

EARTH SCIENCE

PROGRAM MODIFICATION EDITION

Friday, June 18, 1999 — 1:15 to 4:15 p.m., only

The answer paper is stapled in the center of this examination booklet. Open the examination booklet, carefully remove the answer paper, and close the examination booklet. Then fill in the heading of your answer paper.

All of your answers are to be recorded on the separate answer paper. For each question in Part I and Part II, decide which of the choices given is the best answer. Then on the answer paper, in the row of numbers for that question, circle with pencil the number of the choice that you have selected. The sample below is an example of the first step in recording your answers.

SAMPLE: ① 2 3 4

If you wish to change an answer, erase your first penciled circle and then circle with pencil the number of the answer you want. After you have completed all three parts of the examination and you have decided that all of the circled answers represent your best judgment, signal a proctor and turn in all examination material except your answer paper. Then and only then, place an X in ink in each penciled circle. Be sure to mark only one answer with an X in ink for each question. No credit will be given for any question with two or more X's marked. The sample below indicates how your final choice should be marked with an X in ink.

SAMPLE: ⊗ 2 3 4

For questions in Part III, record your answers in accordance with the directions given in the examination booklet.

The *Earth Science Reference Tables*, which you may need to answer some questions in this examination, are supplied separately. Be certain you have a copy of the 1994 edition of these reference tables before you begin the examination.

When you have completed the examination, you must sign the statement printed at the end of the answer paper, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer paper cannot be accepted if you fail to sign this declaration.

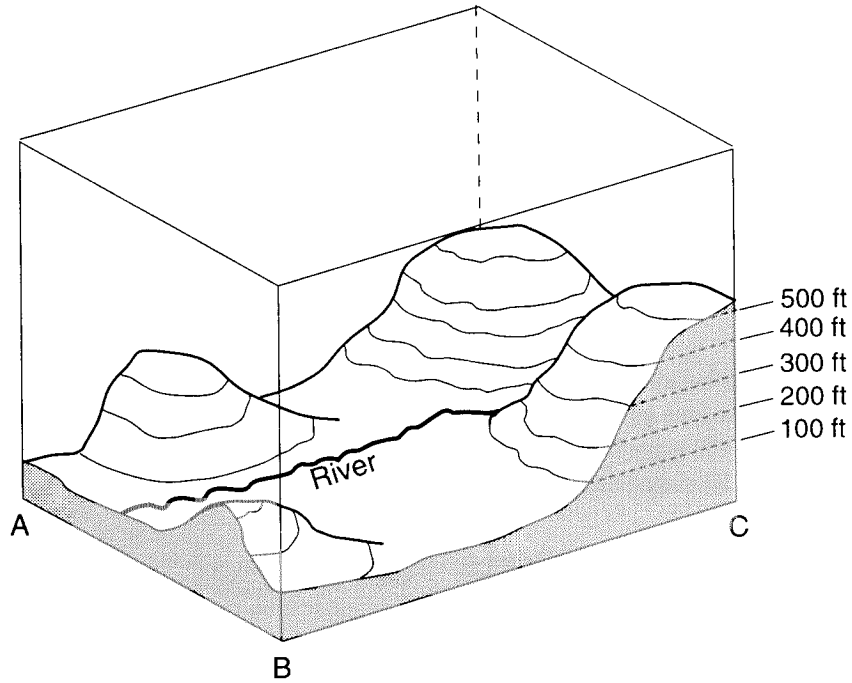
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part I

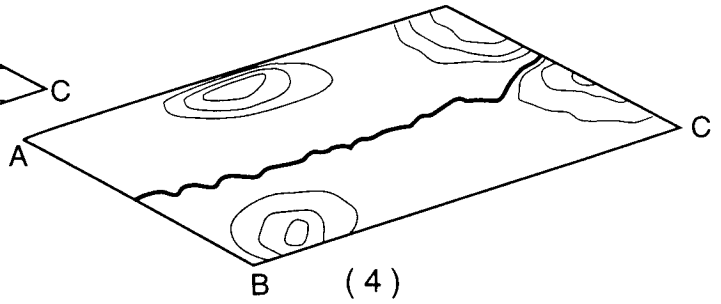
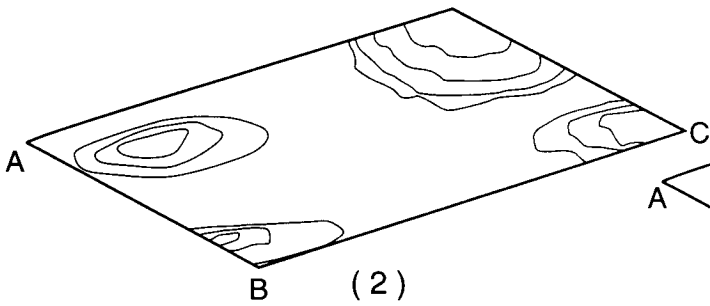
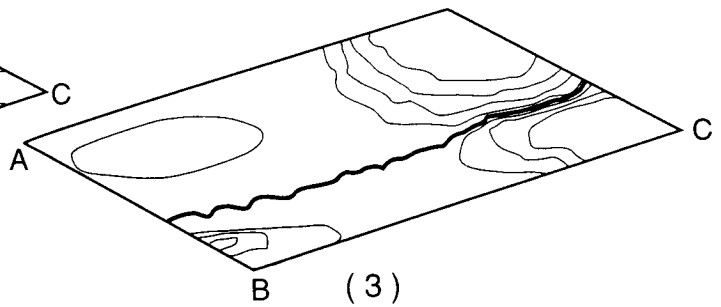
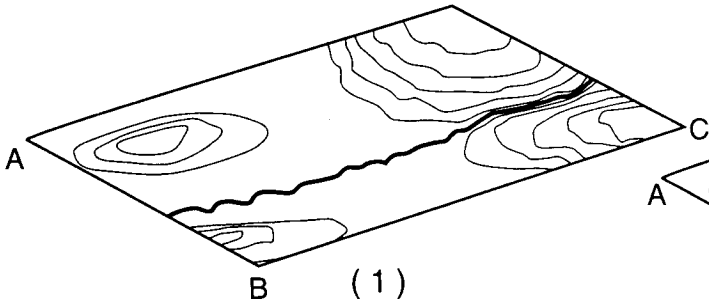
Answer all 40 questions in this part.

Directions (1–40): For each statement or question, select the word or expression that, of those given, best completes the statement or answers the question. Record your answer on the separate answer paper in accordance with the directions on the front page of this booklet. Some questions may require the use of the *Earth Science Reference Tables*. [40]

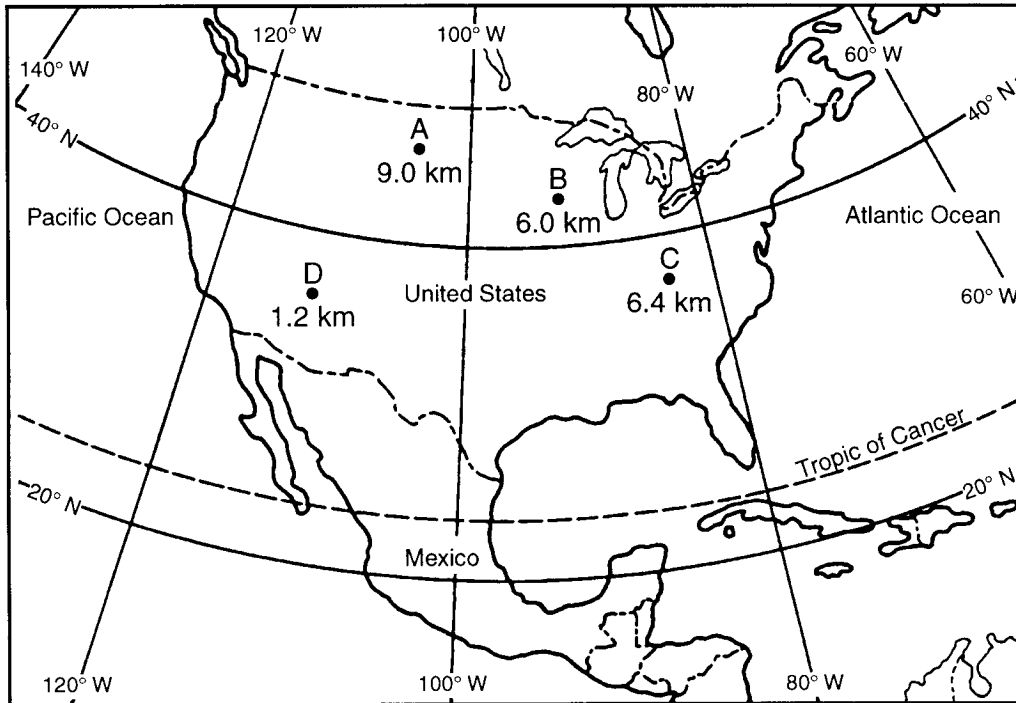
1 The diagram below is a three-dimensional model of a landscape region.



