Name Date Period

Chapter 4 Free Response

1)

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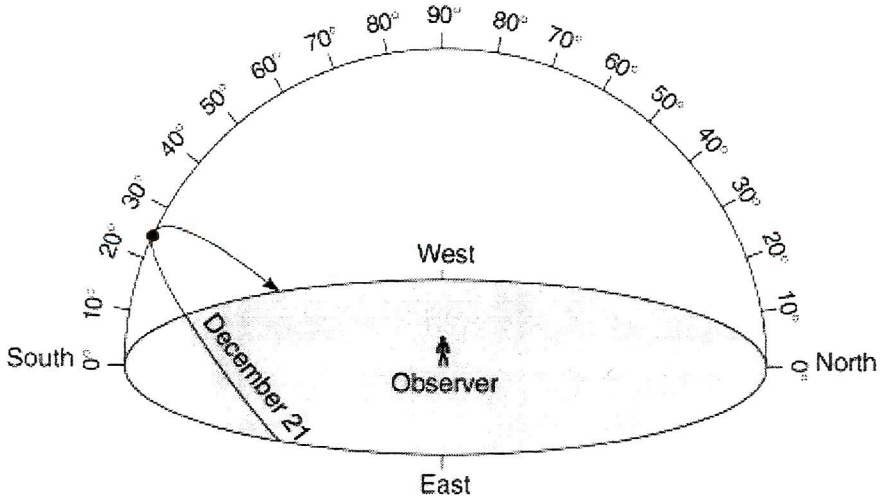

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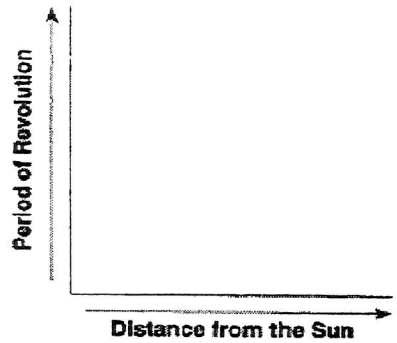

10)

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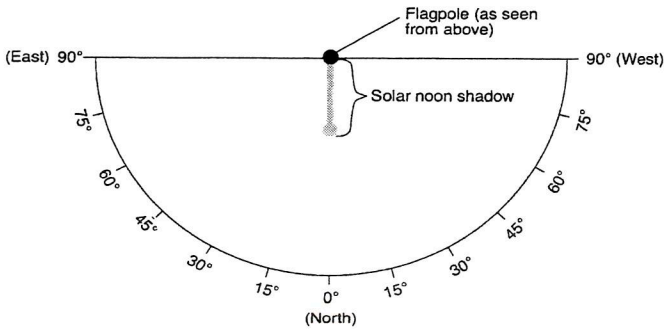
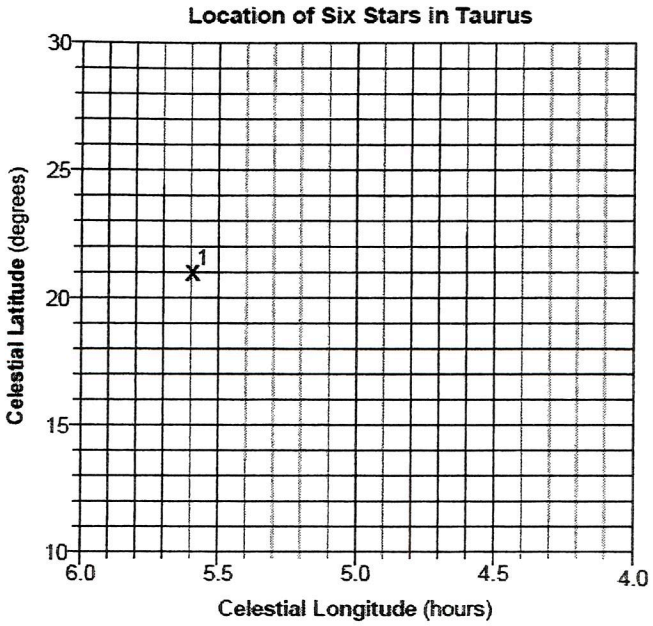


15)

