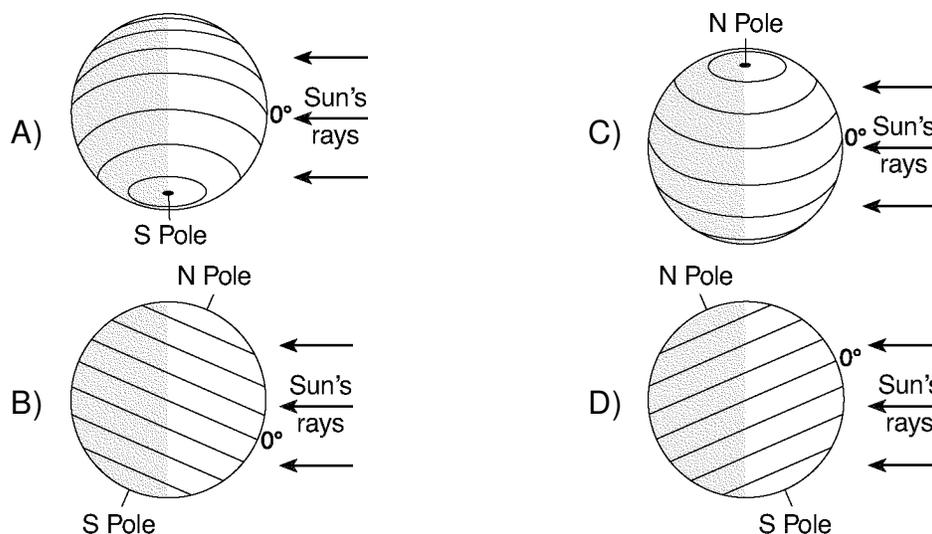
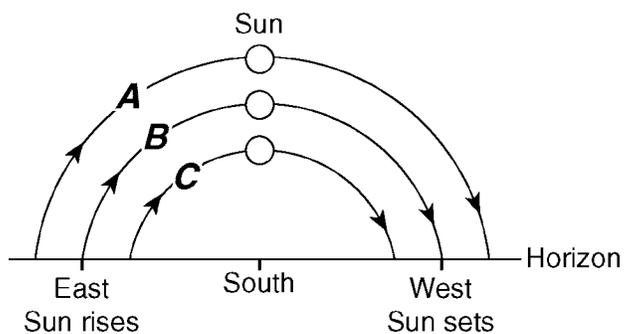


Name: _____

- 1) Which form of electromagnetic energy has the *longest* wavelength?
 - A) radio waves
 - B) ultraviolet rays
 - C) gamma rays
 - D) visible light
- 2) Most of the electromagnetic energy radiated from Earth's surface is in the form of
 - A) x-rays
 - B) gamma rays
 - C) ultraviolet rays
 - D) infrared rays
- 3) Energy is transferred from *Barnard's Star* to Earth mainly by
 - A) red shifts
 - B) conduction
 - C) electromagnetic waves
 - D) density currents
- 4) During which phase change will the *greatest* amount of energy be absorbed by 1 gram of water?
 - A) melting
 - B) evaporation
 - C) freezing
 - D) condensation
- 5) Which factor has the *greatest* influence on the number of daylight hours that a particular Earth surface location receives?
 - A) distance from the Sun
 - B) latitude
 - C) longitude
 - D) diameter of Earth
- 6) Which hot spot location on Earth's surface usually receives the greatest intensity of insolation on June 21?
 - A) Hawaii
 - B) Iceland
 - C) Yellowstone
 - D) Easter Island
- 7) To an observer in New York State the duration of daylight increases continuously from
 - A) September 1 to November 1
 - B) June 1 to August 1
 - C) March 1 to May 1
 - D) December 1 to February 1
- 8) Which diagram represents the tilt of Earth's axis relative to the Sun's rays on December 15?



