Name: _____

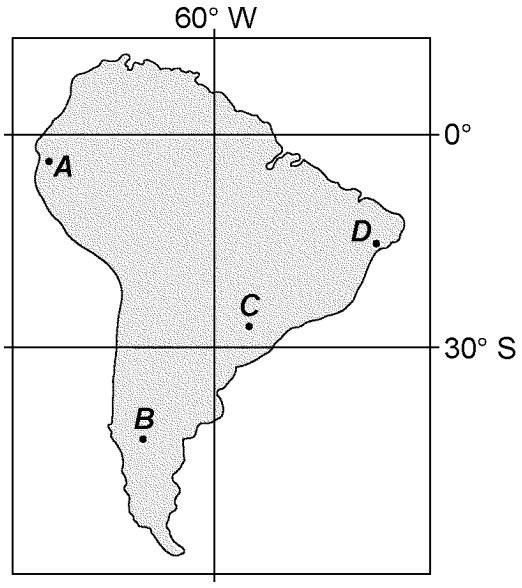
1) Evidence that Earth revolves around the Sun is provided by the
   A) apparent rising and setting of the Sun during one day
   B) hourly changes in the apparent direction of the swing of a Foucault pendulum
   C) apparent rising and setting of *Polaris* during one day
   D) seasonal changes in the apparent positions of constellations

2) How many degrees does the Sun appear to move across the sky in four hours?
   A) 60D B) 45D C) 4D D) 15D

3) During which month does the Sun appear to rise *farthest* north of due east for an observer in New York State?
   A) January C) July
   B) December D) June

4) On which day of the year does the Sun reach the *greatest* altitude at solar noon in New York City?
   A) June 21 C) July 21
   B) September 21 D) August 21

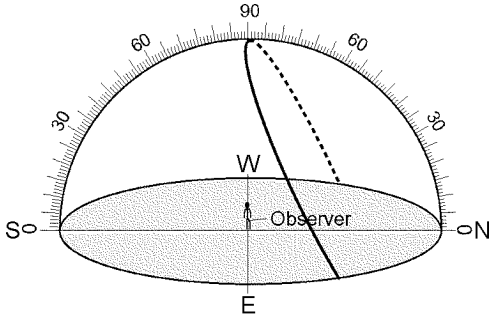
5) The map below shows four locations, *A*, *B*, *C*, and *D*, on the continent of South America.



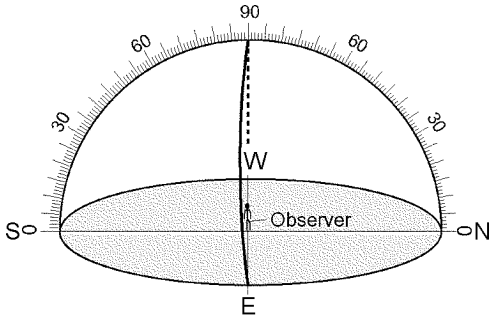
Which location is the first to experience sunset on September 23?
   A) *A* B) *B* C) *C* D) *D*

6) Which diagram represents the apparent path of the Sun on March 21 for an observer at the equator?

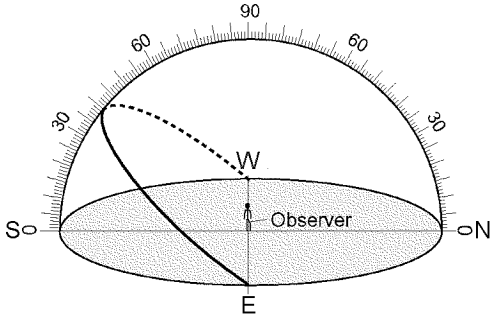
A)



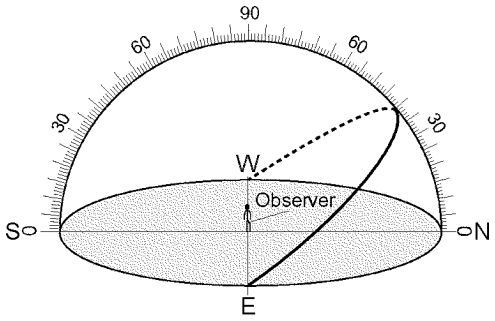
B)



C)

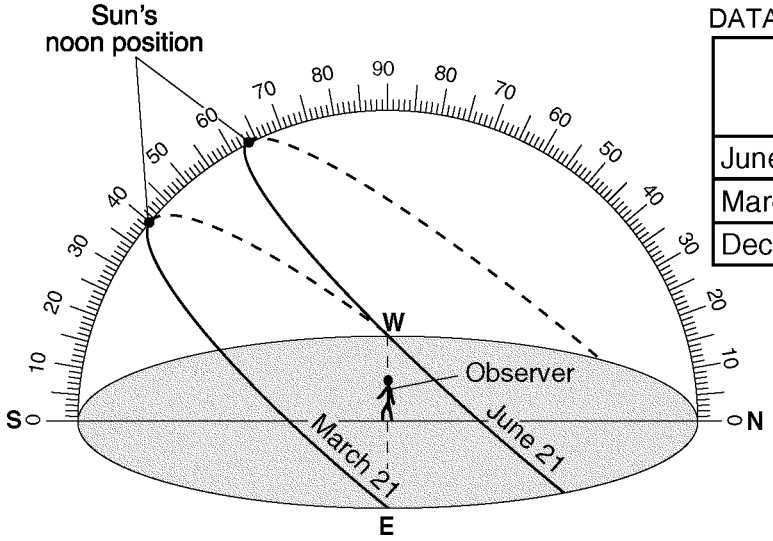


D)



Questions 7 through 9 refer to the following:

The diagram below represents the Sun's apparent paths as viewed by an observer located at 50DN latitude on June 21 and March 21. The data table shows the Sun's maximum altitude for the same two dates of the year. The Sun's maximum altitude for December 21 has been left blank.



DATA TABLE

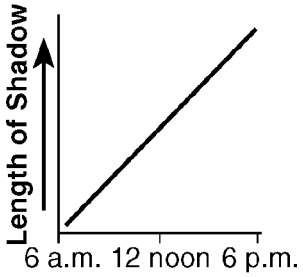
Date	Sun's Maximum Altitude
June 21	63.5°
March 21	40°
December 21	

7) Which value should be placed in the given data table for the Sun's maximum altitude on December 21?

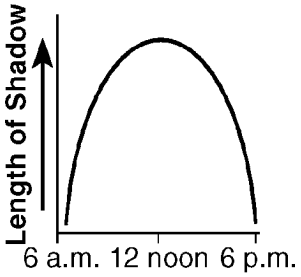
A) 40D B) 90D C) 16.5D D) 23.5D

8) Which graph *best* represents the relationship between the time of day and the length of a shadow cast by the observer on March 21?

