Base your answers to questions 30 and 31 in part on the newspaper article below.

Ancient human footprints found

PARIS — In the darkness of an underground cave lined with prehistoric paintings, French scientists believe they have discovered the oldest footprints of humans in Europe.

Embedded in damp clay, the imprints, slightly more than 8 inches long, appear to be those of a boy, 8 or 10 years old, who was walking barefoot between 25,000 and 30,000 years ago, prehistorians said Wednesday.

They said the dates are only hypothetical because there is no precise way to determine when the markings were made. But Michel-Andre Garcia, one prehistorian who has studied the site, said that the carbon datings in the cave and the context make this "a very strong hypothesis." The four footprints were found in the Ardeche region of southern France, deep inside the Chauvet cave.

— *Times Union*, June 10, 1999

30. Scientists have inferred that these "oldest" European human footprints were made during which geologic epoch? [1]

31. Which characteristic of the radioactive isotope carbon-14 explains why carbon-14, rather than the radioactive isotope uranium-238, was used by archeologists in dating the age of their findings? [1]

30. Pleistocene epoch

31. Carbon-14 has a short half-life

32. Wollastonite forms during the intense metamorphism of a sandy limestone. The expression below shows part of the process that results in the formation of wollastonite.

Metamorphism

$CaCO_3$ + SiO_2 ⟶ $CaSiO_2$ + CO_2

Mineral 1 + Mineral 2 ⟶ Wollastonite + Carbon dioxide

a Name the *two* minerals involved in the formation of wollastonite. [1]

b What *two* conditions normally cause intense metamorphism? [1]

33. Identify the geologic age of the New York State Adirondack Mountain bedrock in which wollastonite deposits are found. [1]

32. *a* Quartz and Calcite

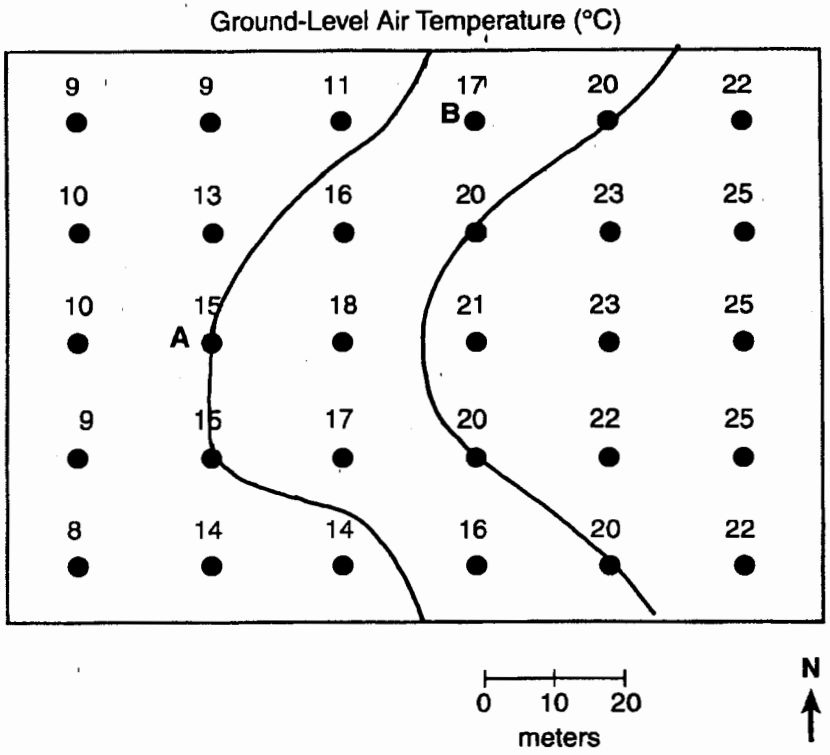
b Heat and Pressure

33. Proterozoic or 1500 million yr or 1.5 billion yr.

Base your answers to questions 34 through 37 on the field map provided in your answer booklet. The field map shows air temperature at specific locations in an area near a school in New York State. Part of this area is a blacktop parking lot. Accurate temperature readings were taken by Earth science students at 10 a.m. on June 1. Two reference points, *A* and *B*, are shown.

34. On the field map provided, draw only the 15°C and the 20°C isotherms. Isotherms must be extended to the edge of the map. [2]

34.