- 9) 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
<i>A</i>	December 21
<i>B</i>	September 23
<i>C</i>	March 21

C)

Path of Sun	Date
<i>A</i>	March 21
<i>B</i>	September 23
<i>C</i>	June 21

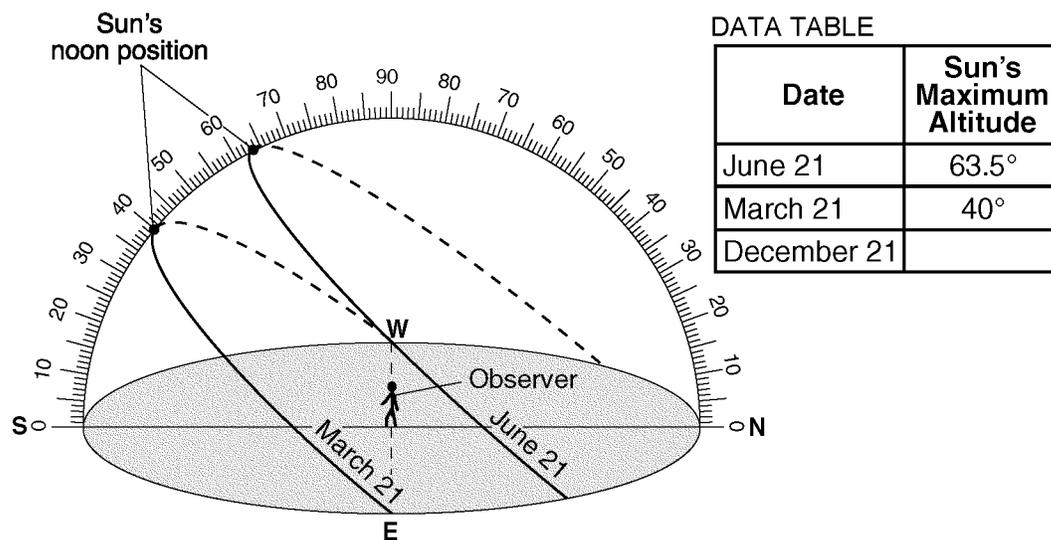
B)

Path of Sun	Date
<i>A</i>	June 21
<i>B</i>	March 21
<i>C</i>	December 21

D)

Path of Sun	Date
<i>A</i>	December 21
<i>B</i>	March 21
<i>C</i>	June 21

- 10) The diagram below represents the Sun's apparent paths as viewed by an observer located at 50°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.

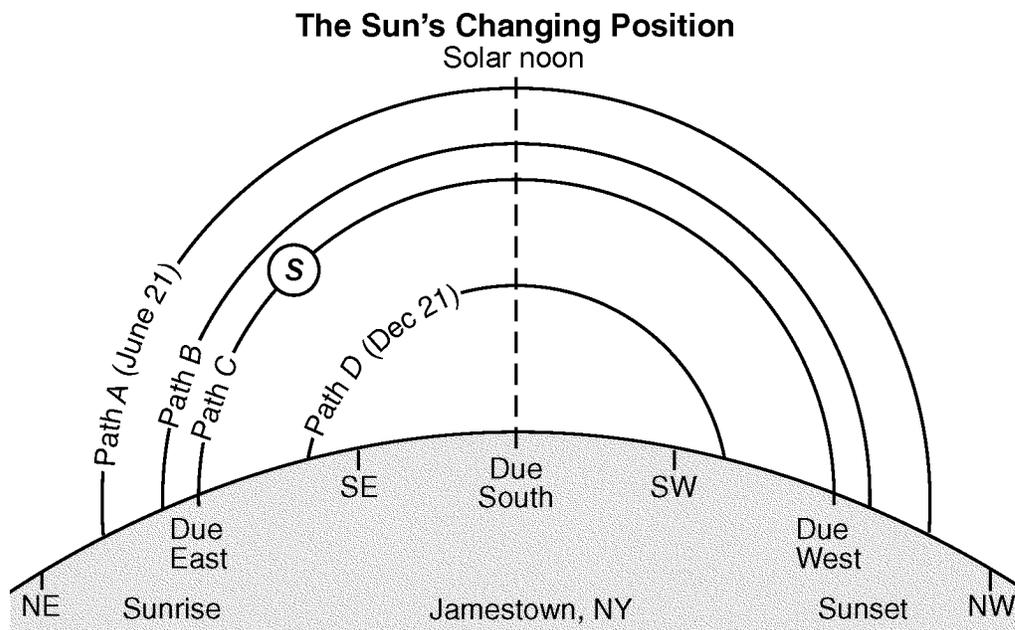


Which statement *best* compares the intensity and angle of insolation at noon on March 21 and June 21?

- A) The intensity and angle of insolation are greatest on June 21.
- B) The intensity and angle of insolation are greatest on March 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.

Questions 11 through 13 refer to the following:

The diagram below 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.



- 11) The *greatest* duration of insolation in Jamestown occurs when the Sun appears to travel along which path in the given diagram?

A) <i>A</i>	B) <i>B</i>	C) <i>C</i>	D) <i>D</i>
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- 12) At what time of day is the Sun at position *S* in the given diagram?

