

## Seasons Question Document

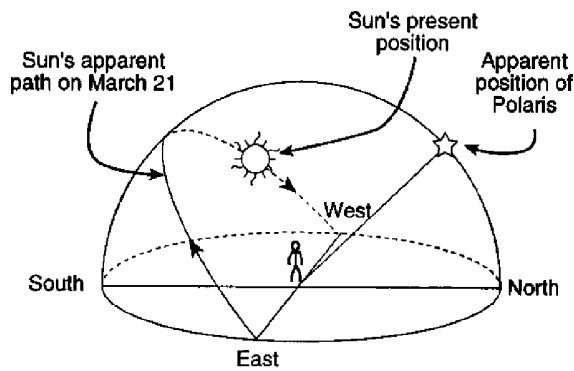
Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. The Sun's apparent daily path through the daytime sky is best described by an observer in New York State as
  - A. a circle around the North Star
  - B. an arc that extends from east to west
  - C. a straight line that passes directly overhead
  - D. a random motion that varies with the seasons
  
2. A student in New York State observed that the altitude of the Sun at noon is decreasing each day. During which month could the student have made these observations?
 

A. January	B. March
C. May	D. October

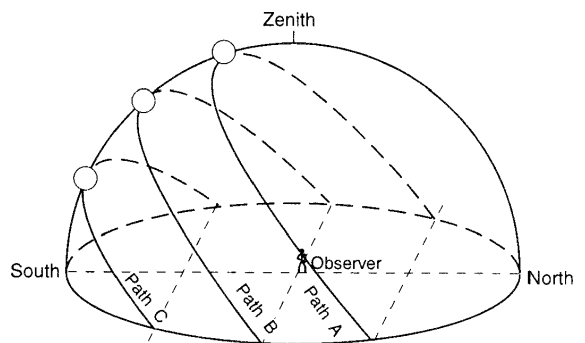
3. Base your answer(s) to the following question(s) on the diagram below, which shows the Sun's apparent path as viewed by an observer in New York State on March 21.



( Not drawn to scale )

On the diagram above, draw the Sun's apparent path as viewed by the observer on December 21.

4. A student in New York State observes the altitude of the Sun at solar noon each day from January 1 through June 1. The altitude of the Sun will
  - A. decrease, only
  - B. increase, only
  - C. decrease, then increase
  - D. increase, then decrease
  
5. Base your answer(s) to the following question(s) on the diagram below and on your knowledge of Earth science. The diagram shows the apparent paths of the Sun at the beginning of each season for an observer at a location in New York State.



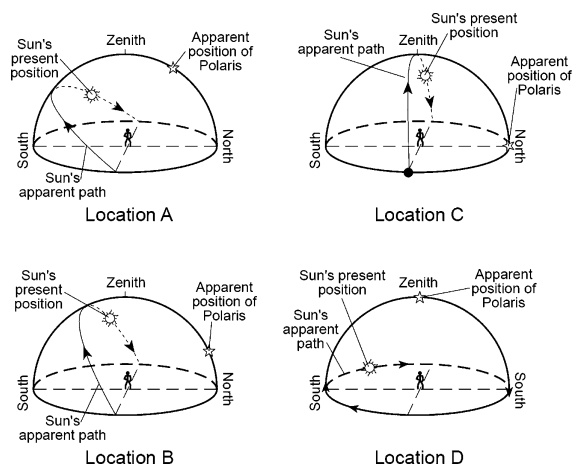
In which compass direction must the observer look to locate the noontime Sun?

- |              |              |
|--------------|--------------|
| A. north     | B. south     |
| C. northeast | D. southwest |
- 
6. A student in New York State observed that the noon Sun increased in altitude each day during the first part of a certain month and then decreased in altitude each day later in the month. During which month were these observations made?
 

A. February	B. June
C. September	D. November

7. To an observer in New York State, the Sun appears to rise each day somewhere along the
- A. northern horizon      B. southern horizon  
C. eastern horizon      D. western horizon
8. A student in New York State observed that the noon Sun increased in altitude each day during the first part of a certain month and then decreased in altitude each day later in the month. During which month were these observations made?
- A. February      B. June  
C. September      D. November

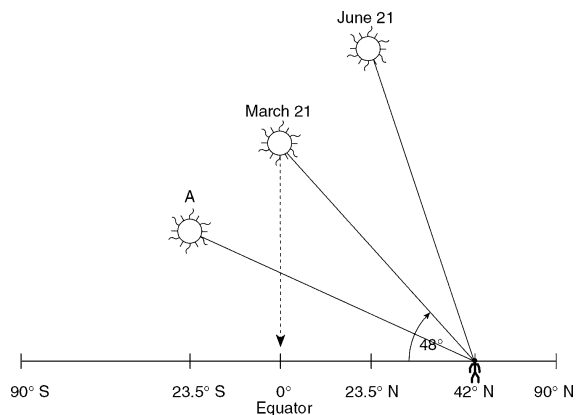
9. Base your answer(s) to the following question(s) on the diagram below. The diagram represents the apparent path of the Sun observed at four locations on Earth's surface on March 21. The present positions of the Sun, Polaris, and the zenith (position directly overhead) are shown for an observer at each location.



The observer at location A casts a shadow at the time represented in the diagram.

- a) State the compass direction in which the observer at location A must look to view her shadow.
- b) Describe the change in the length of the shadow that will occur between the time shown and sunset.
10. State the approximate time of day for the observer at location B when the Sun is at the position shown in the diagram.

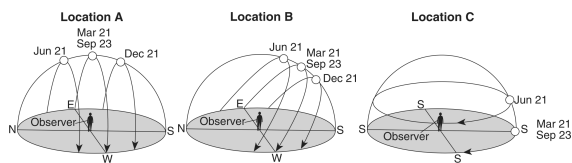
11. Explain why the intensity of sunlight at noon on March 21 is greater at location C than at the other locations.
12. The observer at location D is located at a higher latitude than the other three observers. State one way that this conclusion can be determined from the diagram.
13. State the other day of the year when the Sun's apparent path is exactly the same as that shown for these four locations on March 21.
14. Base your answer(s) to the following question(s) on the diagram below, which represents the position of the Sun with respect to Earth's surface at solar noon on certain dates. The latitudes of six locations on the same line of longitude are shown. The observer is located at  $42^{\circ}\text{N}$  in New York State. The date for the Sun at position A has been deliberately left blank.



At which New York State location could the observer be located?

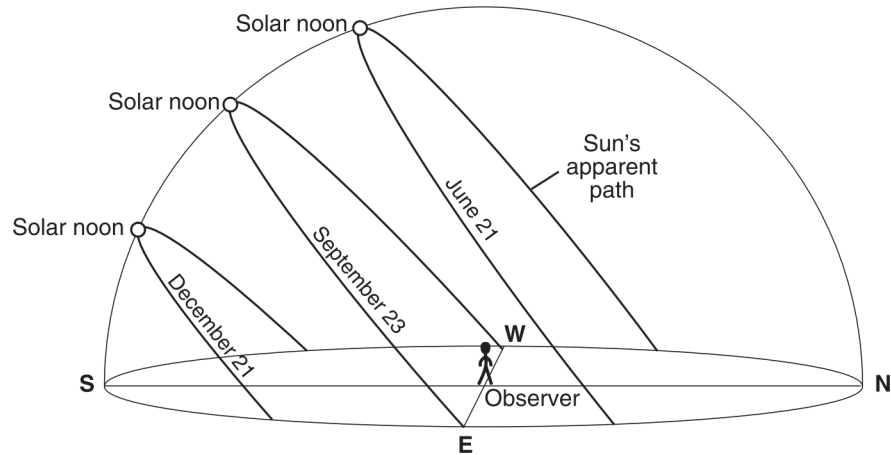
- A. Plattsburgh      B. Mount Marcy  
C. New York City      D. Slide Mountain
15. When the Sun is at position A, which latitude receives the most direct rays of the Sun?
- A. Tropic of Cancer ( $23.5^{\circ}\text{N}$ )  
B. Tropic of Capricorn ( $23.5^{\circ}\text{S}$ )  
C. Equator ( $0^{\circ}$ )  
D. Antarctic Circle ( $66.5^{\circ}\text{S}$ )

16. Base your answer(s) to the following question(s) on the diagrams below, which show the apparent path and solar noon positions of the Sun on specific dates at three different locations on Earth.

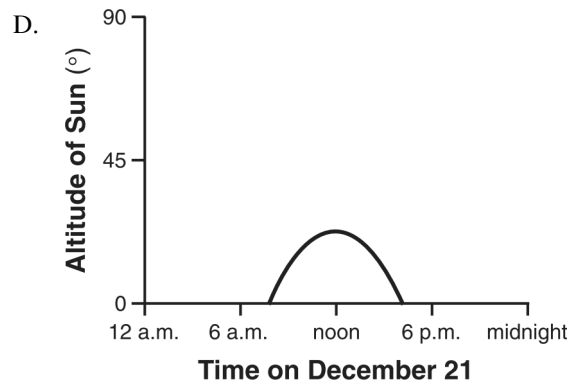
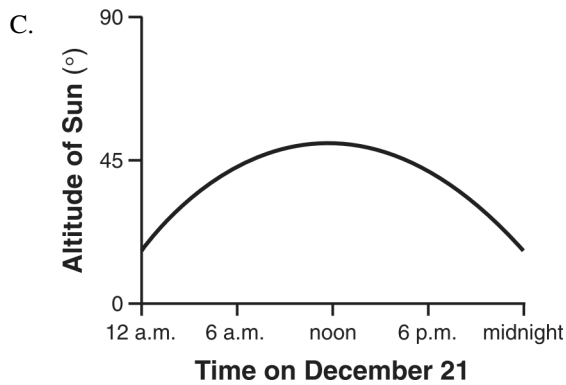
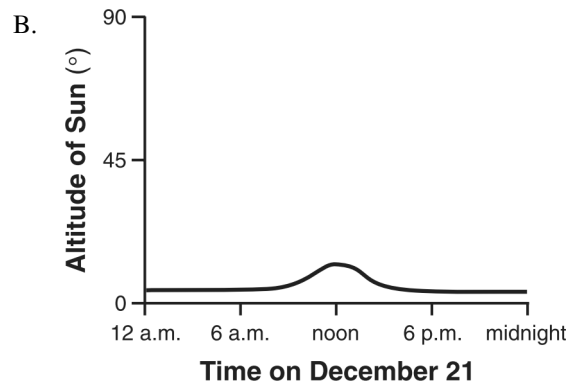
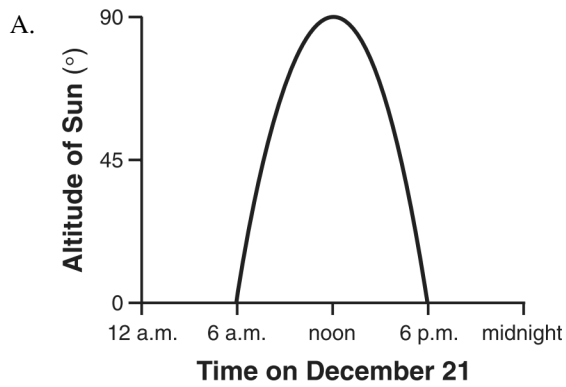


What evidence indicates that the observer at location A is at the equator?