Which map view best represents the topography of this region?



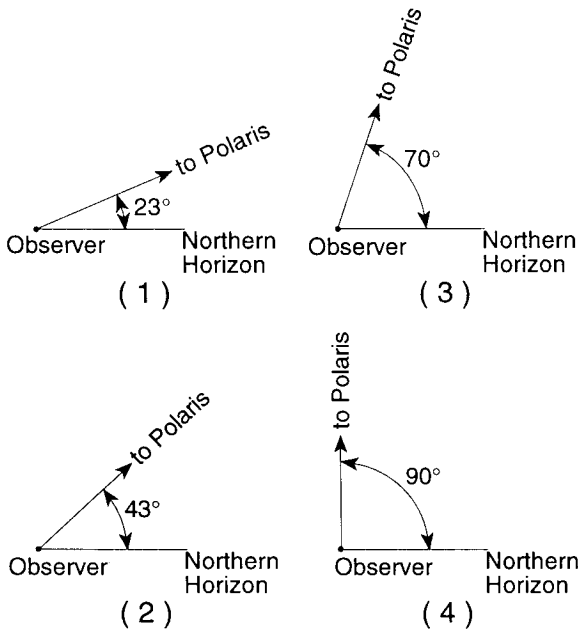
2 The map below shows the location and diameter, in kilometers, of four meteorite impact craters, A, B, C, and D, found in the United States.



What is the approximate latitude and longitude of the largest crater?

- (1) 35° N 111° W
- (2) 39° N 83° W
- (3) 44° N 90° W
- (4) 47° N 104° W

3 Which diagram best shows the altitude of Polaris observed near Buffalo, New York?



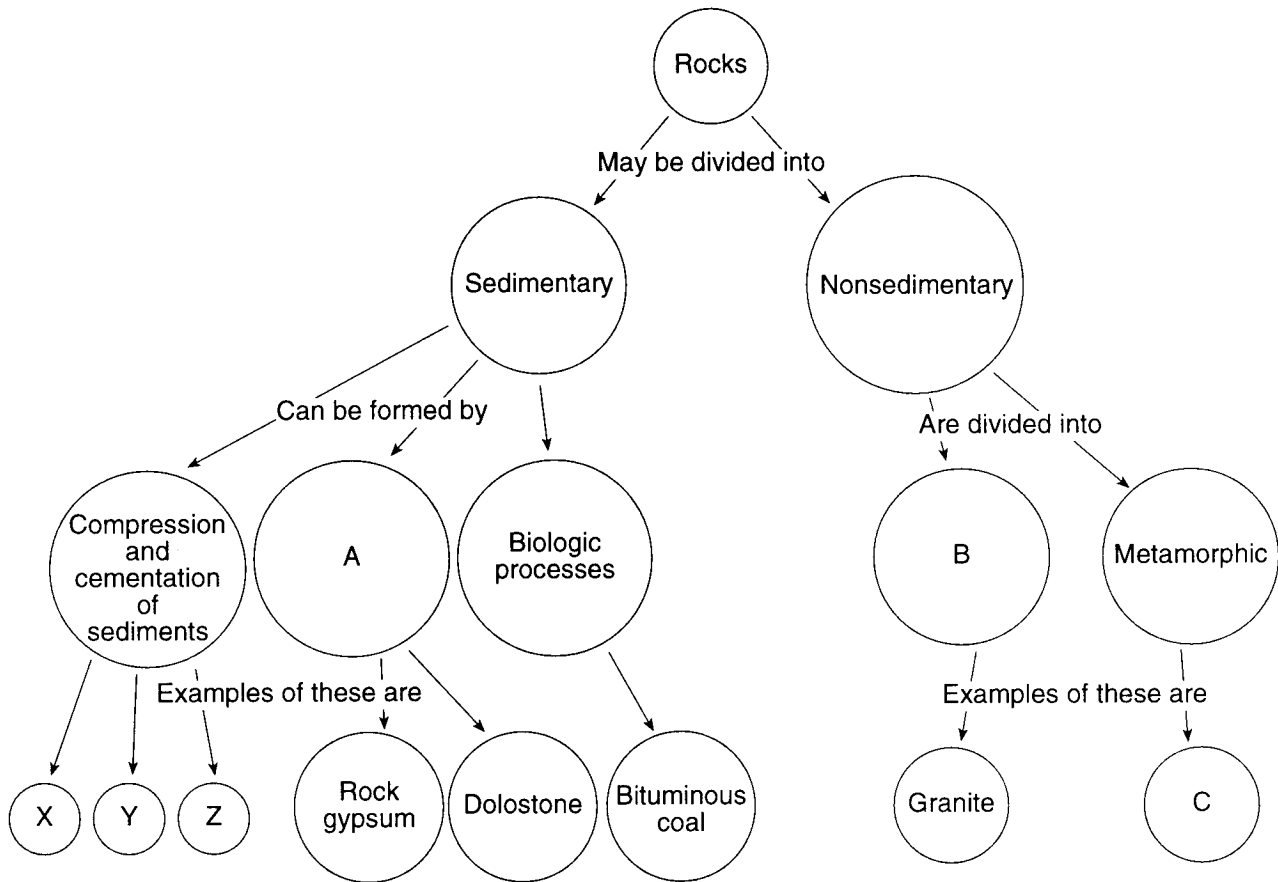
4 Although more than 2,000 minerals have been identified, 90% of Earth's lithosphere is composed of the 12 minerals listed below.

Rock-Forming Minerals	
feldspar	augite
quartz	garnet
mica	magnetite
calcite	olivine
hornblende	pyrite
kaolinite	talc

The best explanation for this fact is that most rocks

- 1 are monomineralic
- 2 are composed only of recrystallized minerals
- 3 have a number of minerals in common
- 4 have a 10% nonmineral composition

Base your answers to questions 5 through 8 on the diagram below, which represents a scheme for classifying rocks. The letters A, B, C and X, Y, Z represent missing labels.



5 The classification of rocks into sedimentary or nonsedimentary groups is based primarily on the rocks'

- | | |
|-----------|---------|
| 1 origin | 3 color |
| 2 density | 4 age |

6 Which processes would form the type of rock that is represented by circle B?

- 1 deposition and compaction
- 2 weathering and erosion
- 3 melting and solidification
- 4 faulting and folding

7 If the rock in circle C formed from limestone, it would be called

- | | |
|-------------------|----------|
| 1 schist | 3 marble |
| 2 anthracite coal | 4 slate |

8 Which rocks could be represented by circles X, Y, and Z?

- 1 shale, slate, and schist
- 2 sandstone, shale, and siltstone
- 3 anthracite coal, metaconglomerate, and rock salt
- 4 breccia, gneiss, and rhyolite

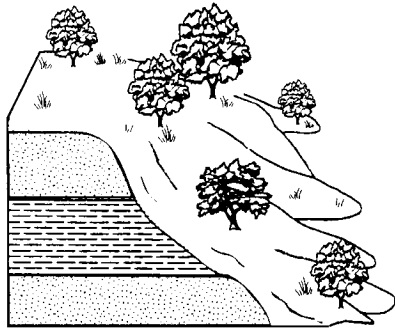
9 What is the largest particle that can generally be transported by a stream that is moving at 200 centimeters per second?

- | | |
|----------|-----------|
| 1 sand | 3 cobble |
| 2 pebble | 4 boulder |

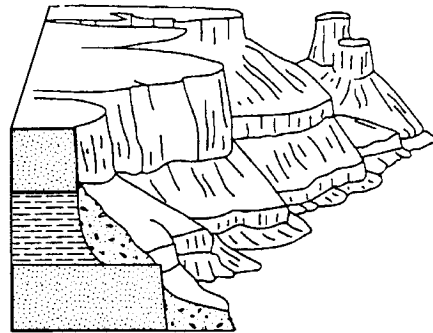
10 Which agent of erosion formed the long U-shaped valleys now occupied by the Finger Lakes in central New York State?

- | | |
|------------------|---------------|
| 1 running water | 3 wind |
| 2 ocean currents | 4 glacial ice |

11 The diagram below shows two landscapes, A and B.



A

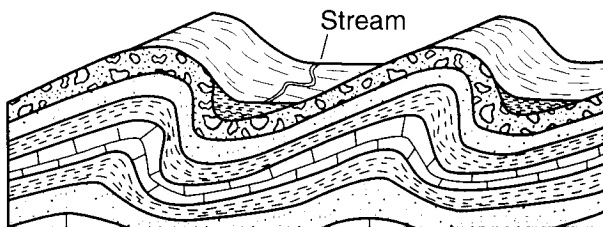


B

The difference in appearance of these two landscapes was caused mainly by a difference in the

- | | |
|--------------------|------------------|
| 1 climate | 3 rock type |
| 2 amount of uplift | 4 rock structure |

12 The diagram below shows a cross section of a portion of Earth's crust.



The hills of this area were formed primarily by

- | | |
|--------------------|---------------------|
| 1 bedrock folding | 3 stream erosion |
| 2 bedrock faulting | 4 volcanic activity |

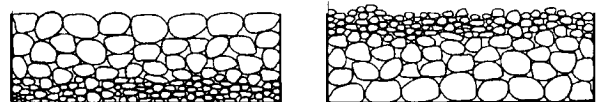
13 Which type of climate has the greatest amount of rock weathering caused by frost action?