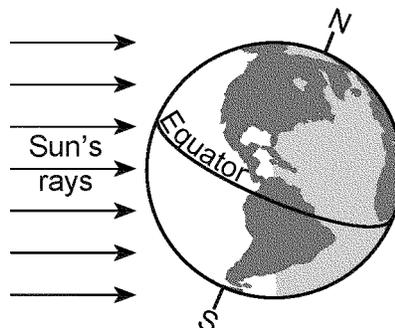
A) 6 a.m.	B) 6 p.m.	C) 9 a.m.	D) 3 p.m.
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- 13) When the Sun appears to travel along path *D* at Jamestown in the diagram shown, which latitude on Earth receives the most direct rays from the Sun?

A) 0°	C) 23.5° N
B) 42° N	D) 23.5° S
- 14) Which type of land surface will most likely absorb the *greatest* amount of incoming solar radiation?

A) rough, dark-colored surface	B) rough, light-colored surface
C) smooth, dark-colored surface	D) smooth, light-colored surface
- 15) A decrease in areas covered in snow and ice leads to an increase in the absorption of insolation because exposed land surfaces are

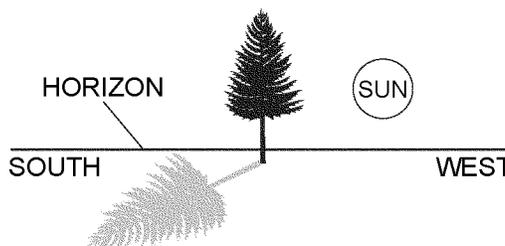
A) rougher and lighter	C) rougher and darker
B) smoother and lighter	D) smoother and darker

- 16) Seasonal changes on Earth are primarily caused by the
- elliptical shape of Earth's orbit around the Sun
 - tilt of Earth's axis as Earth revolves around the Sun
 - parallelism of the Sun's axis as the Sun revolves around Earth
 - changes in distance between Earth and the Sun
- 17) 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?

- fall
 - spring
 - summer
 - winter
- 18) A tree in New York State casts a shadow as shown in the diagram below.



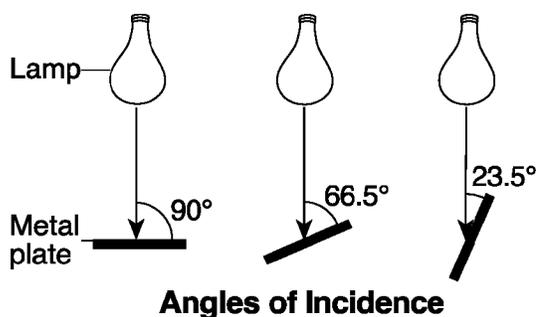
What time of day and season are represented by the diagram?

- late afternoon in winter
 - early morning in summer
 - late afternoon in summer
 - early morning in winter
- 19) Global warming is most likely occurring due to an increase in
- ultraviolet radiation and x-rays reflected from Earth
 - visible light and radio waves reflected from Earth
 - oxygen and nitrogen gases in the atmosphere
 - carbon dioxide and methane gases in the atmosphere
- 20) Two of the greenhouse gases that may be responsible for the increased ice melting in Greenland are
- hydrogen and helium
 - carbon dioxide and methane
 - nitrogen and oxygen
 - oxygen and silicon
- 21) An increase in which gas in Earth's atmosphere will most significantly increase global temperatures?
- hydrogen
 - nitrogen
 - methane
 - oxygen

- 22) Evidence supports the idea that increases in carbon dioxide and methane in Earth's atmosphere are major contributors to global warming. This is based primarily on the fact that carbon dioxide and methane are excellent absorbers of
- A) visible light
 B) infrared radiation
 C) gamma rays
 D) microwaves

Questions 23 through 25 refer to the following:

