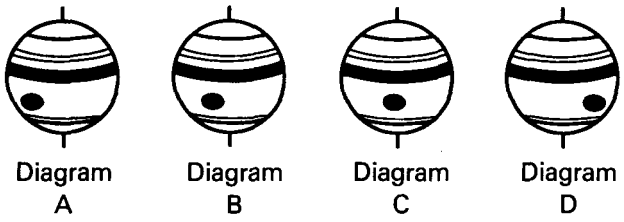
Place mouse over "?" for answers. Place mouse over "key" for hints and explanations.

A planet was viewed from Earth for several hours. The diagrams below represent the appearance of the planet at four different times.



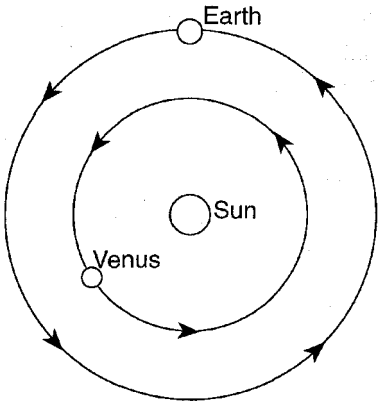
The best inference that can be made based on the diagrams is that this planet is

1) tilted on its axis
2) changing seasons
3) revolving
4) rotating

Compared to Jupiter and Saturn, Venus and Mars have greater

1) periods of revolution
2) orbital velocities
3) mean distances from the Sun
4) equatorial diameters

Base your answers to questions **3** and **4** on the diagram below. The diagram represents the orbital paths of the Earth and Venus.



(Not drawn to scale)

To an observer on the Earth, the planet Venus does *not* appear at one fixed position among the stars because Venus

1) rotates on its axis
2) revolves around the Sun
3) shows an apparent motion around the Earth
4) shows a complete cycle of phases

When measured from the Earth, the apparent diameter of Venus varies in a cyclic manner due to changes in the

1) rotation of Venus
2) altitude of Venus
3) distance between the Earth and Venus
4) gravitational attraction between the Earth and Venus

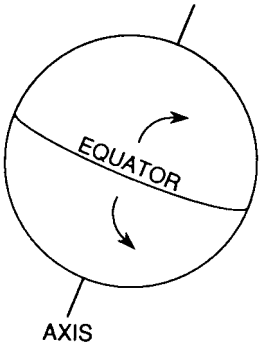
If the distance between the Earth and the Sun were increased, which change would occur?

1) The apparent diameter of the Sun would decrease.
2) The amount of insolation received by the Earth would increase.
3) The time for one Earth rotation (rotation period) would double.
4) The time for one Earth revolution (orbital period) would decrease.

In 1851, the French physicist Jean Foucault constructed a large pendulum that always changed its direction of swing at the same rate in a clockwise direction. According to Foucault, this change in direction of swing was caused by the

1) Moon's rotation on its axis
2) Moon's revolution around the Earth
3) Earth's rotation on its axis
4) Earth's revolution around the Sun

In the diagram below, the arrows represent the paths of moving fluids on the surface of the Earth.



Which statement best explains why the fluid is deflected?

1) The Earth is rotating on its axis.
2) The axis of the Earth is tilted.
3) The Earth is revolving around the Sun.
4) The Earth is moving away from the Sun.

The Coriolis effect provides evidence that Earth

1) rotates
2) has a tilted axis
3) has seasons
4) revolves

The apparent rising and setting of the Sun as seen from the Earth are caused by the

1) rotation of the Sun
2) rotation of the Earth
3) revolution of the Earth
4) revolution of the Sun

What is the total number of degrees that the Earth rotates on its axis during a 12-hour period?

1) 1°
2) 15°
3) 180°
4) 360°

The radius of the Earth is approximately

1) 637 km
2) 6,370 km
3) 63,700 km
4) 637,000 km

Approximately how many degrees does the Earth rotate on its axis in 1 hour?

1) 1°
2) 15°
3) 24°
4) 360°

In the geocentric model (the Earth at the center of the universe), which motion would occur?

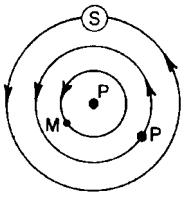
1) The Earth would revolve around the Sun.
2) The Earth would rotate on its axis.
3) The Moon would revolve around the Sun.
4) The Sun would revolve around the Earth.

Which planetary model allows a scientist to predict the exact positions of the planets in the night sky over many years?

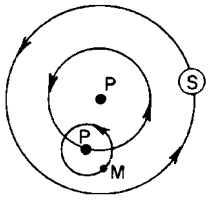
1) The planets' orbits are circles in a geocentric model.
2) The planets' orbits are ellipses in a geocentric model.
3) The planets' orbits are circles in a heliocentric model.
4) The planets' orbits are ellipses in a heliocentric model.

Which diagram best represents the motions of celestial objects in a heliocentric model?

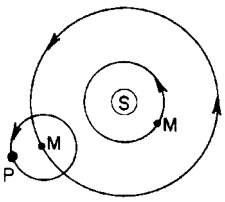
Key:
P● = Planet
M● = Moon
(S) = Sun



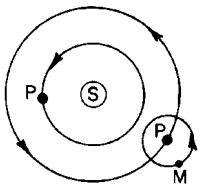
1)



3)

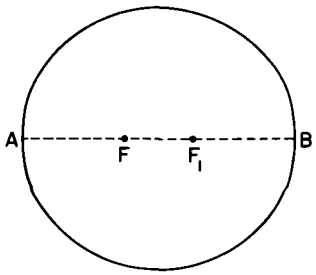


2)



4)

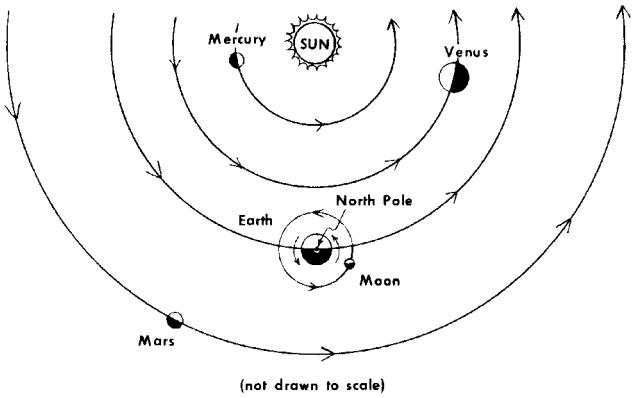
What is the eccentricity of the ellipse shown below?



F, F1 - foci
AB - major axis

1) 1.0
2) 0.5
3) 0.25
4) 0.13

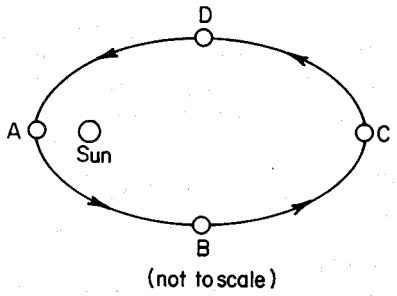
Base your answer to the following question on your knowledge of Earth science, the *Earth Science Reference Tables*, and the diagram below which shows part of the orbital paths of some of the planets of the solar system.