- 1 a wet climate in which temperatures remain below freezing
- 2 a wet climate in which temperatures alternate from below freezing to above freezing
- 3 a dry climate in which temperatures remain below freezing
- 4 a dry climate in which temperatures alternate from below freezing to above freezing

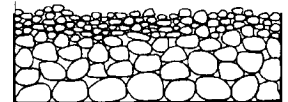
14 The *Generalized Bedrock Geology Map of New York State* provides evidence that water flows from Lake Erie into Lake Ontario by showing that Lake Ontario

- 1 is north of Lake Erie
- 2 is deeper than Lake Erie
- 3 has a larger surface area than Lake Erie
- 4 has a lower surface elevation than Lake Erie

15 Quartz particles of varying sizes are dropped at the same time into deep, calm water. Which cross section best represents the settling pattern of these particles?



(1)



(3)

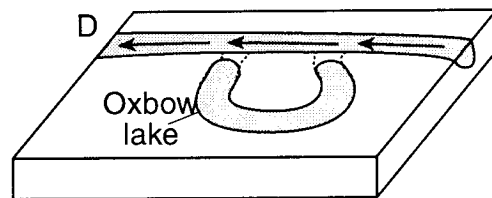
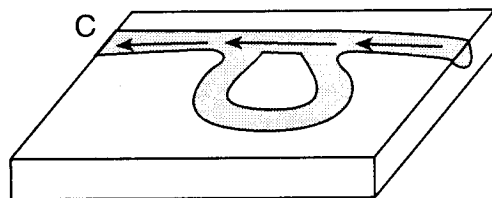
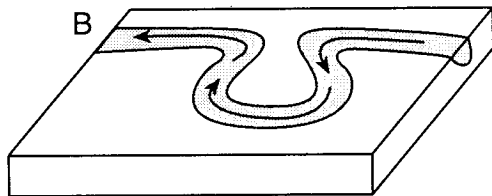
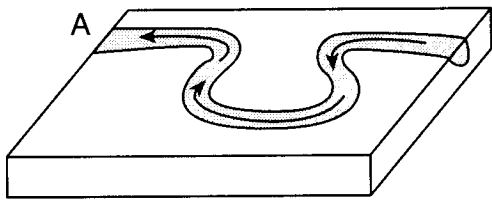


(2)



(4)

16 The diagrams below show the stages, A through D, in the formation of an oxbow lake over a period of time. [The arrows indicate the direction of streamflow.]



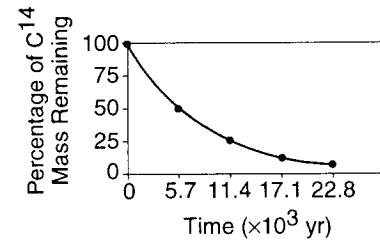
Oxbow lakes are generally formed by

- 1 erosion, resulting in a sudden increase in the stream's gradient
- 2 deposition, resulting in a sudden increase in the stream's gradient
- 3 erosion along the outside banks of the curve in a meandering stream
- 4 deposition along the outside banks of the curve in a meandering stream

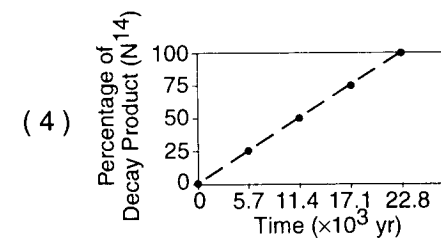
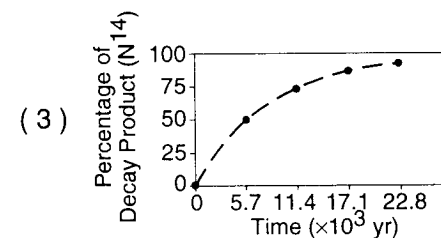
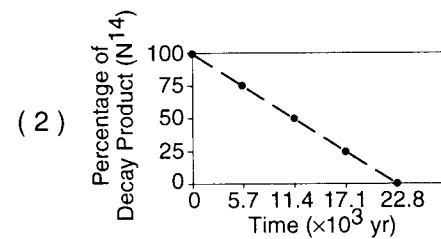
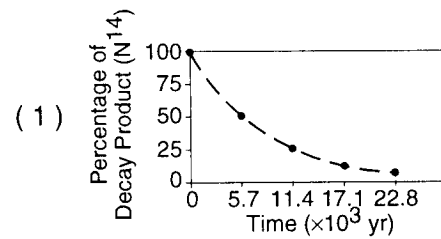
17 Trilobite fossils were recently discovered in Himalayan Mountain bedrock. During which geologic period could these organisms have lived?

- | | |
|--------------|------------|
| 1 Tertiary | 3 Triassic |
| 2 Cretaceous | 4 Cambrian |

18 A graph of the radioactive decay of carbon-14 is shown below.



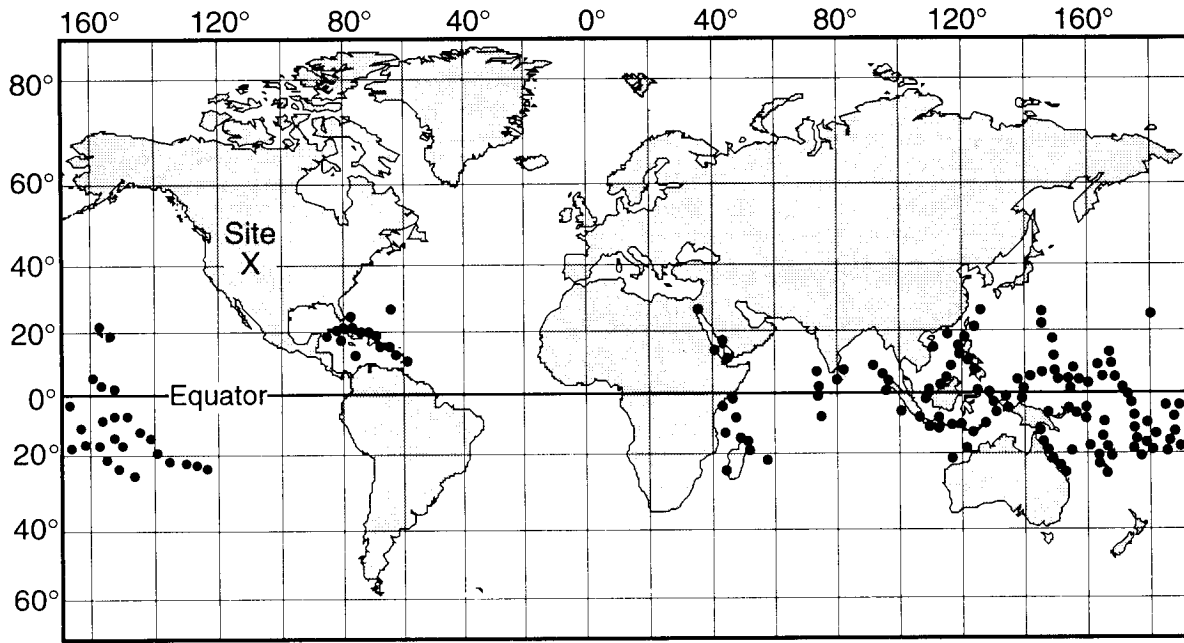
Which graph correctly shows the accumulation of nitrogen-14, the decay product of carbon-14, over the same period?



19 What is the geologic age of the surface bedrock of most of the Allegheny Plateau landscape region in New York State?

- | | |
|------------|--------------|
| 1 Cambrian | 3 Silurian |
| 2 Devonian | 4 Ordovician |

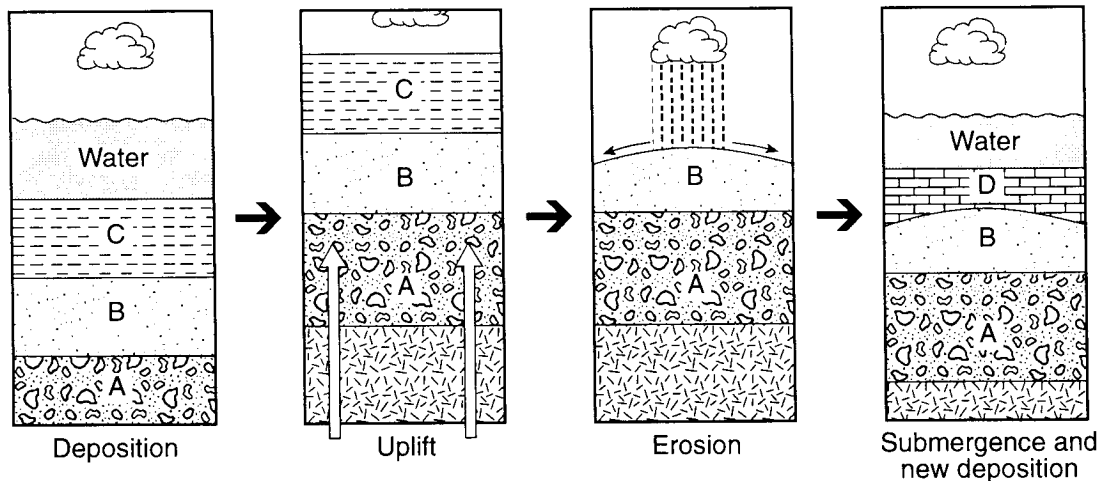
20 The dots on the map below show the present locations of living coral reefs. Site X indicates an area of fossil coral reefs preserved in rocks formed during the Jurassic Period.