35. Surface temperatures are higher on the east side of the field map, where the parking lot is located. Explain how a characteristic of the parking lot surface could cause these higher temperatures. [1]

36. Calculate the temperature gradient along a straight line between point *A* and point *B* on the map by following the directions below.

a Write the equation for determining the temperature gradient.

b Substitute the correct values into the equation. [1]

c Solve the equation and record your answer in decimal form. Label the answer with the correct units. [2]

37. Another Earth science class took accurate temperature readings at 12 noon on the same day and at the same locations. At each location, the temperature was warmer than it had been at 10 a.m. Explain why the temperature readings would normally increase between 10 a.m. and 12 noon. [1]

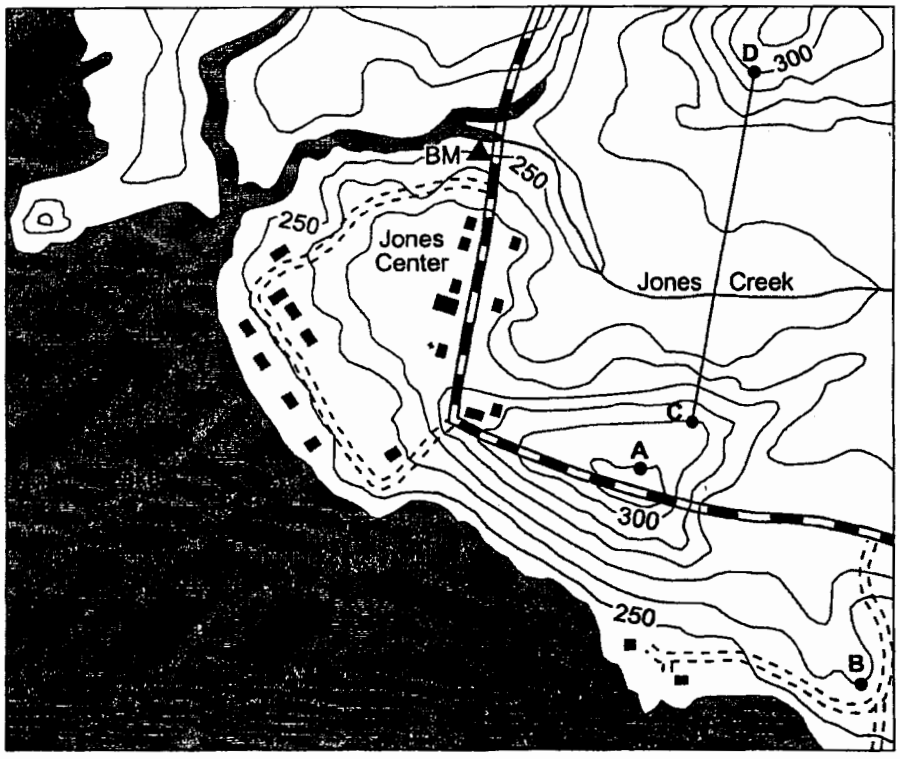
35. The dark colored parking lot absorbs more energy

36.

a gradient = $\frac{\text{change in F.V.}}{\text{distance}}$
b $g = \frac{2\,^\circ C}{50\ m}$
c $g = .04\ ^\circ C/m$

37. The sun was at a higher angle

Base your answers to questions 38 through 40 on the topographic map below. Points *A* through *D* are locations on the map. Elevations are in feet.



38. Explain briefly how the map can be used to determine that Jones Creek is flowing westward into Jones Lake. [1]

39. Determine the gradient from point *A* to point *B* by following the directions below.
   a Write the equation for determining the gradient.
   b Substitute data from the map into the equation. [1]
   c Calculate the gradient and label it with the proper units. [2]

40. On the grid provided *in your answer booklet*, construct a profile of the land surface between point *C* and point *D* by following the directions below.
   a Plot the elevations along line *CD* by marking with a dot *each* point where an isoline is crossed by line *CD*. [1]
   b Connect the dots to complete the profile. [1]

38. Contour lines bend uphill

39.

