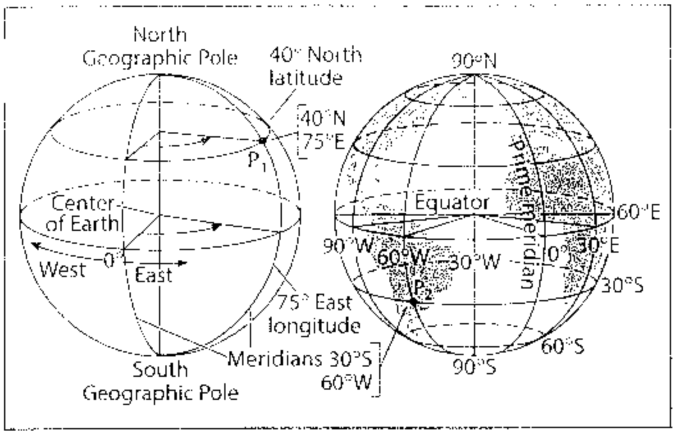


Figure 2-6. The meaning of longitude: Longitude is the angular distance east or west of the prime meridian, which is the meridian passing through Greenwich, England. Latitude and longitude together provide a system of coordinates for locating any point on Earth. The coordinates of point P_1 are 40° N latitude and 75° E longitude. Those for point P_2 are 30° S latitude and 60° W longitude.

Digging Deeper

Find point A on Figure 2-3, and write down the latitude and longitude as accurately as you can. Since this location is right at the intersection of a parallel and meridian, you can be quite accurate. The coordinates for point A are 15° N, 15° W, which is read as "latitude 15 degrees north and longitude 15 degrees west." Try location B. The coordinates are 15° S, 15° E. Location C is 45° S, 135° W. Rio de Janeiro is approximately 23° S, 43° W. Moscow is approximately 56° N, 37° E. Try determining the coordinates of some other locations on Figure 2-3, and check your answers in a world atlas. You can also practice placing locations on a map (such as Figure 2-3) when you know the coordinates. For example, plot 39° N, 77° W on a map. You should be at Washington, D.C. Plot 34° S, 151° E. You should be at Sydney, Australia.

Measuring Longitude

Local noon (12:00) at any point on Earth occurs when a line from the sun to the center of Earth cuts the meridian of that point. At that moment, the sun reaches its highest altitude of the day in the sky. Therefore, the instant of local noon can be determined by observing the sun. Since Earth rotates from west to east at the rate of one rotation per day—360° in 24 hours—it rotates 15° per hour. Therefore, the occurrence of local noon moves from east to west at the same rate of 15° per hour. Longitude can be calculated if, when local noon occurs, the observer knows what time it is at Greenwich, England—or any other location on the prime meridian. For example, if local noon occurs at 1:00 p.m. Greenwich Mean Time (GMT), one hour has passed since the sun crossed the prime meridian; the local longitude is therefore 15° W. Greenwich Mean Time is also called Universal Time. In general, longitude can be calculated by finding the time difference in hours between local sun time and Greenwich Mean Time, and multiplying by 15°. If local time is earlier than Greenwich Mean Time, the longitude is west; if later, it is east.

Using Latitude and Longitude

To read or plot a location on an Earth model such as a map or globe, you need to locate the coordinates for both latitude and longitude and to be able to locate and read the values of the parallels and meridians. Use Figure 2-3 as a typical map with north at the top. The parallels [illegible] bottom of the map. The accuracy of a reading or a plotting of coordinates partly depends upon the size of the map and the spacing of the meridians and parallels.

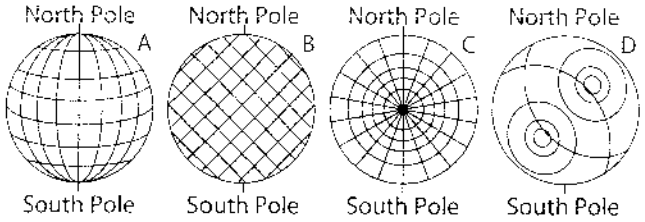
Questions

18. Polaris is used as a celestial reference point for Earth's latitude system because Polaris
    (1) always rises at sunset and sets at sunrise
    (2) is located over Earth's axis of rotation
    (3) can be seen from any place on Earth
    (4) is a very bright star

19. An airplane takes off from a location at 17° S latitude and flies to a new location 55° due north of its starting point. What latitude has the airplane reached?
    (1) 28° N (2) 38° N (3) 55° N (4) 72° N

20. What happens to the altitude of Polaris as you travel northward?

Refer to the following diagrams to answer questions 21 and 22. These diagrams illustrate systems that can be used to determine position on a sphere.