Which inference is best supported by this map?

- 1 The climate at site X during the Jurassic Period was colder than the present climate at site X.
- 2 Site X was covered by warm ocean water during the Jurassic Period.
- 3 Site X has drifted southward since the Jurassic Period.
- 4 The coral at site X evolved from ocean-dwelling animals into land-dwelling animals after the Jurassic Period.

21 The diagrams below show the sequence of events that formed sedimentary rock layers A, B, C, and D.



This sequence of events best illustrates the

- 1 formation of a buried erosional surface (unconformity)
- 2 movement of rock layers along a fault between layers B and D
- 3 overturning of rock layers
- 4 metamorphism of sandstone (layer B) into quartzite

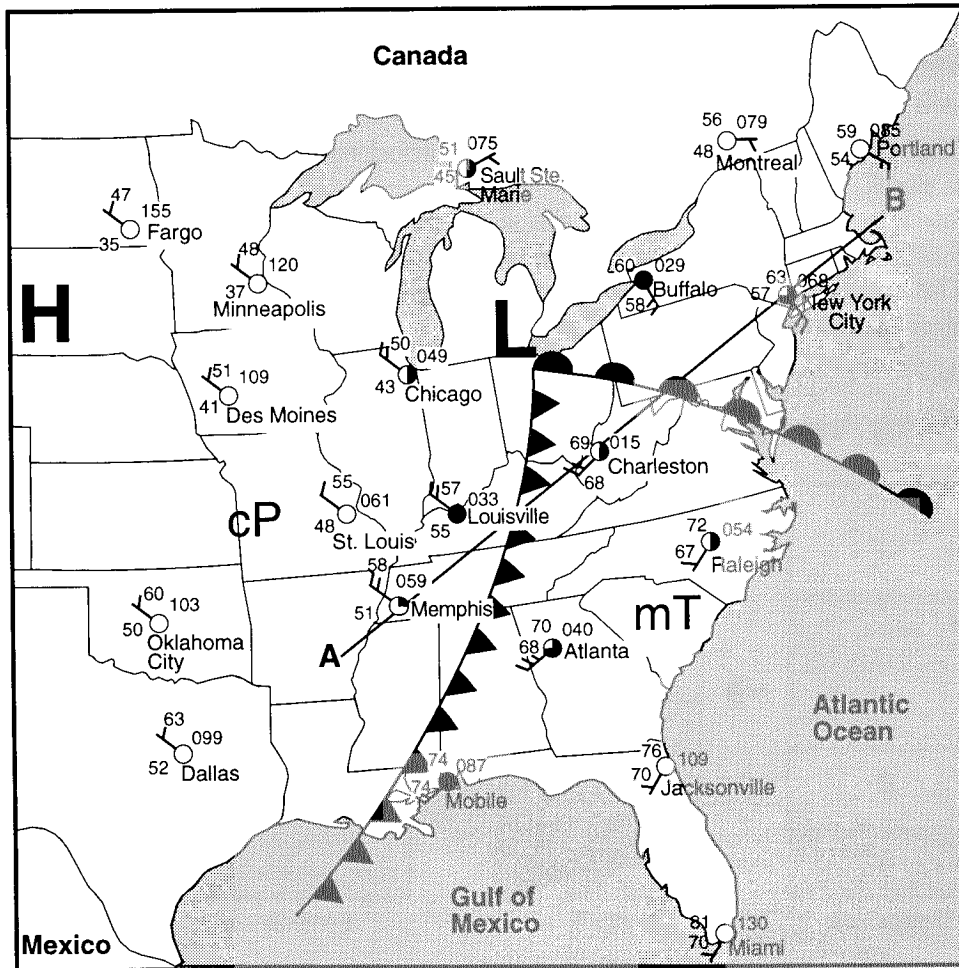
22 The table below shows characteristics of three landscape regions, X, Y, and Z.

Landscape Region	Relief	Bedrock
X	Great relief, high peaks, deep valleys	Many types, including igneous and metamorphic rocks, nonhorizontal structure
Y	Moderate to high relief	Flat layers of sedimentary rock or lava flows
Z	Very little relief, low elevations	Many types and structures

Which terms, when substituted for X, Y, and Z, best complete the table?

- (1) X = mountains, Y = plains, Z = plateaus
- (2) X = plateaus, Y = mountains, Z = plains
- (3) X = plains, Y = plateaus, Z = mountains
- (4) X = mountains, Y = plateaus, Z = plains

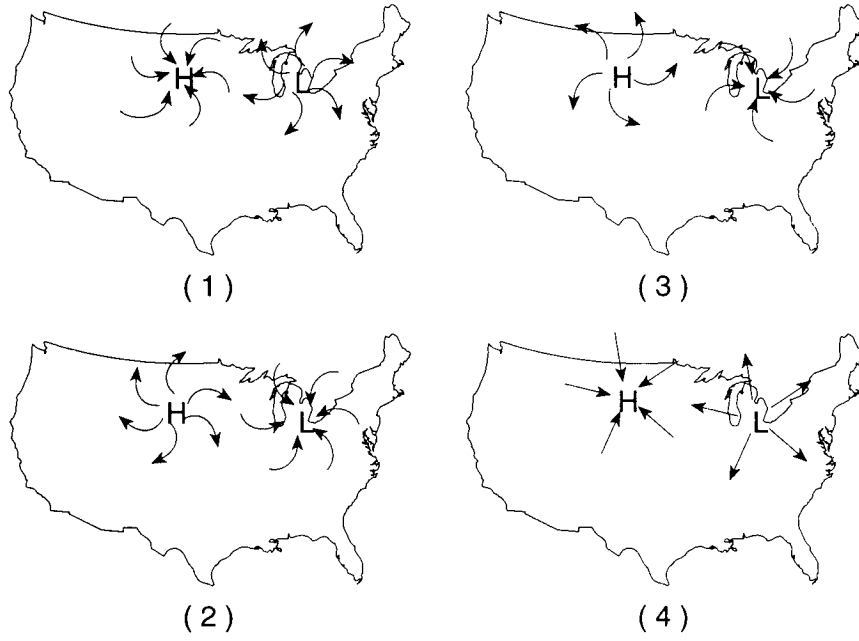
Base your answers to questions 23 through 25 on the weather map below, which shows weather systems over the central and eastern United States and weather data for several cities.



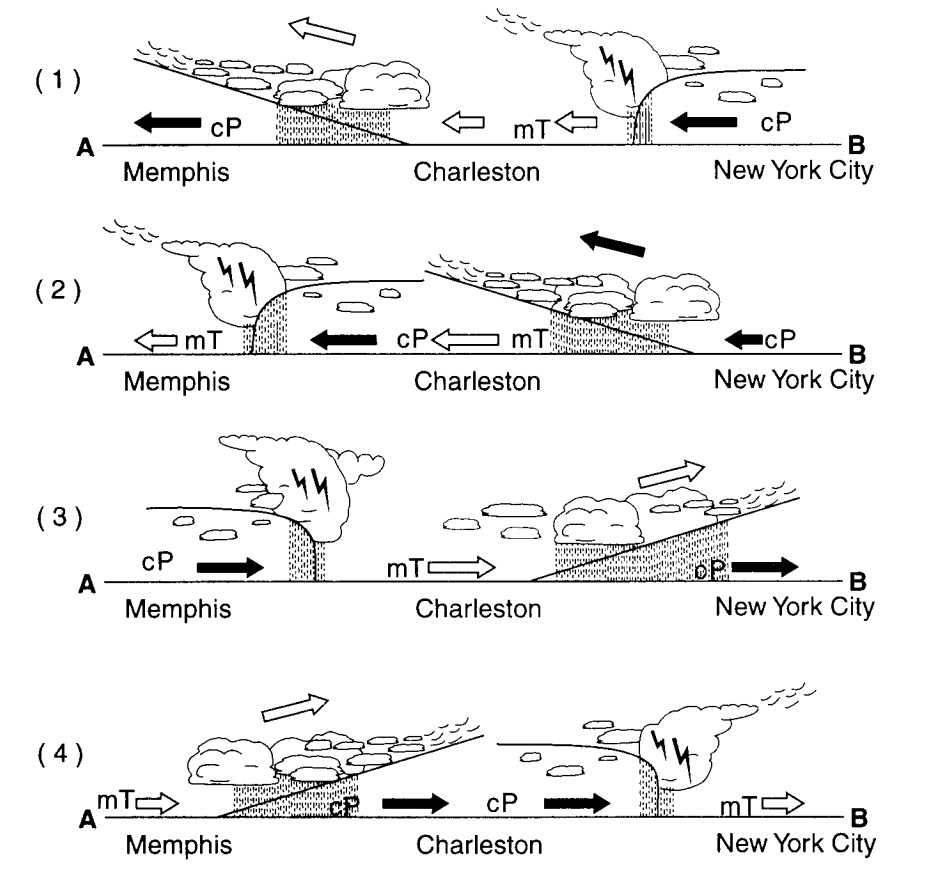
23 The cP air mass shown on the map most likely developed over