Which of the planets shown requires the longest time for one revolution around the Sun?

1) Mercury
2) Venus
3) Earth
4) Mars

The diagram below shows a planet's orbit around the Sun.



At which location is the planet's orbital velocity greatest?

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

The elliptical shape of the Earth's orbit results in

1) changes in the orbital velocity of the Earth
2) tilting of the Earth's axis
3) the oblate spheroid shape of the Earth
4) the phases of the Moon

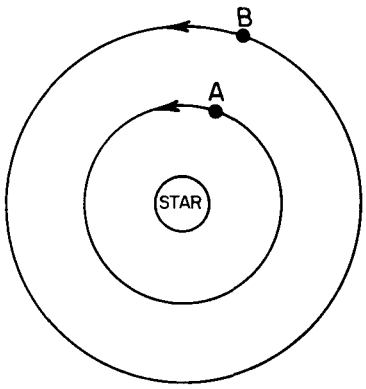
As the distance between the Earth and a satellite increases, the gravitational attraction between them will

1) decrease
2) increase
3) remain the same

Three planets known as gas giants because of their large size and low density are

1) Venus, Neptune, and Jupiter
2) Jupiter, Saturn, and Venus
3) Jupiter, Saturn, and Uranus
4) Venus, Uranus, and Jupiter

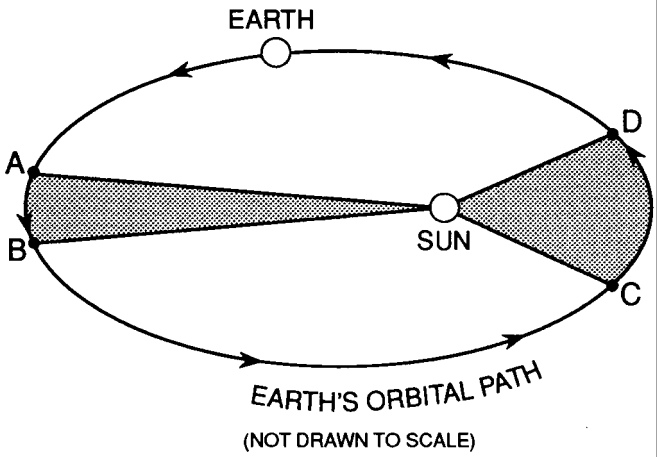
The diagram below shows the orbits of planets *A* and *B* in a star-planet system.



The period of revolution for planet *B* is 40 days. The period of revolution for planet *A* most likely is

1) less than 40 days
2) greater than 40 days
3) 40 days

The diagram below represents the Earth's orbital path around the Sun. The Earth takes the same amount of time to move from *A* to *B* as from *C* to *D*.



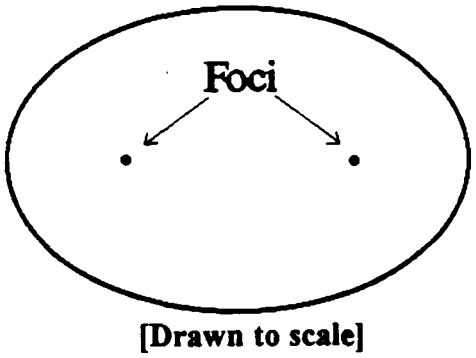
Which values are equal within the system?

1) The shaded sections of the diagram are equal in area.
2) The distance from the Sun to the Earth is the same at point *A* and at point *D*.
3) The orbital velocity of the Earth at point *A* equals its orbital velocity at point *C*.
4) The gravitational force between the Earth and the Sun at point *B* is the same as the gravitational force at point *D*.

Which planet has vast amounts of liquid water at its surface?

1) Venus
2) Mars
3) Jupiter
4) Earth

The diagram below represents the orbit of a spacecraft around the sun.



[Drawn to scale]

The eccentricity of the spacecraft's orbit is

1) more eccentric than Earth's orbit but less eccentric than Mars' orbit
2) more eccentric than planets 300 million km from the sun but less than those 100 million km from the sun
3) more eccentric than the orbit of any planet in the solar system
4) less eccentric than planets with a density less than 5 gm/cm^3

Which planet's day is longer than its year?

1) Mercury
2) Venus
3) Mars
4) Jupiter

Which planet's orbit is most nearly circular?

1) Earth
2) Venus
3) Neptune
4) Pluto

A belt of asteroids is located an average distance of 503 million kilometers from the Sun. Between which two planets is this belt located?

1) Mars and Jupiter
2) Mars and Earth
3) Jupiter and Saturn
4) Saturn and Uranus

Which statement best describes galaxies?

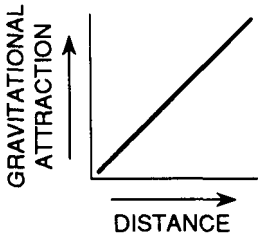
1) They are similar in size to the solar system.
2) They contain only one star but hundreds of planets.
3) They may contain a few hundred stars in a space slightly larger than the solar system.
4) They may contain billions of stars in a space much larger than our solar system.

According to the big bang theory, the universe began as an explosion and is still expanding. This theory is supported by observations that the stellar spectra of distant galaxies show a

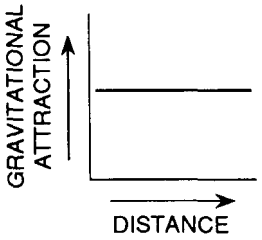
1) concentration in the yellow portion of the spectrum
2) concentration in the green portion of the spectrum
3) shift toward the blue end of the spectrum
4) shift toward the red end of the spectrum

Which graph best represents the relationship between the gravitational attraction of two objects and their distance from each other?

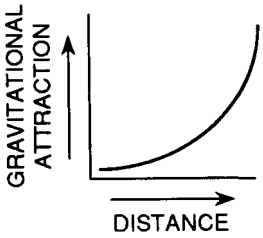
1)



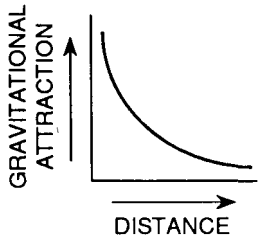
2)



3)



4)



Based on the red-shift data on galaxies, most astronomers infer that the universe is currently

1) expanding
2) contracting
3) moving randomly
4) fixed and stationary

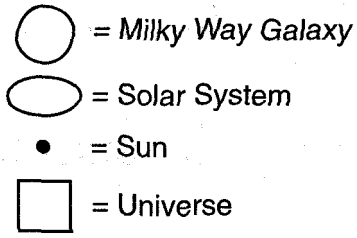
In which list are celestial features correctly shown in order of increasing size?

1) galaxy → solar system → universe → planet
2) solar system → galaxy → planet → universe
3) planet → solar system → galaxy → universe
4) universe → galaxy → solar system → planet

Most astronomers agree that at the present time universe is

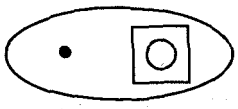
1) contracting
2) expanding
3) staying the same size
4) expanding and contracting regularly

The symbols below represent the Milky Way galaxy, the solar system, the Sun, and the universe.