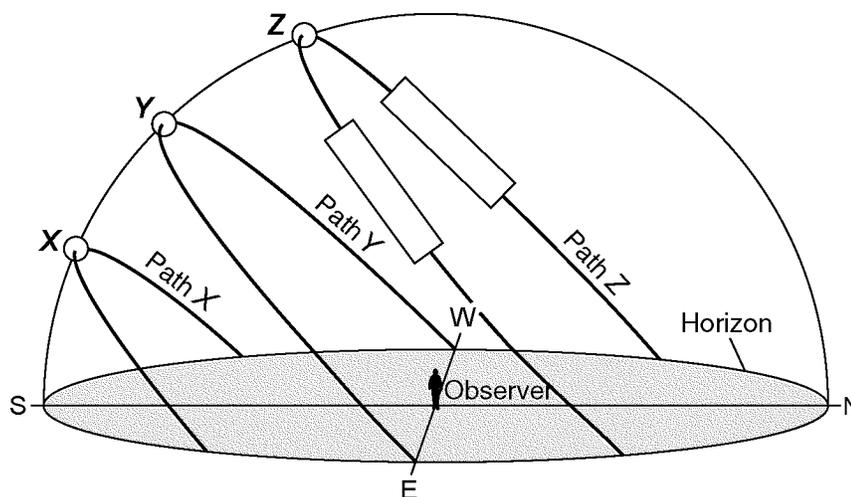
A student was interested in how the angle of insolation affects absorption of radiation. The student took three black metal plates, each containing a built-in thermometer, and placed them at the same distance from three identical lamps. The plates were tilted so that the light from the lamps created three different angles of incidence with the center of the plates, as shown in the diagram. The starting temperatures of the plates were recorded. The lamps were turned on for 10 minutes. Then the final temperatures were recorded.



- 23) Explain why the metal plate at a 90° angle of incidence had a final temperature *higher* than the other two plates in the given experiment.
- 24) How would the final temperatures of the three metal plates in the given experiment be different if the experiment was repeated using white metal plates? Explain why the white plates would have these final temperatures.
- 25) The metal plate at a 90° angle of incidence in the given experiment represents a location on Earth at solar noon on March 21. What is the latitude of this location?

Questions 26 through 28 refer to the following:

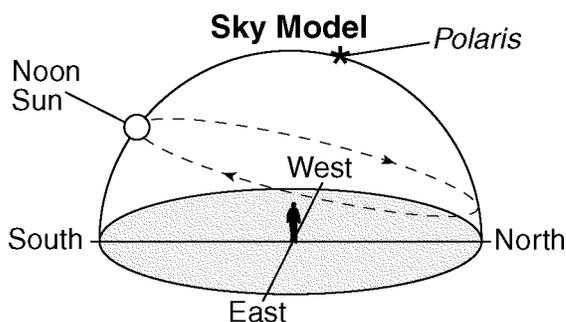
The diagram below represents the Sun's apparent path on the equinoxes and the longest and shortest days of the year for a location in New York State. Points X, Y, and Z represent the solar noon positions along daily Sun paths X, Y, and Z.



- 26) On the diagram provided, draw *one* arrow in *each* box on path Z to indicate the Sun's apparent direction of movement along path Z.
- 27) State *one* possible date of the year represented by *each* apparent path of the Sun shown in the diagram.
- 28) State the rate, in degrees per hour, that the Sun appears to travel along path X in the given diagram from sunrise to sunset.

Questions 29 and 30 refer to the following:

The sky model below shows the Sun's apparent path through the sky as seen by an observer in the Northern Hemisphere on June 21.

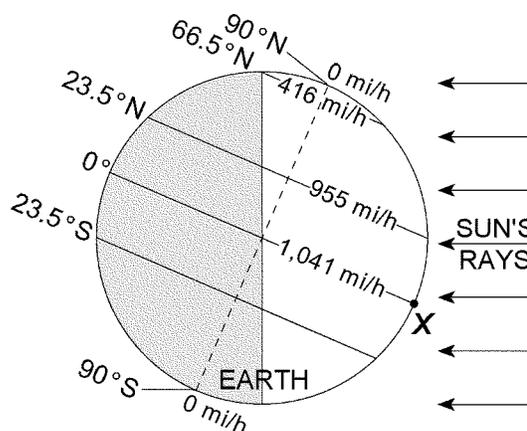


- 29) Describe the evidence, shown in the sky model, which indicates that the observer is *not* located at the North Pole.

- 30) The diagram shown represents the position of Earth in its orbit on March 21. On this diagram, 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.
- 31) State *one* factor, other than the tilt of Earth's axis, which causes seasons to change on Earth.