- 1 central Canada
- 2 central Mexico
- 3 the Gulf of Mexico
- 4 the North Atlantic

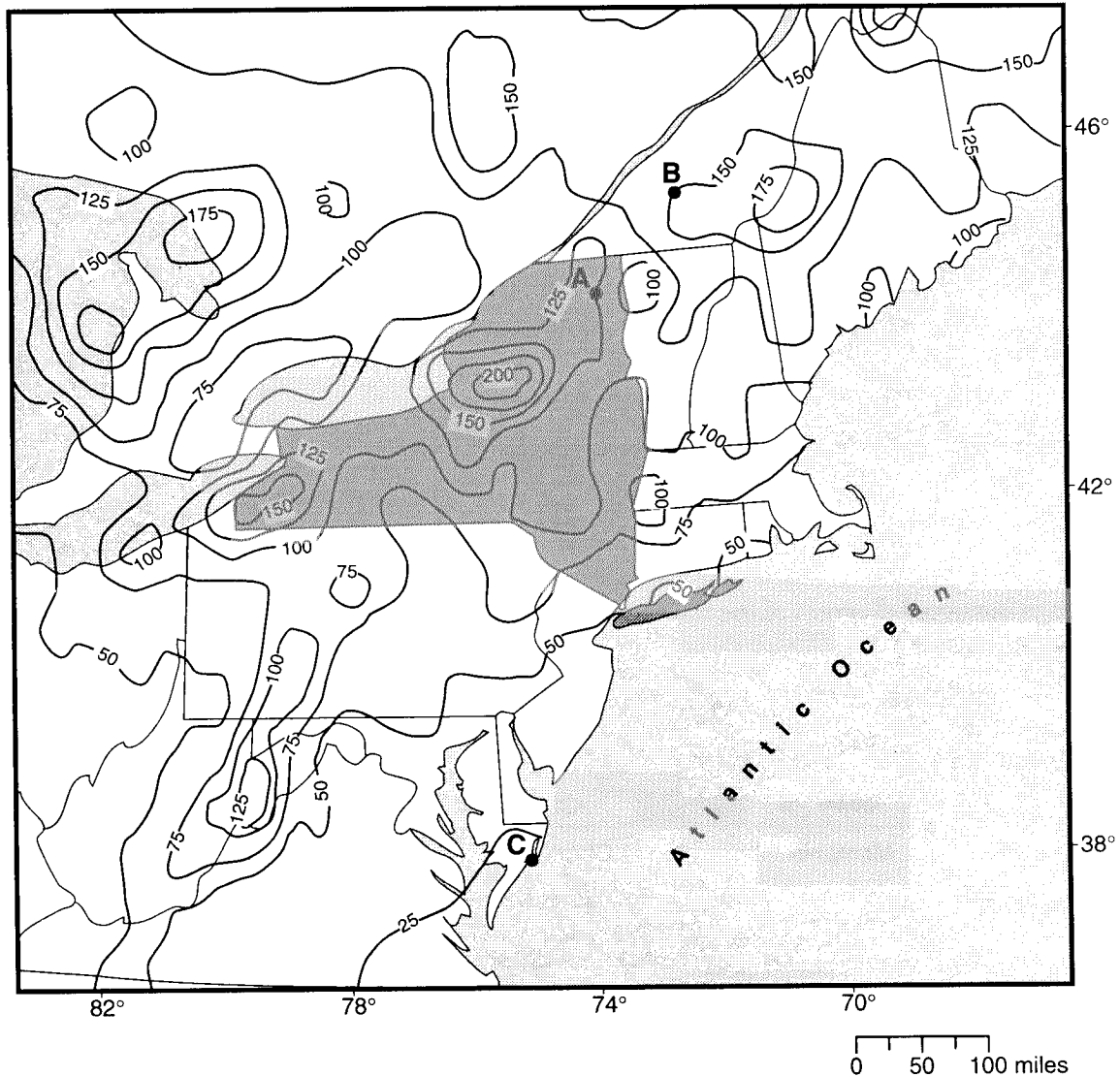
24 Which map correctly shows the movement of surface air associated with the high-pressure and low-pressure systems?



25 Which cross-sectional diagram of the lower atmosphere along line AB best represents the movement of the fronts and air masses?



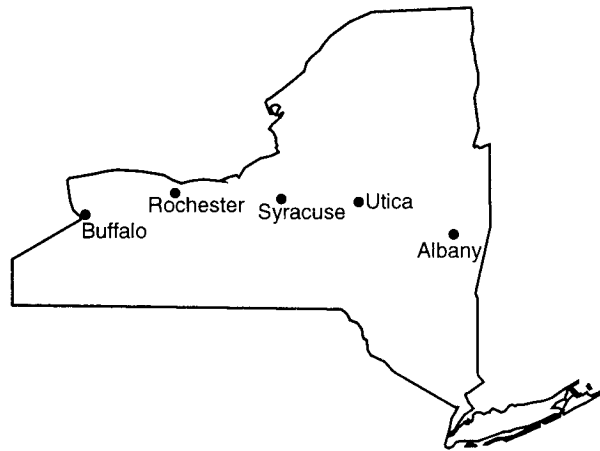
Base your answers to questions 26 through 28 on the map below. The map shows a portion of the eastern United States with New York State shaded. The isolines on the map indicate the average yearly total snowfall, in inches, recorded over a 20-year period. Points A, B, and C are locations on Earth's surface. Latitude and longitude coordinates are shown along the border of the map.



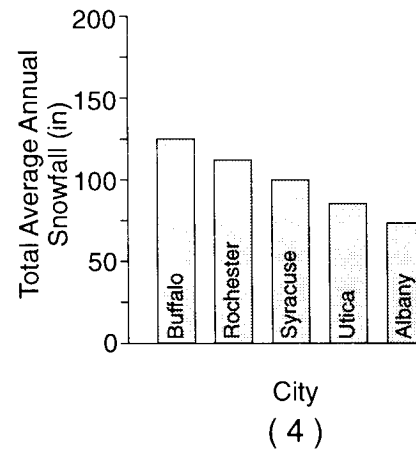
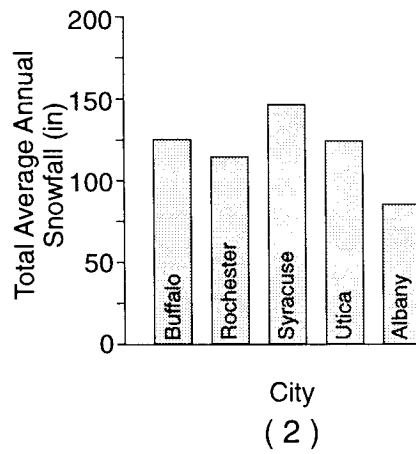
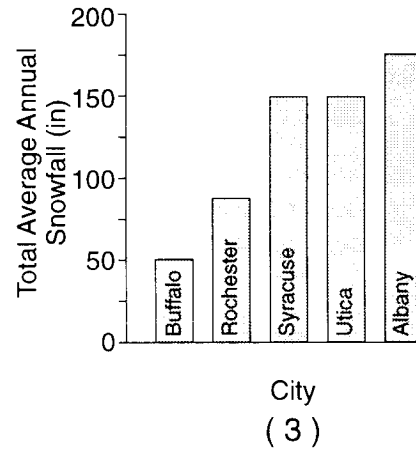
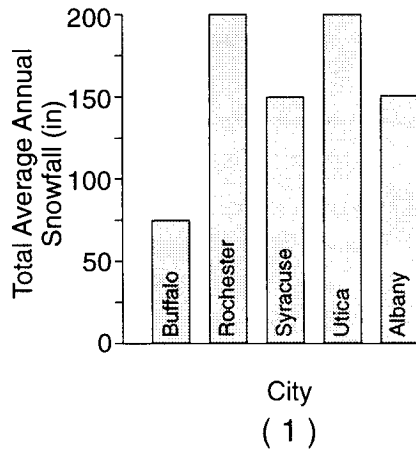
- 26 Location C has a lower average yearly snowfall than location A primarily because location C has a
- 1 lower latitude
 - 2 higher longitude
 - 3 higher elevation
 - 4 different prevailing wind direction