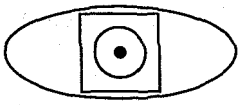


Which arrangement of symbols is most accurate?

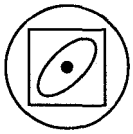
1)



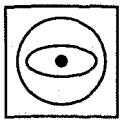
3)



2)



4)



A light year is

1) the distance traveled by light in one year
2) the distance the Earth moves in one year
3) the time it takes light to go once around the Earth's orbit
4) the time it takes light to travel one year

The Doppler effect predicts that light from a source moving away from Earth will be

1) shifted to shorter wavelengths.
2) shifted to longer wavelengths.
3) appear blue.
4) appear red.

The explosion of a massive star near the end of its life is known as a

1) nova
2) pulsar
3) supernova
4) nebula

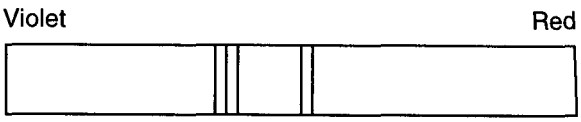
Compared to the sun, Polaris is

1) hotter and less luminous
2) cooler and more luminous
3) the same temperature and larger
4) hotter and larger

Which star is cooler and many times brighter than Earth's Sun?

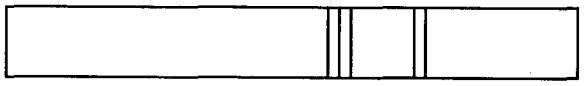
1) *Barnard's Star*
2) *Betelgeuse*
3) *Rigel*
4) *Sirius*

The diagram below represents a standard dark-line spectrum for an element.

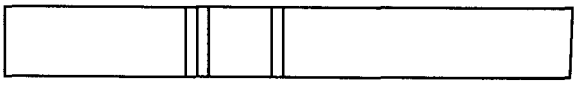


The spectral lines of this element are observed in light from a distant galaxy. Which diagram represents these spectral lines?

1)


2)


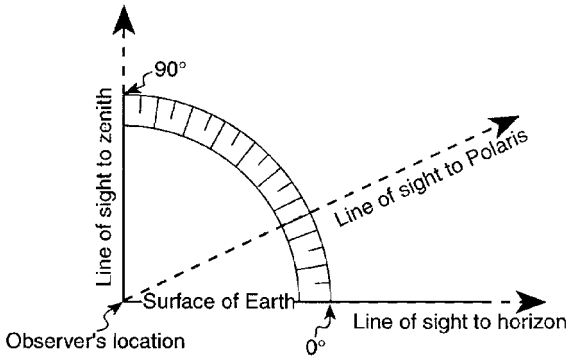
3)


4)


To an observer on a ship at sea, at which latitude does the North Star appear closest to the horizon?

1) 5° N
2) 20° N
3) 50° N
4) 85° N

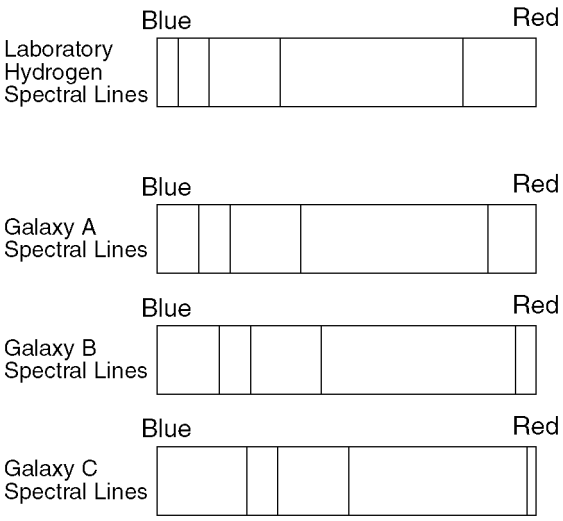
The diagram below shows the angular altitude of *Polaris* above the horizon at a certain location.



What is the latitude of the observer?

1) 15° N
2) 25° N
3) 30° N
4) 65° N

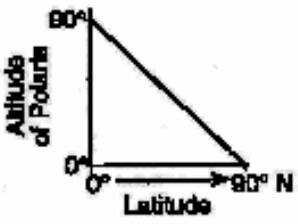
In the diagram below, the spectral lines of hydrogen gas from three galaxies, *A*, *B*, and *C*, are compared to the spectral lines of hydrogen gas observed in a laboratory.

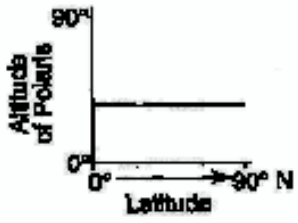


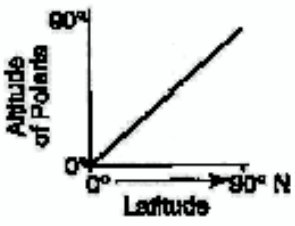
What is the best inference that can be made concerning the movement of galaxies *A*, *B*, and *C*?

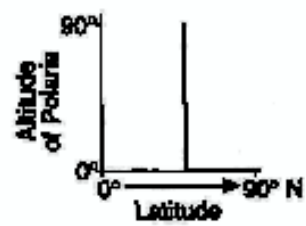
1) Galaxy *A* is moving away from Earth, but galaxies *B* and *C* are moving toward Earth.
2) Galaxy *B* is moving away from Earth, but galaxies *A* and *C* are moving toward Earth.
3) Galaxies *A*, *B*, and *C* are all moving toward Earth.
4) Galaxies *A*, *B*, and *C* are all moving away from Earth.

Which graph best represents the altitude of *Polaris* observed at northern latitude positions on the Earth's surface?

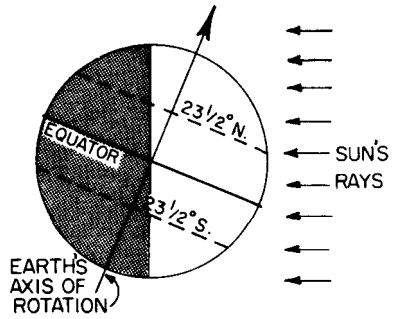
1)


3)


2)


4)


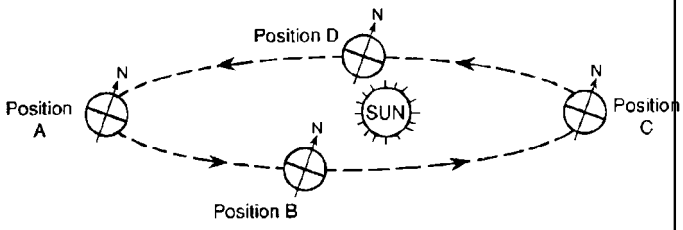
? In the diagram below, the direct rays of the Sun are striking the Earth's surface at 23 ¡ º N. What is the date shown in the diagram?



1) March 21
2) June 21
3) September 23
4) December 21

HINT

? The diagram below represents four positions of the Earth as it revolves around the Sun.



At which position is the Earth located on December 21?

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

HINT

? Which location on the Earth would the Sun's vertical rays strike on December 21?