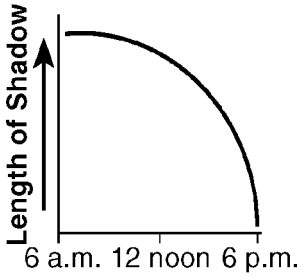
A)



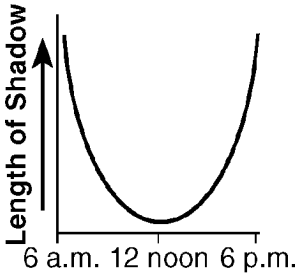
C)



B)

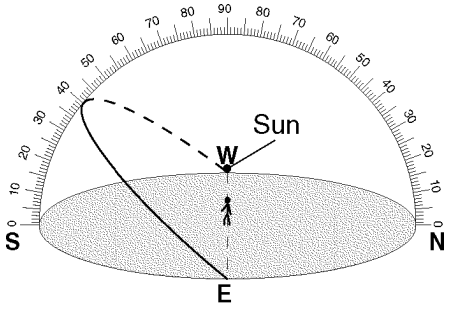


D)

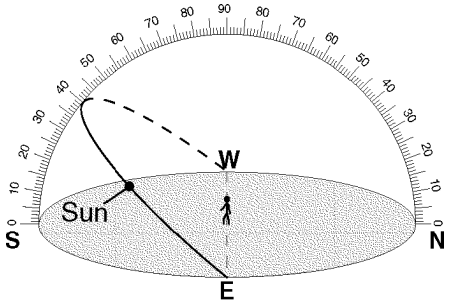


9) Which diagram represents the approximate location of the Sun at 3 p.m. on March 21?

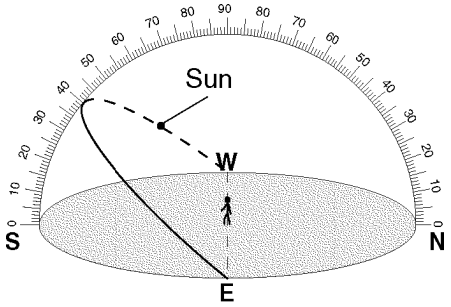
A)



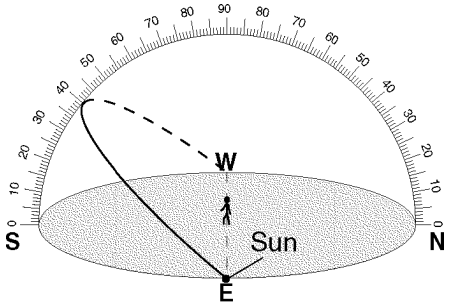
B)



C)



D)

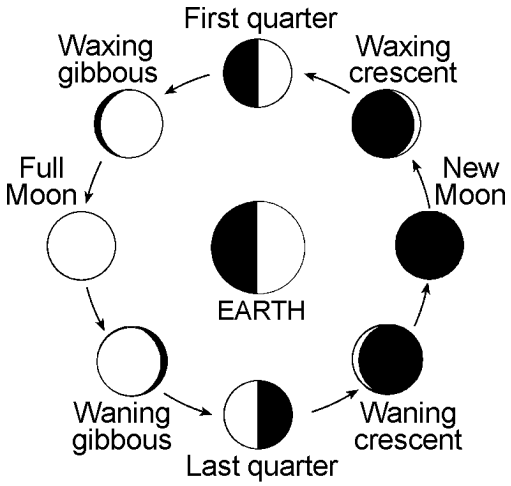


10) Which one of the following statements *best* explains why the same side of the Moon is viewed from Earth as the Moon goes through its phases?

A) The Moon's period of rotation equals Earth's period of revolution around the Sun.
B) The Moon's period of rotation equals the Moon's period of revolution around Earth.
C) The Moon's period of rotation equals Earth's period of rotation.
D) The Moon does not rotate as it revolves around Earth.

Questions 11 and 12 refer to the following:

The diagram below shows positions of the Moon in its orbit and phases of the Moon as viewed from New York State.



(not drawn to scale)

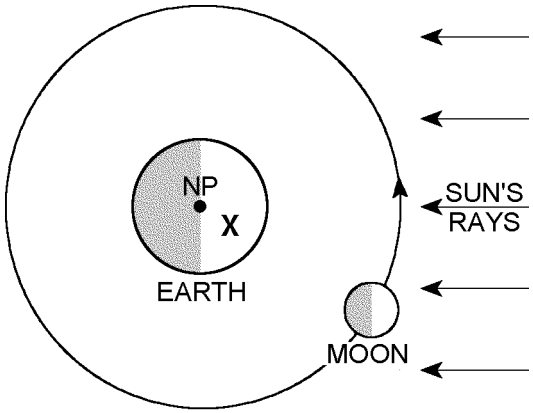
11) Approximately how many days occur between the Moon's first-quarter phase and the Moon's last-quarter phase?

A) 15 d
B) 365.26 d
C) 29.5 d
D) 7 d

12) During which Moon phase might a solar eclipse be viewed on Earth?

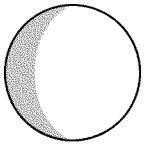
A) full Moon
B) last quarter
C) first quarter
D) new Moon

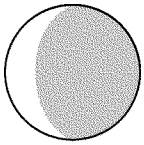
13) The diagram below shows the Moon at one position in its orbit around Earth. Letter *X* indicates the location of an observer in New York State.

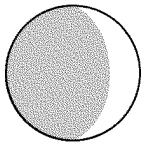


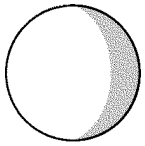
(not drawn to scale)

Which phase of the Moon will the observer see when the Moon is at the position shown in its orbit?

A) 

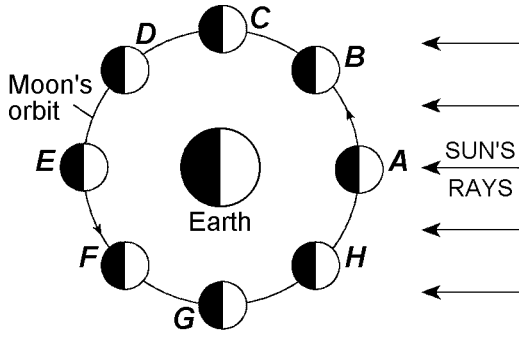
B) 

C) 

D) 

Questions 14 through 16 refer to the following:

The diagram below represents the Moon in eight positions, *A* through *H*, in its orbit around Earth.



(not drawn to scale)

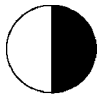
14) When a solar eclipse is viewed from Earth, the Moon must be located at which orbital position shown in the diagram?

A) *A* B) *E* C) *C* D) *G*

15) How many days are required for the Moon to complete a cycle of phases from the New Moon position represented in the diagram to the New Moon the following month?

A) 29.5 d
B) 27.3 d
C) 2.2 d
D) 365.26 d

16) Which Moon phase is observed in New York State when the Moon is located at position *F* in the diagram?

A)  B)  C)  D) 

Questions 17 and 18 refer to the following:

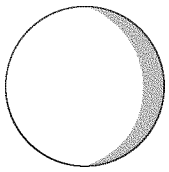
The calendar below shows the month of July of a recent year. The dates of major Moon phases, as seen in New York State, are shown.

July

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

KEY:
- New Moon
- First-quarter Moon
- Full Moon
- Last-quarter Moon

17) The diagram below represents the phase of the Moon observed from New York State one night during the month of July.



On which date on the calendar was this phase of the Moon visible from New York State?

A) July 19 B) July 4 C) July 11 D) July 26

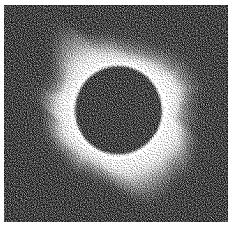
18) On which date on the calendar will the next first-quarter Moon phase occur?

A) August 16
B) August 22
C) August 6
D) August 10

19) Eclipses do *not* occur every month because the Moon's

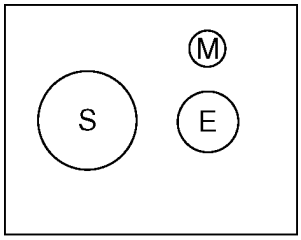
A) period of rotation and period of revolution are the same
B) orbit is inclined to Earth's orbit
C) rate of rotation is 15D each hour
D) period of revolution is 27.3 days

20) The diagram below represents a total solar eclipse as seen from Earth.