Questions 32 and 33 refer to the following:

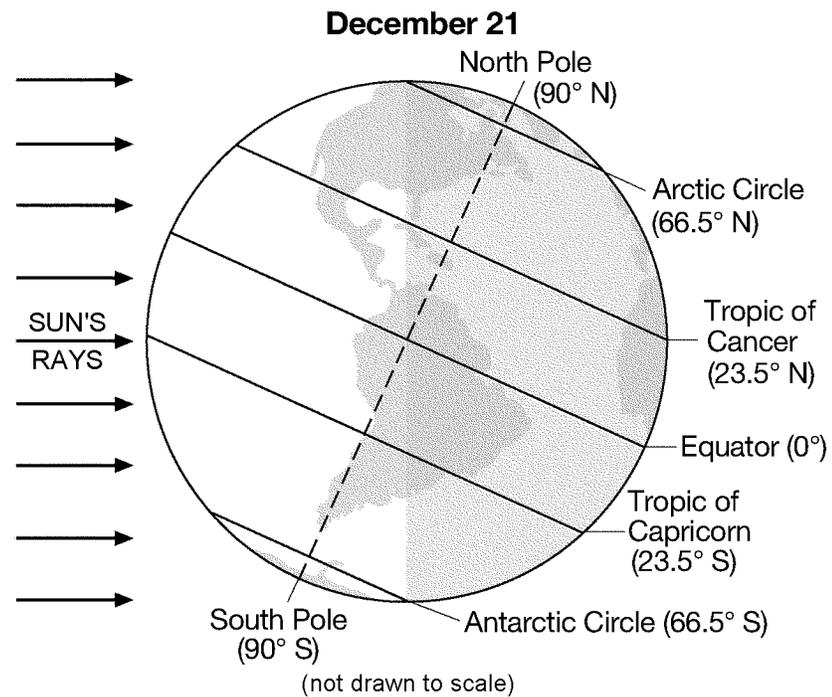
The diagram below represents daytime and nighttime on Earth. Point *X* is a location on Earth's surface. Earth's rotational surface velocity is shown in miles per hour (mi/h) at specific latitudes.



- 32) Record, to the nearest hour, the duration of insolation at location *X* on the given diagram for one Earth rotation.
- 33) Identify the Northern Hemisphere season that is just beginning when Earth is at the position represented in the given diagram.

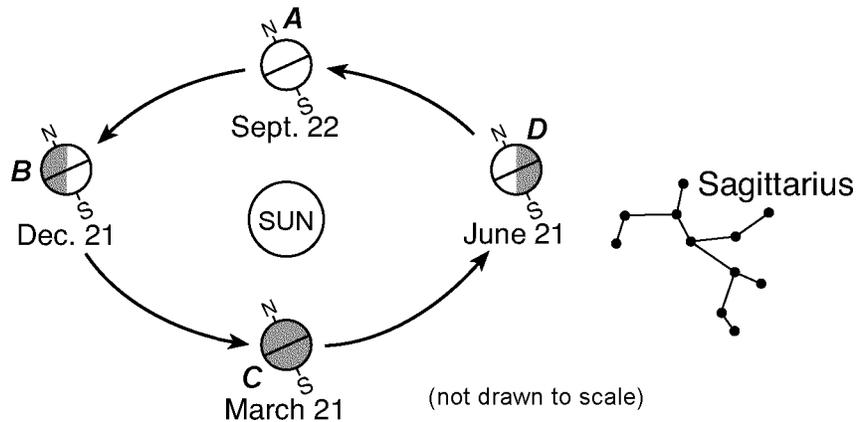
Questions 34 and 35 refer to the following:

The diagram below shows Earth as viewed from space on December 21. Some latitudes are labeled.



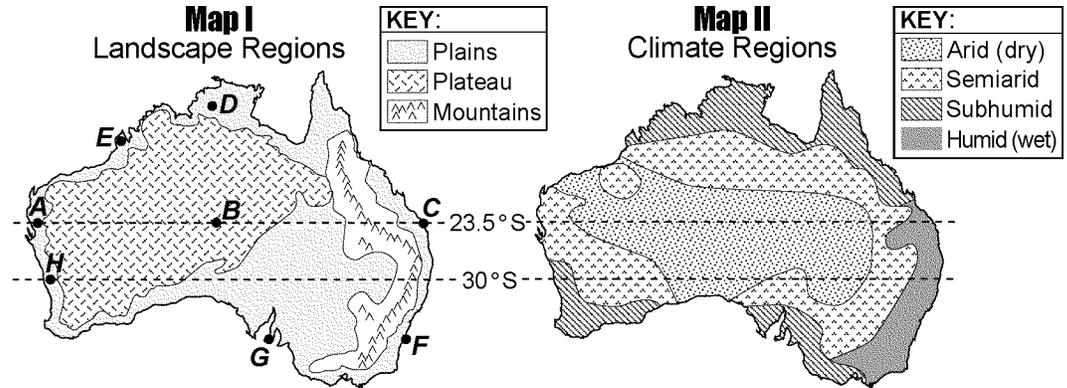
- 34) On the diagram provided, place an **X** at a location on Earth's surface where the Sun was directly overhead at some time on December 21.
- 35) At which latitude is *Polaris* observed at an altitude of 66.5D?