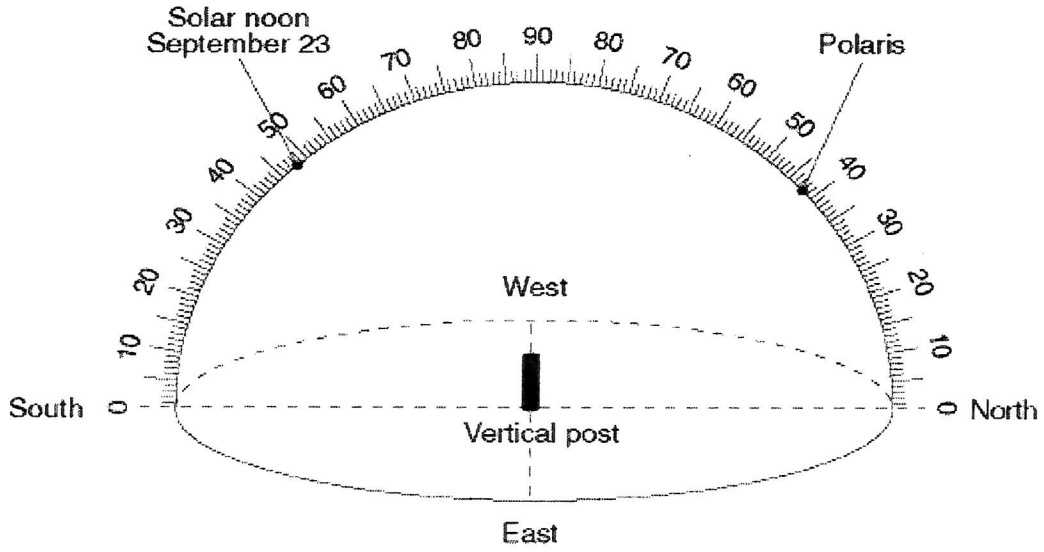


16) _____

17) _____

18) _____

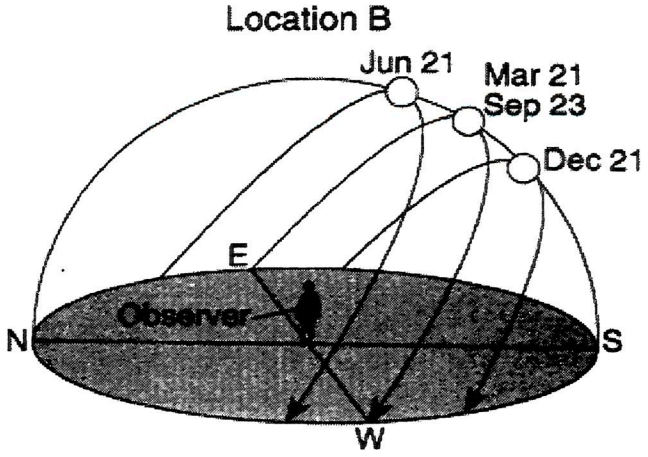
19, 21 and 22 on diagram



20) _____

23) _____

24)



25) _____ hours

26) _____

_____

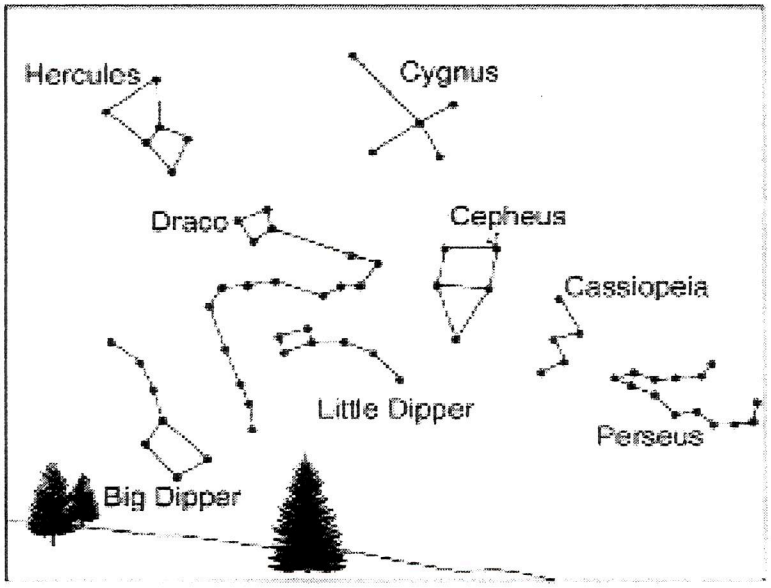
27) _____

_____

28) _____

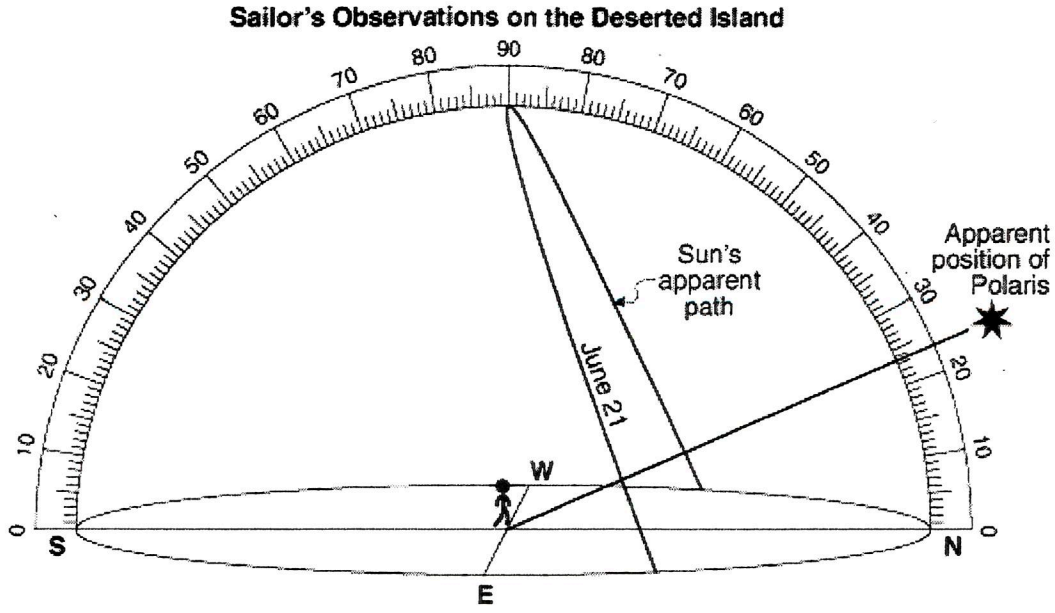
29)

Diagram 2 — 11:00 p.m.



30) _____

31 and 34 on diagram



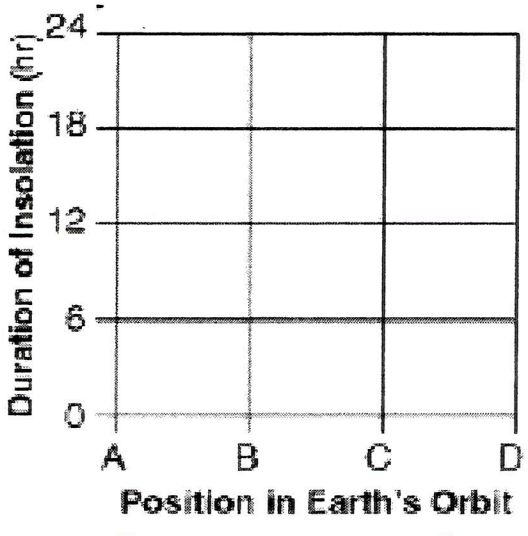
32) _____

33) _____

35) _____

36) _____

37)



