questions and problems

Narrow It Down: Multiple-Choice Questions

1. How does the altitude of the Sun at noon on the same day in the Northern Hemisphere’s summer compare for two observers at latitudes 12° north and 54° north, respectively?

a. It is the same for both observers because they are in the same hemisphere, experiencing summer.

b. It cannot be determined without knowing their longitudes.

c. It is 42° higher for the observer at 12° north because of the difference in latitude.

d. It is 42° higher for the observer at 54° north because of the difference in latitude.

e. The relative altitude of the Sun cannot be determined for the two locations without knowing the exact date.

2. Which observers on Earth can see Polaris on a clear night?

a. all observers on Earth

b. only observers above the Arctic Circle

c. only observers in the Western Hemisphere

d. only observers in the Southern Hemisphere

e. only observers in the Northern Hemisphere

3. You are observing distant object A of 30 arcseconds in diameter. From your understanding of the small-angle formula, and compared with your observation of A, which of these statements is always true?

a. A larger object at the same distance will appear the same size.

b. A smaller object at the same distance will appear the same size.

c. A smaller object at a greater distance will appear smaller.

d. A smaller, less distant object will appear larger.

e. A larger, less distant object will appear smaller.

4. The Sun is highest on the sky at noon on

a. the winter solstice.

b. the spring equinox.

c. the summer solstice.

d. the autumn equinox.

e. any day, because the Sun reaches the same altitude daily   
regardless of season.

5. Which statement about constellations is true?

a. Any group of stars can be called a constellation.

b. A constellation includes a group of stars within specific boundaries in the same region of the sky.

c. The stars that form a constellation must be in a configuration resembling an animal or human.

d. The stars within a constellation are all located at the same distance from Earth.

e. The stars within a constellation are all about the same brightness.

6. From which location are the same constellations above the horizon at any time of year?

a. the North Pole

b. the equator

c. Rio de Janeiro, Brazil

d. New York City

e. No such location exists.

7. Warmer summertime temperatures in the Northern Hemisphere are due partly to

a. longer days.

b. a lower angle of the Sun’s rays.

c. Earth’s being closer to the Sun in summer.

d. the Sun radiating more energy in summer.

e. the tilt of the Northern Hemisphere away from the Sun.

8. Which statement about Moon phases is true?

a. In waxing phases, the lit portion of the Moon faces the eastern horizon.

b. The new Moon has its whole face illuminated as seen from Earth.

c. The Moon rises at sunset every day.

d. The waning gibbous phase follows the full Moon.

e. In waning phases, the lit portion of the Moon faces the western horizon.

9. You observe the full Moon just rising in the east. What time of day is it?

a. sunrise (about 6:00 a.m.)

b. noon (about 12:00 p.m.)

c. sunset (about 6:00 p.m.)

d. midnight (about 12:00 a.m.)

e. midafternoon (about 3:00 p.m.)

10. Synodic and sidereal months differ because of

a. the Moon’s orbit.

b. Earth’s orbit.

c. the Sun’s orbit.

d. the fact that Earth’s year is not exactly 365 days.

e. the different number of days in each calendar month.

11. The direct (and most typical) seasonal motion of the planets as observed from Earth is

a. west to east with respect to the background stars.

b. east to west with respect to the background stars.

c. east to west at the same rate as the background stars.

d. north to south with respect to the background stars.

e. south to north with respect to the background stars.

12. Using only Stonehenge to calibrate astronomical motions, early people would *not* have been able to tell which of the following? Choose all that apply.

a. when to plant

b. when the longest day had come

c. when Mars would appear

d. when the Moon would be full

e. when winter would begin

13. Which Greek philosopher is most closely associated with first rejecting supernatural explanations and arguing that reason alone could explain phenomena?

a. Thales

b. Aristotle

c. Socrates

d. Hipparchus

e. Pythagoras

14. For what significant contribution is Eratosthenes most famous?

a. inventing trigonometry

b. measuring the circumference of Earth

c. constructing the geocentric model of the Universe

d. creating the first catalog of bright stars

e. defining the four basic elements

15. Which of the following statements about parallax is true?

a. Our two eyes enable us to use parallax to determine distances to objects.