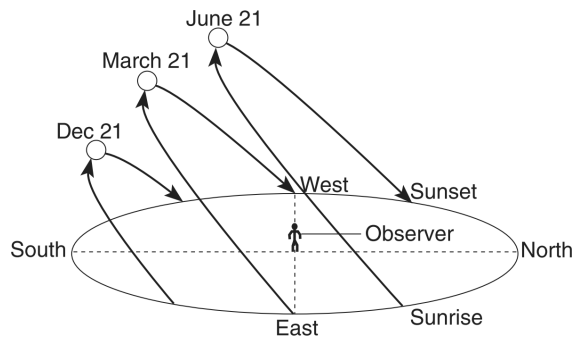
17. Base your answer(s) to the following question(s) on the diagram below, which represents the Sun's apparent paths and the solar noon positions for an observer at  $42^{\circ}\text{N}$  latitude on December 21, September 23, and June 21.



Which graph best shows the altitude of the Sun, as measured by the observer located at  $42^{\circ}\text{N}$ , at various times on December 21?

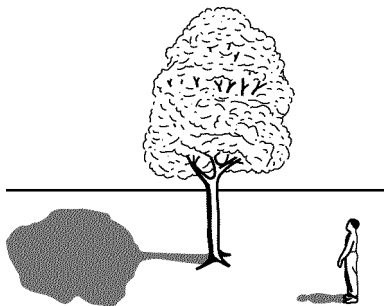


18. The diagram below shows the apparent daily path of the Sun, as viewed by an observer at a certain latitude on three different days of the year.



At which latitude were these apparent Sun paths most likely observed?

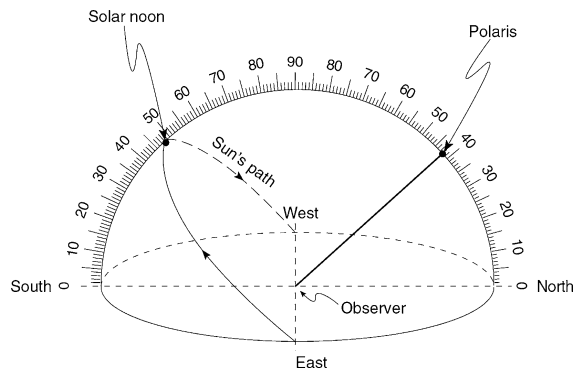
- A.  $0^\circ$                       B.  $23.5^\circ$  N  
 C.  $43^\circ$  N                    D.  $66.5^\circ$  N
19. The diagram below shows the noontime shadows cast by a student and a tree.



If the time is solar noon and the student is located in New York State, in what direction is the student facing?

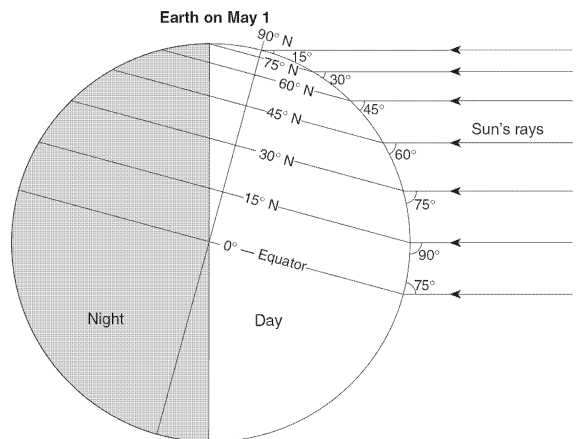
- A. north    B. south    C. east    D. west

20. Base your answer(s) to the following question(s) on the diagram below, which represents a model of the sky (celestial sphere) for an observer in New York State. The curved arrow represents the Sun's apparent path for part of one day. The altitude of Polaris is also indicated.



Where is this observer most likely located?

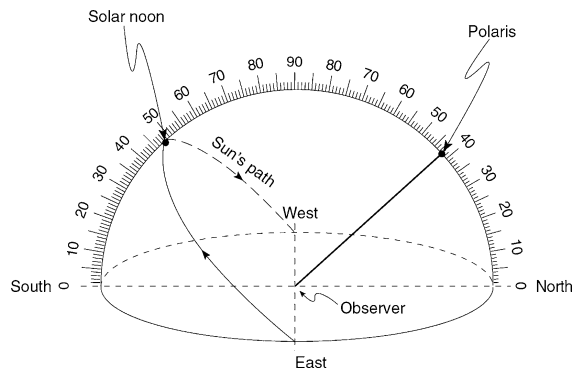
- A. Massena                      B. Oswego  
 C. Slide Mountain            D. Mt. Marcy
21. Base your answer(s) to the following question(s) on the diagram below, which shows the angle of the Sun's noontime rays received at different Earth latitudes on May 1.



At which latitude can the noontime Sun be observed in the northern part of the sky?

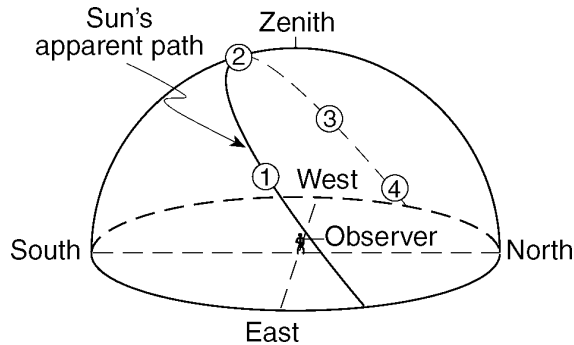
- A.  $0^\circ$     B.  $30^\circ$  N    C.  $60^\circ$  N    D.  $90^\circ$  N

22. Base your answer(s) to the following question(s) on the diagram below, which represents a model of the sky (celestial sphere) for an observer in New York State. The curved arrow represents the Sun's apparent path for part of one day. The altitude of Polaris is also indicated.



According to this diagram, what is the Sun's altitude at solar noon?

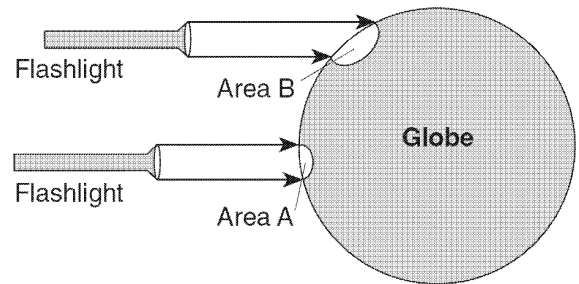
- A.  $23.5^\circ$  B.  $42^\circ$  C.  $48^\circ$  D.  $90^\circ$
23. Base your answer(s) to the following question(s) on the diagram below, which shows numbered positions of the Sun at four different times along the Sun's apparent daily path, as seen by an observer in New York State. Numbers 1 through 4 represent apparent positions of the Sun.



During which day of the year is the Sun most likely to follow the apparent path shown?

- A. March 1 B. July 1  
C. October 1 D. December 1
24. The observer had the longest shadow when the Sun was at position
- A. 1 B. 2 C. 3 D. 4

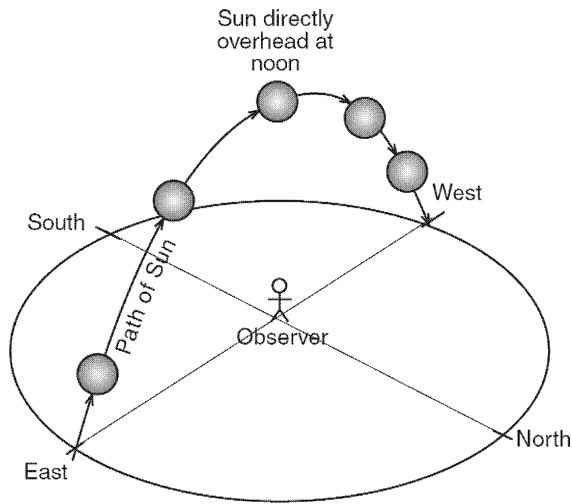
25. The diagram below shows a classroom demonstration. Two identical flashlights were placed in the positions shown and they illuminated areas of varying size, A and B, on a classroom globe. Thermometers were then placed at the center of each illuminated area to measure the rate of temperature increase. Readings were taken over a period of 30 minutes.



Students most likely observed that the temperature of area A increased at a

- A. slower rate than the temperature of area B because area A received rays that were less concentrated
- B. slower rate than the temperature of area B because area A received rays that were more slanted
- C. faster rate than the temperature of area B because area A received rays that were more perpendicular to the surface
- D. faster rate than the temperature of area B because area A received rays with less total energy

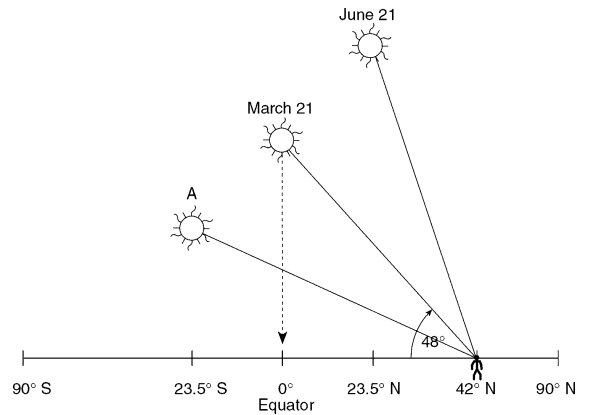
26. The accompanying diagram shows the apparent path of the Sun as viewed by an observer at a certain Earth location on March 21.



At which latitude is the observer located?

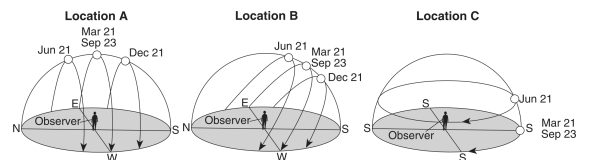
- A. the Equator ( $0^\circ$ )      B.  $23\frac{1}{2}^\circ$  N  
 C.  $66\frac{1}{2}^\circ$  N                      D.  $90^\circ$  N

27. Base your answer(s) to the following question(s) on the diagram below, which represents the position of the Sun with respect to Earth's surface at solar noon on certain dates. The latitudes of six locations on the same line of longitude are shown. The observer is located at  $42^\circ$  N in New York State. The date for the Sun at position A has been deliberately left blank.