a

$$\text{gradient} = \frac{\Delta \text{ in F.V.}}{\text{distance}}$$

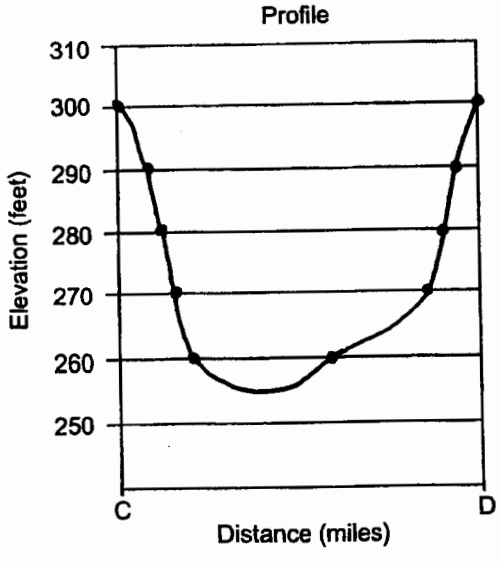
b

$$g = \frac{60 \text{ ft}}{.5 \text{ mi}}$$

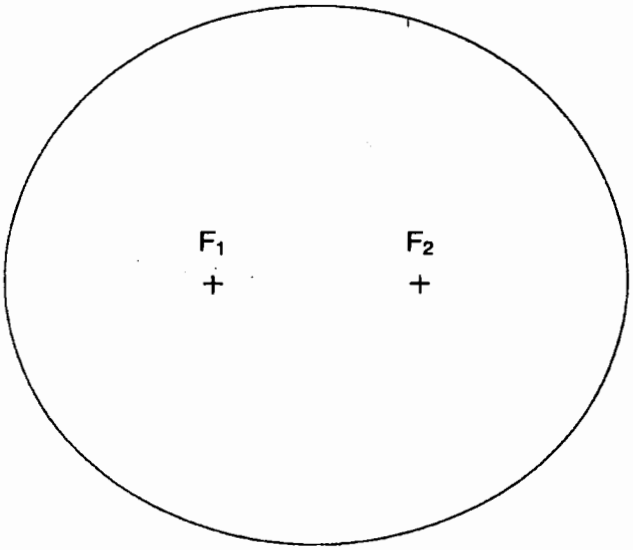
c

$$g = 30 \text{ Ft/mi}$$

40 *a–b*



Base your answers to questions 41 and 42 on the diagram of the ellipse below.



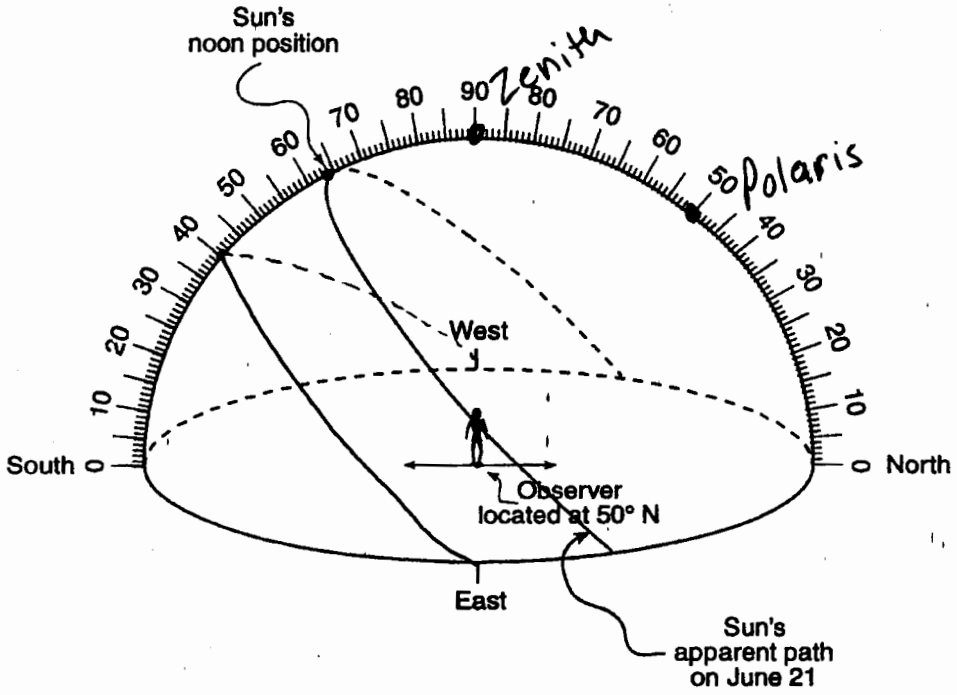
41. Calculate the eccentricity of the ellipse to the *nearest thousandth*. [1]

42. State how the eccentricity of the given ellipse compares to the eccentricity of the orbit of Mars. [1]

41. **Eccentricity =** .333

42. The given ellipse has a greater eccentricity than Mars

Base your answers to questions 43 through 45 on the diagram below. The diagram is a model of the sky (celestial sphere) for an observer at 50° N latitude. The Sun's apparent path on June 21 is shown.