b. Earth’s orbit provides astronomers an opportunity to use parallax.

c. Most stars do not appear to shift position, because they are too far away for parallax to be observed.

d. If all stars were on the surface of a celestial sphere and located at the same distance, we would observe no stellar parallax.

e. all of the above

16. Which of the following was/were elements of Ptolemy’s geocentric model? Choose all that apply.

a. It provided a true explanation for why we don’t feel a constant strong wind on Earth.

b. It included epicycles.

c. It accounted for retrograde motion.

d. It supposed that Mercury and Venus orbit the Sun.

e. It assumed that all planetary orbits were ellipses.

17. A lunar eclipse can occur at which Moon phase(s)? Choose all that apply.

a. new Moon

b. first quarter

c. full Moon

d. third quarter

e. all of the above

18. Which of the following statements about solar eclipses is/are correct? Choose all that apply.

a. A total eclipse is possible because the Sun and Moon sometimes appear to be identical in size.

b. Solar eclipses can only occur at full Moon.

c. Not all solar eclipses achieve totality.

d. Prediction of solar eclipses became possible only with the advent of computers.

e. A solar eclipse is visible to everyone on Earth equally.

19. True/False: Total eclipses can occur only when both the Moon and the Sun simultaneously pass through the line of nodes.

20. Eclipses are possible only when both Sun and Moon are at specific positions relative to Earth. How many times each month does this alignment occur?

a. one

b. two

c. three

d. four

e. It varies widely.

To the Point: Qualitative and Discussion Questions

21. What are some factors that led to the advancement of human civilization and culture?

22. What likely uses did the ancients have for megaliths?

23. Name at least one important contribution associated with each of the following Greek thinkers: Thales of Miletus, Pythagoras, Plato, Aristotle, Eudoxus, Aristarchus, Eratosthenes, Hipparchus.

24. If the Moon crosses the meridian at midnight, what phase must the Moon be in?

25. Suppose that a month ago you saw the star Betelgeuse in the constellation Orion just rising at the eastern horizon at 8:00 p.m. Describe its position at the same time today.

26. Define retrograde motion and explain how Ptolemy’s model represented it.

27. Define the celestial sphere. How is it a useful (if imaginary) tool?

28. From what location on Earth can you see every part of the celestial sphere over the course of the year?

29. How does the Sun’s path across the sky differ in summer versus   
winter?

30. What is an analemma, and what gives it its characteristic shape?

31. If Earth’s axis had no tilt relative to the plane of its orbit, how would the seasons differ from those we experience today?

32. If Earth’s axis had a more significant tilt relative to the plane of its orbit, how would the seasons differ from those we experience today?

33. Explain the difference between sidereal and synodic months.

34. Describe and compare the models of the Universe defined by Aristotle and Ptolemy.

35. How did Aristotle use the lack of measurable parallax to disprove the heliocentric model championed by Aristarchus? Comment on the flaw in Aristotle’s logic.

Going Further: Quantitative Questions

36. How many arcseconds are there in 4°?

37. How many degrees are there between the horizon and the zenith?

38. From your location, the Sun is at an altitude of 80° as it crosses the meridian on the summer solstice. Describe its altitude as it crosses the meridian one month later.

39. A star is at the zenith for an observer at latitude 44° north. What is its declination on the celestial sphere? (Note that astronomers use a “+” before the number for north declination and a “–” before the number for south declination.)

40. You observe the Moon’s position on the sky at the same time on two consecutive days. Across how many degrees of sky has its position moved?

41. How many days are there between new Moon and full Moon?

42. You observe Mars with an angular diameter of 18″. What is its distance from Earth in kilometers? (Hint: The diameter of Mars is   
6,792 km.)

43. A globular star cluster has an angular diameter of 20′. It is 25,000 light-years away. What is its diameter in light-years?

44. An object at a distance of 200 meters is 0.5 meter wide. What is its corresponding angular width in arcseconds? in arcminutes?

45. Comet Hale-Bopp has a core diameter of 40 km. At its closest approach to Earth, it was about 137 million km away. How large in arcseconds did its core appear to observers at that distance?

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