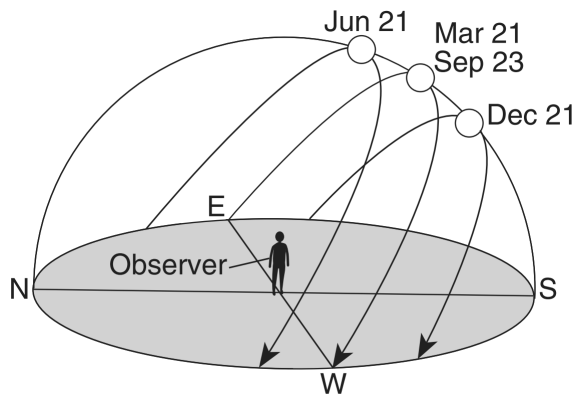
When the Sun is at the March 21 position, New York State will usually have

- A. longer days than nights  
 B. 12 hours of daylight and 12 hours of darkness  
 C. the lowest annual altitude of the Sun at solar noon  
 D. the highest annual altitude of the Sun at solar noon
28. Base your answer(s) to the following question(s) on the diagrams below, which show the apparent path and solar noon positions of the Sun on specific dates at three different locations on Earth.



Explain why the observer's shadow at location B will always point northward at solar noon.

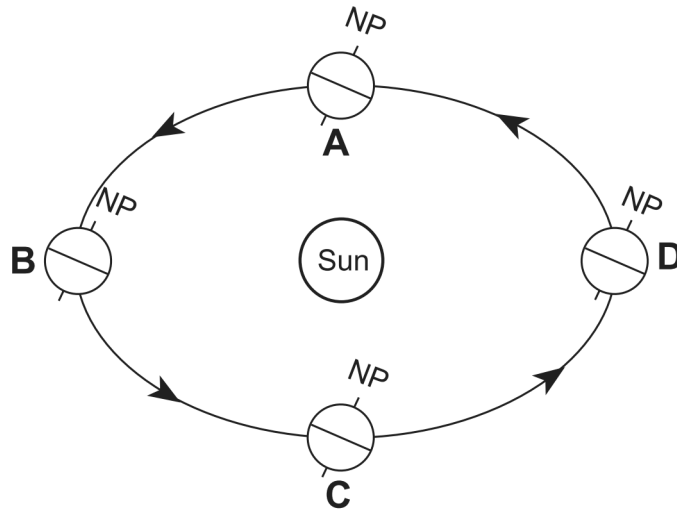
29. On the diagram below, draw a line representing the apparent path of the Sun at location *B* on August 21.



30. How many hours of daylight are seen by the observer at location *C* on June 21?

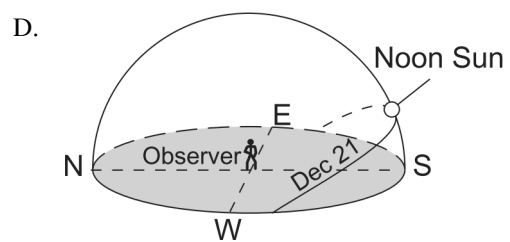
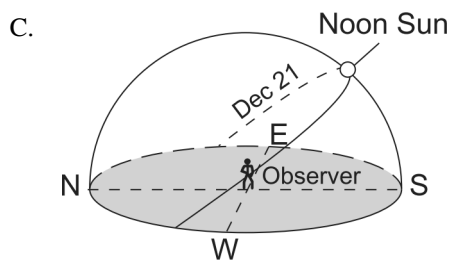
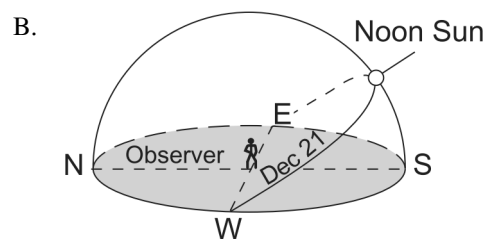
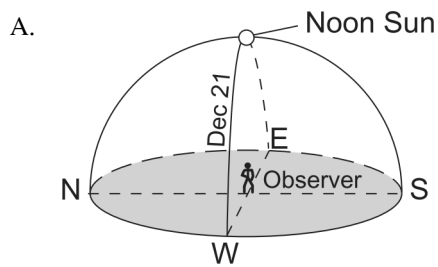


31. Base your answer(s) to the following question(s) on the diagram below, which represents Earth revolving around the Sun. Letters *A*, *B*, *C*, and *D* represent Earth's location in its orbit on the first day of the four seasons. NP represents the North Pole.

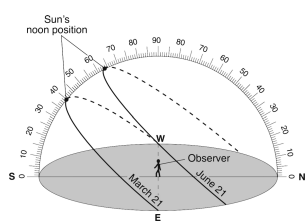


(Not drawn to scale)

Which diagram best represents the Sun's apparent path as seen by an observer at  $43.5^\circ$  N latitude on December 21?



32. Base your answer(s) to the following question(s) on the diagram and data table below. The diagram represents the Sun's apparent paths as viewed by an observer located at  $50^{\circ}$  N 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.

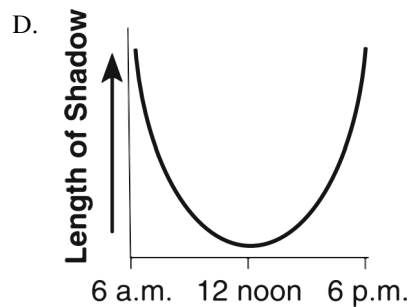
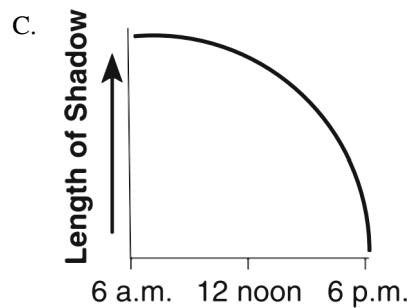
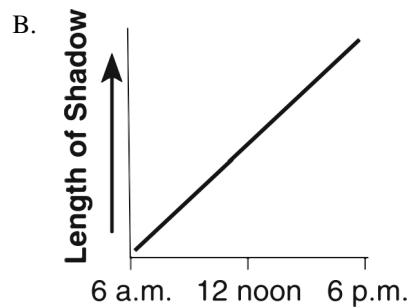
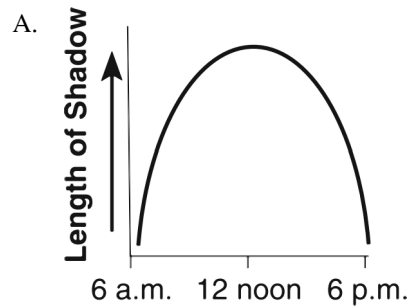


Data Table	
Date	Sun's Maximum Altitude
June 21	$63.5^{\circ}$
March 21	$40^{\circ}$
December 21	

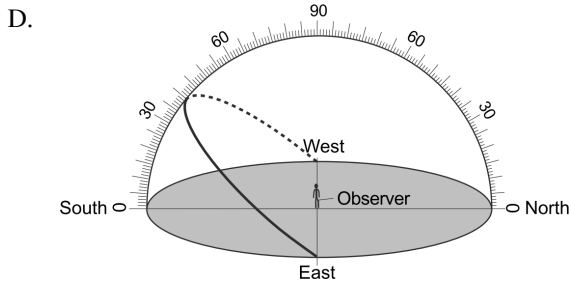
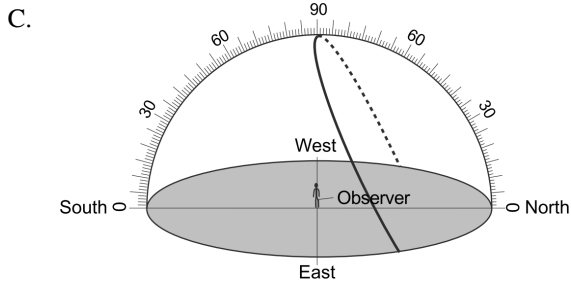
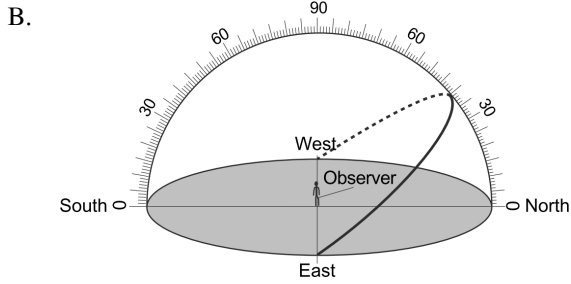
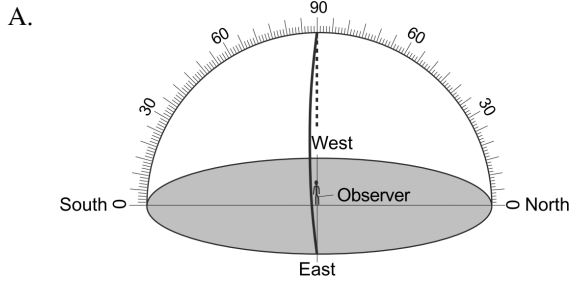
Which value should be placed in the data table for the Sun's maximum altitude on December 21?

- A.  $16.5^{\circ}$    B.  $23.5^{\circ}$    C.  $40^{\circ}$    D.  $90^{\circ}$

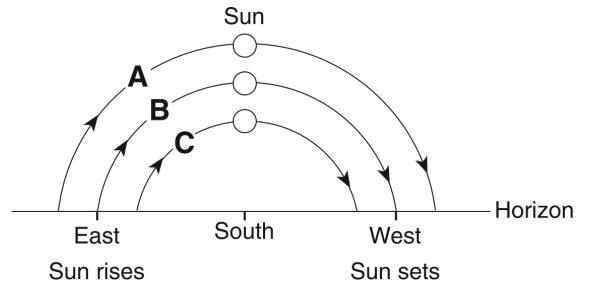
33. Which graph best represents the relationship between the time of day and the length of a shadow cast by the observer on March 21?



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



35. The diagram below represents the horizon and the Sun's apparent paths, A, B, and C, on three different dates, as viewed from the same location in New York State.



Which table correctly shows the dates on which the apparent paths of the Sun were observed?

A.

Path of Sun	Date
A	December 21
B	September 23
C	March 21

B.

Path of Sun	Date
A	December 21
B	March 21
C	June 21

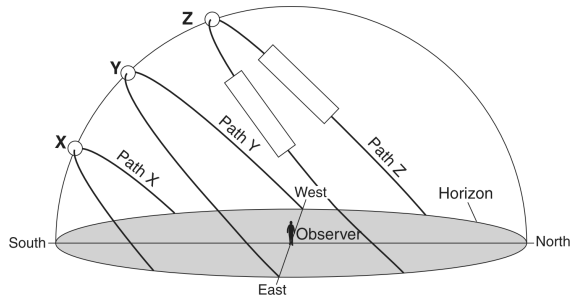
C.