1) Tropic of Cancer ($23\frac{1}{2}^{o}$ N)
2) Equator (0^{o})
3) Tropic of Capricorn ($23\frac{1}{2}^{o}$ S)
4) South Pole (90^{o} S)

HINT

? Which observation is a direct result of the 23½º tilt of Earth's axis as Earth orbits the Sun?

1) Locations on Earth's Equator receive 12 hours of daylight every day.
2) The apparent diameter of the Sun shows predictable changes in size.
3) A Foucault pendulum shows predictable shifts in its direction of swing.
4) Winter occurs in the Southern Hemisphere at the same time that summer occurs in the Northern Hemisphere.

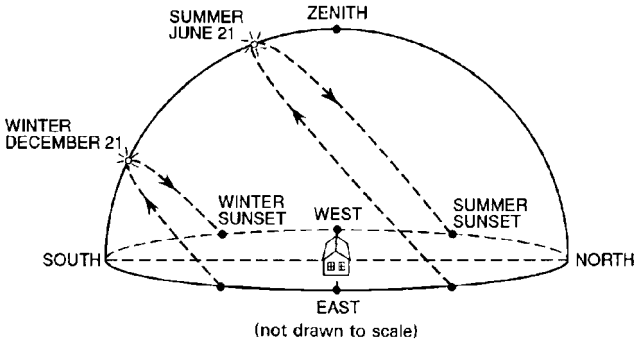
HINT

? During how many days of a calendar year is the Sun directly overhead at noon in New Jersey?

1) only 1 day
2) only 2 days
3) 365 days
4) 0 days

HINT

? The diagram below shows the apparent paths of the Sun in relation to a house in New York State on June 21 and December 21.

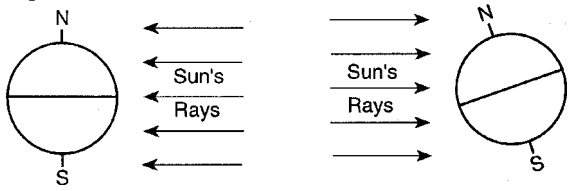


Which statement best explains the cause of this apparent change in the Sun's path?

1) The Sun's orbital velocity changes as it revolves around the Earth.
2) The Earth's orbital velocity changes as it revolves around the Sun.
3) The Earth's axis is tilted 23 ¡ º
4) The Sun's axis is tilted 23 ¡ º

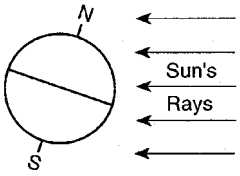
HINT

? Which diagram shows the position of the Earth relative to the Sun's rays during a winter day in the Northern Hemisphere?

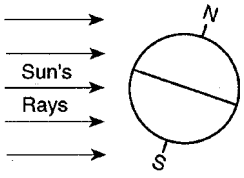


1)

3)



2)



4)

HINT

? On which day of the year does Connecticut have the *fewest* hours of daylight?

1) April 21
2) June 21
3) October 21
4) December 21

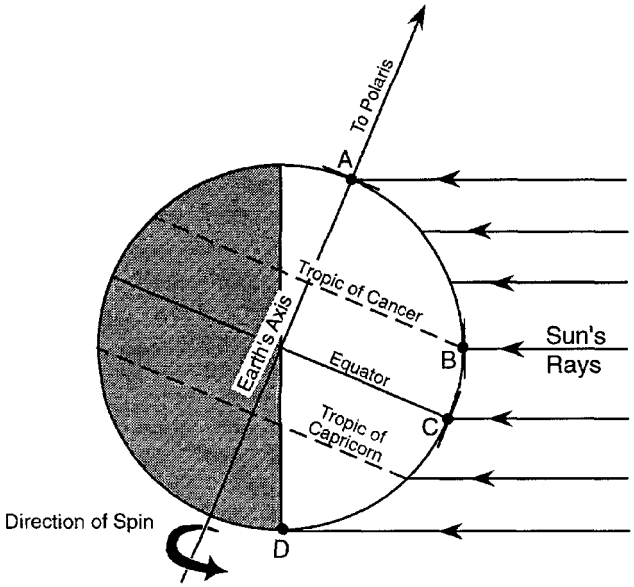
HINT

? Which motion causes the apparent rising and setting of the Moon each day, as seen from a location in Kansas?

1) the Earth revolving around the Sun
2) the Moon revolving around the Earth
3) the Earth rotating on its axis
4) the Moon rotating on its axis

HINT

Base your answers to questions **10** through **13** on the diagram below. The diagram represents the Earth at a position in orbit around the Sun, the Sun's rays at solar noon, and the direction to *Polaris*. Letters *A* through *D* represent positions on the Earth's surface.



? What is the latitude of position *A*?

1) 23 ¡ º N
2) 47º N
3) 66 ¡ º N
4) 90º N

HINT

? Which position is receiving the Sun's rays from directly overhead at solar noon?

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

HINT

? Which date is represented by the diagram?

1) March 21
2) June 21
3) September 23
4) December 21

HINT

? During one complete rotation of the Earth on its axis, which position receives the *least* number of hours of daylight?

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

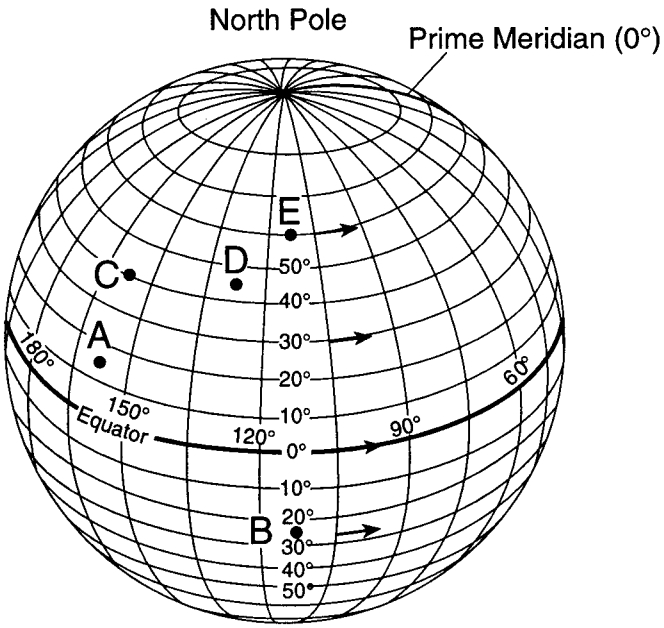
HINT

? The passage of the Moon into Earth's shadow causes a

1) lunar eclipse
2) solar eclipse
3) new Moon
4) full Moon

HINT

? Base your answer to the following question on the diagram below, which represents latitude and longitude lines on Earth. Points *A* through *E* represent locations on Earth. Arrows represent direction of rotation.