38) _____

_____

_____

_____

39) _____ days

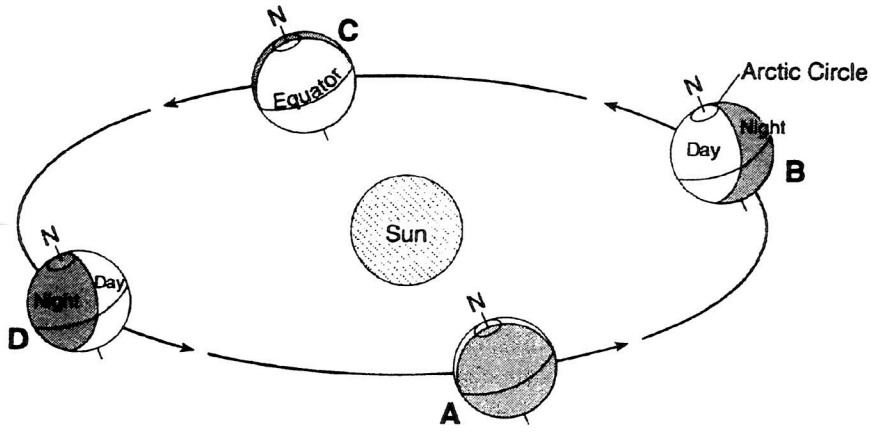
40)

Season	Earth's Position
spring	
summer	
fall	
winter	

Name: [Chapter 4 Free Response] All Answers in booklet Period:

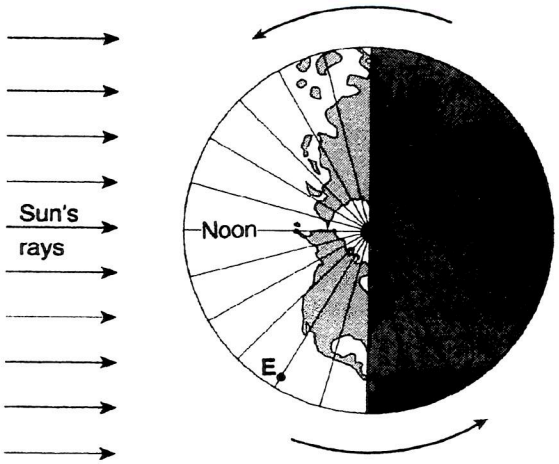
Base your answers to questions **1** through **4** on the diagram below. Diagram 1 shows Earth's location in its orbit on the first day of each of the four seasons, labeled A through D. Diagram 2 shows a north polar view of Earth on March 21. Point E represents a location on Earth's surface. Longitude lines are shown at 15° intervals.

Diagram 1



(Not drawn to scale)

Diagram 2



March 21

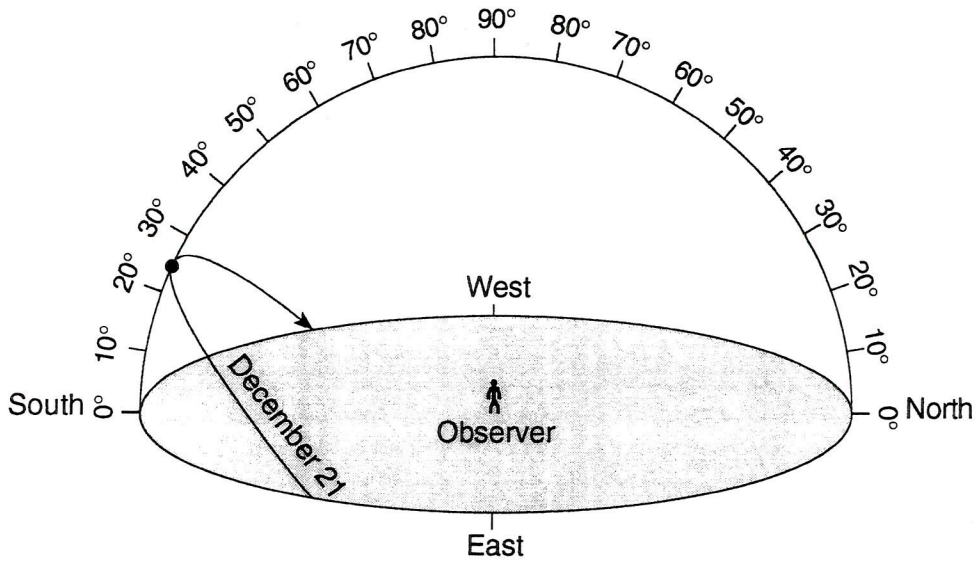
1. How does the altitude of the Sun at solar noon appear to change each day for an observer in New York State as Earth moves from position *A* to position *B* to position *C*?

2. Explain why the duration of insolation is 12 hours at both the Artic Circle and the equator when Earth is at position *C*.

3. State the hour of the day at point *E*.

4. Describe one piece of evidence shown in the diagram which indicates that the Northern Hemisphere is experiencing winter at position *D*.

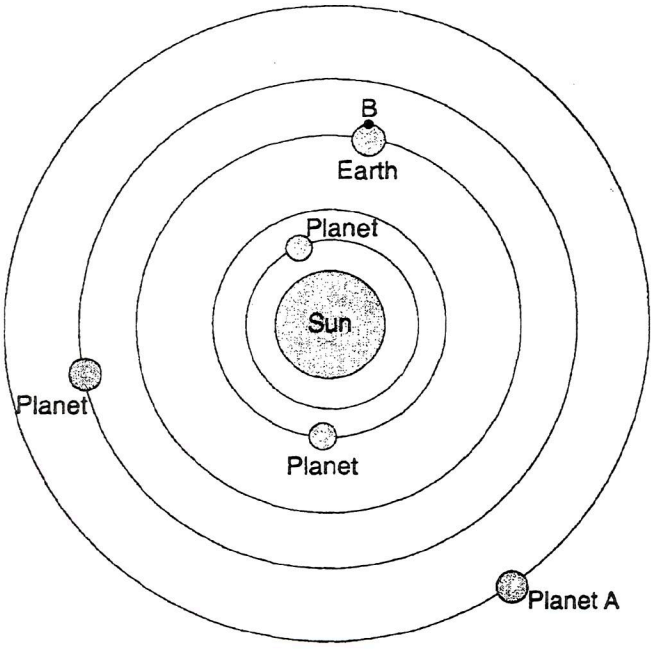
Base your answers to questions **5** and **6** on the diagram below, which represents the sky above an observer in Elmira, New York. Angular distances above the horizon are indicated. The Sun's apparent path for December 21 is shown.