Path of Sun	Date
A	March 21
B	September 23
C	June 21

D.

Path of Sun	Date
A	June 21
B	March 21
C	December 21

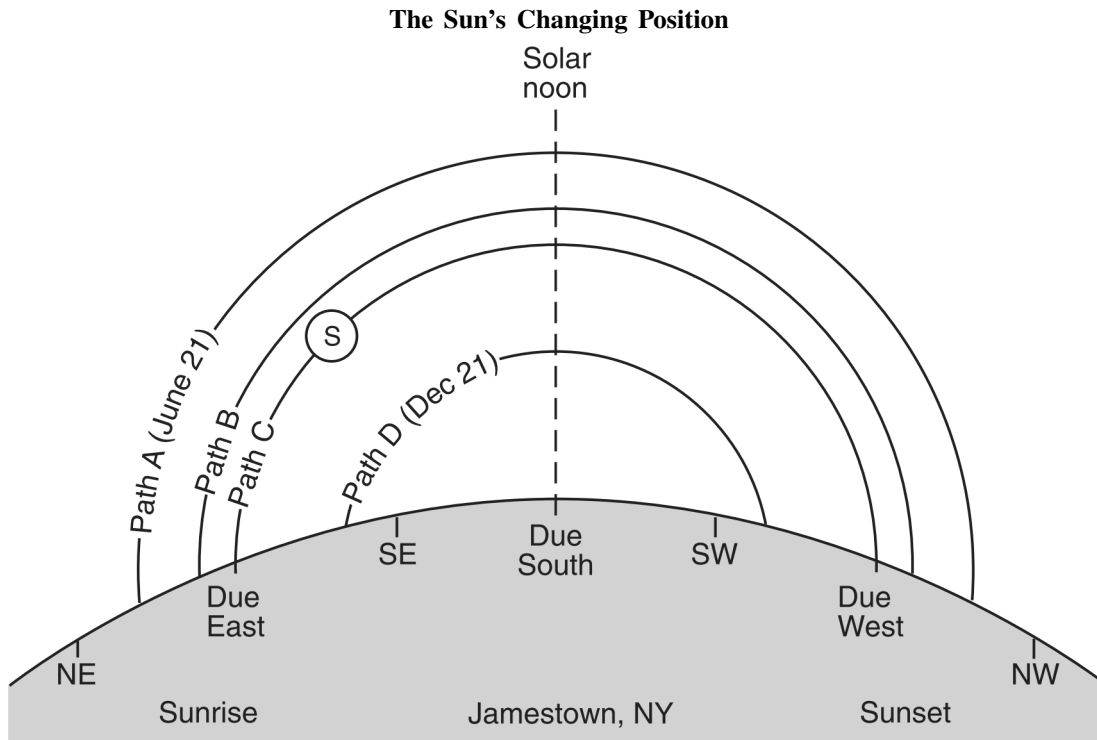
36. Base your answer(s) to the following question(s) on the diagram below and on your knowledge of Earth science. The diagram represents the Sun's apparent path on the equinoxes and the longest and shortest days of the year for a location in New York State. Points X, Y, and Z represent the solar noon positions along daily Sun paths X, Y, and Z.



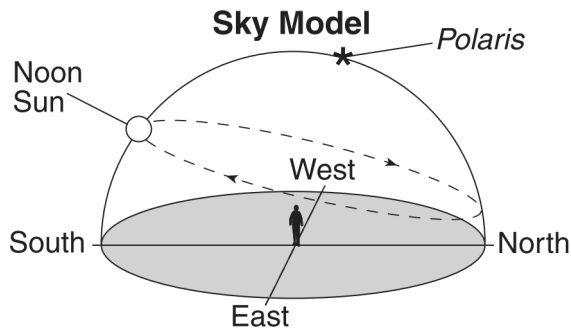
On the diagram above, draw *one* arrow in *each* box on path Z to indicate the Sun's apparent direction of movement along path Z.

37. State *one* possible date of the year represented by *each* apparent path of the Sun.
38. State the rate, in degrees per hour, that the Sun appears to travel along path X from sunrise to sunset.

Base your answer(s) to the following question(s) on the diagram below and on your knowledge of Earth science. The diagram represents four apparent paths of the Sun, labeled *A*, *B*, *C*, and *D*, observed in Jamestown, New York. The June 21 and December 21 sunrise and sunset positions are indicated. Letter *S* identifies the Sun's position on path *C* at a specific time of day. Compass directions are indicated along the horizon.

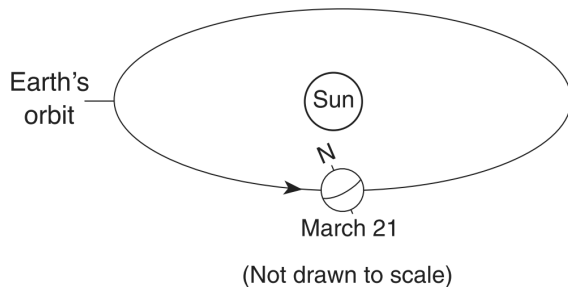


39. The greatest duration of insolation in Jamestown occurs when the Sun appears to travel along path
- A. *A*      B. *B*      C. *C*      D. *D*
40. Base your answer(s) to the following question(s) on the sky model below and on your knowledge of Earth science. The model shows the Sun's apparent path through the sky as seen by an observer in the Northern Hemisphere on June 21.



Describe the evidence, shown in the sky model, which indicates that the observer is *not* located at the North Pole.

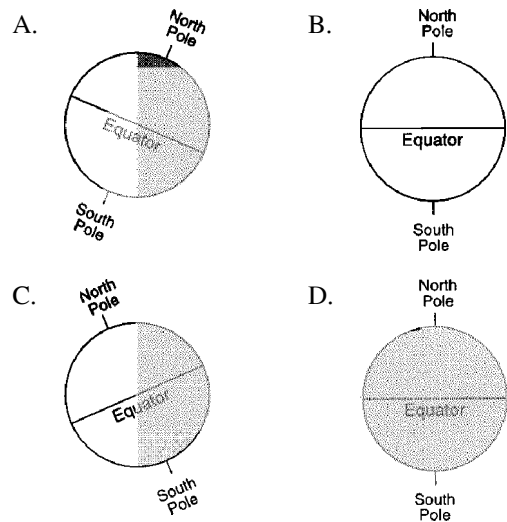
41. The diagram below represents the position of Earth in its orbit on March 21. Place an **X** on Earth's orbit to represent Earth's orbital position when the apparent path of the Sun in the sky model was observed.



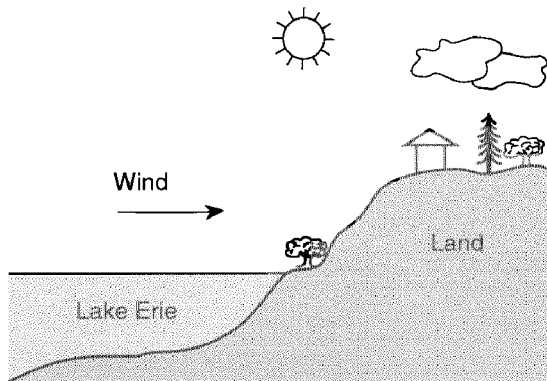
42. Identify the cause of the apparent daily motion of the Sun through the sky.
43. An object that is a good absorber of electromagnetic energy is most likely a good
- A. convector                      B. reflector
- C. radiator                         D. refractor

44. The hottest climates on Earth are located near the Equator because this region
- A. is usually closest to the Sun
- B. reflects the greatest amount of insolation
- C. receives the most hours of daylight
- D. receives the most nearly perpendicular insolation

45. The diagrams below represent Earth's tilt on its axis on four different dates. The shaded portion represents the nighttime side of the Earth. Which diagram best represents the day on which the longest duration of insolation occurs in New York State?



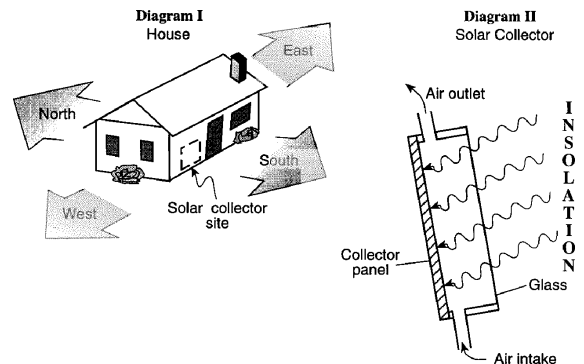
46. Base your answer(s) to the following question(s) on the *Earth Science Reference Tables*, the diagram below, and your knowledge of Earth science. The diagram represents a cross section of the shoreline of Lake Erie.



Which characteristics of the land surface have the greatest effect on the amount of insolation the land surface absorbs?

- A. hardness and age
- B. density and hardness
- C. age and roughness
- D. roughness and color

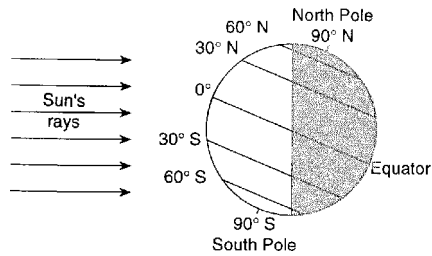
47. Base your answer(s) to the following question(s) on the *Earth Science Reference Tables*, the diagrams below, and your knowledge of Earth science. Diagram I shows a house located in New York State. Diagram II shows a solar collector that the homeowner is using to help heat the house.



The homeowner decides to install carpet on the floor in the room that receives the most sunlight. A carpet with which characteristics would absorb the most insulation?