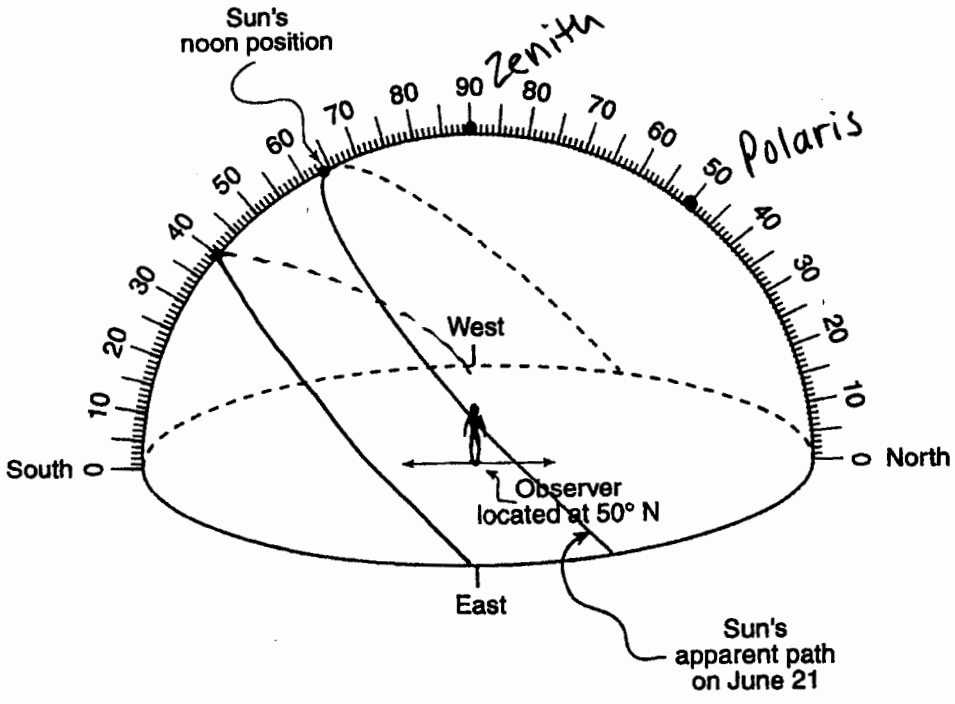


43. On the diagram provided *on your answer paper*, mark with a dot the position of Polaris as viewed by the observer. Label this dot "Polaris." [1]

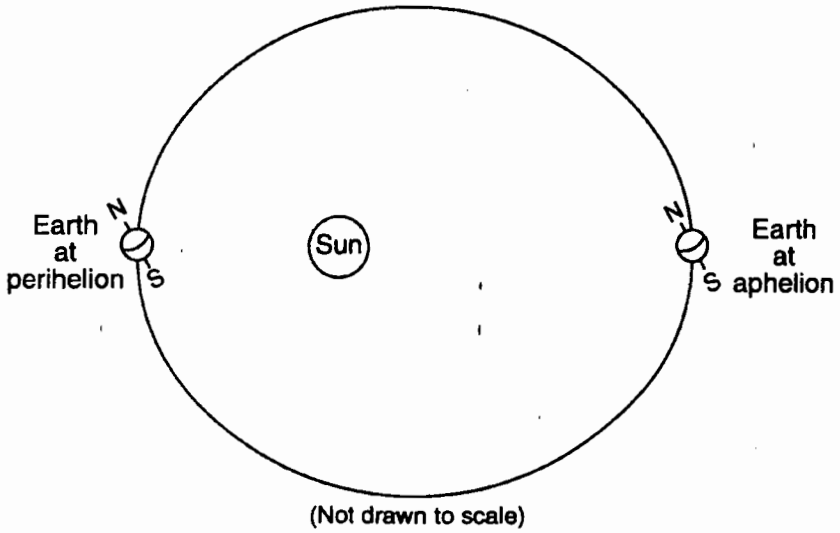
44. On the diagram provided *on your answer paper*, mark with a dot the position of the observer's zenith. Label this dot "Zenith." [1]

45. The altitude of the Sun's position at noon on March 21 is 40° at this location. On the diagram provided *on your answer paper*, draw and label the approximate apparent path of the Sun on March 21. [1]

43-45



Base your answers to questions 46 through 49 on the diagram below, which represents an exaggerated model of Earth's orbital shape. Earth is closest to the Sun at one time of year (perihelion) and farthest from the Sun at another time of year (aphelion).