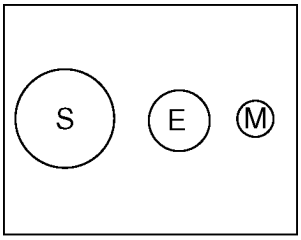


Which diagram correctly represents the relative positions of the Sun (S), Earth (E), and the Moon (M) in space during a total solar eclipse? [*The diagrams are not drawn to scale*.]

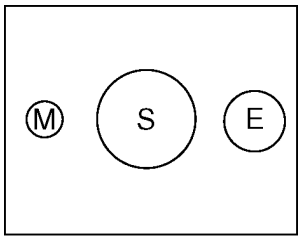
A)



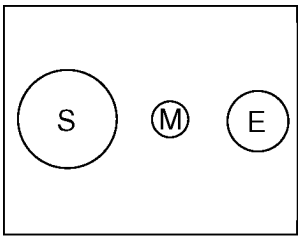
C)



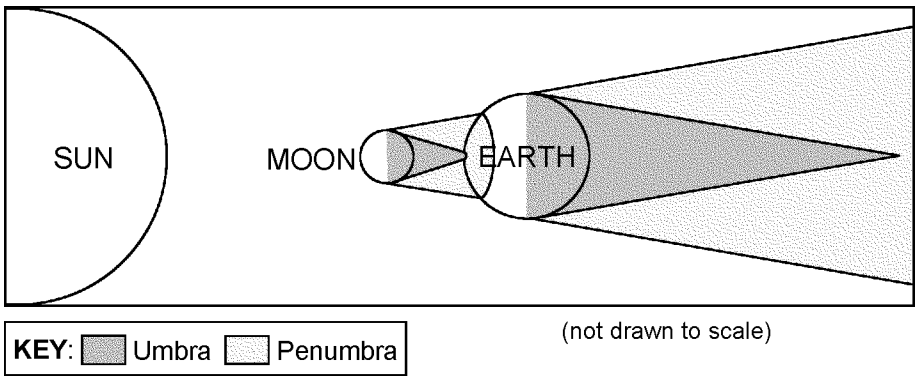
B)



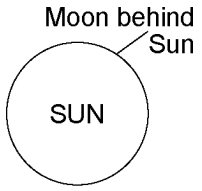
D)

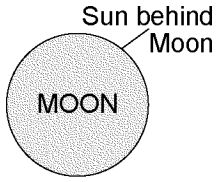


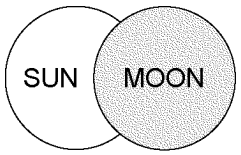
21) The diagram below shows the position of the Sun, the Moon, and Earth during a solar eclipse. The full shadow (umbra) and partial shadow (penumbra) of the Moon and Earth are shown.

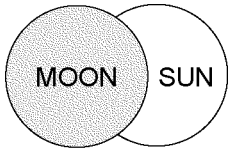


Which diagram *best* represents the appearance of the Sun and the Moon to an observer located within the umbra of the Moon's shadow on Earth's surface?

A)


B)


C)


D)


22) Which motion is responsible for the regular seasonal changes of the constellations visible in the night sky?

A) The Moon orbits Earth.
B) The stars orbit Earth.
C) Earth orbits the Sun.
D) The stars orbit the Sun.

23) Which motion causes some constellations to be visible in New York State only during winter nights and other constellations to be visible only during summer nights?

A) Stars in constellations revolve around Earth.
B) Earth rotates on its axis.
C) Stars in constellations revolve around the Sun.
D) Earth revolves around the Sun.

Questions 24 and 25 refer to the following:

The data table below shows some constellations that can be seen by an observer in New York State during different seasons.

Season	Constellations
spring	Ursa Minor, Orion, Leo, Scorpius
summer	Ursa Minor, Leo, Scorpius, Aquarius
fall	Ursa Minor, Orion, Scorpius, Aquarius
winter	Ursa Minor, Orion, Leo, Aquarius

24) Which statement best explains why some constellations are *not* seen during all four seasons?

A) Earth revolves around the Sun.
B) The Moon revolves around Earth.
C) The Sun revolves around the center of the Milky Way.
D) Constellations revolve around the Sun.

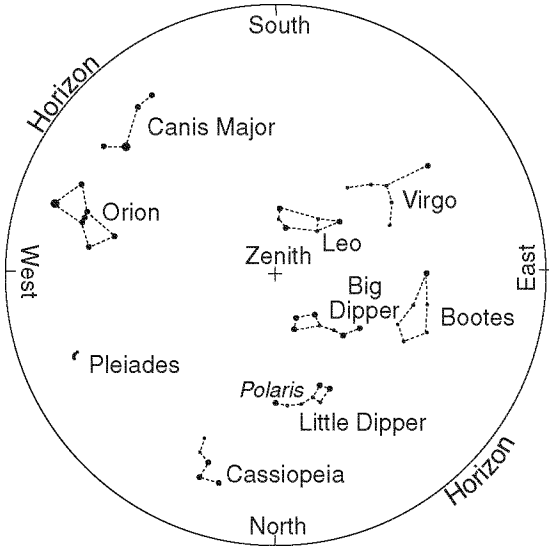
25) The diagram below represents a portion of the constellation Ursa Minor. The star *Polaris* is identified.

Ursa Minor can be seen by an observer in New York State during all four seasons because Ursa Minor is located almost directly

A) above Earth's equator
B) between Earth and the center of the Milky Way
C) overhead in New York State
D) above Earth's North Pole

Questions 26 and 27 refer to the following:

The map of the night sky below represents the apparent locations of some of the constellations that are visible to an observer at approximately 40DN latitude at 9 p.m. in April. The point directly above the observer is labeled zenith.

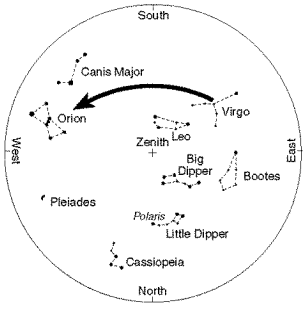


26) Which motion causes the constellation Leo to no longer be visible to an observer at 40DN in October?

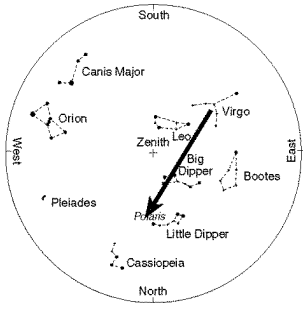
A) revolution of the constellation around the Sun
B) revolution of Earth around the Sun
C) spin of Earth on its axis
D) spin of the constellation on its axis

27) Which map *best* illustrates the apparent path of Virgo during the next 4 hours?