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



How many hours of daylight will an observer in New York State experience when Earth is at position *C* in the given diagram?

- 37) Two maps of Australia are shown below. Map *I* shows Australia's major landscape regions. Letters *A* through *H* represent locations in Australia. Map *II* shows Australia's general climate regions.



On which day will the noon Sun be directly overhead at location *C* on the given map?

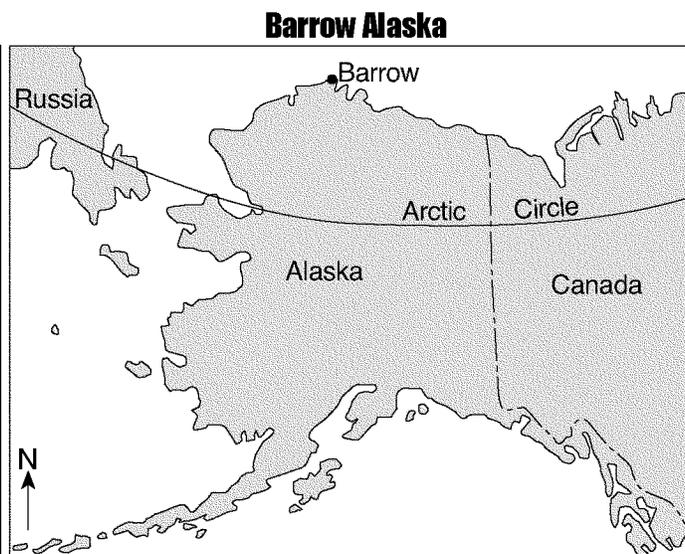
- A) December 21
 B) September 23
 C) June 21
 D) March 21

Questions 38 through 42 refer to the following:

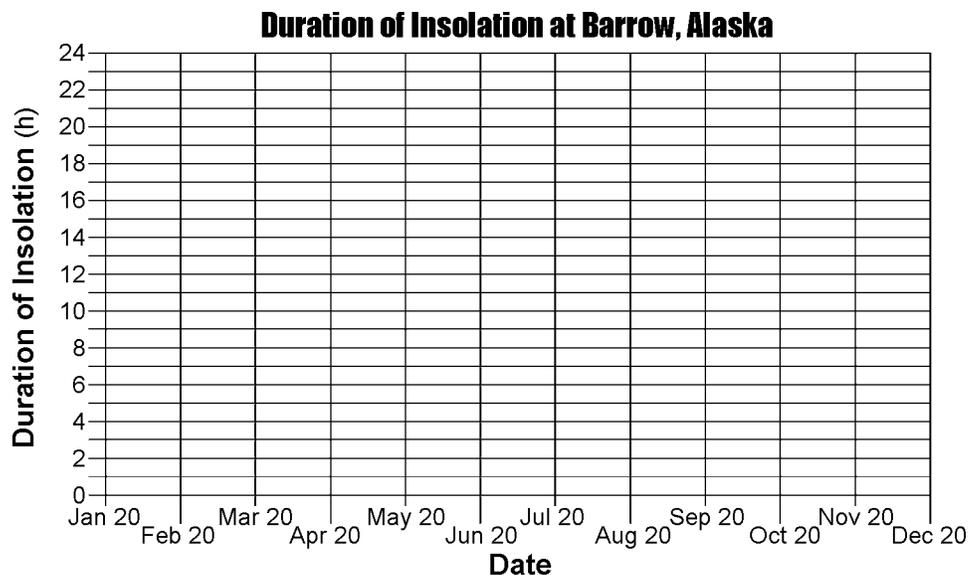
The table below shows the duration of insolation, in hours, at Barrow, Alaska, on the twentieth day of each month during 2008. The map below shows the location of Barrow at 71°DN 156.5°DW.

Duration of Insolation at Barrow Alaska

Date	Duration of Insolation (h)
Jan 20	0
Feb 20	7.8
Mar 20	12.5
Apr 20	17.6
May 20	24
June 20	24
July 20	24
Aug 20	16.7
Sept 20	12.6
Oct 20	7.8
Nov 20	0
Dec 20	0



- 38) On the grid below, construct a line graph by plotting the data for the duration of insolation at Barrow for each date shown on the data table. Connect the plots with a line.