21. Systems of lines such as those illustrated above are called

(1) latitude systems
(2) coordinate systems
(3) great circle systems
(4) axis systems

22. Which of the illustrated systems is most like the latitude-longitude system used on Earth?

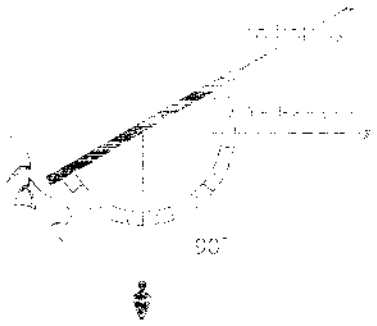
(1) A (2) B (3) C (4) D

---

23. How are latitude and longitude lines drawn on a globe of Earth?

(1) Latitude lines are parallel and longitude lines meet at the poles.
(2) Latitude lines are parallel and longitude lines meet at the equator.
(3) Longitude lines are parallel and latitude lines meet at the poles.
(4) Longitude lines are parallel and latitude lines meet at the equator.

24. In the following diagram, what is the latitude of the observer?

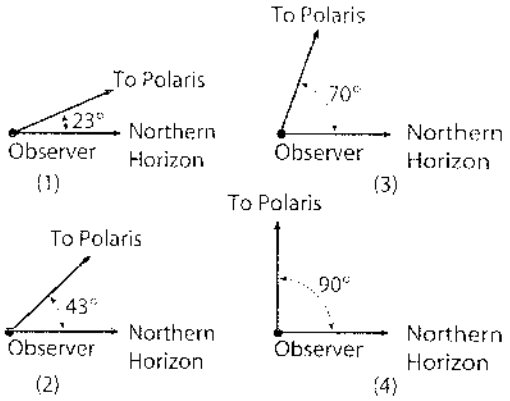


(1) 30° N (2) 60° N (3) 90° N (4) 120° N

25. What is the location of Binghamton, New York?

(1) 42°06′ N, 75°55′ W
(2) 42°06′ S, 76°05′ W
(3) 42°54′ N, 76°05′ W
(4) 42°54′ N, 75°55′ W

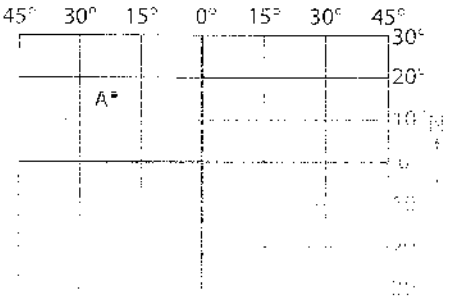
26. Which diagram best shows the altitude of Polaris observed near Buffalo, New York?



27. Which reference line passes through both the geographic North Pole and the geographic South Pole?

(1) 0° latitude
(2) 0° longitude
(3) Tropic of Cancer (23 $\frac{1}{2}$° S)
(4) Tropic of Capricorn (23 $\frac{1}{2}$° N)

28. The following diagram represents a portion of Earth's latitude and longitude system. What are the approximate latitude and longitude of point A?



(1) 15° S 20° W (3) 15° N 20° W
(2) 15° S 20° E (4) 15° N 20° E

29. A person knows the sun time on the prime meridian and the local sun time. What determination can be made?

(1) the date
(2) the altitude of Polaris
(3) the longitude at which the person is located
(4) the latitude at which the person is located

30. Which New York landscape region includes the location 43°30′ N, 75°45′ W?

(1) Adirondack Mountains
(2) Erie-Ontario Lowlands
(3) St. Lawrence Lowlands
(4) Tug Hill Plateau