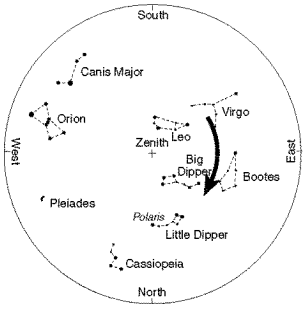
A)



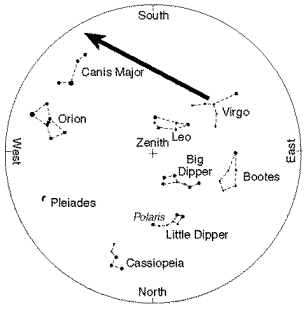
C)



B)

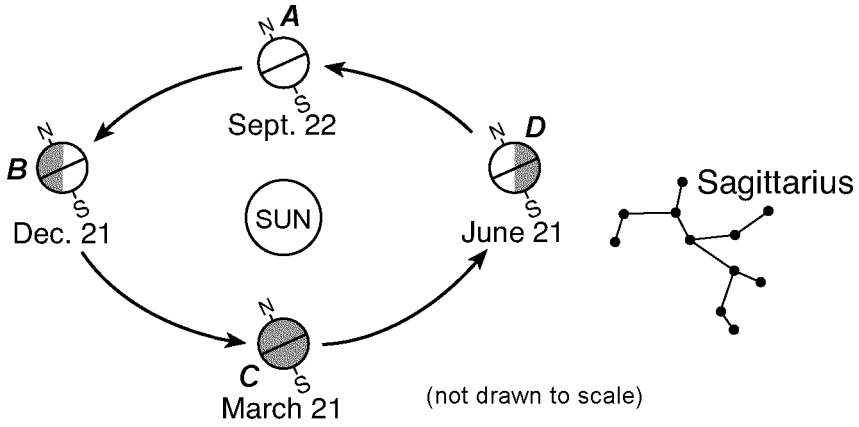


D)



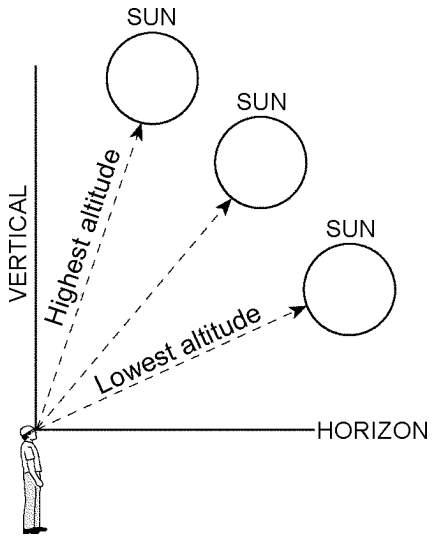
Questions 28 and 29 refer to the following:

A diagram of the Sun, Earth, and the constellation Sagittarius is shown below. Positions *A* through *D* show Earth in its orbit around the Sun on the first day of each season. Sagittarius is represented in its position in space relative to Earth's orbit.



28) At which lettered position in the given diagram does Sagittarius appear *highest* in the sky at midnight to observers near Earth's equator?

29) The diagram below shows the yearly range of altitudes of the noontime Sun as seen by an observer in New York State. Write the letters for each of the four Earth positions, *A*, *B*, *C*, and *D*, in the Sun circles on this diagram to identify when the observer will see the Sun at these noontime altitudes in New York State. [*More than one letter may be written in a circle.*]

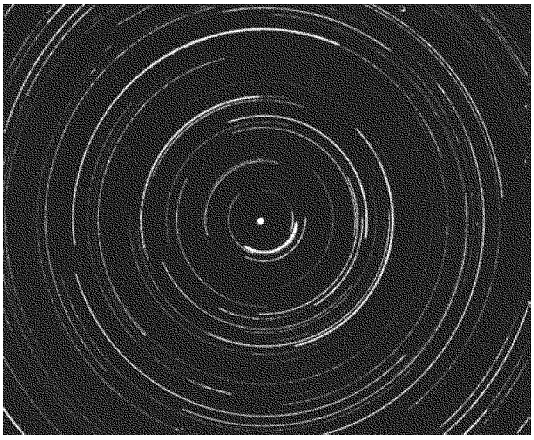


30) To a nighttime observer on Earth, how many degrees do the stars appear to move around *Polaris* in 3 hours?

A) 60D B) 3D C) 45D D) 15D

Questions 31 and 32 refer to the following:

The time-exposure photograph shown below was taken by aiming a camera at a portion of the night sky above a New York State location and leaving the camera's shutter open for a period of time to record star trails.



31) Which celestial object is shown in the given photograph near the center of the star trails?

A) *Polaris*
B) the Moon
C) *Sirius*
D) the Sun

32) During the time exposure of the given photograph, the stars appear to have moved through an arc of 120D. How many hours did this time exposure take?

A) 8 h B) 5 h C) 15 h D) 12 h

33) The motion of a Foucault pendulum provides evidence that Earth

A) varies in distance from the Sun
B) spins on its axis
C) is tilted on its axis
D) travels around the Sun

34) A Foucault pendulum appears to change its direction of swing because Earth

A) has a density of 5.5 g/cm^3
B) is tilted on its axis
C) is spinning on its axis
D) has a curved surface

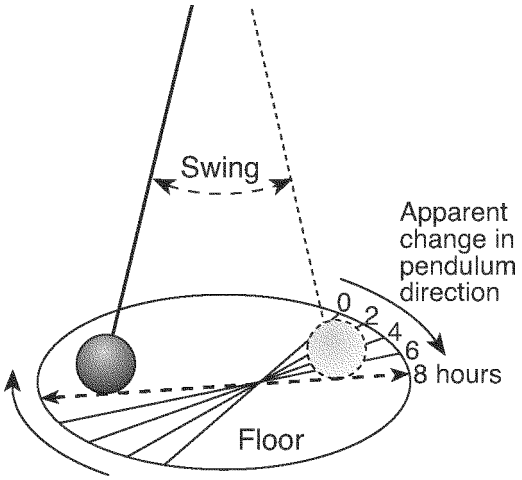
35) The direction of swing of a Foucault pendulum appears to change due to Earth's

A) rotation
B) elliptical orbit
C) spherical shape
D) revolution

36) The *best* evidence that Earth rotates on its axis is the changing

A) velocity of Earth in its orbit
B) phases of the Moon
C) apparent path of a Foucault pendulum
D) altitude of the noontime Sun from day to day

37) The diagram below shows a large pendulum in motion over an 8-hour period.



What is the *main* reason the pendulum appears to change its direction of swing over time?

A) tilt of Earth on its axis
B) speed of Earth in its orbit
C) rotation of Earth on its axis
D) revolution of Earth in its orbit

38) What causes the planetary winds and ocean currents to be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere?

A) seasonal changes
B) the Coriolis effect
C) the Doppler effect
D) plate tectonics

39) What causes many surface winds to deflect to the right in the Northern Hemisphere?

A) gravitational force of the Moon
B) gravitational force of the Sun
C) unequal heating of Earth's surface
D) rotation of Earth on its axis

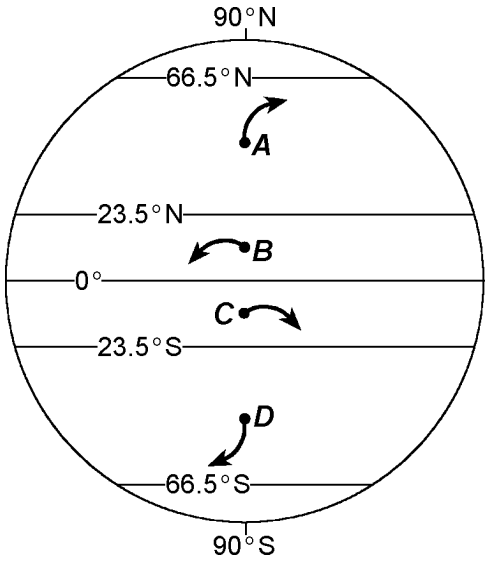
40) The curving of the planetary winds to the right in the Northern Hemisphere is evidence of

A) Earth's revolution
B) the Coriolis effect
C) the tilt of Earth's axis
D) high-and low-pressure belts