- 39) Explain why Barrow, Alaska receives 0 hours of insolation on December 20.
- 40) State the altitude of *Polaris* as seen from Barrow, Alaska.

- 41) Explain why Barrow is in a different time zone than New York City.
- 42) On what date was the noontime Sun *highest* in the sky at Barrow, Alaska?

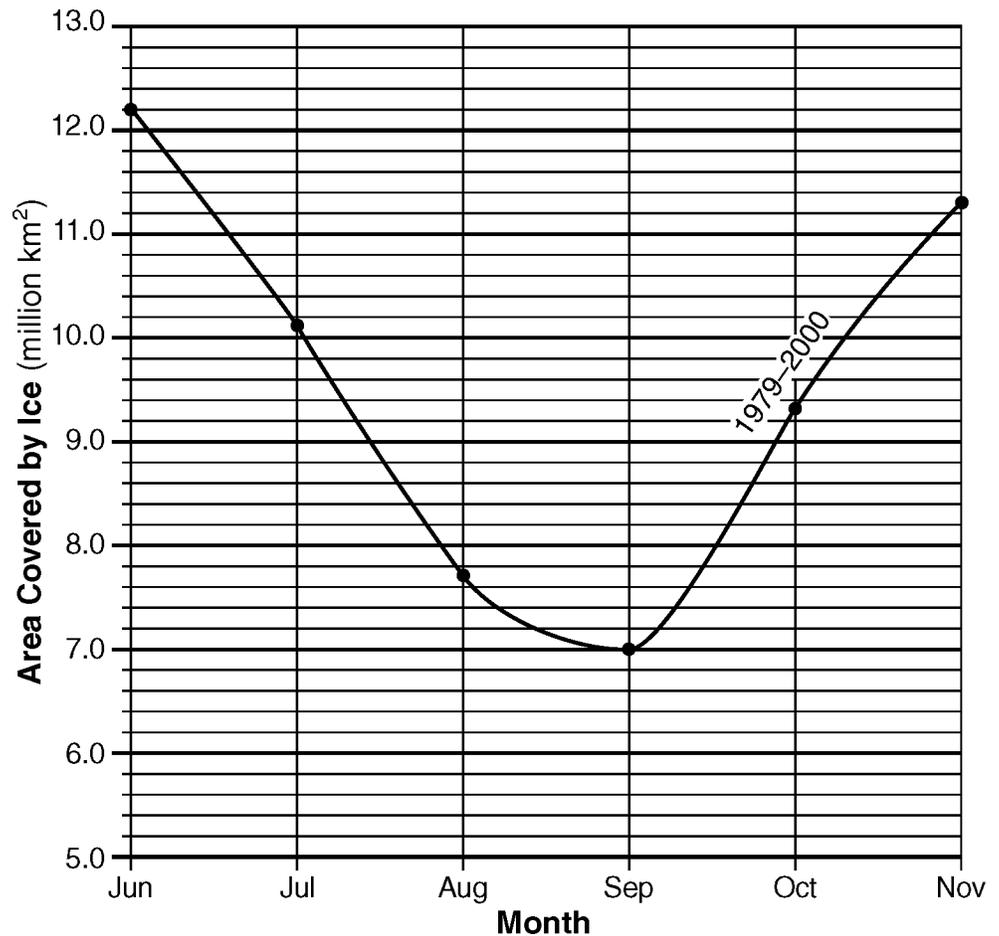
Questions 43 and 44 refer to the following:

The data table below shows the area, in million square kilometers, of the Arctic Ocean covered by ice from June through November. The average area covered by ice from 1979 to 2000 from June to November is compared to the area covered by ice in 2005 for the same time period.

DATA TABLE:

Month	Average Area Covered by Ice 1979–2000 (million km²)	Area Covered by Ice 2005 (million km²)
June	12.2	11.3
July	10.1	8.9
August	7.7	6.3
September	7.0	5.6
October	9.3	8.5
November	11.3	10.5

- 43) Use the information in the given data table to construct a line graph. On the grid provided, plot the data for the area covered by ice in 2005 for *each* month shown on the data table and connect the plots with a line. The average area covered by ice for 1979-2000 has been plotted and labeled on the grid.