46. State the actual geometric shape of Earth's orbit. [1]

47. Identify the season in the Northern Hemisphere when Earth is at perihelion. [1]

48. Describe the change that takes place in the apparent size of the Sun, as viewed from Earth, as Earth moves from perihelion to aphelion. [1]

49. State the relationship between Earth's distance from the Sun and Earth's orbital velocity. [1]

46. Slightly elliptical

47. Winter

48. The size of the sun will look smaller

49. As the distance ↑ orbital velocity ↓

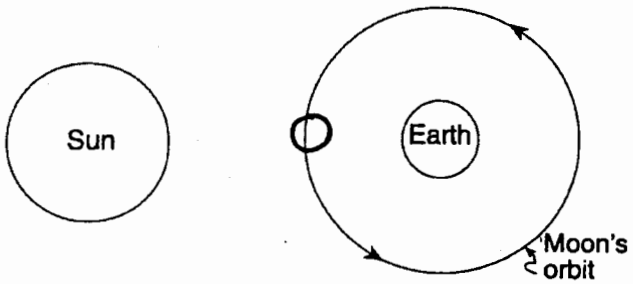
Base your answers to questions 50 through 52 on the diagram provided in your answer booklet and on your knowledge of Earth science. The diagram shows the Sun, Earth, and the Moon's orbit around Earth as viewed from space.

50. On the diagram provided *in your answer booklet,* draw a circle of approximately this size ◯ to represent the Moon's position in its orbit when a solar eclipse is viewed from Earth. [1]

51. Approximately how many complete revolutions does the Moon make around Earth each month? [1]

52. Explain why solar eclipses do not occur every time the Moon revolves around Earth. [1]

50.



(Not drawn to scale)

51. 1 **revolution(s)**

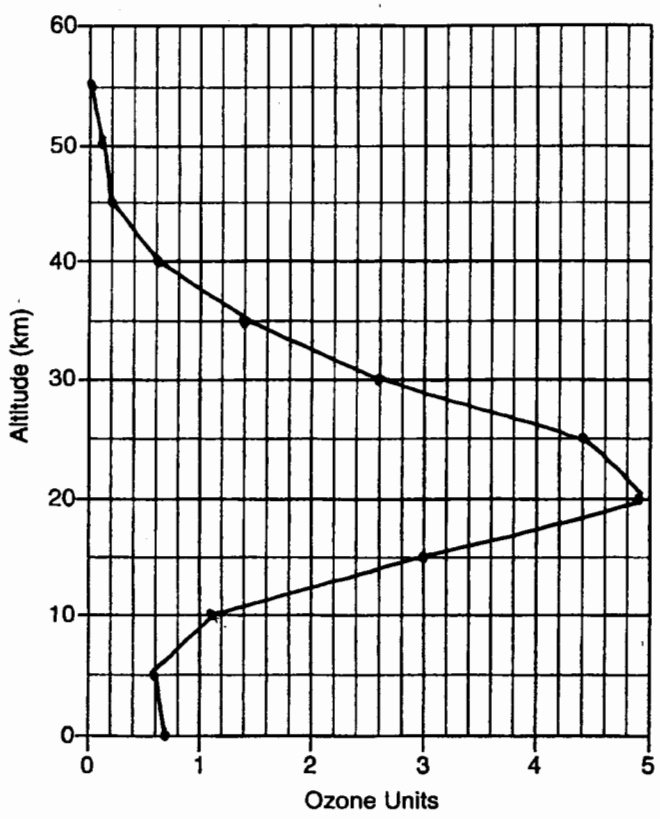
52. The moon's orbit is tilted 5° off planar

Base your answers to questions 53 through 55 on the table below, which shows the concentration of ozone, in ozone units, in Earth's atmosphere at different altitudes. [One ozone unit is equal to 10^{12} molecules per cubic centimeter.]