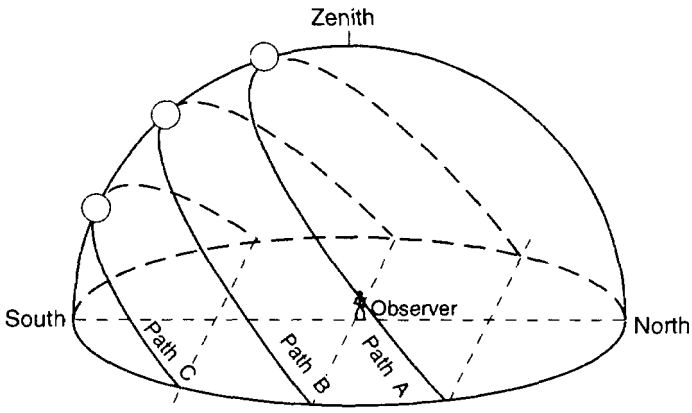


Which location has the longest duration of insolation on December 21?

1) *A*
2) *B*
3) *C*
4) *E*

HINT

? Base your answer to the following question on the diagram below, which shows the apparent paths of the Sun at the beginning of each season for an observer at a location in Connecticut.

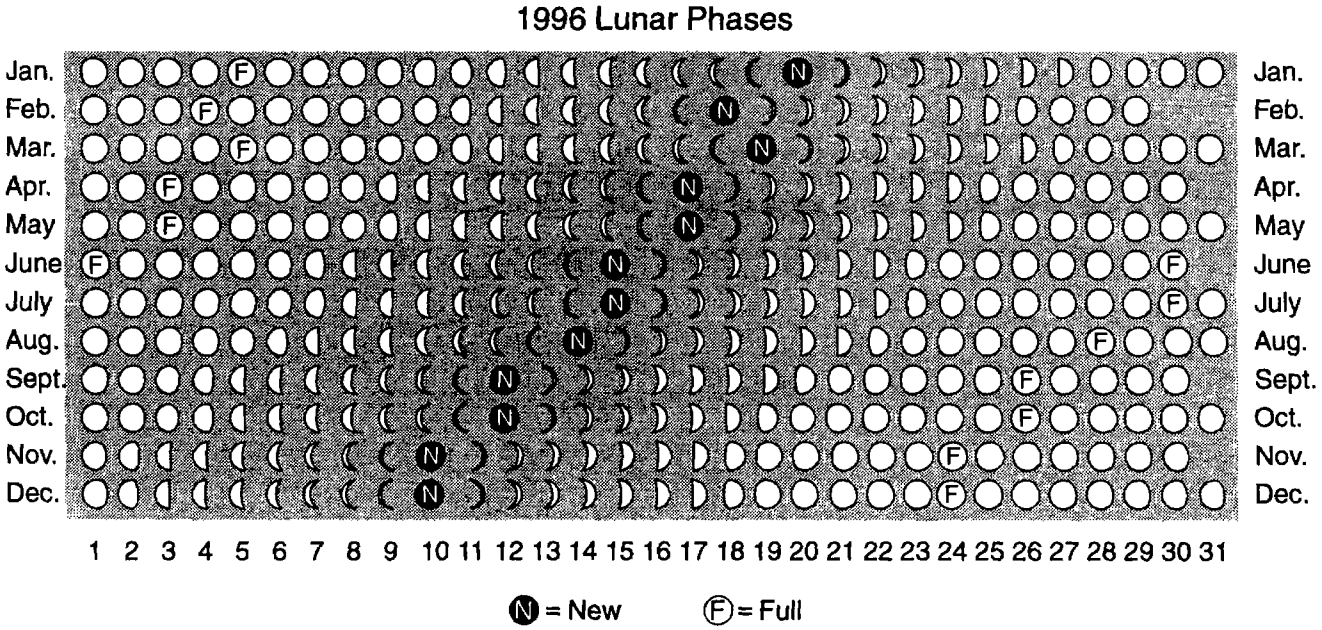


What is the time interval from the Sun's apparent path *A* to the Sun's apparent path *C*?

1) 1 day
2) 1 month
3) 6 months
4) 12 months

HINT

Base your answers to questions **17** and **18** on the chart below, which shows phases of the Moon as viewed by an observer on Earth during 1996.



? The Moon goes through a complete cycle of phases approximately every

1) 14 days 2) 23 days 3) 29 days 4) 365 days

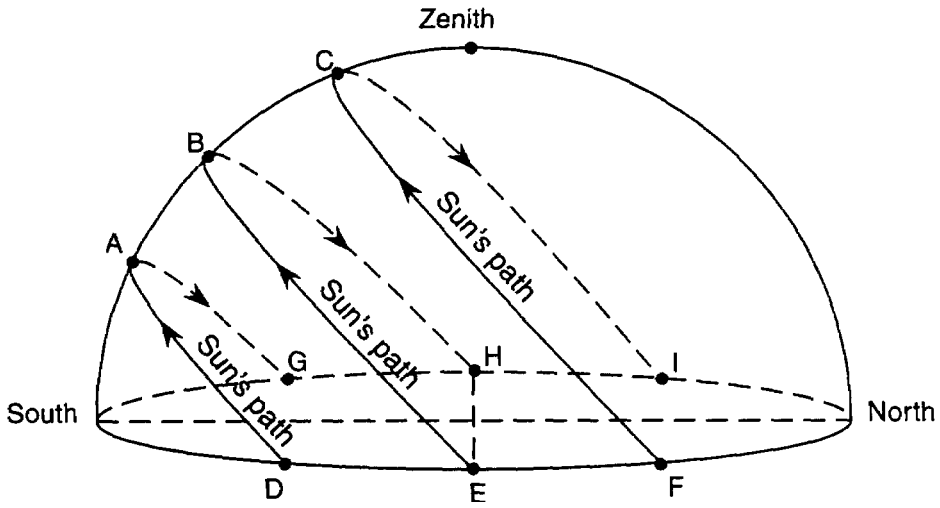
Hint

? What is the approximate diameter of the Moon?

1) 1.74×10^3 km 2) 6.96×10^5 km 3) 3.48×10^3 km 4) 7.35×10^{22} km

HINT

? The diagram below represents a plastic hemisphere upon which lines have been drawn to show the apparent paths of the Sun at a location in New York State on the first day of each season. Letters *A* through *I* represent points on the paths.



Which point represents the sunrise location on the first day of winter?

1) *G* 2) *F* 3) *E* 4) *D*

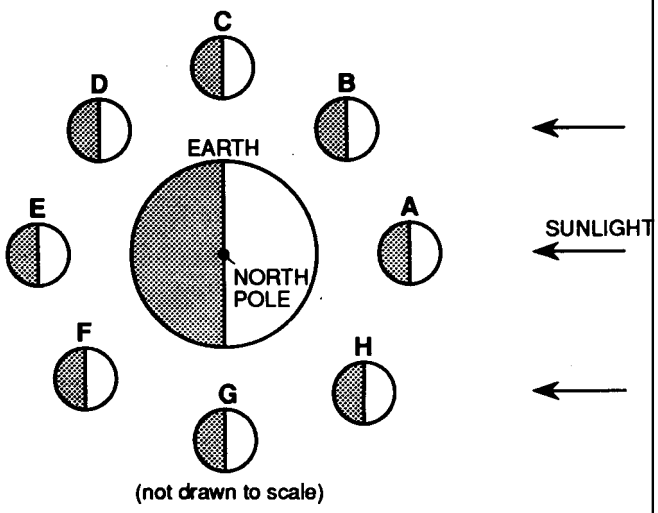
HINT

? Which object is closest to Earth?