5. On March 21, the altitude of the noon Sun in Elmira is 48°. On the diagram above, draw the Sun's apparent path for March 21, as it would appear to the observer. Be sure your path begins and ends at the correct positions on the horizon and indicates the correct altitude of the noon Sun.

6. On what date of the year does the maximum duration of insolation usually occur at Elmira?

Base your answers to questions **7** through **10** on the diagram below, which shows the heliocentric model of a part of our solar system. The planets closest to the Sun are shown. Point *B* is a location on Earth's equator.

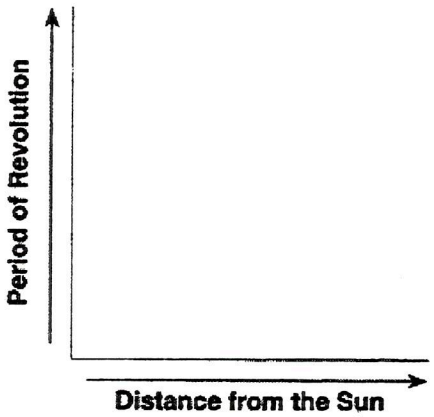


(Not drawn to scale)

7. Identify *one* feature of the geocentric model of our solar system that differs from the heliocentric model shown.

8. Explain why location *B* experiences both day and night in a 24-hour period.

9. On the graph below, draw a line to show the general relationship between a planet's distance from the Sun and the planet's period of revolution.



10. State the name of planet *A*.

_____

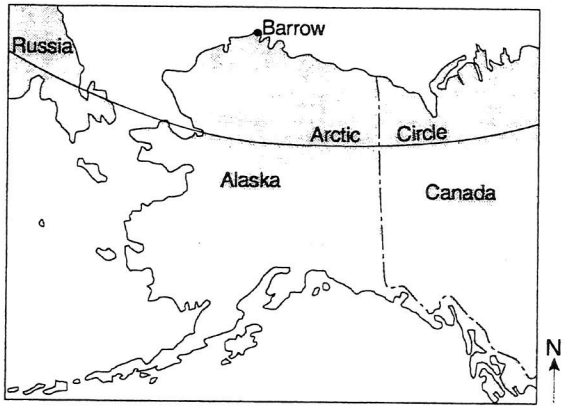
Base your answers to questions **11** through **13** on

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

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

Barrow, Alaska

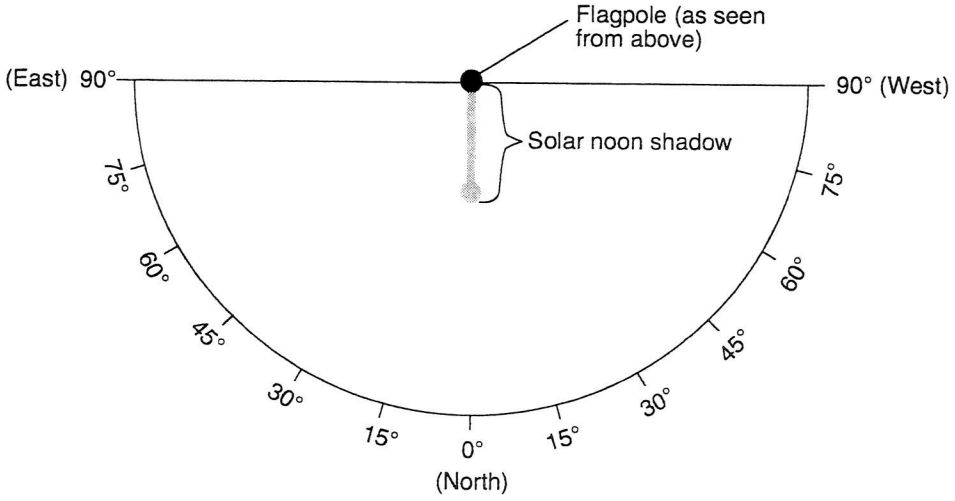


11. Explain why Barrow is in a different time zone than New York City.

12. State the altitude of *Polaris* as seen from Barrow.

13. On what date was the noontime Sun highest in the sky at Barrow?

14.



The diagram above shows a view of the ground from directly above a flagpole in New York State at solar noon on a particular day of the year. The flagpole's shadow at solar noon is shown. Draw the position and relative length of the shadow that would be cast by this flagpole three hours later.

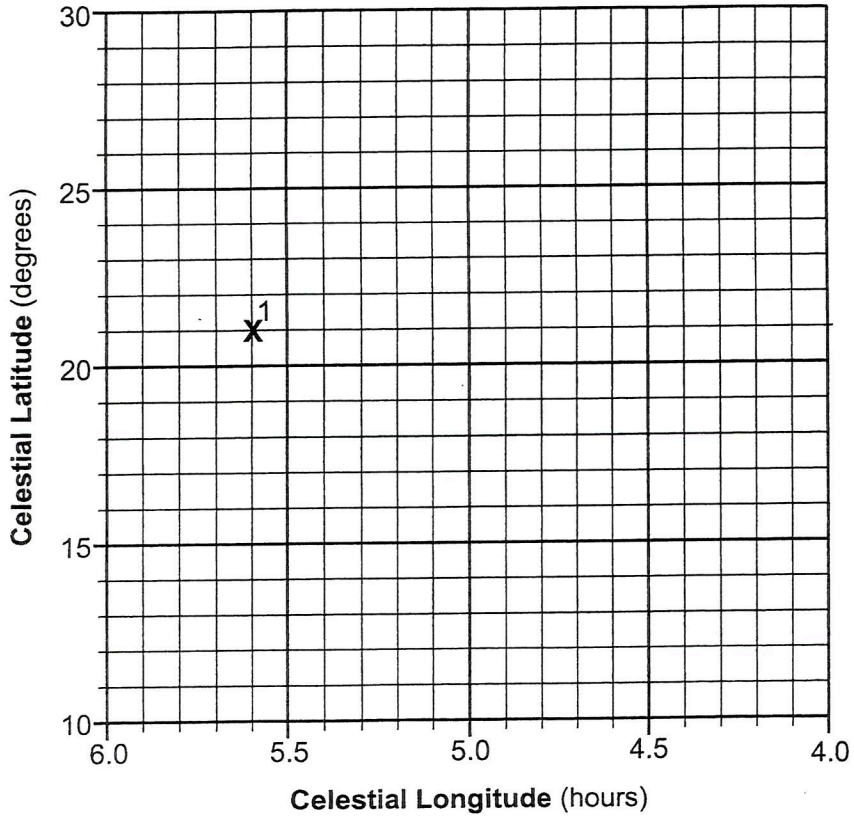
15. Base your answer to the following question on the data table below, which lists six stars, numbered 1 through 69 found in the constellation Taurus. The table shows the celestial coordinates for these six stars.