41) In the Northern Hemisphere, planetary winds deflect to the

A) left, due to the Doppler effect
B) left, due to the Coriolis effect
C) right, due to the Coriolis effect
D) right, due to the Doppler effect

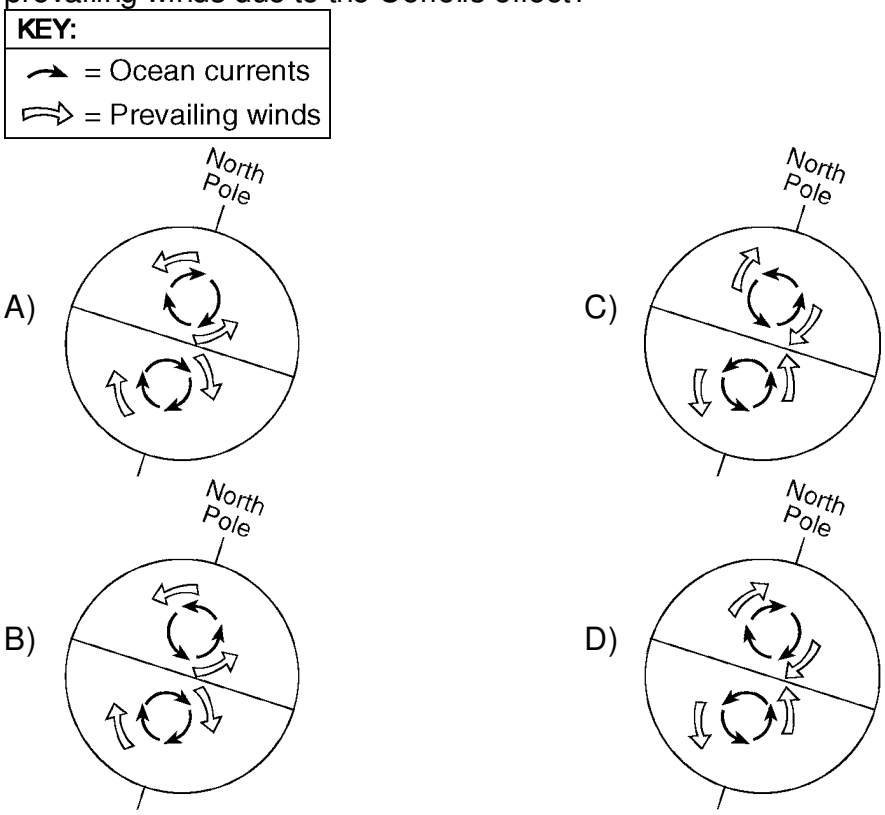
42) The arrows in the diagram below show changes in the direction of surface winds at four lettered locations, *A*, *B*, *C*, and *D*, on Earth.



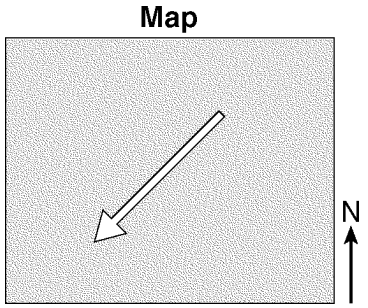
The arrow at which location correctly shows a deflection of the wind that could be due to the Coriolis effect?

A) *A* B) *B* C) *C* D) *D*

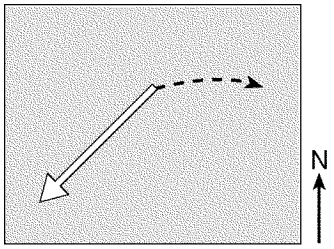
43) Which diagram correctly represents the curving of Earth's ocean currents and prevailing winds due to the Coriolis effect?

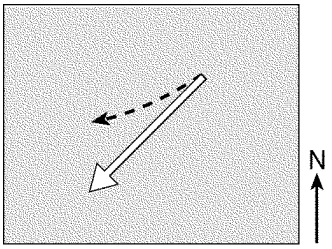


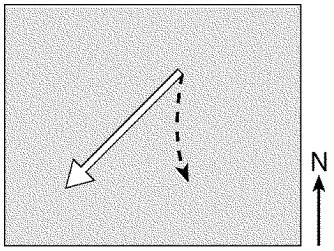
44) The arrow on the map below represents the direction a wind is blowing over a land surface in the Northern Hemisphere without showing the Coriolis effect.

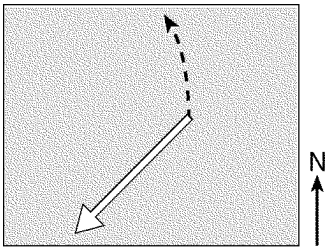


Which dashed arrow represents how the wind direction will change in the Northern Hemisphere due to the Coriolis effect?

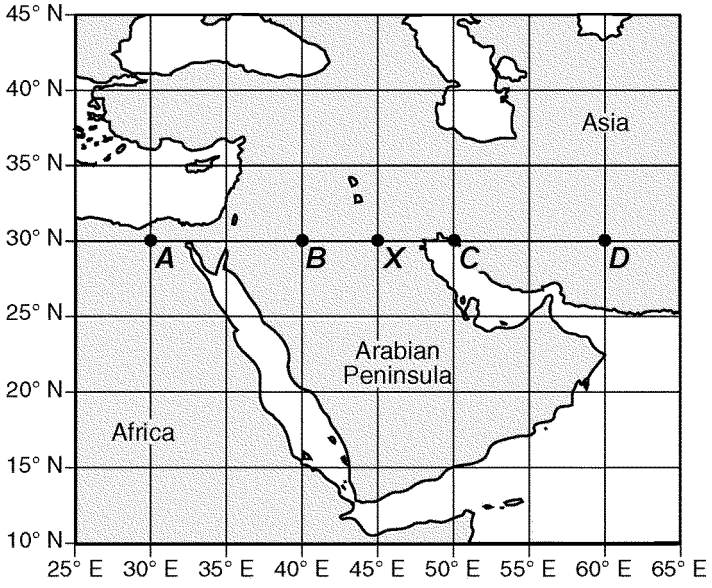
A)


C)


B)


D)


45) The map below shows a portion of the Middle East. Points *A*, *B*, *C*, *D*, and *X* are locations on Earth's surface.



When it is 10:00 a.m. solar time at location *X*, at which location is 11:00 a.m. solar time being observed?

A) *D* B) *A* C) *B* D) *C*

46) Identify the cause of the apparent daily motion of the Sun through the sky.

47) State the number of days the Moon takes to go through one complete cycle of Moon phases from full Moon to full Moon as viewed from Earth.

48) Explain why the Moon's orbital velocity is slowest when the Moon is farthest from Earth.

49) Explain how the Moon's rotation and revolution cause the same side of the Moon to always face Earth.

50) Using the terms rotation and revolution, explain why the same side of the Moon always faces Earth.

51) Explain why the Moon's gravity has a *greater* effect on Earth's ocean tides than the Sun's gravity.

52) The table below shows times of ocean tides on March 4 for a city on the Atlantic coast of the United States.

Ocean Tides on March 4

Tide	Time
high	12:00 a.m.
low	6:13 a.m.
high	12:26 p.m.

Determine the time when the next low tide occurred. [*Include a.m. or p.m. in your answer, if needed.*]

Questions 53 through 58 refer to the following:

The calendar below shows the month of February 2007, indicating the dates when some lunar phases occurred. February 24 lists only the name of the Moon phase that occurred on that day. The data table shows the *highest* and *lowest* tides (in feet) recorded for the Hudson River at Kingston, New York over a 2-day period in February 2007.