1) the Sun 3) the Moon
2) Venus 4) Mars

HINT

? The diagram below represents eight positions of the Moon as it revolves around the Earth.



When viewed from the Earth, which phase of the Moon will be seen when the Moon is at point *E*?

1) first quarter
2) full moon
3) new moon
4) last quarter

HINT

? Which object orbits Earth in both the Earth-centered (geocentric) and Sun-centered (heliocentric) models of our solar system?

1) the Moon
2) the Sun
3) Venus
4) *Polaris*

HINT

? The same side of the Moon always faces Earth because the

1) Moon's period of rotation is longer than its period of revolution around Earth
2) Moon's period of rotation is shorter than its period of revolution around Earth
3) Moon rotates once as it completes one revolution around Earth
4) Moon does not rotate as it completes one revolution around Earth

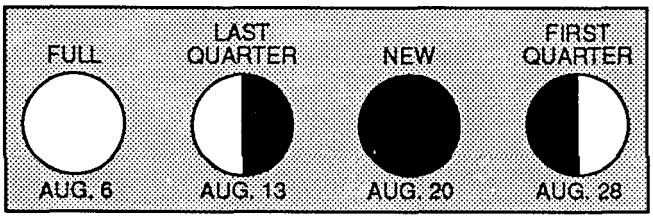
Hint

? Why do stars appear to move through the night sky at the rate of 15 degrees per hour?

1) The Earth actually moves around the Sun at a rate of 15° per hour.
2) The stars actually move around the center of the galaxy at a rate of 15° per hour.
3) The Earth actually rotates at a rate of 15° per hour.
4) The stars actually revolve around the Earth at a rate of 15° per hour.

HINT

? The diagrams below show the phases of the Moon as viewed by an observer in New York State at different times in August.



Which phase could have been observed on August 17?


NEW CRESCENT
1)


OLD GIBBOUS
3)


NEW MOON
2)


OLD CRESCENT
4)

HINT

? Most scientists believe the Milky Way Galaxy is

1) spherical in shape
2) 4.6 billion years old
3) composed of stars revolving around Earth
4) one of billions of galaxies in the universe

HINT

? Which statement best describes the age of our solar system and the universe?

1) The universe is at least twice as old as our solar system.
2) Our solar system is at least twice as old as the universe.
3) Our solar system and the universe are estimated to be 5 billion years old.
4) Our solar system and the universe are estimated to be 10 billion years old.

HINT

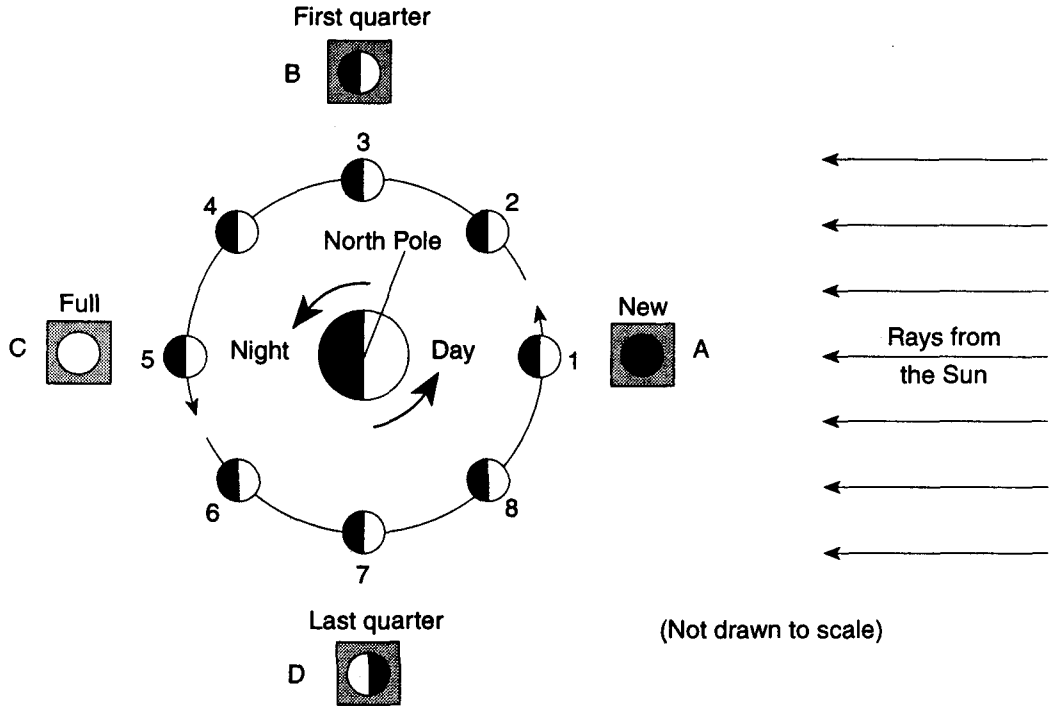
? In New York State, how do the points of sunrise and sunset change during the course of 1 year?

1) They vary with each season in a cyclic manner.
2) They move toward the north in the autumn months.
3) They move toward the south in the spring months.
4) They remain the same during the four seasons.

HINT

?

Base your answer to the following question on the diagram below, which represents a model of the Earth-Moon system as viewed from above the North Pole. The numbers 1 through 8 represent positions of the Moon as it revolves around Earth. The parts of the diagram lettered A through D show how the Moon's phases appear to an observer in New Jersey.

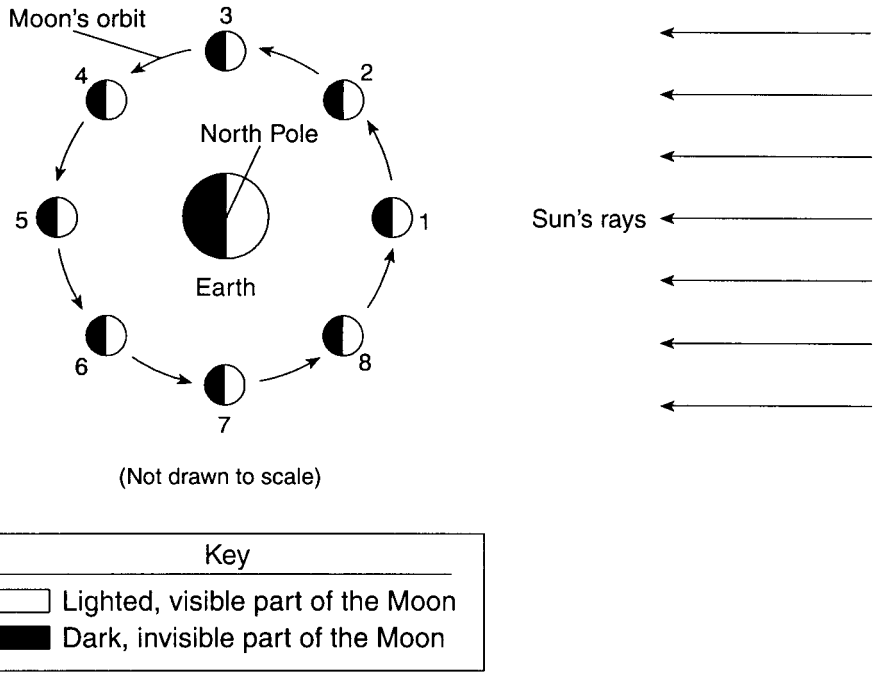


Which motion causes the Moon to show phases when viewed from Earth?