Location of Six Stars in Taurus

Star Number	Celestial Longitude (hours)	Celestial Latitude (degrees)	Name
1	5.6	21	*Zeta Tauri*
2	4.6	16	*Aldebaran*
3	4.3	15	*Gamma Tauri*
4	4.5	19	*Epsilon Tauri*
5	4.7	23	*Tau Tauri*
6	5.4	29	*Elnath*

On the grid below, use an **X** to plot the position of each of the six stars. Record the number of the plotted star beside each **X** and connect the **X**s in the following order: 1, 2, 3, 4, 5, 6. The first star, *Zeta Tauri,* has been plotted for you.

Location of Six Stars in Taurus



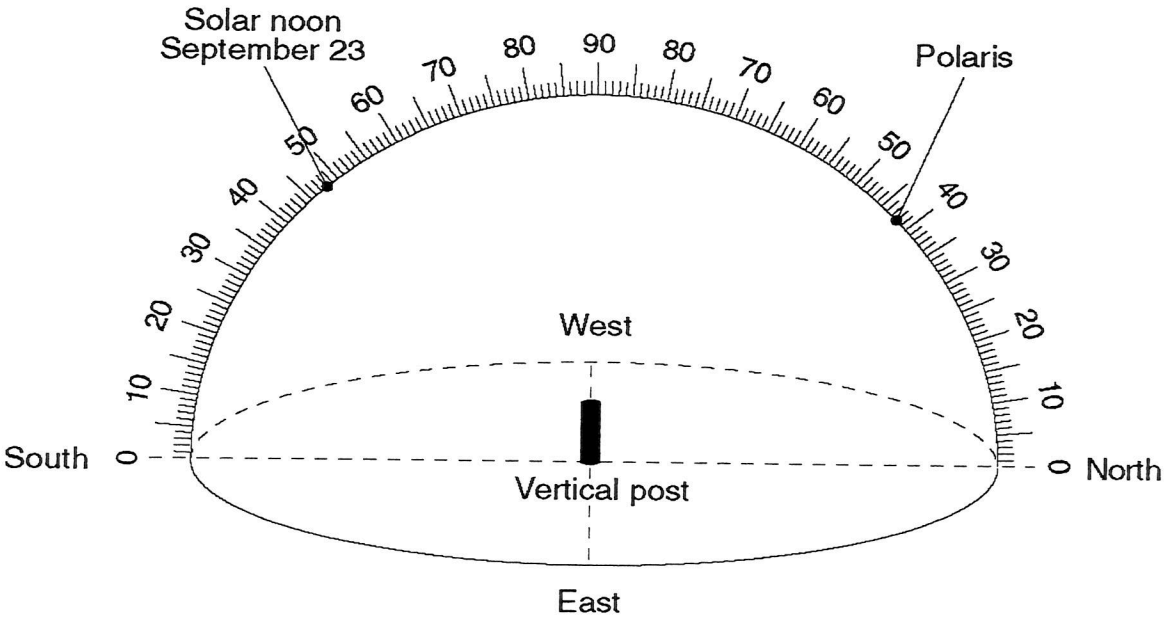
Base your answers to questions **16** and **17** on the information below.

Accurate observations of the Sun were made by a New York State observer. This person observed the time of sunrise and the position of sunrise along the eastern horizon for each day during the month of May.

16. Describe how the time of sunrise changed for the observer each day during the month of May.

17. State the actual Earth motion that causes the Sun to appear to rise each day.

Base your answers to questions **18** through **22** on the diagram below, which represents a model of the sky above a vertical post in New York State. The diagram shows the position of the Sun at solar noon on September 23 and the position of *Polaris* above the horizon.