- 27 What is the approximate average yearly total snowfall gradient between locations A and B?
- | | |
|----------------|----------------|
| (1) 0.25 in/mi | (3) 0.40 in/mi |
| (2) 2.50 in/mi | (4) 4.00 in/mi |

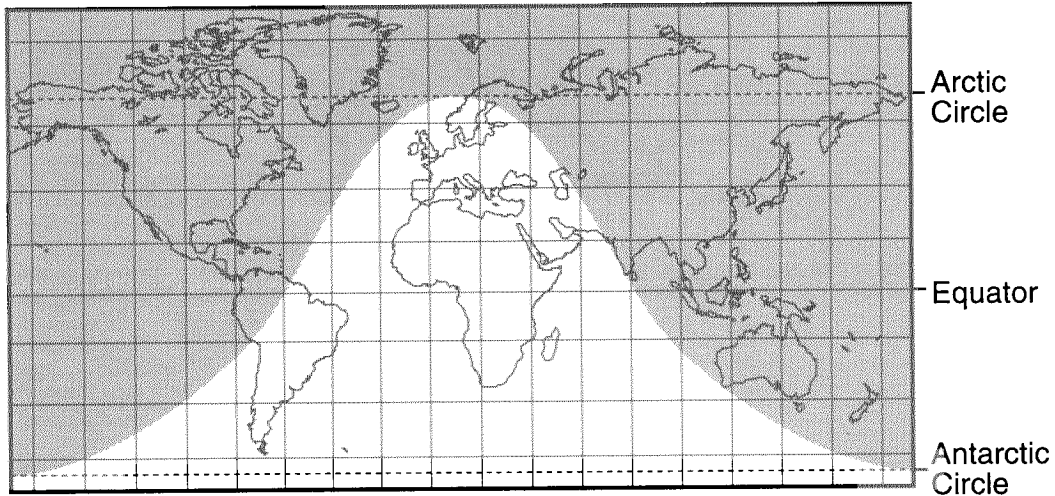
28 The diagram below shows the location of five cities in New York State.



Which graph best represents the total average annual snowfall for each of the five cities?



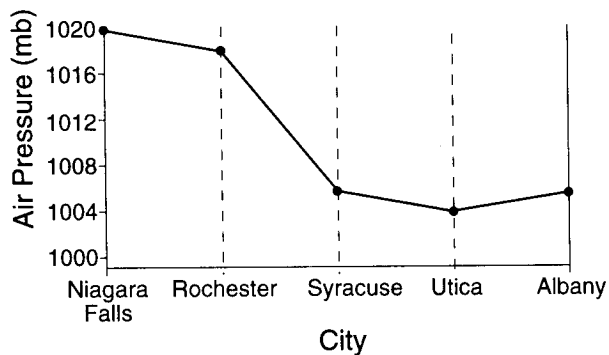
29 The shaded portion of the map below indicates areas of night and the unshaded portion indicates areas of daylight.



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

- | | |
|------------|----------------|
| 1 March 21 | 3 September 21 |
| 2 June 21 | 4 December 21 |

30 The graph below shows the air pressure recorded at the same time at several locations between Niagara Falls and Albany.



Based on the information in this graph, the wind velocity is probably greatest between which two cities?

- 1 Niagara Falls and Rochester
- 2 Rochester and Syracuse
- 3 Syracuse and Utica
- 4 Utica and Albany

31 Which current is a cool ocean current that flows completely around Earth?

- 1 West Wind Drift
- 2 Gulf Stream
- 3 North Equatorial Current
- 4 California Current

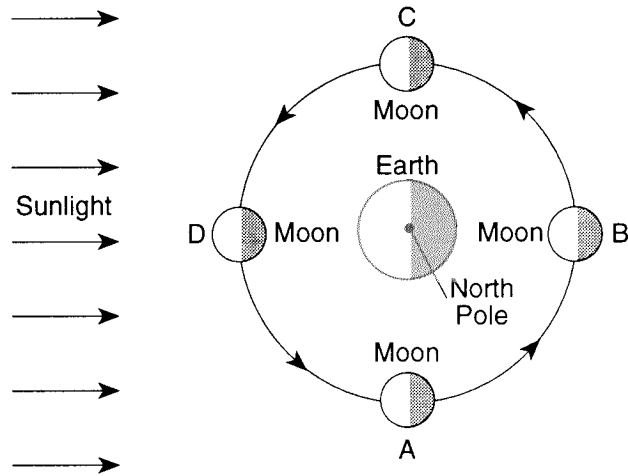
32 During how many days of a calendar year is the Sun directly overhead at noon in New York State?

- | | |
|-----------------|--------------|
| (1) only 1 day | (3) 365 days |
| (2) only 2 days | (4) 0 days |

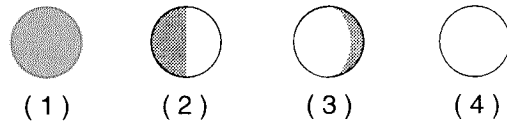
33 Ozone is important to life on Earth because ozone

- 1 cools refrigerators and air-conditioners
- 2 absorbs energy that is reradiated by Earth
- 3 absorbs harmful ultraviolet radiation
- 4 destroys excess atmospheric carbon dioxide

Base your answers to questions 34 and 35 on the diagram below, which shows the Moon in four different positions, A, B, C, and D, as it orbits Earth.



34 How does the Moon appear to an observer in New York State when the Moon is located at position A?



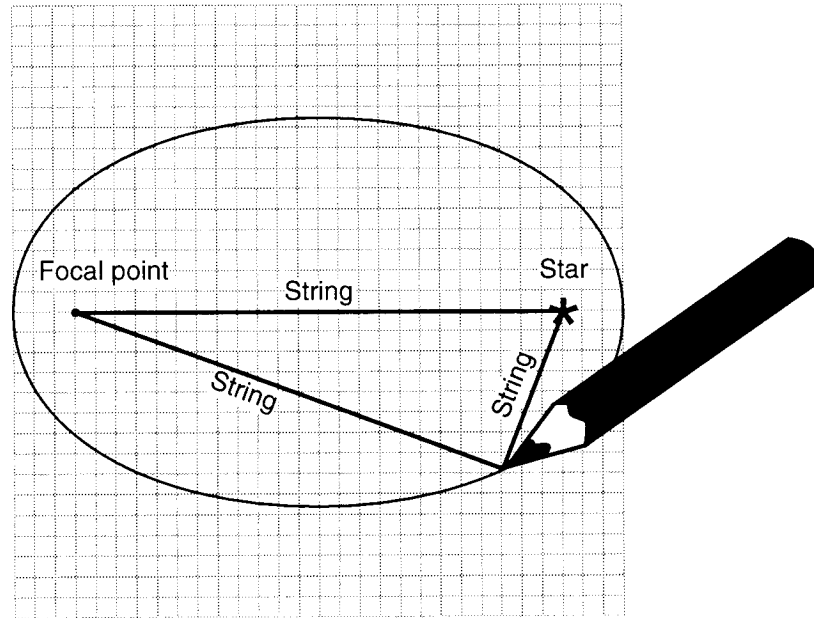
35 The cartoon below shows a comical view of an eclipse as viewed from Earth.



The type of eclipse represented in the cartoon might occur when the Moon is located at position

- (1) A (3) C
 (2) B (4) D

36 The diagram below represents the construction of a model of an elliptical orbit of a planet traveling around a star. The focal point and the center of the star represent the foci of the orbit.

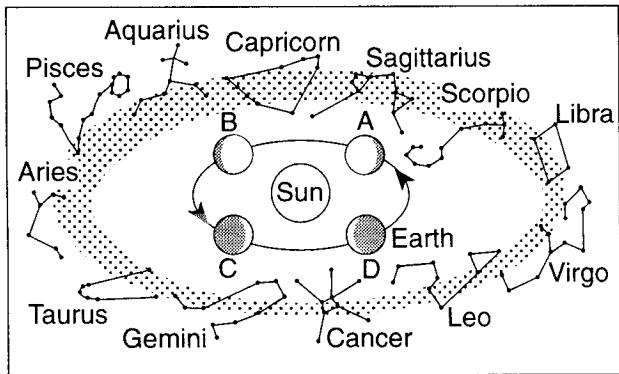


(Drawn to scale)

The eccentricity of this orbit is approximately

- | | |
|---------|---------|
| (1) 1.3 | (3) 0.5 |
| (2) 0.8 | (4) 0.3 |

Base your answers to questions 37 and 38 on the diagram below. The diagram shows twelve constellations that are visible in the night sky to an observer in New York State, over the course of a year. Different positions of Earth are represented by letters A through D. The arrows represent the direction of Earth's motion around the Sun.