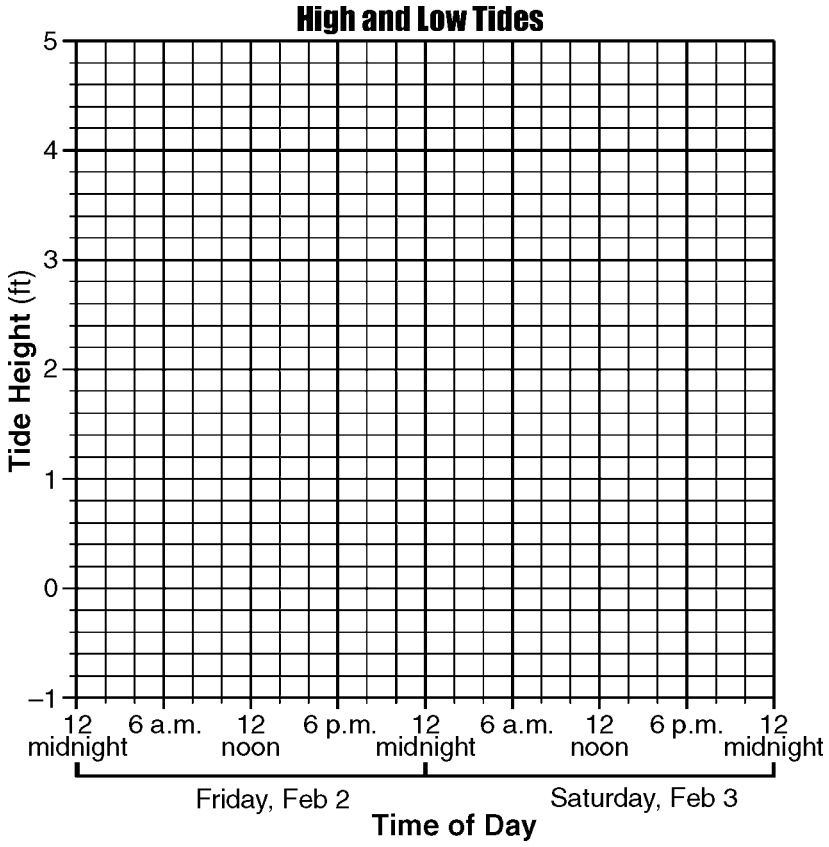
February 2007

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2 Full	3
4	5	6 Old gibbous	7	8	9	10 Last quarter
11	12	13	14	15	6	17 New
18	19	20 New crescent	21	22	3	24 First quarter
25	26	27	28			

High and Low Tides for Kingston, NY

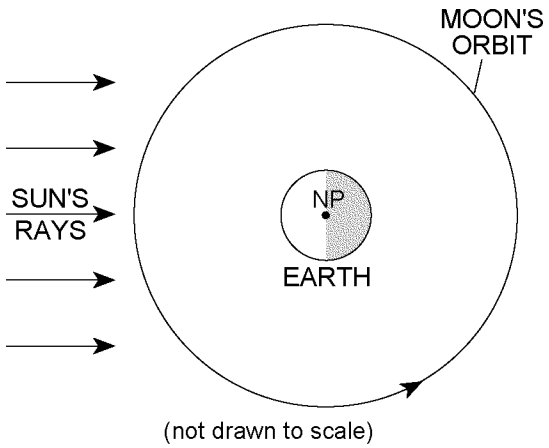
Date	Time of Day	Tide Height (ft)
Friday, Feb. 2	1:30 a.m.	3.5
	7:30 a.m.	−0.2
	1:30 p.m.	4.1
	8:00 p.m.	−0.4
Saturday, Feb. 3	2:00 a.m.	3.6
	8:30 a.m.	−0.2
	2:00 p.m.	4.0
	9:00 p.m.	−0.4

53) On the grid below, plot the tide height for each time of day listed in the given data table. Connect the plots with a line.



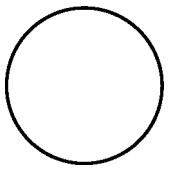
54) Using the given data, predict the time of the first high tide on Sunday, February 4. [*Include a.m. or p.m. in your answer.*]

55) On the diagram below, draw a small circle (0) on the Moon's orbit to show the position of the Moon in its orbit on February 2 based on the given calendar.



56) Based on the calendar shown, state the date of the next full Moon that occurred after February 2.

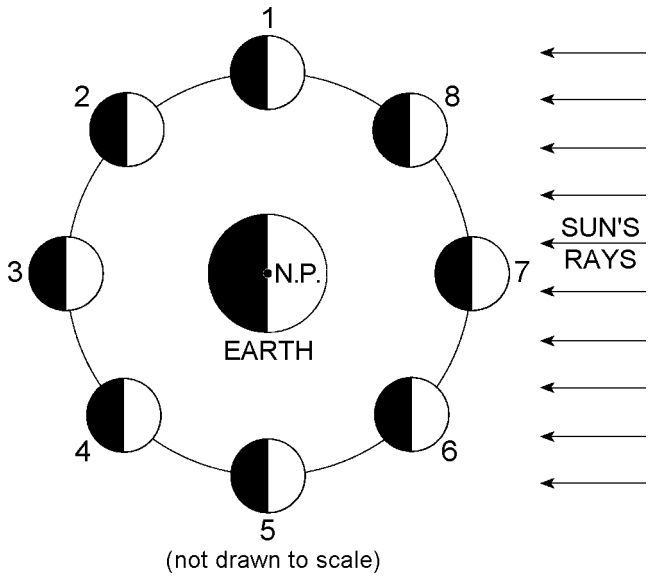
57) Based on the calendar shown, shade the part of the Moon that appeared dark to an observer in New York State on February 24 on the circle below.



58) Determine the altitude of *Polaris* at Kingston, New York to the *nearest* degree.

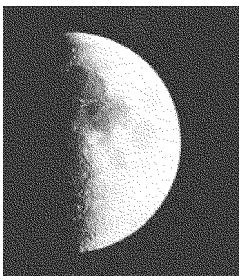
Questions 59 and 60 refer to the following:

The diagram below represents the Moon at eight numbered positions in its orbit around Earth. The nighttime sides of the Moon and Earth are shaded.



(not drawn to scale)

59) The photograph below shows a phase of the Moon as observed from New York State.

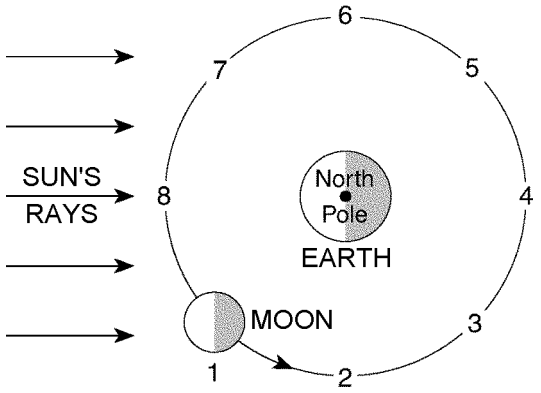


State the numbered position in the given diagram at which the Moon was located when this photograph was taken.

60) State the numbered position of the Moon in the given diagram that could result in a lunar eclipse.

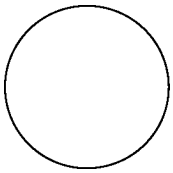
Questions 61 through 64 refer to the following:

The diagram below shows the Moon at position 1 in its orbit around Earth. Numbers 2 through 8 represent other positions in the Moon's orbit.