18. How many degrees will the Sun appear to move across the sky from 1 p.m. to 3 p.m. on June 21?

19. On the diagram above, draw the shadow of the vertical post as it would appear at solar noon on September 23.

20. At which latitude is this vertical post located? Include the unit and compass direction in your answer.

21. Place an **X** on the diagram above to indicate the altitude of the Sun at solar noon on June 21.

22. On the diagram above, draw the apparent path of the Sun across the sky on September 23 from sunrise to sunset.

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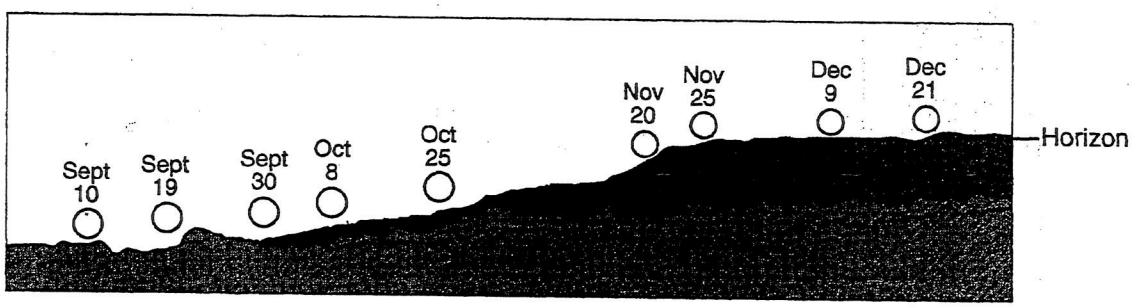
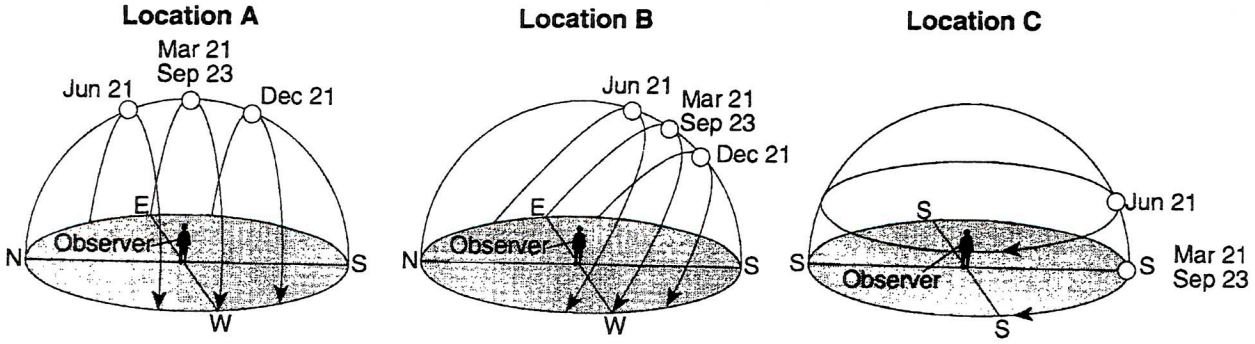
23. The diagram below shows the position of sunrise along the horizon for a period of time from September 10 until December 21, as seen by an observer near Binghamton, New York.

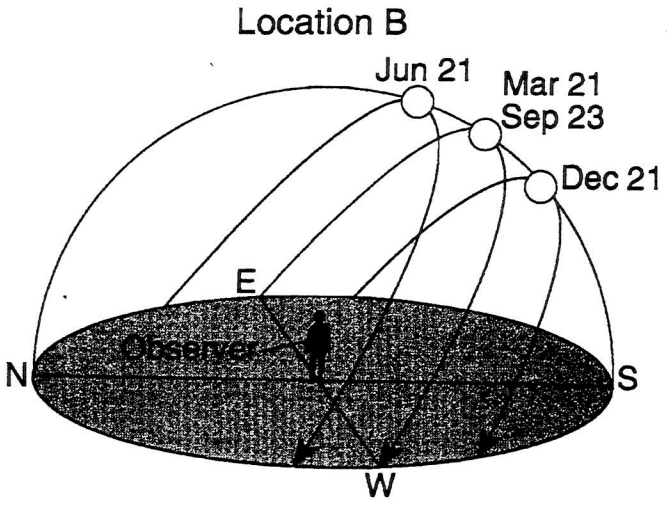


State *one* reason why the position of sunrise changes during this time period.

Base your answers to questions **24** through **27** 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.



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



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

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

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

Base your answers to questions **28** through **30** on diagram 1 and diagram 2 below, which show some constellations in the night sky viewed by a group of students. Diagram 1 below shows the positions of the constellations at 9:00 p.m. Diagram 2 below shows their positions two hours later.

Diagram 1 — 9:00 p.m.

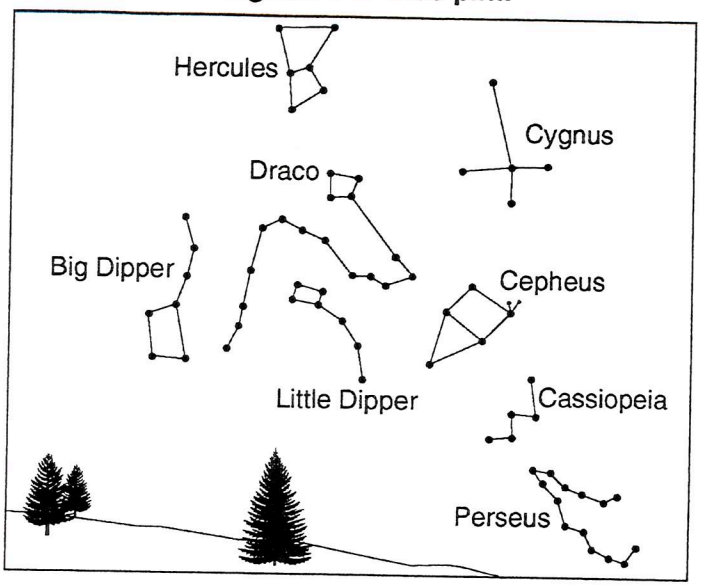
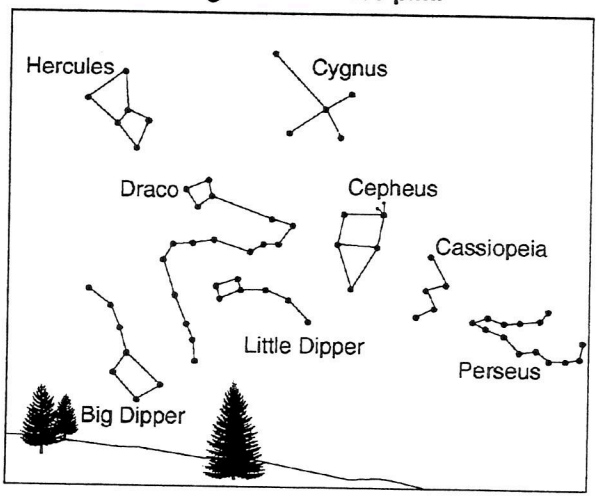


Diagram 2 — 11:00 p.m.