Concentration of Ozone	
Altitude (km)	**Ozone Units**
0	0.7
5	0.6
10	1.1
15	3.0
20	4.9
25	4.4
30	2.6
35	1.4
40	0.6
45	0.2
50	0.1
55	0.0

53 On the grid provided *in your answer booklet*, construct a line graph of the ozone concentration in the atmosphere recorded at the different altitudes shown on the table by plotting the data from the table and connecting the points. [3]

53.



54. State the name of the temperature zone of the atmosphere in which the concentration of ozone is greatest. [1]

55. State how incoming solar radiation (insolation) is affected by the ozone in the atmosphere. [1]

54. Stratosphere

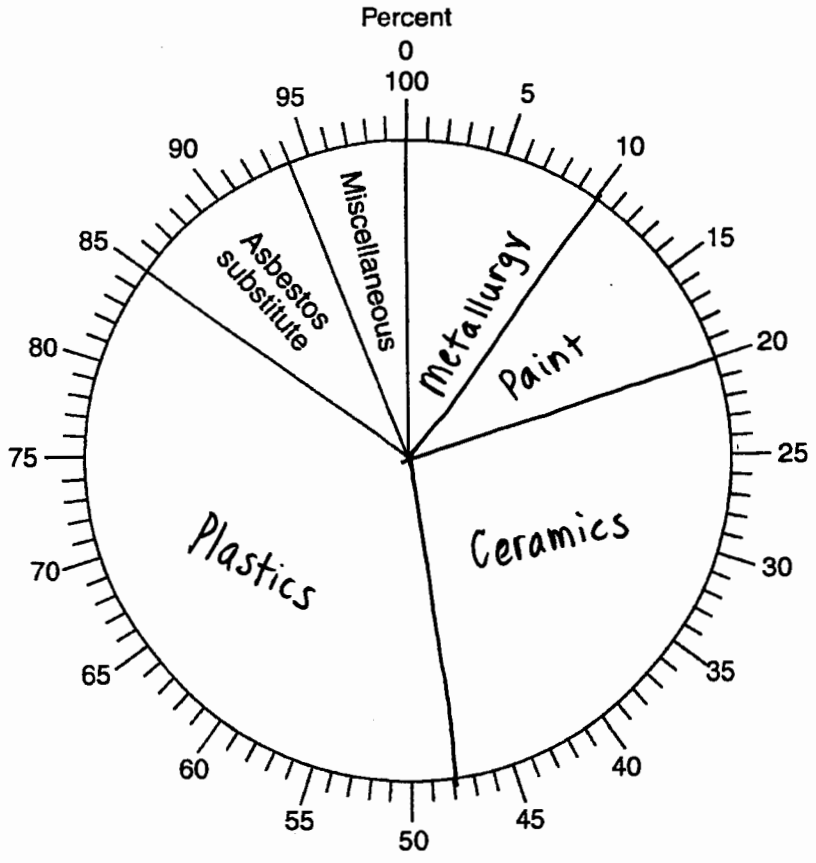
55. Ozone will decrease incoming solar radiation

Base your answers to questions 56 through 57 on your knowledge of Earth science and on the data table below, which shows the industrial uses of wollastonite, a mineral mined in the eastern Adirondack Mountains of New York State.

Industrial Uses of Wollastonite in the United States

Industrial Uses of Wollastonite	Percent of Total Use
Plastics	37
Ceramics	28
Metallurgy	10
Paint	10
Asbestos substitute	9
Miscellaneous	6

56-57 On the pie graph provided *in your answer booklet*, complete the graph to show the percent of *each* industrial use of wollastonite. Label *each* section of the pie graph with its industrial use. The percent for Miscellaneous and for Asbestos substitute has been drawn and labeled for you. [2]



Base your answers to questions 61 through 64 on the reading passage below and on your knowledge of Earth science.

Greenhouse Effect

The warming of Earth's surface and lower atmosphere tends to intensify with an increase in atmospheric carbon dioxide. The atmosphere allows a large percentage of the visible light rays from the Sun to reach Earth's surface. Some of this energy is reradiated by Earth's surface in the form of long-wave infrared radiation. Much of this infrared radiation warms the atmosphere when it is absorbed by molecules of carbon dioxide and water vapor. A similar warming effect is produced by the glass of a greenhouse, which allows sunlight in the visible range to enter, but prevents infrared radiation from leaving the greenhouse.