- 44) Scientists have noted that since 2002, the area of the Arctic Ocean covered by ice during the warmer months listed in the table has shown an overall decrease from the long-term average (1979-2000). State *one* way in which this ice coverage since 2002 and the ice coverage shown in the 2005 data provide evidence of global warming, when compared to this long-term average.
- 45) Identify *one* greenhouse gas that is believed to cause global warming.
- 46) Identify *one* greenhouse gas, other than carbon dioxide, that contributes to global warming.

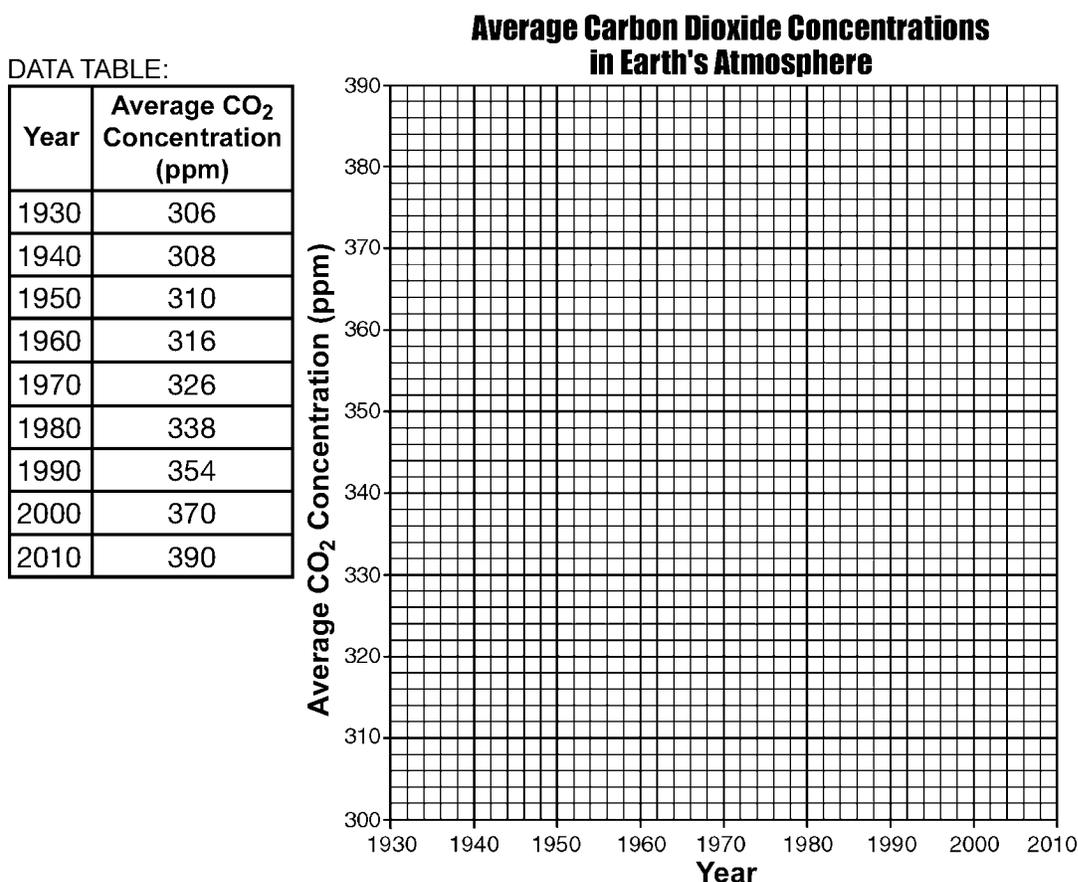
Questions 47 and 48 refer to the following:

Average temperatures on Earth are primarily the result of the total amount of insolation absorbed by Earth's surface and atmosphere compared to the amount of long-wave energy radiated back into space. Scientists believe that the addition of greenhouse gases into Earth's atmosphere gradually increases global temperatures.

- 47) Identify *one* major greenhouse gas that contributes to global warming.
- 48) Using the given information, explain how increasing the amount of greenhouse gases in Earth's atmosphere increases global temperatures.

Questions 49 and 50 refer to the following:

The data table below shows the average carbon dioxide (CO₂) concentrations in Earth's atmosphere for specific years from 1930 to 2010. Carbon dioxide is a greenhouse gas in Earth's atmosphere that contributes to global warming. The average carbon dioxide concentrations were measured in parts per million (ppm).



- 49) On the grid provided, construct a line graph by plotting the average carbon dioxide concentrations in Earth's atmosphere for each year shown on the data table. Connect the plots with a line.
- 50) Using the given information, calculate the rate of change from 2000 to 2010 of the average carbon dioxide concentrations, in parts per million per year.