb lecture), slide 21. The answer is ~1,300 km/hr. The Earth rotates at its slowest at the poles (0 km/hour), and fastest at the equator (1650 km/s). At the latitude of northern America, this value is very close to 1,300 km/hr.

5. An astronomical unit (AU) is

A) any very large unit, such as a light-year.
B) the *average* distance between Earth and the Sun.
C) the *current* distance between Earth and the Sun.
D) the average distance between any planet and the Sun.

Answer: B – By definition, this is the correct answer. It is also distance of the semi-major axis.

6. Which of the following correctly describes the *meridian* in your sky?

A) a half-circle extending from your horizon due east, through your zenith, to your horizon due west
B) a half-circle extending from your horizon due north, through your zenith, to your horizon due south
C) a half-circle extending from your horizon due east, through the north celestial pole, to your horizon due west
D) the point directly over your head
E) the boundary between the portion of the celestial sphere you can see at any moment and the portion that you cannot see

Answer: B – The meridian lines are longitudinal circles around the earth, passing through the North and South poles, and connecting via your zenith which is the point directly above you wherever you are.

7. What makes the North Star, Polaris, special?

A) It is the brightest star in the sky.
B) It is the star straight overhead.
C) It appears very near the north celestial pole.
D) It is the star directly on your northern horizon.
E) It can be used to determine your longitude on Earth.

Answer: C – Take a look at slides **15**, 25, 27, 28 from ch2_pt2.

8. Why do we have seasons on Earth?

A) As Earth goes around the Sun and Earth's axis remains pointed toward Polaris, the Northern and Southern hemispheres alternately receive more and less direct sunlight.
B) The tilt of Earth's axis constantly changes between 0 and 23 1/2°, giving us summer when Earth is tilted more and winter when it is straight up.
C) Earth's distance from the Sun varies, so that it is summer when we are closer to the Sun and winter when we are farther from the Sun.
D) Seasons are caused by the influence of the planet Jupiter on our orbit.

Answer: A – The seasons are caused by different hemispheres being exposed to more hours in the sunlight depending on whether the Earths tilt causes the northern latitudes to experience increased daylight hours in summer and less daylight hours in the winter solstices. See ch2_pt2 slides 31-33.

9. At approximately what time would a first quarter Moon rise?

A) 6 A.M.
B) 9 A.M.
C) noon
D) 6 P.M.
E) midnight

Answer: C – See slide 13 on ch2_pt3. The sun rises at 6am. A new moon would also rise at 6am… so a first quarter moon would be 90 degrees anti-clockwise from that, (90 degrees in 24 hours is 6 hours later), so we should expect the first quarter moon to rise at noon. The crescent phase always follows the sun, and is illuminated on its right side, whereas the waning crescent is visible before the sun. It also may help to think when these objects are at their highest point in the sky (the Sun will always be at noon, whereas the full Moon will always be at midnight).

10. Suppose you live on the Moon. How long is a day (i.e., from sunrise to sunrise)?

A) 23 hours 56 minutes
B) 24 hours
C) a lunar month
D) a year
E) about 18 years

Answer: C – Unfortunately, by terminology a lunar month = a lunar day. It takes 27 days for the moon to make a full rotation (sidereal time), but 29.5 days to appear at the same point in the night sky since the Earth has moved around the Sun a bit. You should be able to rule out the options A & B (these are talking about the Earth), as well as options D and E (which are talking about Earth years, and the Saros cycle for predicting lunar eclipses, respectively).

11. What conditions are required for a solar eclipse?

A) The phase of the Moon must be new, and the nodes of the Moon's orbit must be nearly aligned with Earth and the Sun.
B) The phase of the Moon must be full, and the nodes of the Moon's orbit must be nearly aligned with Earth and the Sun.
C) The phase of the Moon can be new or full, and the nodes of the Moon's orbit must be nearly aligned with Earth and the Sun.
D) The phase of the Moon must be new, and the Moon's orbital plane must lie in the ecliptic.
E) The phase of the Moon must be full, and the Moon's orbital plane must lie in the ecliptic.

Answer: A – see ch2_pt3 slides 17-20, and 24-27. The important aspect is that since the moons orbit is tilted 5 degrees relative to the ecliptic plane, there also needs to be an alignment of the nodes (like equinoxes) so that the moon is directly in front of the Earth. If the Moon is between the Earth and the Sun, we can only see the back half of it, which is getting no light from the Sun (i.e. it is a new Moon).

12. Which of the following statements about parallax is *not* true?

A) You can demonstrate parallax simply by holding up a finger and looking at it alternately from your left and right eyes.
B) The existence of stellar parallax is direct proof that Earth orbits the Sun.
C) Measurement of stellar parallax allows us to determine distances to nearby stars.
D) The technique of stellar parallax was used by Hubble to determine that the Andromeda Galaxy (M 31) is about 2 million light-years away.
E) Ancient astronomers were unable to measure parallax and used the absence of observed parallax as an argument in favor of an Earth-centered universe.

Answer: D – Parallax can only be used to measure the movement of nearby stars against background stars that are much further away; every star that you can see is within the Milky Way and the furthest that is visible is no more than ~15,000 light years, with most being much closer (<2,000 light years). Therefore, it could not be used to determine distances as large as 2 million light-years away because there are no background stars, and the parallax angle would be incredibly small and hard to measure.

13. The Star Tau Ceti is 11.9 light years away from Earth. What would the observed parallax be for this star?

A) 0.084'

B) 0.274''

C) 0.084''

D) 0.274'

Answer: B – We must remember that the equation $d = 1/p$ (where d is distance, in parsecs and p is angle in arc seconds) requires our distance to be in parsecs. We first need to calculate what the distance to Tau Ceti is in parsecs. We do this by dividing 11.9 light years by 3.26 parsecs/light year to get a distance of 3.650 parsecs. We can then use rearrange the equation to get p=1/d, and plugging in the distance we need to find p = 1/3.650, which is 0.274'' (where the notation ' is arc minutes, and '' is arcseconds).

14. If the Sun is at a mean distance of 1 AU from Earth (1 AU = 1.496×10^8 km), and has a radius of 696,392 km, what is its angular diameter in the sky?

A) 0.27°

B) 0.39°

C) 0.46°

D) 0.53°

Answer: D - See the midterm review notes (Wed 7th Feb lecture), slide 30.