The absorption of infrared radiation causes Earth's surface and the lowest layer of Earth's atmosphere to warm to a higher temperature than would otherwise be the case. Without this "greenhouse" warming, Earth's average surface temperature could be as low as –73°C. The oceans would freeze under such conditions.

Many scientists believe that modern industrialization and the burning of fossil fuels (coal, oil, and natural gas) have increased the amount of atmospheric carbon dioxide. This increase may result in an intensified greenhouse effect on Earth causing significant alterations in climate patterns in the future. Scientists estimate that average global temperatures could increase by as much as 5°C by the middle of the 21st century.

61. The lowest layer of Earth's atmosphere has undergone a large increase in temperature due to the presence of greenhouse gases. State the name of this temperature-zone layer. [1]

62. State a possible wavelength, in centimeters, of infrared radiation. [1]

63. Explain why most scientists believe an increase in the greenhouse effect will cause sea levels to rise. [1]

64. State one possible change humans could make to significantly reduce the amount of greenhouse gases added to the atmosphere each year. [1]

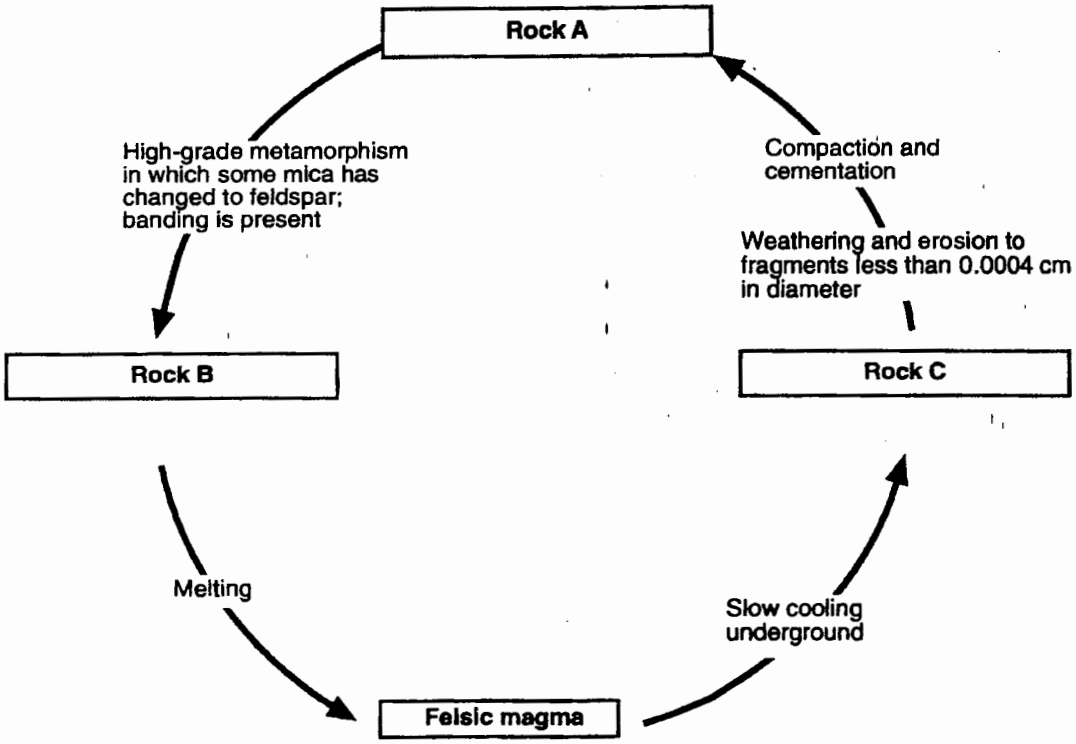
61. Troposphere

62. 10^{-3} cm

63. Polar ice caps will melt

64. Use electric cars, car pool

Base your answers to questions 65 and 66 on the rock cycle diagram below.