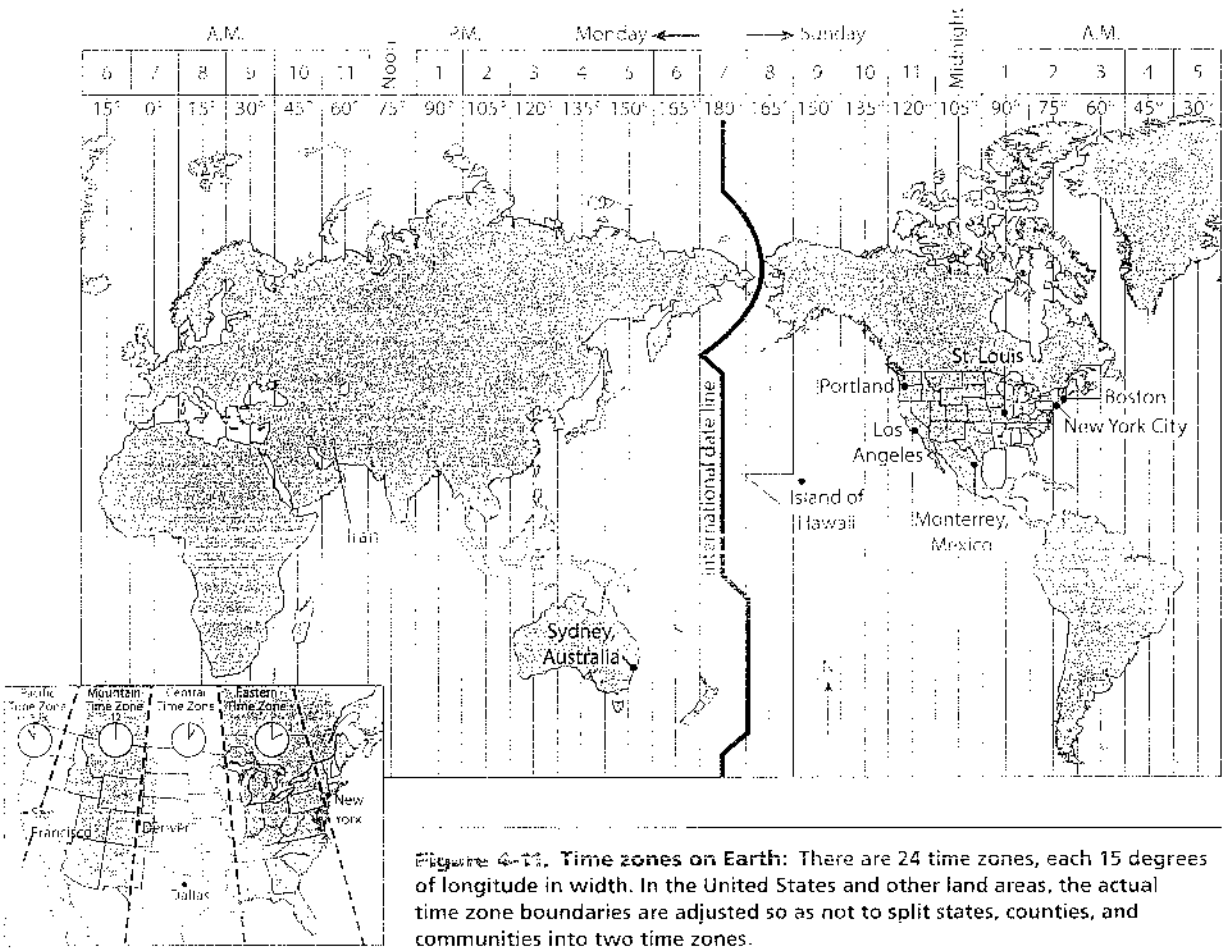


Figure 4-11. Time zones on Earth: There are 24 time zones, each 15 degrees of longitude in width. In the United States and other land areas, the actual time zone boundaries are adjusted so as not to split states, counties, and communities into two time zones.

Review Questions

28. Traditionally, most units of time are based upon

(1) [illegible]
(2) [illegible]
(3) [illegible]
(4) [illegible]

29. [illegible] would be an increase in the

(1) length of the seasons
(2) sun's angle of insolation at noon
(3) number of observable stars seen at night during the year
(4) length of an Earth day

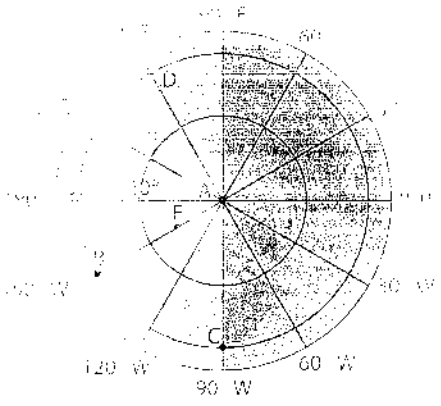
30. How long does Earth take to complete one orbit around the Sun?