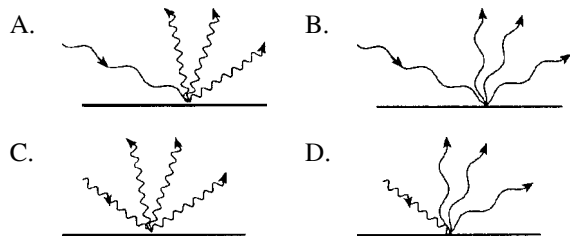
- A. smooth texture and light color
  - B. smooth texture and dark color
  - C. rough texture and light color
  - D. rough texture and dark color
48. At which latitude and on which date does the surface of Earth receive the greatest intensity of insolation?
- A. the Tropic of Cancer ( $23\frac{1}{2}^{\circ}$  N) on December 21
  - B. the Equator ( $0^{\circ}$ ) on September 23
  - C. the Antarctic Circle ( $66\frac{1}{2}^{\circ}$  S) on June 21
  - D. the South Pole ( $90^{\circ}$  S) on March 21
49. Insolation is often converted into potential energy by
- A. evaporation of water from the oceans
  - B. formation of fog in a valley
  - C. freezing of water droplets on a highway
  - D. precipitation of rain from a thunderstorm

50. The diagram below shows Earth as viewed from space on December 21.



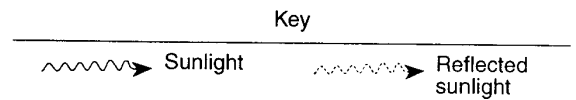
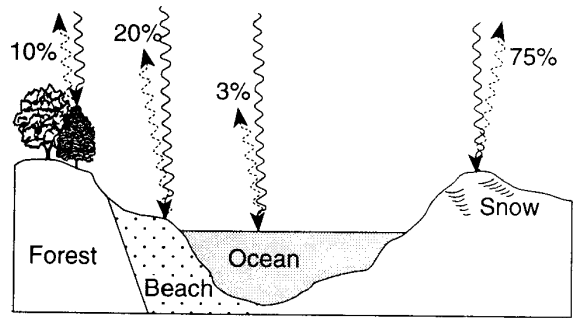
The longest duration of insolation on December 21 will occur at

- A. 90° N B. 30° N C. 30° S D. 90° S
51. How do the rates of warming and cooling of land surfaces compare to the rates of warming and cooling of ocean surfaces?
- A. Land surfaces warm faster and cool more slowly.  
 B. Land surfaces warm more slowly and cool faster.  
 C. Land surfaces warm faster and cool faster.  
 D. Land surfaces warm more slowly and cool more slowly.
52. Which diagram best represents the wavelength of most of the sunlight energy absorbed and the wavelength of infrared energy reradiated by the roof of a building at 2 pm on a clear summer day?



53. Most of the energy radiated by Earth's surface at night is in the form of
- A. infrared rays B. ultraviolet rays  
 C. radiation D. insolation

54. The accompanying diagram shows the percentage of sunlight reflected by different Earth surfaces when the Sun is directly overhead.

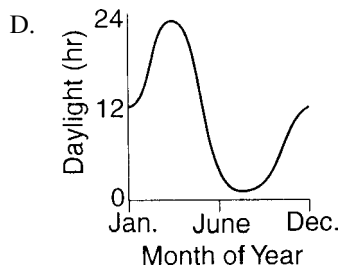
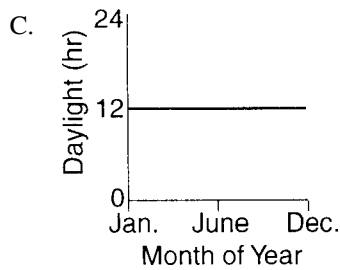
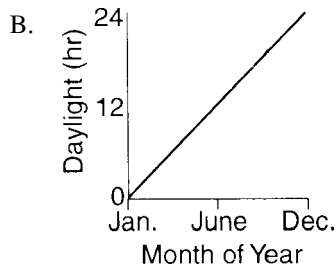
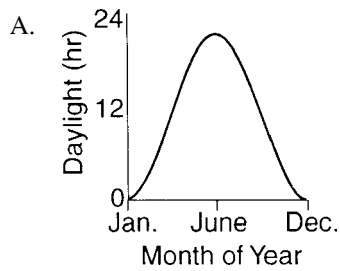


What material reflects the *least* sunlight?

- A. forest B. beach C. ocean D. snow
55. If equal areas are compared, which Earth surface would normally absorb the least electromagnetic energy from the Sun?
- A. basaltic lava flow  
 B. shallow lake bottom  
 C. snow-covered field  
 D. plowed field



56. Which graph best represents the duration of insolation during the year at the Equator.



57. Which statement best explains why the angle of insolation received at any Earth location changes in a cyclic pattern throughout the year?

- A. The Sun's orbit around Earth is an ellipse.
- B. Earth's orbit around the Sun is an ellipse.
- C. The Sun rotates on a tilted axis while revolving around Earth.
- D. Earth rotates on a tilted axis while revolving around the Sun.

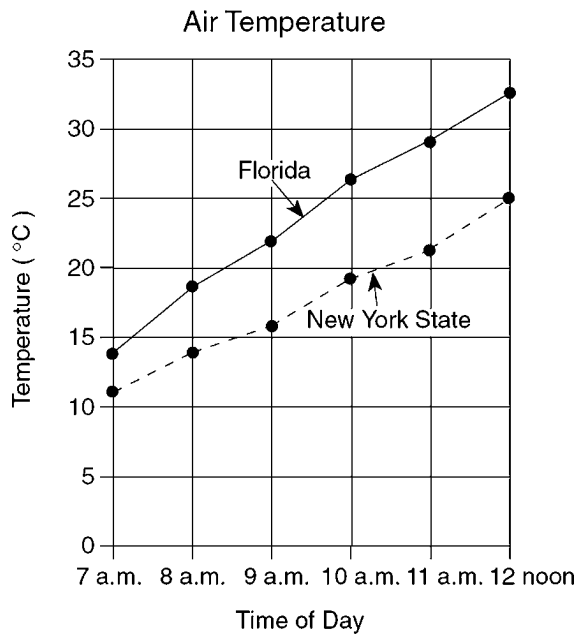
58. The data table below compares the percentage of sunlight reflected from various types of Earth surfaces.

Surface	Percent of Sunlight Reflected
Fresh snow	80–85
Old snow	50–60
Sand	20–30
Grass	20–25
Dry soil	15–25
Wet soil	10
Forest	5–10
Water (Sun at sunset)	50–80
Water (Sun overhead)	3–5
Thick cloud	70–80
Thin cloud	25–50

Which statement is best supported by the table?

- A. Light-colored surfaces reflect more sunlight than dark-colored surfaces.
- B. Rough surfaces reflect more sunlight than smooth surfaces.
- C. Soil surfaces reflect more sunlight than cloud surfaces.
- D. Vegetative surfaces reflect more sunlight than ice surfaces.

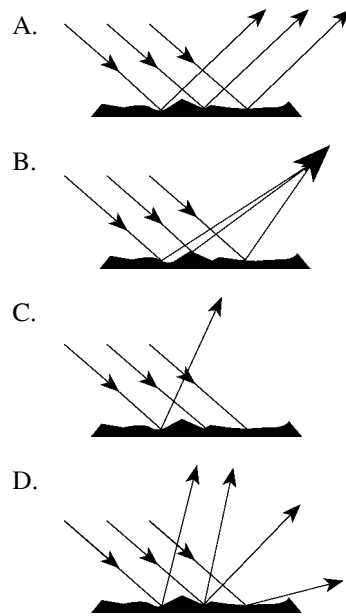
59. The accompanying graph shows air temperatures on a clear summer day from 7 am to 12 noon at two locations, one in Florida and one in New York State.



Air temperature rose slightly faster in Florida than in New York State because Florida

- A. has a lower angle of insolation
- B. has a higher angle of insolation
- C. is closer to the Prime Meridian
- D. is farther from the Prime Meridian

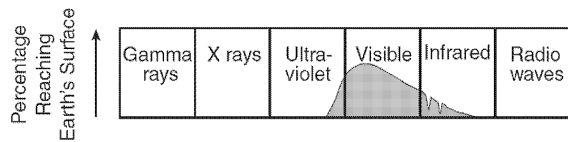
60. Which diagram best represents visible light rays after striking a dark, rough surface?



61. Which characteristics of a building material would provide the most energy-absorbing exterior covering for a house?

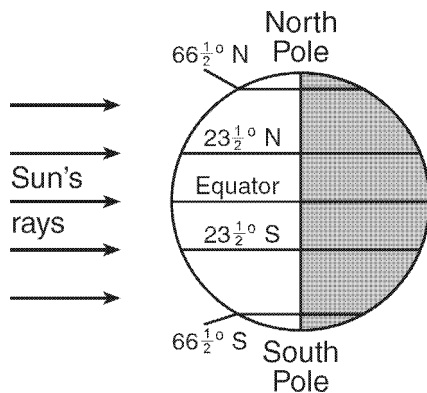
- A. dark colored and smooth textured
- B. dark colored and rough textured
- C. light colored and smooth textured
- D. light colored and rough textured

62. The accompanying diagram shows the types of electromagnetic energy given off by the Sun. The shaded part of the diagram shows the approximate amount of each type actually reaching Earth's surface.



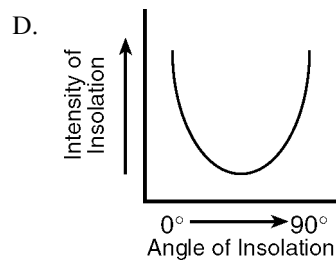
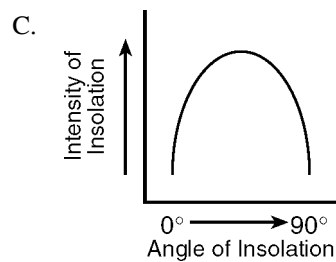
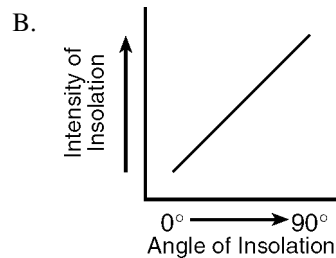
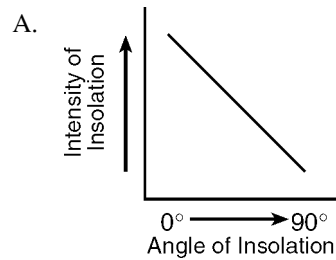
Which conclusion is best supported by the diagram?

- A. All types of electromagnetic energy reach Earth's surface.
- B. Gamma rays and x rays make up the greatest amount of electromagnetic energy reaching Earth's surface.
- C. Visible light makes up the greatest amount of electromagnetic energy reaching Earth's surface.
- D. Ultraviolet and infrared radiation make up the greatest amount of electromagnetic energy reaching Earth's surface.
63. The diagram below represents Earth at a specific position in its orbit as viewed from space. The shaded area represents nighttime. Which Earth latitude receives the greatest intensity of insolation when Earth is at the position shown in the diagram?



- A.  $0^\circ$                       B.  $23\frac{1}{2}^\circ$  N
- C.  $66\frac{1}{2}^\circ$  N                D.  $90^\circ$  N

64. Which graph best represents the relationship between the angle of insolation and the intensity of insolation?



65. The table below shows the duration of insolation (hours of daylight) measured by four observers, W, X, Y, and Z, at four different Earth latitudes on both March 21 and June 21. There were clear skies at all four latitudes on both days.