1) rotation of Earth
2) revolution of Earth
3) rotation of the Moon
4) revolution of the Moon

HINT

Base your answers to questions **30** through **32** on the diagram below, which represents the Moon orbiting Earth as viewed from space above the North Pole. The Moon is shown at eight different positions in its orbit.



? The approximate time required for the Moon to move from position 3 to position 7 is

1) 1 hour 2) 2 weeks 3) 3 months 4) 4 days

HINT

? As the Moon changes location from position 2 to position 6, the visible portion of the Moon as observed from Earth

1) decreases, only 2) increases, only 3) decreases, then increases 4) increases, then decreases

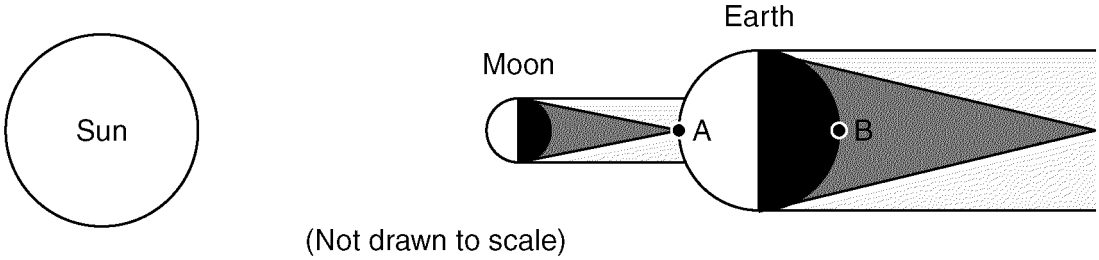
HINT

? Which device when placed on the Moon would provide evidence of Moon rotation?

1) Foucault pendulum 2) seismograph 3) thermometer 4) wind vane

HINT

? The diagram below shows the relative positions of the Sun, the Moon, and Earth when an eclipse was observed from Earth. Positions *A* and *B* are locations on Earth's surface.

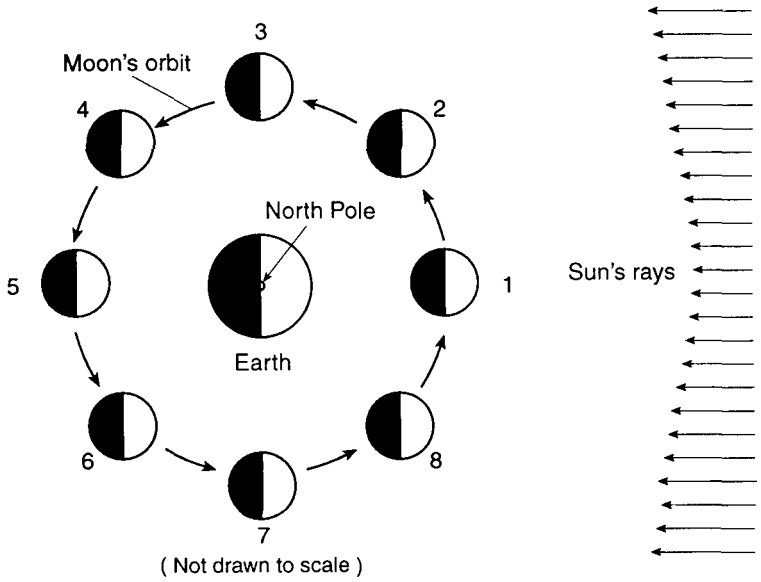


Which statement correctly describes the type of eclipse that was occurring and the position on Earth where this eclipse was observed?

1) A lunar eclipse was observed from position *A*.
2) A lunar eclipse was observed from position *B*.
3) A solar eclipse was observed from position *A*.
4) A solar eclipse was observed from position *B*.

HINT

? The diagram below shows the Moon orbiting Earth as viewed from space above the North Pole. The Moon is shown at eight different positions in its orbit.

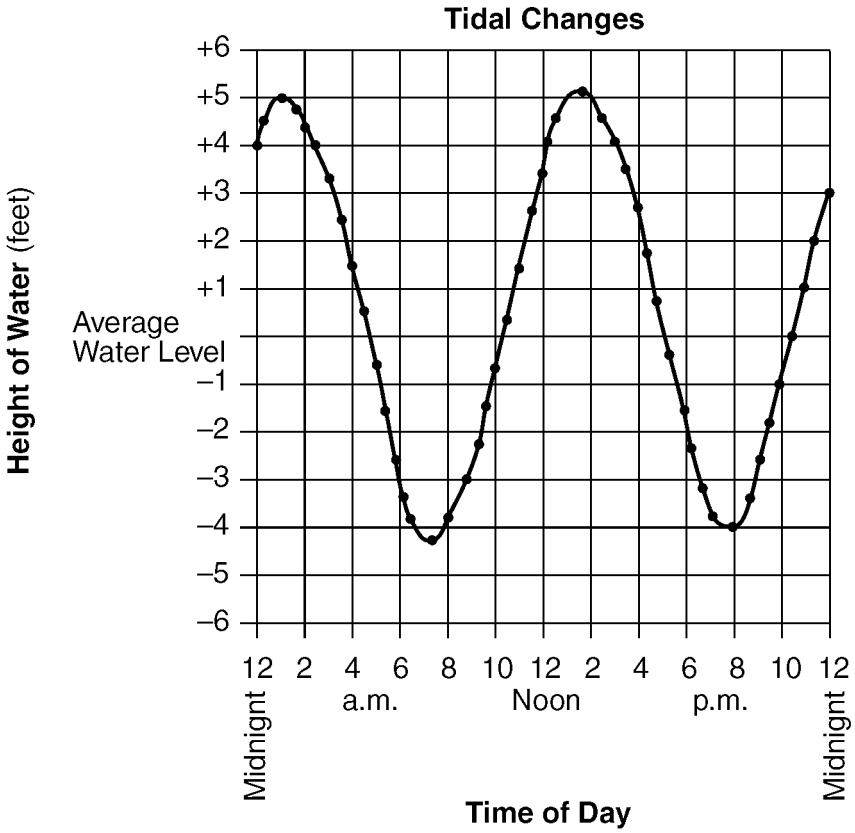


At which two positions of the Moon is an eclipse of the Sun or Moon possible?

1) 1 and 5 2) 2 and 6 3) 3 and 7 4) 4 and 8

HINT

Base your answers to questions **35** and **36** on the graph below. The graph shows the recorded change in water level (ocean tides) at a coastal city in the northeastern United States during 1 day.



? Which inference about tides is best made from this graph?