(1) 1 day (3) 1 year
(2) 1 month (4) 1 decade

Units of time are based on Earth's motion relative to other celestial objects. The year is best defined as Earth's motion relative to the

(1) [illegible] (2) [illegible] (3) [illegible] (4) planets

32. According to the diagram below, the time at point C is closest to



(1) 6 A.M. (3) 6 P.M.
(2) 12 noon (4) 12 midnight

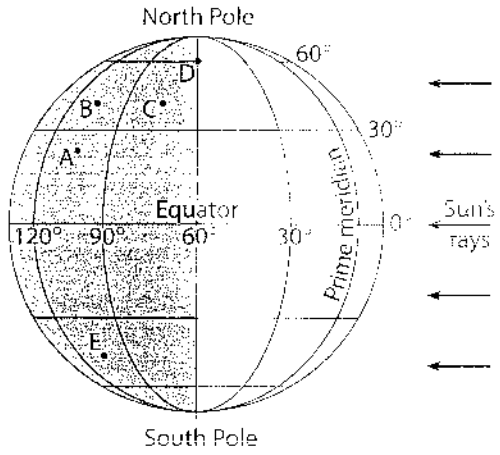
33. Cities located on the same meridian must have the same

(1) altitude (3) length of daylight
(2) latitude (4) local solar time

34. When does local solar noon always occur for an observer in New York State?

(1) when the clock reads 12 noon
(2) when the sun reaches its maximum altitude
(3) when the sun is directly overhead
(4) when the sun is on the prime meridian

Base your answers to questions 35 through 37 on the following diagram of Earth. Some of the latitude and longitude lines have been labeled. Points A through E represent locations on Earth's surface.



35. What do locations A, B, and E have in common?

(1) They are in the same season.
(2) They have the same local time.
(3) They have the same prevailing wind direction.
(4) They are at the same latitude.

36. The latitude and longitude of which location are closest to those of New York State?

(1) A (2) B (3) C (4) D

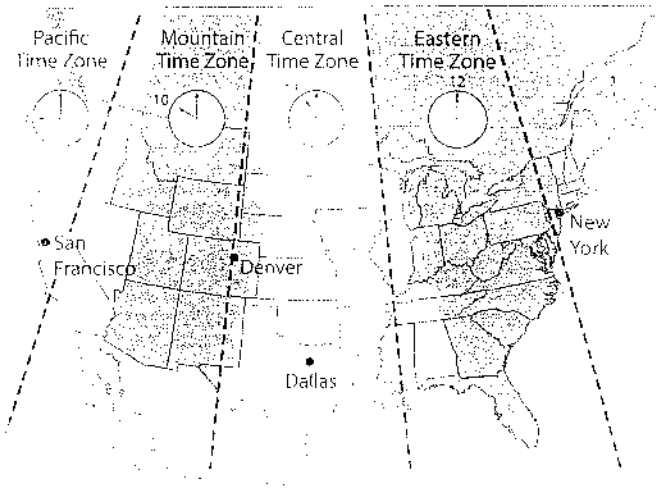
37. What is the approximate time at location D?

(1) 6 A.M. (3) 9 P.M.
(2) 12 noon (4) 12 midnight

38. Ship X and ship Y are sailing along the equator. The difference in local solar time between their locations is 2 hours. What is their difference in longitude?

(1) 0° (2) 15° (3) 30° (4) 45°

Base your answers to questions 39 and 40 on the following time zone map.



39. What is the time in San Francisco when it is 6 A.M. in Dallas?

(1) 5 A.M. (2) 7 A.M. (3) 8 A.M. (4) 4 A.M.

40. The dashed boundaries between time zones are how many degrees of longitude apart?

(1) 10 (2) 15 (3) 30 (4) 60

The revolution of the moon around Earth as Earth revolves around the sun results in many common observable events, including phases of the moon, tides, and eclipses. The moon revolves around Earth in an elliptical orbit that is tilted about 5° from Earth's orbit and that has a period of 27 $\frac{1}{3}$ days. Besides revolving around Earth in 27 $\frac{1}{3}$ days, the moon also rotates on its axis in 27 $\frac{1}{3}$ days. Thus as the moon revolves once, it rotates once. This is the reason why the same "face" or side of the moon always points toward Earth. Figure 4-12 provides some details of the orbital motions of Earth and its moon.

Moon Phases

Half of the moon is always receiving light from the sun at any given time—except during lunar eclipses. Since the moon revolves around Earth, an observer on Earth sees varying amounts of this lighted half as the moon moves through its orbit. The varying amounts of the lighted portion seen