61) Identify *one* numbered orbital position on the given diagram where the gravitational attraction of the Moon and the Sun cause Earth to experience the *highest* high tides.

62) On the circle below, shade the portion of the Moon that is in darkness as viewed from New York State when the Moon is at position 1 on the given diagram.

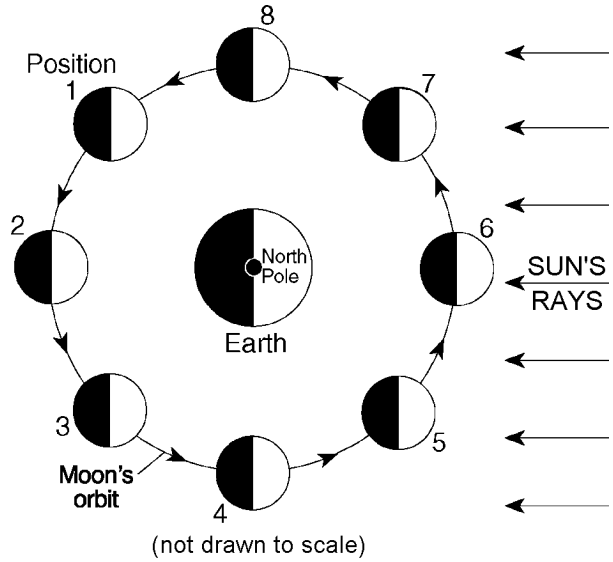


63) How many days does it take the Moon to go from one full-Moon phase to the next full-Moon phase when viewed from Earth?

64) A solar eclipse could occur when the Moon is located at which numbered position on the given diagram?

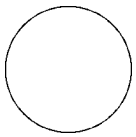
Questions 65 and 66 refer to the following:

The diagram below represents eight positions of the Moon in its orbit around Earth.



(not drawn to scale)

65) On the diagram below, shade the portion of the Moon that is in darkness to show the phase of the Moon at position 3 in the orbital diagram shown, as viewed from New York State.



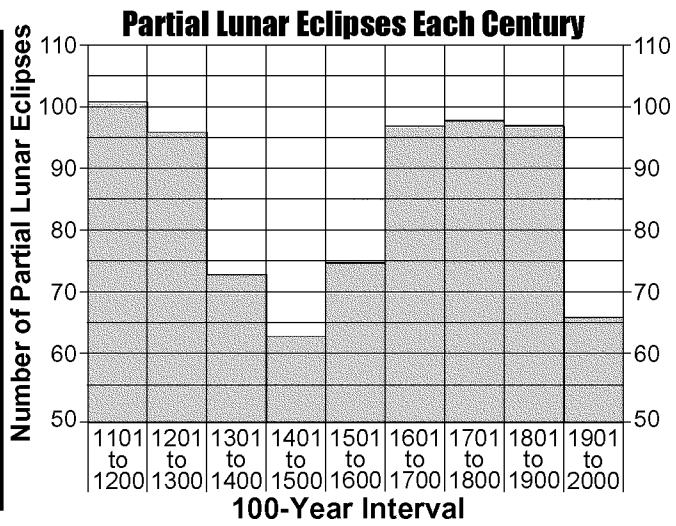
66) On the diagram shown, circle the position of the Moon where a solar eclipse is possible.

Questions 67 through 69 refer to the following:

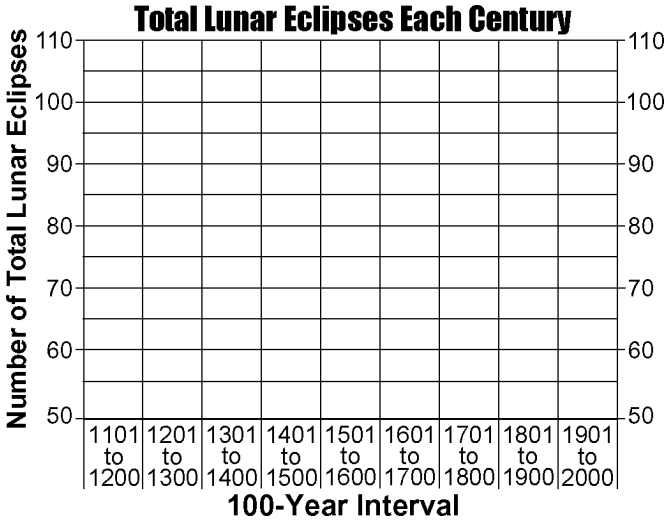
The bar graph below shows the number of partial lunar eclipses that occurred during each of the last nine centuries (100-year intervals) on Earth. A partial lunar eclipse occurs when only part of the Moon is within the darkest part of Earth's shadow. The data table below shows the number of total lunar eclipses that occurred during the same nine centuries. A total lunar eclipse occurs when the entire Moon is completely within the darkest part of Earth's shadow.

DATA TABLE

100-Year Intervals	Number of Total Lunar Eclipses
1101 to 1200	60
1201 to 1300	60
1301 to 1400	78
1401 to 1500	85
1501 to 1600	77
1601 to 1700	61
1701 to 1800	60
1801 to 1900	63
1901 to 2000	81

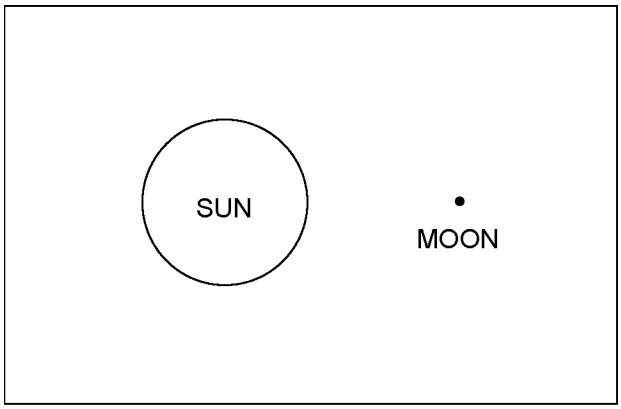


67) On the grid below, construct a bar graph of the number of total lunar eclipses for each 100-year interval listed on the given data table.



68) Based on the given information, state the relationship between the number of partial lunar eclipses per century and the number of total lunar eclipses per century.

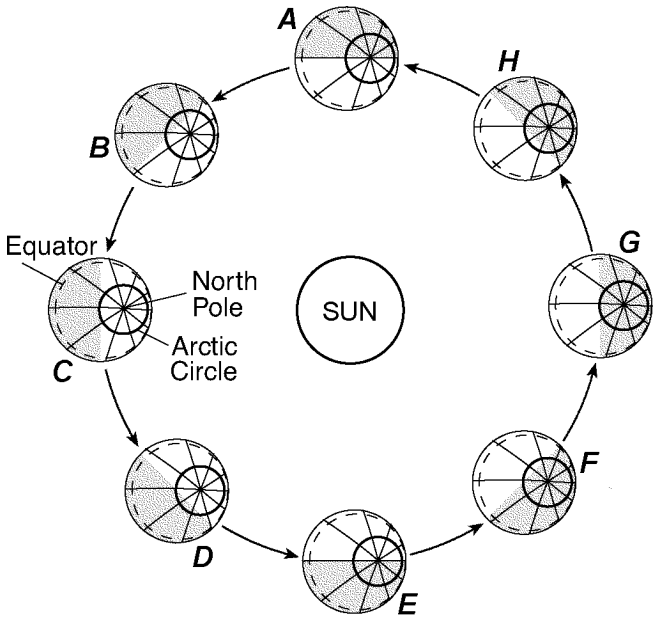
69) On the diagram below, draw an **X** so the center of the **X** indicates the position of Earth during a lunar eclipse.