65. State the specific names of rocks *A*, *B*, and *C* in the diagram. Do *not* write the terms "sedimentary," "igneous," and "metamorphic." [3]

66. State *one* condition or process that would cause the high-grade metamorphism of rock *A*. [1]

65. **Rock A** Shale

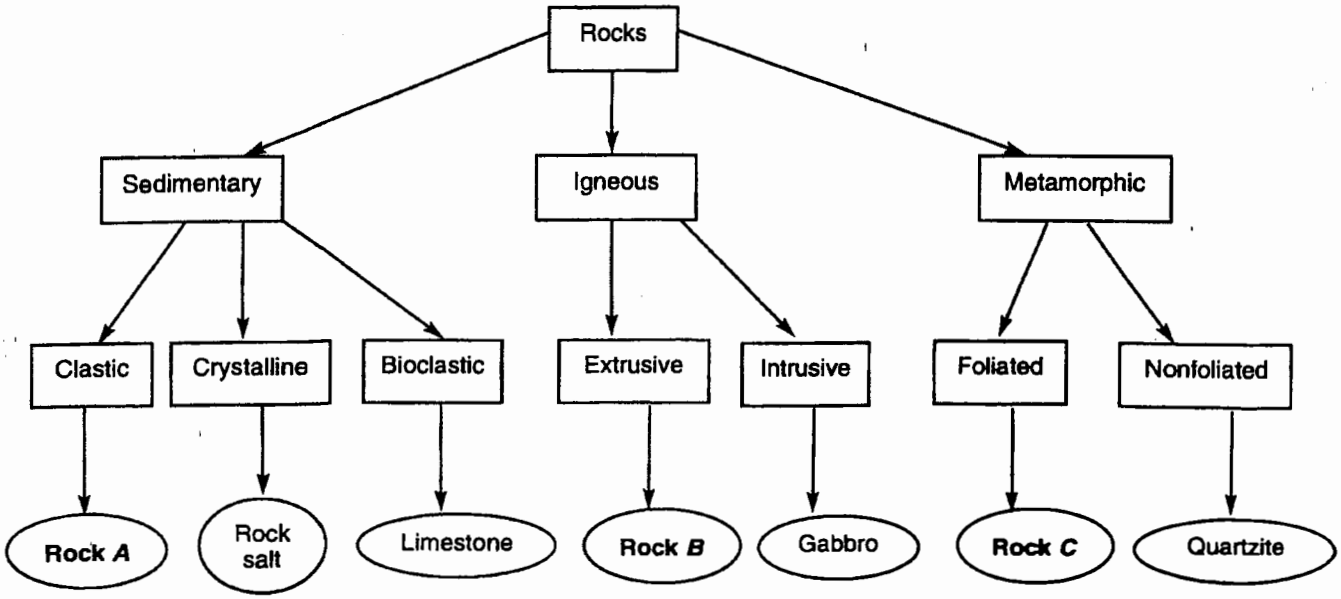
Rock B Gneiss

Rock C Granite

66. High Pressure or High Heat without melting

Base your answers to questions 67 through 70 on the Rock Classification flowchart shown below. Letters *A*, *B*, and *C* represent specific rocks in this classification scheme.

Rock Classification Flowchart

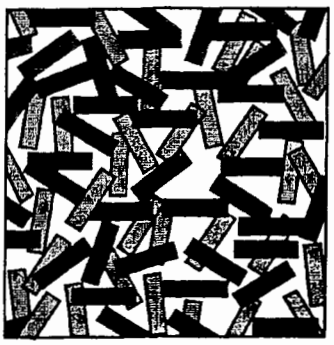


67. Rock *A* is composed of very fine-grained quartz and feldspar particles 0.005 centimeter in diameter. State the name of rock *A*. [1]

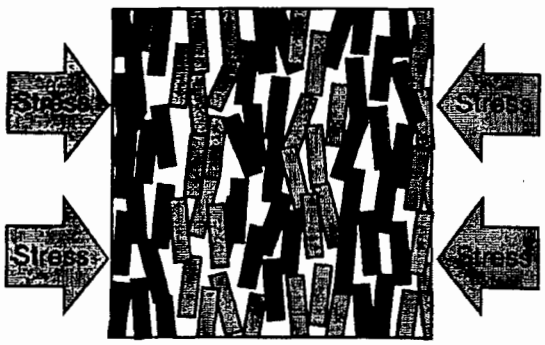
68. Rock *B* has a glassy, vesicular texture and is composed mainly of potassium feldspar and quartz. State the name of rock *B*. [1]

69. Granite could be placed in the same position in the flowchart above as gabbro. Describe *two* differences between granite and gabbro. [1]

70. The diagram below represents two magnified views showing the arrangement of minerals before and after metamorphism of rock *C*. State the name of rock *C*. [1]



Mineral Arrangement
Before Metamorphism



Rock C Showing Banding
After Metamorphism

67. Siltstone

68. Pumice

69. (1) Color

(2) Mineral Composition

70. Gneiss