(Not drawn to scale)

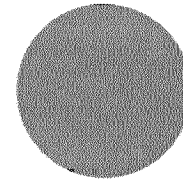
37 Which constellations are both visible at midnight to an observer in New York State when Earth is located at position D?

- 1 Aries and Taurus
- 2 Pisces and Libra
- 3 Leo and Virgo
- 4 Aquarius and Scorpio

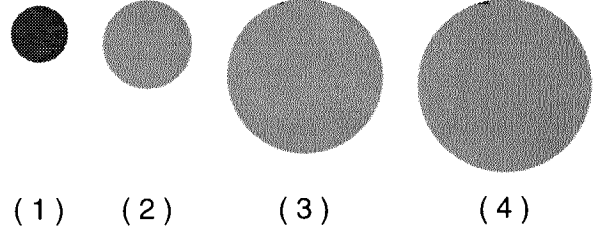
38 The constellations observed from New York State when Earth is at position A are different from the constellations observed when Earth is at position C because

- 1 Earth moves in its orbit
- 2 Earth is tilted on its axis
- 3 the lengths of day and night are different
- 4 the stars move around Earth as shown by star trails

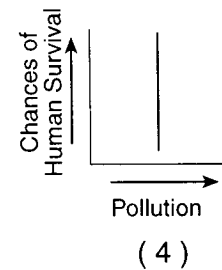
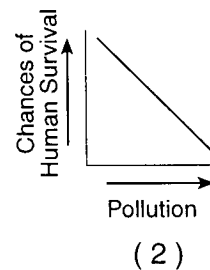
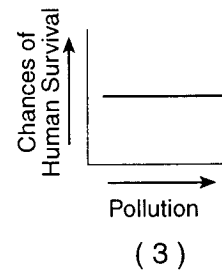
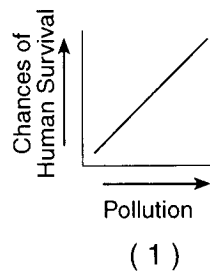
39 The diagram below represents Earth.



Which diagram best represents Mars, drawn to the same scale?



40 Which graph shows the most probable effect of environmental pollution on the chances of human survival?



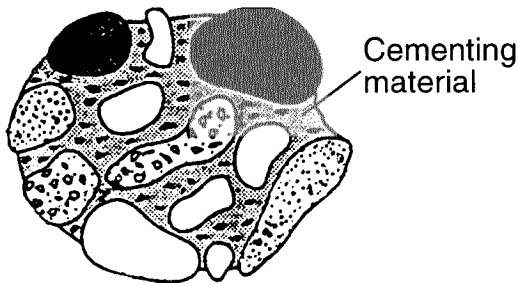
Part II

This part consists of six groups, each containing five questions. Choose any *two* of these six groups. Be sure that you answer all five questions in each of the two groups chosen. Record the answers to these questions on the separate answer paper in accordance with the directions on the front cover of this booklet. Some questions may require the use of the *Earth Science Reference Tables*. [10]

Group A — Rocks and Minerals

If you choose this group, be sure to answer questions 41–45.

Base your answers to questions 41 and 42 on the rock sample shown below.



(Actual size)

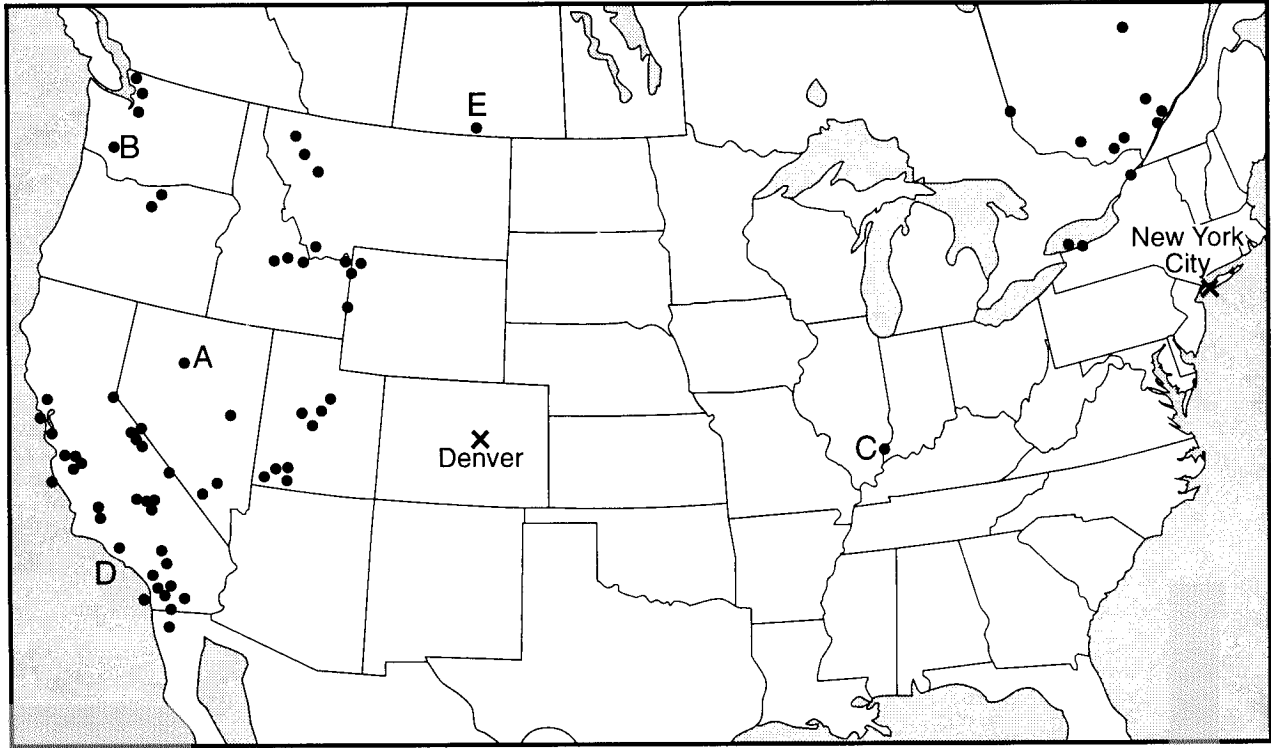
- 41 The rounded pebbles of this rock have been cemented together to form
- 1 granite, an igneous rock
 - 2 conglomerate, a sedimentary rock
 - 3 siltstone, a sedimentary rock
 - 4 gneiss, a metamorphic rock
- 42 The average size of the pebbles in the sample is approximately
- | | |
|------------|-------------|
| (1) 1.2 cm | (3) 6.4 cm |
| (2) 0.2 cm | (4) 13.2 cm |

- 43 Different arrangements of tetrahedra in the silicate group of minerals result in differences in the minerals'
- 1 age, density, and smoothness
 - 2 cleavage, color, and abundance
 - 3 hardness, cleavage, and crystal shape
 - 4 chemical composition, size, and origin
- 44 Some Moon rock samples have coarse intergrown crystals composed of plagioclase feldspar, hornblende, and olivine. These Moon rock samples are most similar to Earth rock samples of
- | | |
|----------|-----------|
| 1 gabbro | 3 breccia |
| 2 marble | 4 pumice |
- 45 Which common mineral fizzes when dilute hydrochloric acid (HCl) is placed on it?
- | | |
|------------|----------|
| 1 calcite | 3 quartz |
| 2 feldspar | 4 talc |

Group B — Plate Tectonics

If you choose this group, be sure to answer questions 46–50.

Base your answers to questions 46 and 47 on the map below. The map shows epicenters of some of the earthquakes that occurred in North America during a 2-week period. Five epicenters are labeled A through E. Denver and New York City are also indicated.



0 500 1000 1500 2000 km

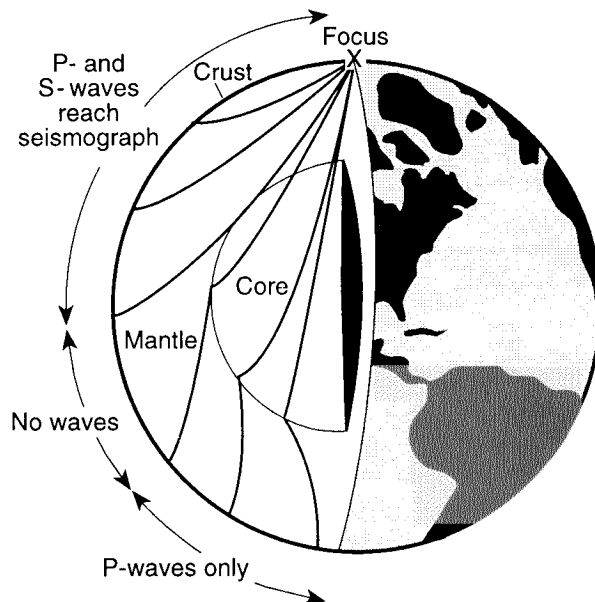
46 A seismograph station at Denver recorded the arrival of *P*-waves at 8:00 a.m. and the arrival of *S*-waves at 8:02 a.m. Which epicenter is located above the source of this earthquake?