Observer	Duration of Insolation March 21	Duration of Insolation June 21
W	12 hr	0 hr
X	12 hr	12 hr
Y	12 hr	18 hr
Z	12 hr	24 hr

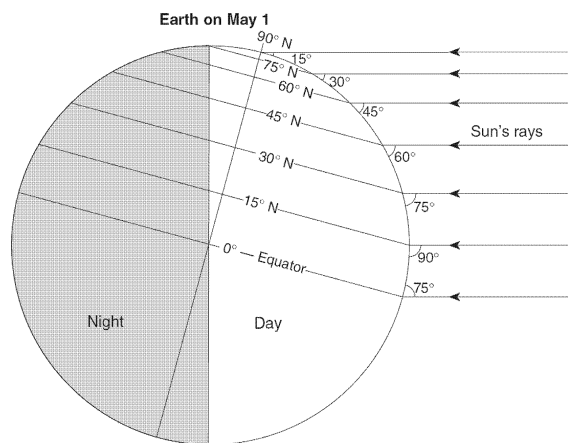
Which observer was located at the Equator?

- A. W      B. X      C. Y      D. Z

66. A square meter of surface of which of these natural areas would most likely absorb the most insolation during a clear day?

- A. a fast-moving river
- B. a dark-green forest
- C. a beach with white sand
- D. a snow-covered field

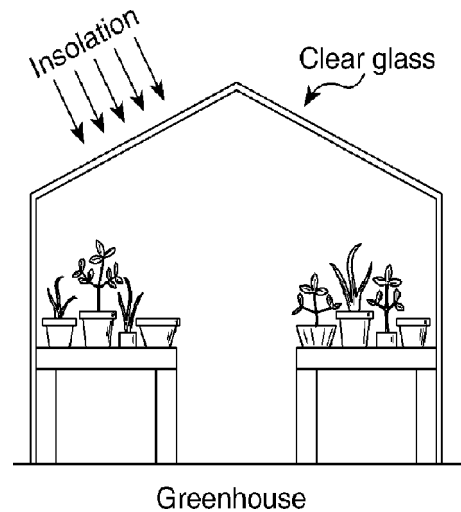
67. Base your answer(s) to the following question(s) on the diagram below, which shows the angle of the Sun's noontime rays received at different Earth latitudes on May 1.



Which changes can be expected to occur at 45° N over the next 30 days?

- A. The duration of insolation will decrease and the temperature will decrease.
- B. The duration of insolation will decrease and the temperature will increase.
- C. The duration of insolation will increase and the temperature will decrease.
- D. The duration of insolation will increase and the temperature will increase.

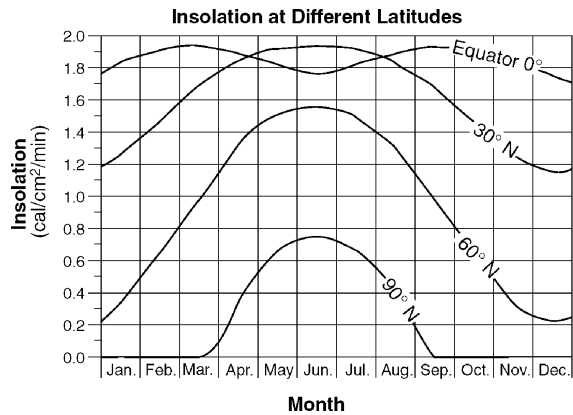
68. The diagram below shows a greenhouse.



What is the primary function of the clear glass of the greenhouse?

- A. The glass reduces the amount of insolation entering the greenhouse.
  - B. The glass allows all wavelengths of radiation to enter and all wavelengths of radiation to escape.
  - C. The glass allows short wavelengths of radiation to enter, but reduces the amount of longwavelength radiation that escapes.
  - D. The glass allows long wavelengths of radiation to enter, but reduces the amount of shortwavelength radiation that escapes.
69. On which day of the year would the intensity of insolation at Kingston, New York, most likely be greatest?
- A. March 21
  - B. June 21
  - C. September 23
  - D. December 21
70. The coldest climates on Earth are located at or near the poles primarily because Earth's polar regions
- A. receive mostly low-angle insolation
  - B. receive less total yearly hours of daylight
  - C. absorb the greatest amount of insolation
  - D. are usually farthest from the Sun

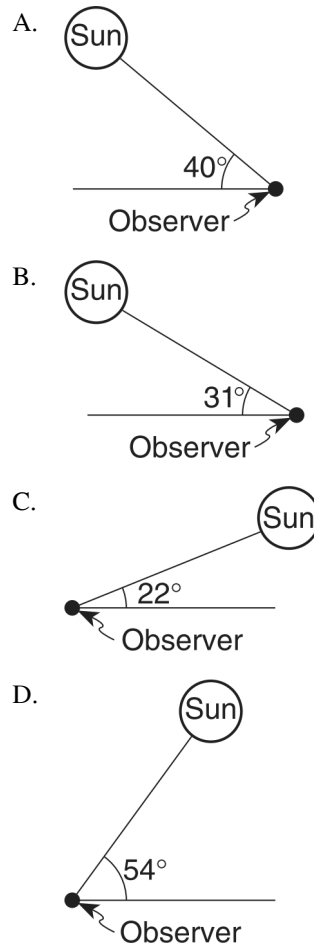
71. Base your answer(s) to the following question(s) on the graph below, which shows the amount of insolation during one year at four different latitudes on Earth's surface.



This graph shows that insolation varies with

- A. latitude and time of day
  - B. latitude and time of year
  - C. longitude and time of day
  - D. longitude and time of year
72. Why is less insolation received at the equator in June than in March or September?
- A. The daylight period is longest at the equator in June.
  - B. Winds blow insolation away from the equator in June.
  - C. The Sun's vertical rays are north of the equator in June.
  - D. Thick clouds block the Sun's vertical rays at the equator in June.
73. Why is insolation 0 cal/cm<sup>2</sup>/min from October through February at 90° N?
- A. Snowfields reflect sunlight during that time.
  - B. Dust in the atmosphere blocks sunlight during that time.
  - C. The Sun is continually below the horizon during that time.
  - D. Intense cold prevents insolation from being absorbed during that time.

74. In which diagram is the observer experiencing the greatest intensity of insolation?

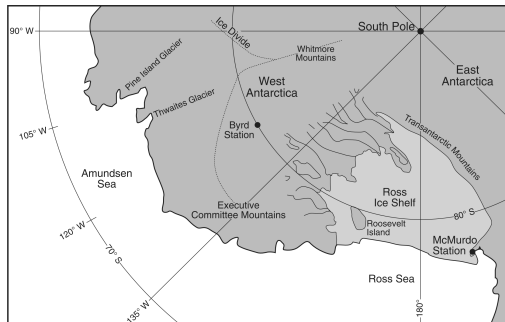


75. Base your answer(s) to the following question(s) on the passage and map below. The map shows a portion of the continent of Antarctica.

### Antarctica's Ice Sheet

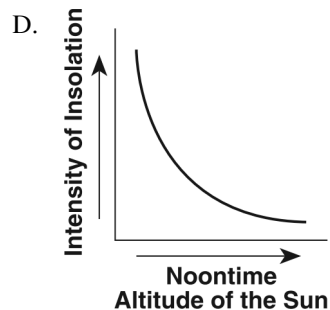
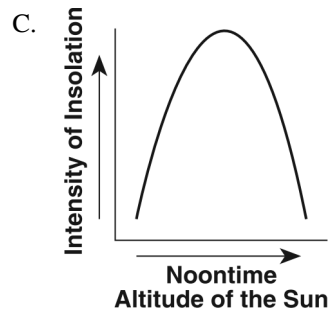
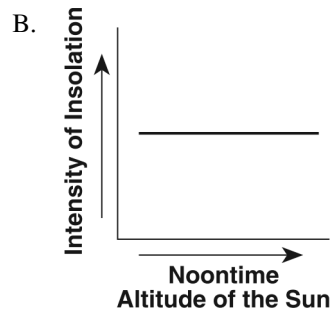
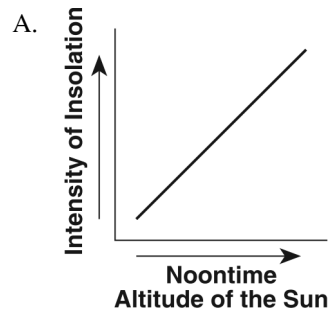
The size and shape of the West Antarctic Ice Sheet depends on many factors, including melting and freezing beneath the glacier, the amount of snowfall, snow removal by wind, iceberg formation, and the rate of ice flow. Glacial moraines are found in the Executive Committee Mountains shown on the map. Moraines are located up to 100 meters in elevation above the present ice sheet surface, which indicates that a thicker ice sheet existed 20,000 years ago.

The world's oceans and climate are influenced by Antarctica's ice. Even a small increase in sea level from melting glaciers would be a disaster for the nearly two billion people who live near coastal areas.



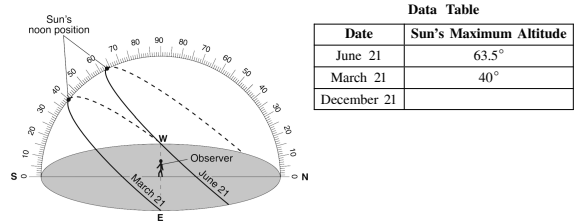
What is the duration of insolation on December 21 at McMurdo Station?

76. Which graph best shows the general relationship between the altitude of the noontime Sun and the intensity of insolation received at a location?



77. In New York State, summer is warmer than winter because in summer New York State has
- A. fewer hours of daylight and receives low angle insolation
  - B. fewer hours of daylight and receives high angle insolation
  - C. more hours of daylight and receives low angle insolation
  - D. more hours of daylight and receives high angle insolation

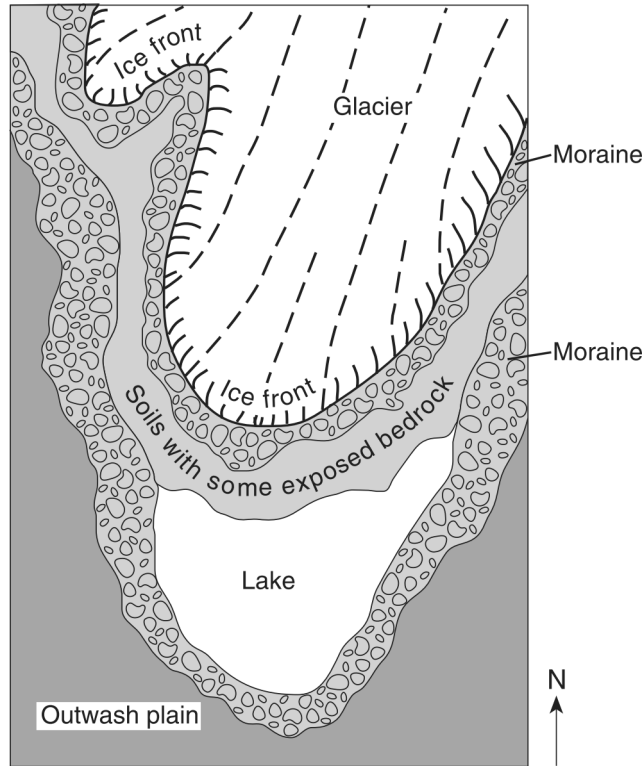
78. Base your answer(s) to the following question(s) on the diagram and data table below. The diagram represents the Sun's apparent paths as viewed by an observer located at  $50^{\circ}$  N latitude on June 21 and March 21. The data table shows the Sun's maximum altitude for the same two dates of the year. The Sun's maximum altitude for December 21 has been left blank.