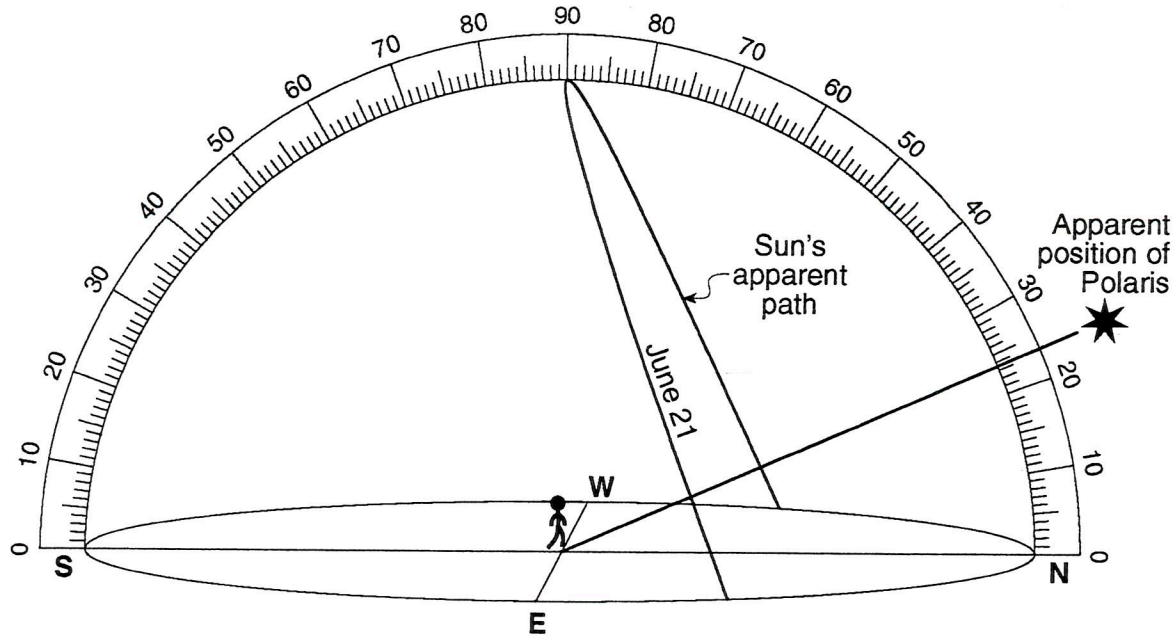
28. Describe the apparent direction of movement of the constellations Hercules and Perseus during the two hours between student observations.

29. Circle *Polaris* on diagram 2 provided above.

30. In which compass direction were the students facing?

Base your answers to questions **31** through **34** on the diagram provided which shows observations made by a sailor who left his ship and landed on a small deserted island on June 21. The diagram represents the apparent path of the Sun and the position of *Polaris*, as observed by the sailor on this island.

Sailor's Observations on the Deserted Island



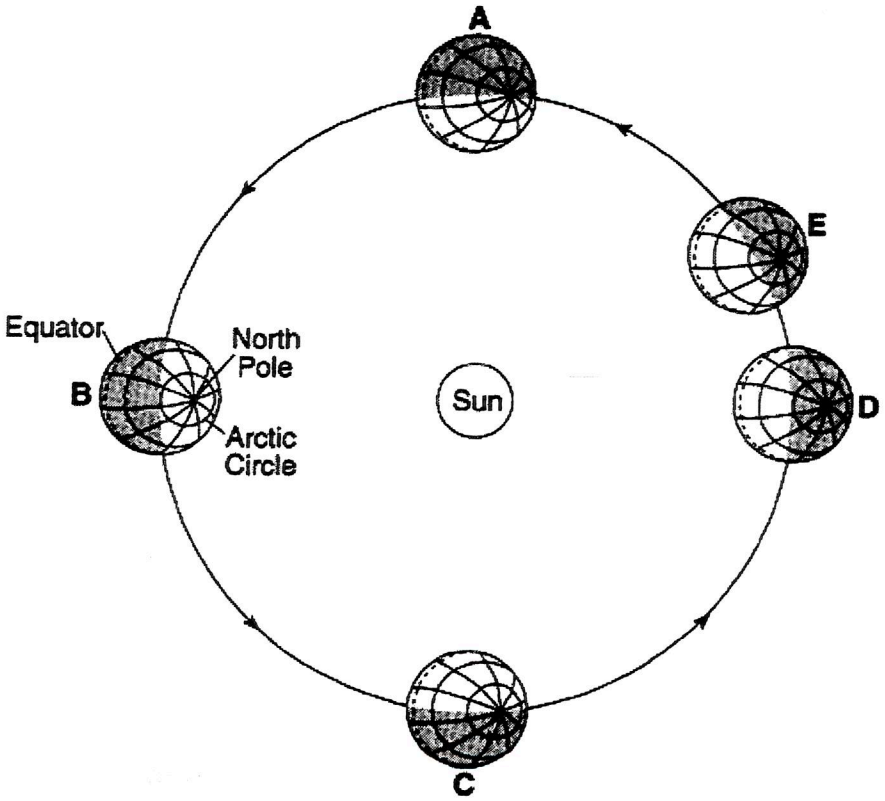
31. On the diagram provided draw an arrow on the June 21 path of the Sun to show the Sun's direction of apparent movement from sunrise to sunset.

32. Based on the sailor's observations, what is the latitude of this island? Include the units and the compass direction in your answer.

33. The sailor observed a 1-hour difference between solar noon on the island and solar noon at his last measured longitude onboard his ship. How many degrees of longitude is the island from the sailor's last measured longitude onboard his ship?

34. The sailor was still on the island on September 23. On the diagram provided draw the Sun's apparent path for September 23, as it would have appeared to the sailor. Be sure your September 23 path indicates the correct altitude of the noon Sun and begins and ends at the correct points on the horizon.