1) The hourly rate of tidal change is always the same.
2) The rate of tidal change is greatest at high tide.
3) The tidal change is a random event.
4) The tidal change is cyclic.

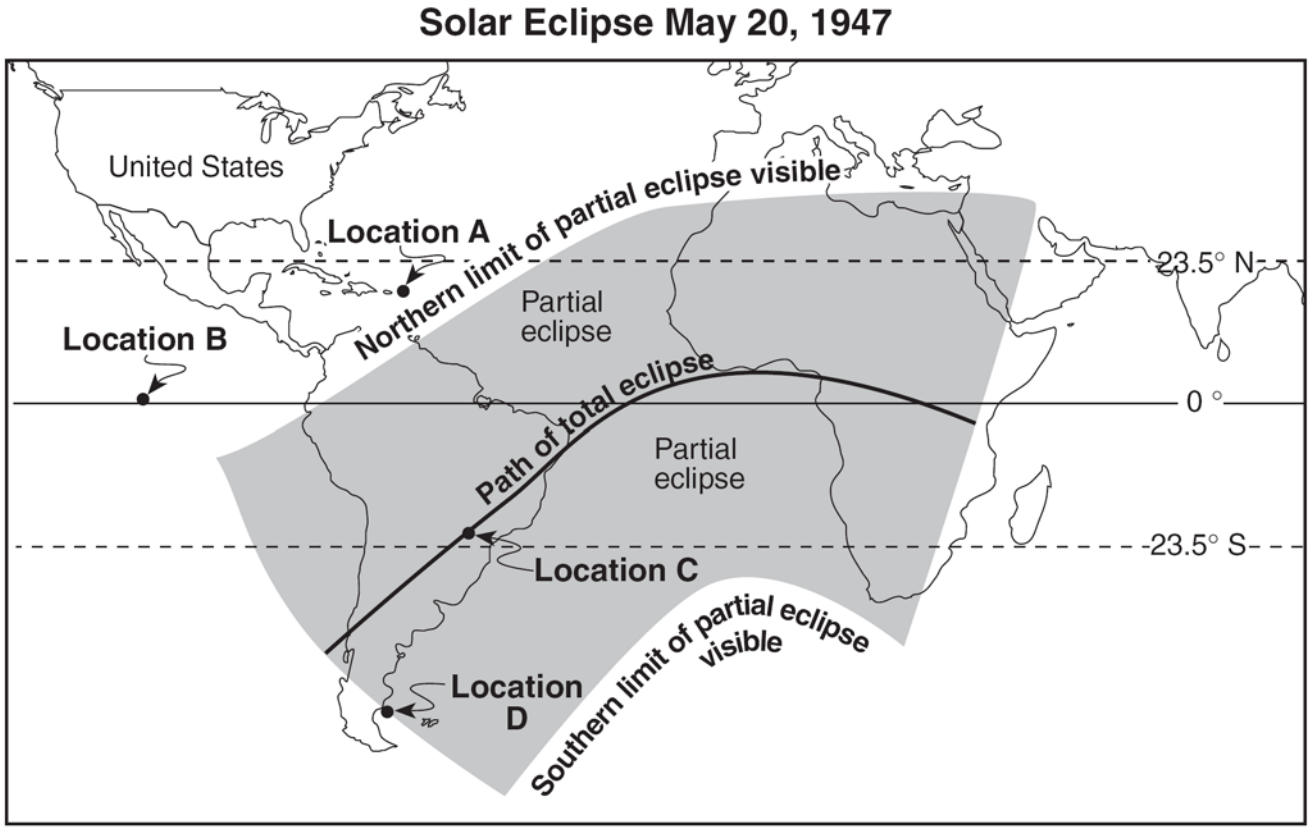
HINT

? According to the pattern shown on the graph, the next high tide will occur on the following day at approximately

1) 12:30 a.m.
2) 2:00 a.m.
3) 3:15 a.m.
4) 4:00 a.m.

HINT

Base your answers to questions **37** and **38** on the world map below, which shows regions of Earth where a solar eclipse was visible on May 20, 1947. Location *A*, *B*, *C*, and *D* are on Earth's surface.

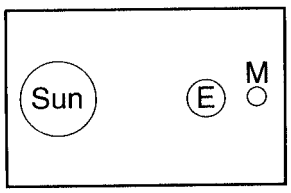


? Which statement best describes the visibility of this eclipse from locations in New York State?

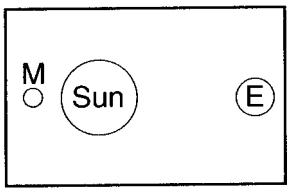
1) A total eclipse was visible all day.
2) A total eclipse was visible only from noon until sunset.
3) A partial eclipse was visible only from noon until sunset.
4) Neither a partial nor a total eclipse was visible.

Hint

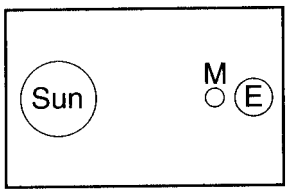
? Which diagram best represents the positions of Earth *(E)*, the Sun, and the Moon that created the solar eclipse? (Diagrams are not drawn to scale.)



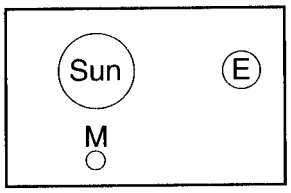
1)



3)



2)



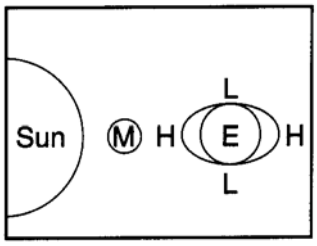
4)

HINT

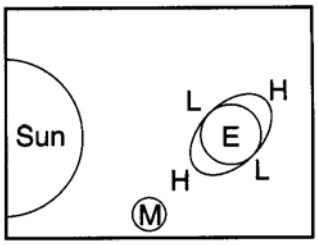
? The diagrams below represent Earth's ocean tides at four different positions of the Moon. Which diagram shows the Moon position that will produce the highest high tides and the lowest low tides? (The diagrams are not drawn to scale.)

Key	
E = Earth	H = High tide
M = Moon	L = Low tide

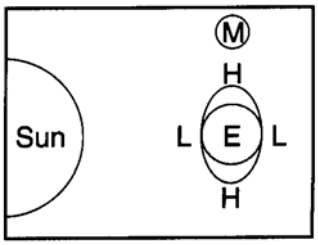
1)



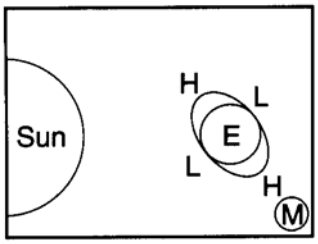
2)



3)



4)

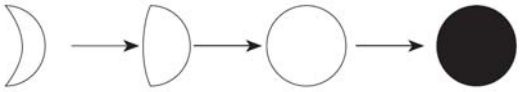


HINT

? Which sequence of Moon phases could be observed from Earth during a 2-week period?

Key	
○	Full Moon phase
●	New Moon phase

1)



2)

3)

4)

HINT