Which statement best compares the intensity and angle of insolation at noon on March 21 and June 21?

- A. The intensity and angle of insolation are greatest on March 21.
- B. The intensity and angle of insolation are greatest on June 21.
- C. The intensity of insolation is greatest on June 21 and the angle of insolation is greatest on March 21.
- D. The intensity of insolation is greatest on March 21 and the angle of insolation is greatest on June 21.

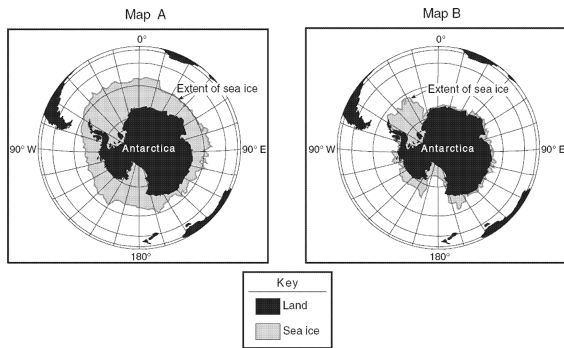
Base your answer(s) to the following question(s) on the map below and on your knowledge of Earth science. The map shows a retreating valley glacier and the features that have formed because of the advance and retreat of the glacier.





79. Explain why the glacial ice absorbs *less* solar radiation than the surrounding exposed bedrock and soil.

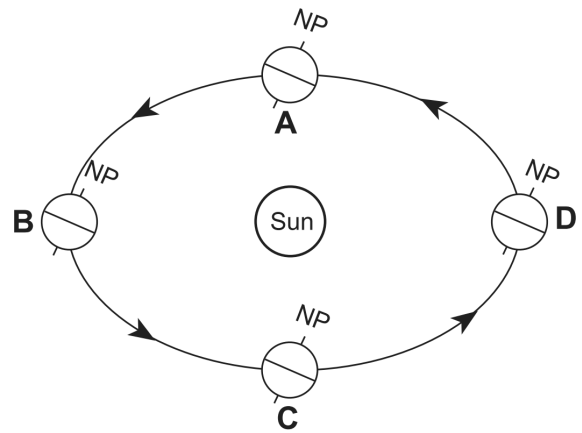
80. The accompanying maps show the amount of sea ice surrounding the continent of Antarctica at two different times of the year. Map A represents late August when the area covered by sea ice approaches its greatest extent. Map B represents the minimum extent of sea ice.



Which month is most probably represented by map B?

- A. February
- B. May
- C. June
- D. October

81. Base your answer(s) to the following question(s) on the diagram below, which represents 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. NP represents the North Pole.



(Not drawn to scale)

Which location in Earth's orbit represents the first day of summer in New York State?

- A. A
- B. B
- C. C
- D. D

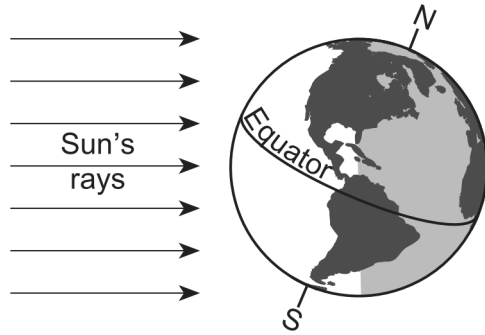
82. If the tilt of Earth's axis were decreased from 23.5° to 15°, New York State's winters would become

- A. warmer, and summers would become cooler
- B. warmer, and summers would become warmer
- C. cooler, and summers would become cooler
- D. cooler, and summers would become warmer

83. To an observer in New York State, the duration of daylight increases continuously from

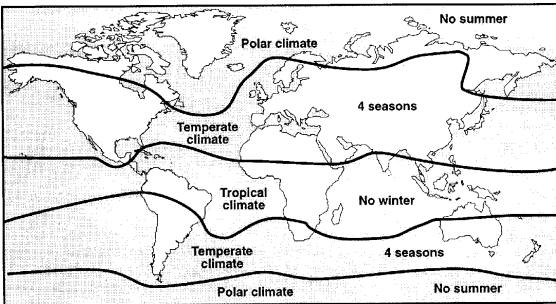
- A. March 1 to May 1
- B. June 1 to August 1
- C. September 1 to November 1
- D. December 1 to February 1

84. The diagram below represents Earth in space on the first day of a season.



Which season is beginning in New York State on the day represented in the diagram?

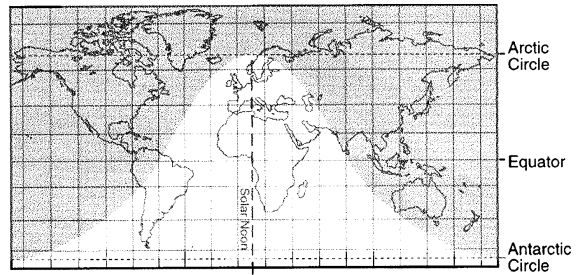
- A. winter                      B. spring  
C. summer                      D. fall
85. The map below shows the major climate zones on Earth



The primary factor controlling these climate zones is

- A. elevation                      B. solar time  
C. latitude                      D. longitude
86. Locations in New York State are warmest in summer because sunlight in summer is
- A. least intense and of shortest duration  
B. least intense and of longest duration  
C. most intense and of shortest duration  
D. most intense and of longest duration

87. The shaded portion of the accompanying map indicates areas of night and the unshaded portion indicates areas of daylight.



What day of the year is best represented by the map?

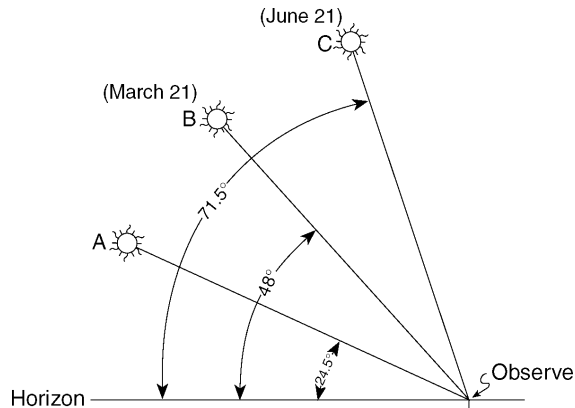
- A. March 21                      B. June 21  
C. September 21                      D. December 21
88. The accompanying data table shows the altitude of Polaris as recorded by four observers at different locations on Earth.

Observer	Altitude of Polaris
A	90°
B	30°
C	30°
D	20°

Which statement is best supported by the information in the table?

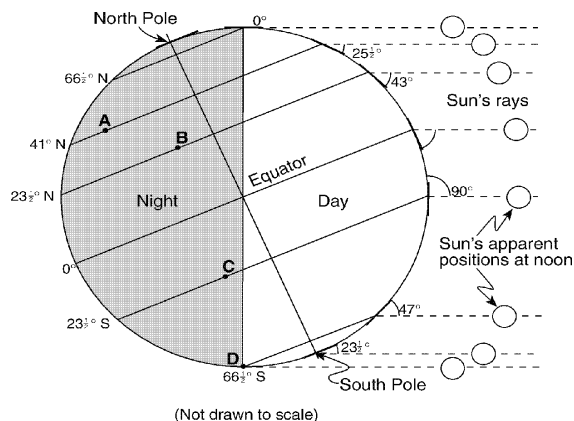
- A. Observer A was at the Equator.  
B. Observers A and B measured the altitude during daytime hours.  
C. Observers B and C measured the altitude at the same latitude.  
D. Observers B, C, and D were in the Southern Hemisphere.

89. Base your answer(s) to the following question(s) on the diagram below, which shows the altitude of the Sun at solar noon on certain dates. The positions of the Sun, labeled A, B, and C, were measured by an observer at  $42^\circ$  north latitude. The date when the Sun was observed at position A has been deliberately left blank.



Which season begins in New York State when the noontime Sun is observed at position A?

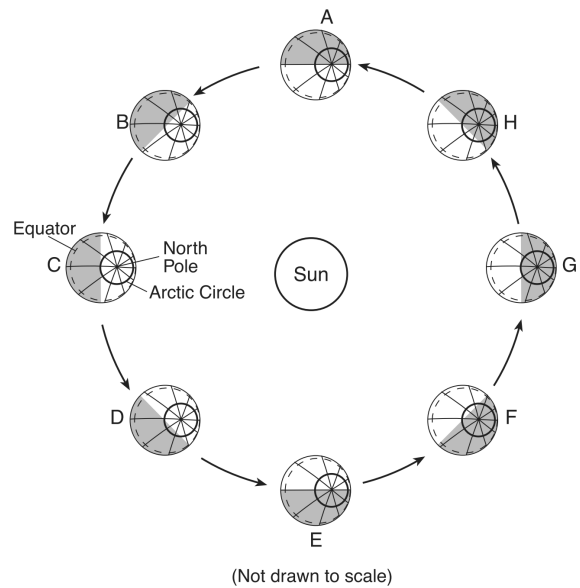
90. Position B represents the Sun's position at solar noon on March 21. On what other date of the year would the noontime Sun be observed at position B?
91. Base your answer(s) to the following question(s) on the diagram below, which shows the altitude and apparent position of the noontime Sun, as seen from various latitudes on Earth on a particular day of the year. Letters A through D represent locations on Earth's surface.



Which season will begin at  $41^\circ$  N latitude, three months after the date represented by this diagram?

- A. summer                      B. fall  
C. winter                        D. spring

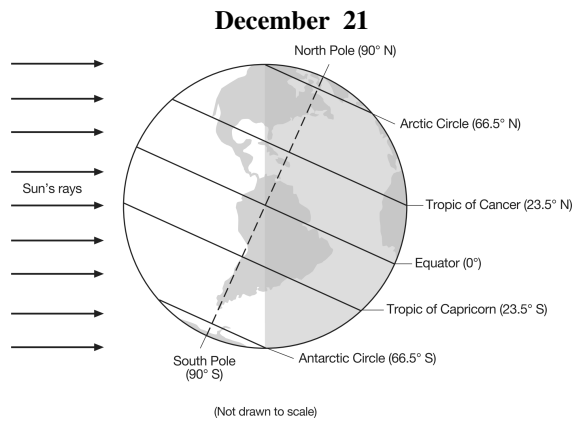
92. Base your answer(s) to the following question(s) on the diagram below, which shows Earth's orbit around the Sun as viewed from space. Earth is shown at eight different positions labeled A through H. Earth's North Pole, Arctic Circle, and equator have been labeled at position C. The arrows show the direction of orbital motion.