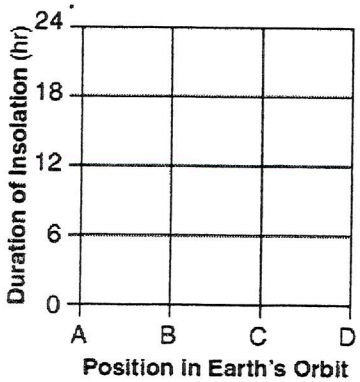
Base your answers to questions **35** through **37** on on the diagram below, which shows the parts of Earth experiencing daylight and darkness as Earth orbits the Sun. Letters A, B, C, D, and E are positions in Earth's orbit as viewed from above the Northern Hemisphere.



(Not drawn to scale)

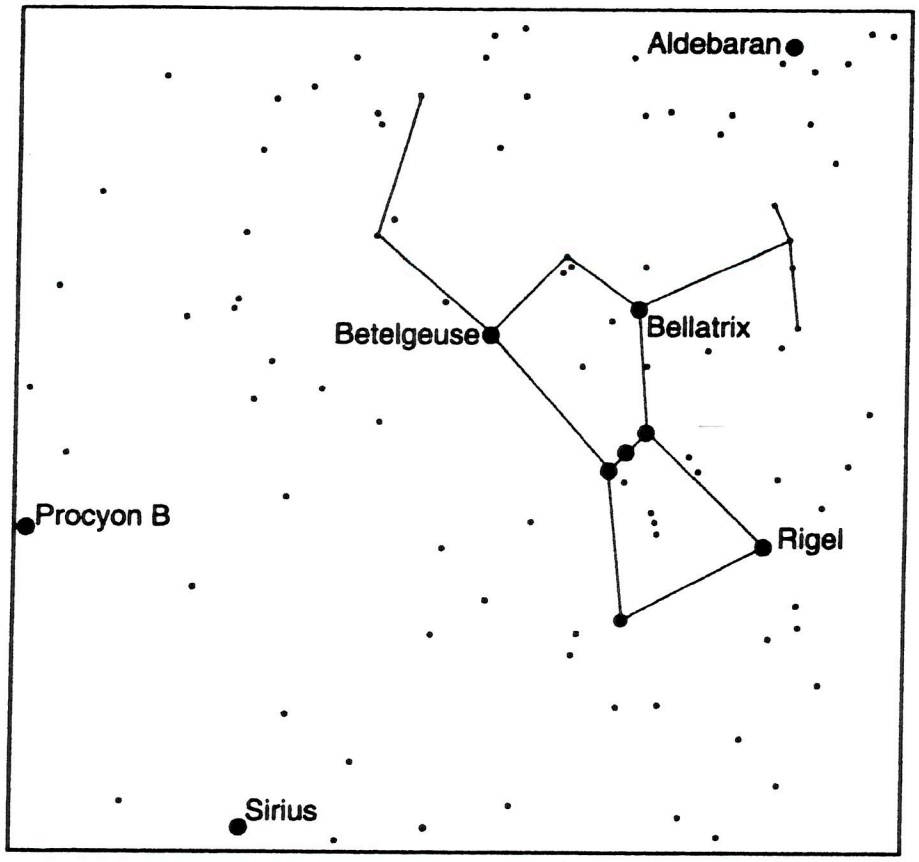
35. Which season is the Northern Hemisphere experiencing when Earth is at position E?

36. Approximately how many days does it take Earth to move from position A to position C?



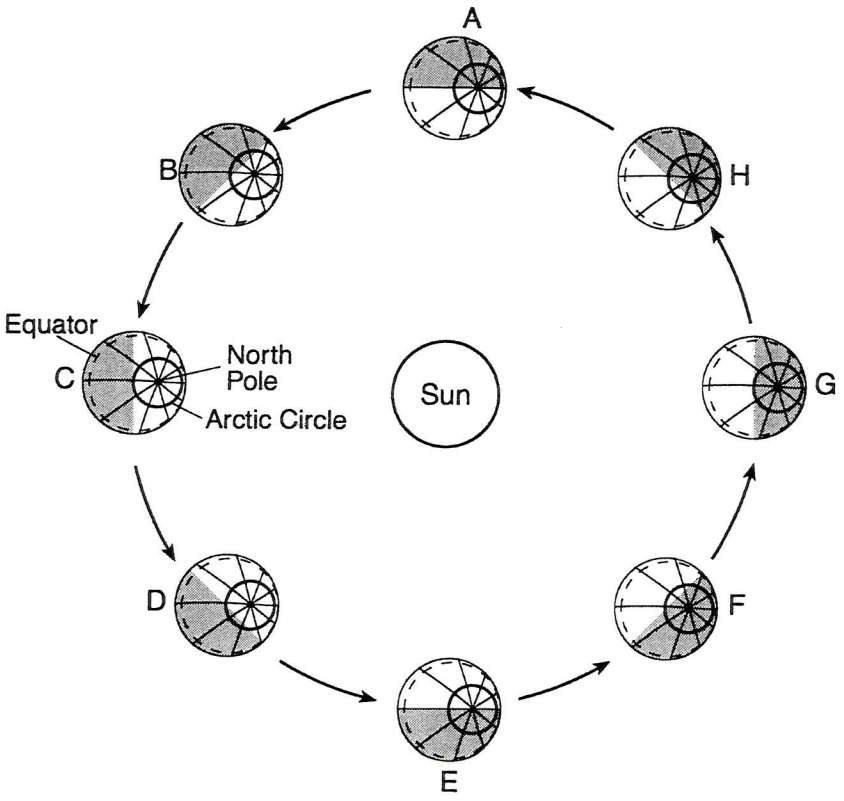
37. On the grid, place **X**s to show the duration of insolation at the Arctic Circle (66.5° N) as Earth orbits the Sun at positions A, B, C, and D. Connect the **X**s with a line.

38. Base your answer to the following question on the star chart below, which shows part of the winter sky visible from New York State. Some of the brighter stars are labeled and the constellation Orion is outlined.



Explain why the constellation Orion is visible at night to an observer in New York State in December and January, but not in June and July.

Base your answers to questions **39** and **40** 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.



(Not drawn to scale)

39. Approximately how many days does Earth take to move from position *A* to position *C*?

40. 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	