(not drawn to scale)

Questions 70 and 71 refer to the following:

The diagram below shows Earth's orbit around the Sun as viewed from space. Earth is shown at eight different positions labeled *A* through *H*. Earth's North Pole, Arctic Circle, and equator have been labeled at position *C*. The arrows show the direction of orbital motion.



(not drawn to scale)

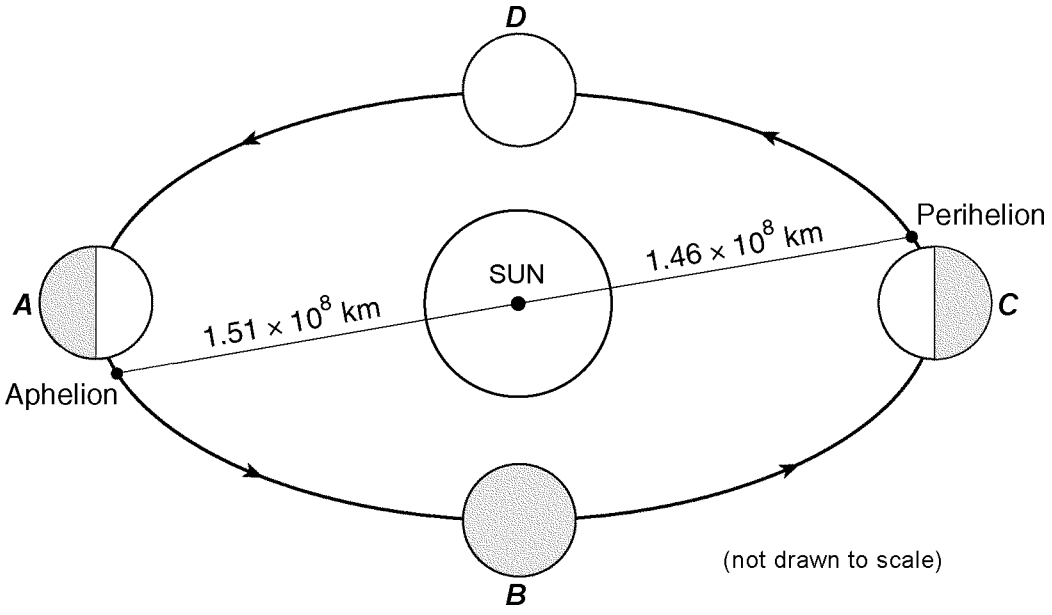
70) Complete the data table below by placing the letter from the given diagram that represents the position of Earth at the start of each season in the Northern Hemisphere.

Season	Earth's Position
spring	
summer	
fall	
winter	

71) Approximately how many days does Earth take to move from position *A* to position *C* in the given diagram?

Questions 72 through 76 refer to the following:

The diagram below shows Earth revolving around the Sun. Letters *A*, *B*, *C*, and *D* represent Earth's location in its orbit on the first day of the four seasons. Aphelion (farthest distance from the Sun) and perihelion (closest distance to the Sun) are labeled to show the approximate times when they occur in Earth's orbit.



72) On the diagram provided, draw a line through Earth at location *A* to represent Earth's tilted axis on the first day of summer in the Northern Hemisphere. Label the North Pole end of the axis.

73) On the diagram provided, draw an arrow on Earth at location *D* to show the direction of Earth's rotation. Extend the arrow from one side of Earth to the other side of Earth.

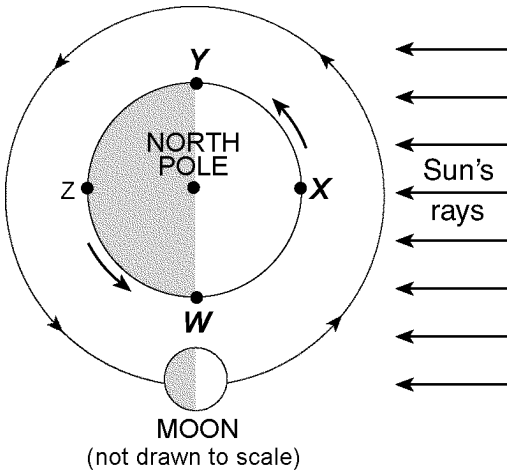
74) Approximately how many days does it take Earth to travel from location *B* to location *C* in the given diagram?

75) Explain why the gravitational attraction between the Sun and Earth *decreases* as Earth travels from location *D* to location *A* in the given diagram.

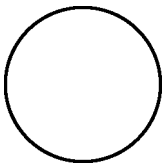
76) Explain why an observer in New York State sees some different constellations in the night sky when Earth is at location *A* compared to when Earth is at location *C* in the given diagram.

Questions 77 and 78 refer to the following:

The diagram below shows one position of the Moon in its orbit around Earth. Letters *W*, *X*, *Y*, and *Z* are locations on Earth's surface.



77) On the model of the Moon below, shade the part of the Moon that appears dark to an observer in New York State when the Moon is at the position shown in the given diagram.

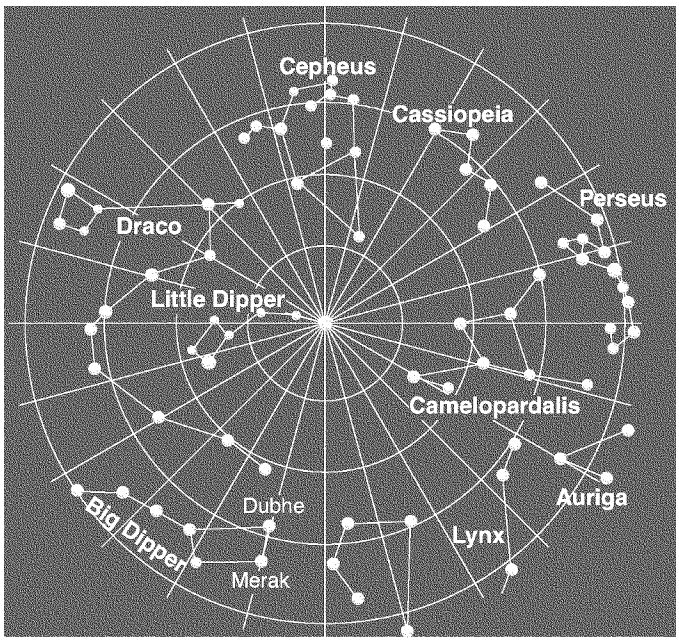


78) What is the solar time at location *Y* on the given diagram? [*Include a.m. or p.m. in your answer.*]

79) Which Earth motion causes the apparent daily movement of constellations in the night sky?

Questions 80 through 84 refer to the following:

The star chart below shows the locations of several constellations visible in the night sky. These constellations appear to move counterclockwise around the star in the center of the chart. Straight lines are at 15-degree intervals. *Merak* and *Dubhe* are two stars in the Big Dipper.



(not drawn to scale)

80) Complete the table below by identifying the classification of the star *Dubhe*. The classification for the star *Merak* has been provided as an example.

Star	**Luminosity**	**Temperature** (K)	**Classification**
Merak	50	10,000	main sequence
Dubhe	230	4,800	

81) Identify the star located in the center of this star chart.

82) How many degrees would the star directly below the "ss" in Cassiopeia appear to move in 3 hours?

83) The stars *Merak* and *Dubhe* are located within the same galaxy as our Sun. Identify the galaxy in which these stars are located.

84) On the chart of the night sky below, place an **X** to indicate the location of the Big Dipper at the same time of night 6 months later.