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

Season	Earth's position
spring	
summer	
fall	
winter	

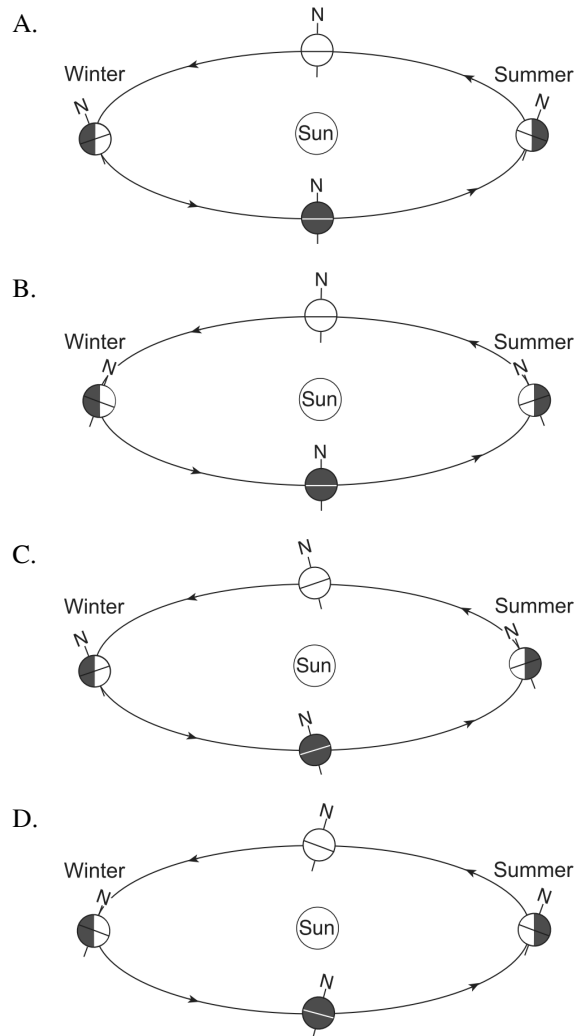
93. Base your answer(s) to the following question(s) on the diagram below which shows Earth as viewed from space on December 21. Some latitudes are labeled.



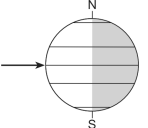
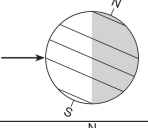
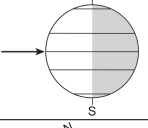
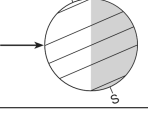
Place an X at a location on Earth's surface where the Sun was directly overhead at some time on December

94. State *one* factor, other than the tilt of Earth's axis, that causes seasons to change on Earth.
95. At which latitude is *Polaris* observed at an altitude of 66.5°?

96. Which diagram best represents the tilt of Earth's axis that causes the Northern Hemisphere seasons shown? (Diagrams are not drawn to scale.)



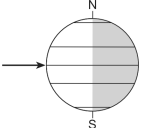
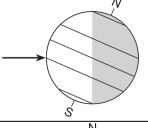
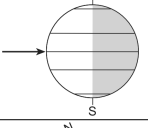
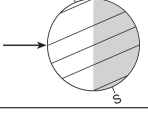
97. Base your answer(s) to the following question(s) on the table below and on your knowledge of Earth science. The table provides information about sunlight received on four dates of a certain year. Letter *A* represents a date. The arrows indicate the Sun's direct rays.

Date	Position of Earth Relative to the Sun's Rays	Seasonal Event
Sept 23		Fall equinox: Equal day and night Sun on the horizon at poles Direct ray at equator
Dec 21		Winter solstice: Area north of Arctic Circle in constant darkness
A		Spring equinox: Equal day and night Sun on the horizon at poles Direct ray at equator
June 21		Summer solstice: Area south of Antarctic Circle in constant darkness Direct ray at 23.5° N

Identify *one* possible date represented by letter *A*.

98. State the numerical latitude at which the Sun is directly overhead at noon on December 21. Include the units and compass direction in your answer.

99. Base your answer(s) to the following question(s) on the table below and on your knowledge of Earth science. The table provides information about sunlight received on four dates of a certain year. Letter *A* represents a date. The arrows indicate the Sun's direct rays.

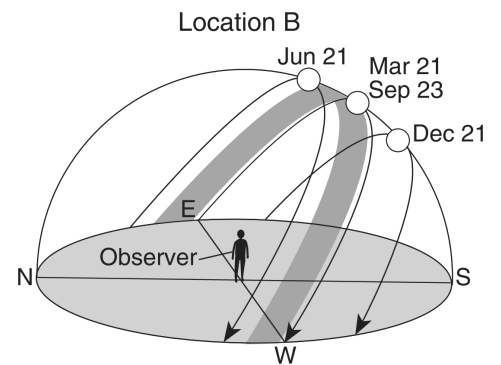
Date	Position of Earth Relative to the Sun's Rays	Seasonal Event
Sept 23		Fall equinox: Equal day and night Sun on the horizon at poles Direct ray at equator
Dec 21		Winter solstice: Area north of Arctic Circle in constant darkness
A		Spring equinox: Equal day and night Sun on the horizon at poles Direct ray at equator
June 21		Summer solstice: Area south of Antarctic Circle in constant darkness Direct ray at 23.5° N

State the number of daylight hours occurring north of the Arctic Circle on June 21.

100. Explain why the Sun's direct rays are at different latitudes as Earth revolves around the Sun.

1.  
Answer: B
2.  
Answer: D
3.  
Answer:
4.  
Answer: B
5.  
Answer: B
6.  
Answer: B
7.  
Answer: C
8.  
Answer: B
9.  
Answer:
10.  
Answer:
11.  
Answer:
12.  
Answer:
13.  
Answer:
14.  
Answer: D
15.  
Answer: B
16.  
Answer: Acceptable responses include, but are not limited to:  
 - The Sun is directly overhead at solar noon on March 21.  
 - The Sun reaches an altitude of  $90^\circ$  on an equinox.  
 - Each apparent path of the Sun has a daylight duration of 12 hours.
17.  
Answer: D

18.  
Answer: C
19.  
Answer: A
20.  
Answer: C
21.  
Answer: A
22.  
Answer: C
23.  
Answer: B
24.  
Answer: D
25.  
Answer: C
26.  
Answer: A
27.  
Answer: B
28.  
Answer: Acceptable responses include, but are not limited to:  
 - Location B represents an area where the Sun is above the southern horizon at solar noon.  
 - The Sun is in the southern portion of the sky.
29.  
Answer: Credit for a line drawn approximately parallel to the existing Sun's paths and within the shaded portion shown below.



30.  
Answer: Credit for 24 h.

31.  
Answer: D

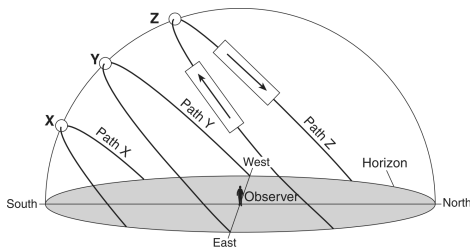
32.  
Answer: A

33.  
Answer: D

34.  
Answer: A

35.  
Answer: D

36.  
Answer:



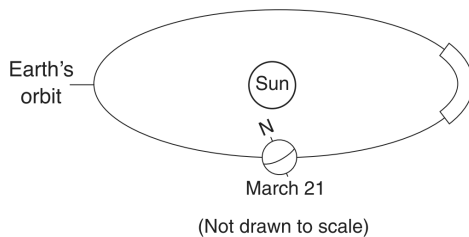
37.  
Answer: [answers vary] Ex: X: winter solstice, first day of winter, Dec. 20–22; Y: March 20–22, an equinox, first day of spring; Z: June 20–22, summer solstice, first day of summer

38.  
Answer: 15°/hour

39.  
Answer: A

40.  
Answer: Acceptable responses include, but are not limited to:  
– Polaris is not overhead.  
– All compass directions are shown.  
– The Sun's path is tilted.  
– At the North Pole, the altitude of Polaris is 90°.

41.  
Answer:



42.  
Answer: Acceptable responses include, but are not limited to: the rotation of Earth; Earth is spinning on its axis.

43.  
Answer: C

44.  
Answer: D

45.  
Answer: B

46.  
Answer: D

47.  
Answer: D

48.  
Answer: B

49.  
Answer: A

50.  
Answer: D

51.  
Answer: C

52.  
Answer: D

53.  
Answer: A

54.  
Answer: C

55.  
Answer: C

56.  
Answer: C

57.  
Answer: D

58.  
Answer: A

59.  
Answer: B

60.  
Answer: C

61.  
Answer: B

62.  
Answer: C

63.  
Answer: A

64.  
Answer: B

65.  
Answer: B
66.  
Answer: B
67.  
Answer: D
68.  
Answer: C
69.  
Answer: B
70.  
Answer: A
71.  
Answer: B
72.  
Answer: C
73.  
Answer: C
74.  
Answer: D
75.  
Answer: 24 hours
76.  
Answer: A
77.  
Answer: D
78.  
Answer: B
79.  
Answer: Acceptable responses include, but are not limited to:  
 – The ice is white/light colored.  
 – The smooth ice reflects better than rougher land terrain.  
 – The bedrock/soil is darker colored.  
 – Snow and ice reflect more insolation.  
 – has a higher albedo
80.  
Answer: A
81.  
Answer: B
82.  
Answer: A
83.  
Answer: A

84.  
Answer: A
85.  
Answer: C
86.  
Answer: D
87.  
Answer: D
88.  
Answer: C
89.  
Answer:
90.  
Answer:
91.  
Answer: D
92.  
Answer:

Season	Earth's position
spring	A
summer	C
fall	E
winter	G

93.  
Answer: The center of the X should be located closely to the Tropic of Capricorn ( $23.5^{\circ}$  S).
94.  
Answer:
  - parallelism of Earth's axis
  - The North Pole always points toward Polaris.
  - revolution of Earth
  - location of the Sun's vertical ray
  - duration/intensity of insolation
  - angle of insolation
95.  
Answer:
  - $66.5^{\circ}$  N or  $66\frac{1}{2}^{\circ}$  N or  $66^{\circ} 30' N$
  - at the Arctic Circle
96.  
Answer: C
97.  
Answer: March 19 or March 20 or March 21 or March 22
98.  
Answer: any value from  $23.4^{\circ}$  S to  $23.5^{\circ}$  S
99.  
Answer: 24 h



100.

Answer:

Earth's axis is tilted 23.5 degrees from a line perpendicular to the plane of Earth's orbit; axis is tilted; Earth's axis is always parallel to itself at any other place in Earth's orbit; parallelism of Earth's axis; Earth's axis is always aligned with the North Star (Polaris) as Earth orbits the Sun.