- (1) A (3) C
(2) B (4) D

47 The distance from epicenter *E* to New York City is 3,000 kilometers. What was the approximate travel time for the *P*-waves from this epicenter to New York City?

- (1) 1 min 20 sec (3) 7 min 30 sec
(2) 5 min 40 sec (4) 10 min 00 sec

48 The cutaway diagram below shows the paths of earthquake waves generated at point X.



Only *P*-waves reach the side of Earth that is opposite the focus because *P*-waves

- 1 are stronger than *S*-waves
 - 2 travel faster than *S*-waves
 - 3 bend more than *S*-waves
 - 4 can travel through liquids and *S*-waves cannot
-

49 Magnetic readings taken across mid-ocean ridges provide evidence that

- 1 the seafloor is spreading
- 2 the ocean basins are older than the continents
- 3 the mid-ocean ridges are higher than the nearby plains
- 4 Earth's rate of rotation has changed

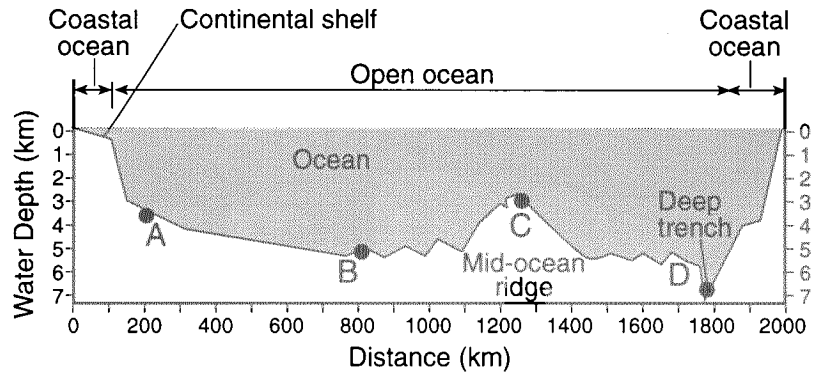
50 Compared to Earth's oceanic crust, Earth's continental crust is

- 1 thinner and composed of granite
 - 2 thinner and composed of basalt
 - 3 thicker and composed of granite
 - 4 thicker and composed of basalt
-

Group C — Oceanography

If you choose this group, be sure to answer questions 51–55.

- 51 The cross section below shows the ocean floor between two continents. Points A through D represent locations on the ocean floor where samples of oceanic crust were collected.



The youngest rock sample most likely was collected from location

- (1) A (2) B (3) C (4) D

- 52 Waste produced by people in New York State has been dumped into the Atlantic Ocean, where it is distributed by surface ocean currents. Which coastal area is most likely to become polluted by this waste?

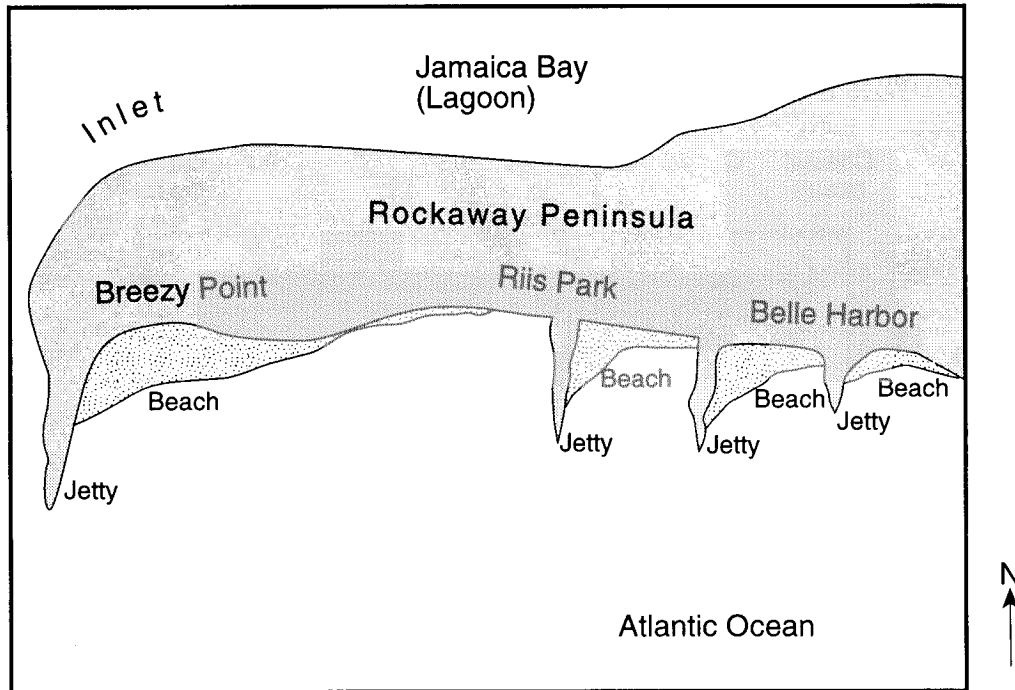
- 1 western coast of Europe
2 southern coast of South America
3 western coast of Mexico
4 eastern coast of Africa

- 53 Tsunamis are caused by

- 1 Earth's rotation 3 hurricane winds
2 dynamic equilibrium 4 earthquakes

GO RIGHT ON TO THE NEXT PAGE. 

Base your answers to questions 54 and 55 on the map below, which shows Rockaway Peninsula, part of Long Island's south shore.



54 Students compared recent photographs of the beaches with photographs taken three years ago and discovered that parts of the shoreline have changed. Which characteristic of the shoreline probably has changed most?

- 1 composition of the beach sand
- 2 size of the beaches
- 3 positions of the jetties
- 4 length of the peninsula

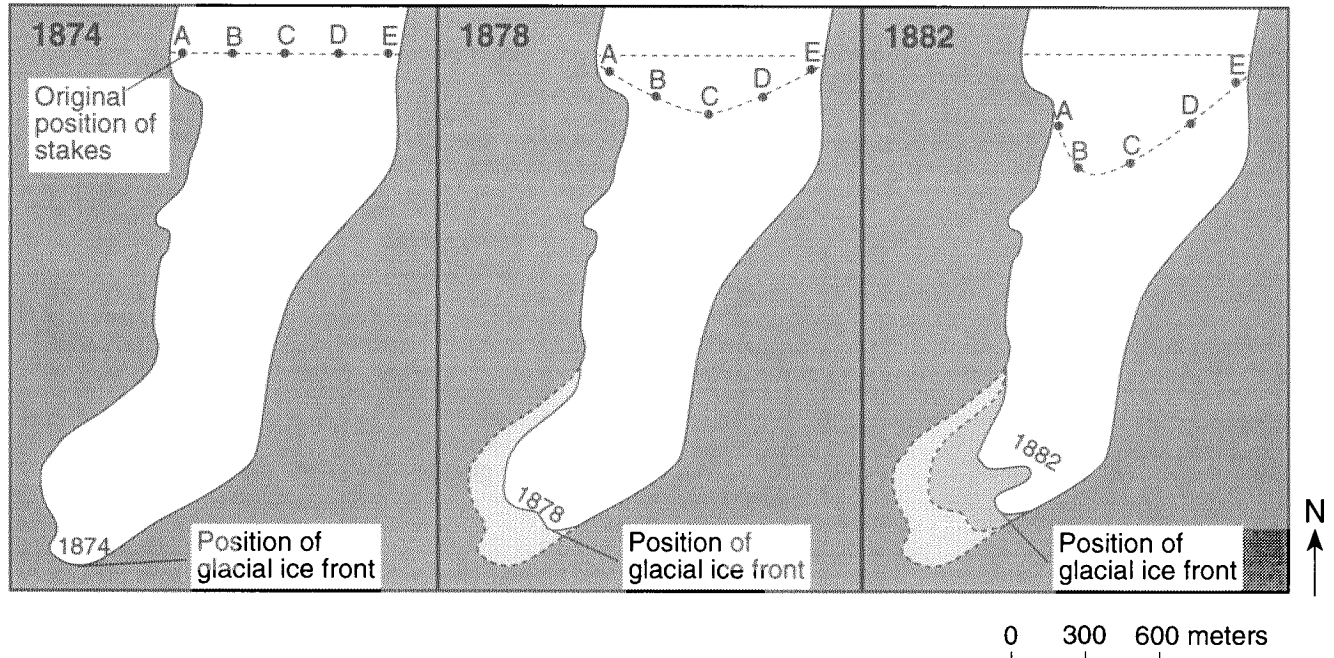
55 Toward which direction is sand being transported along the shoreline within the zone of breaking waves?

- | | |
|-------------|-------------|
| 1 northeast | 3 southeast |
| 2 south | 4 west |

Group D — Glacial Processes

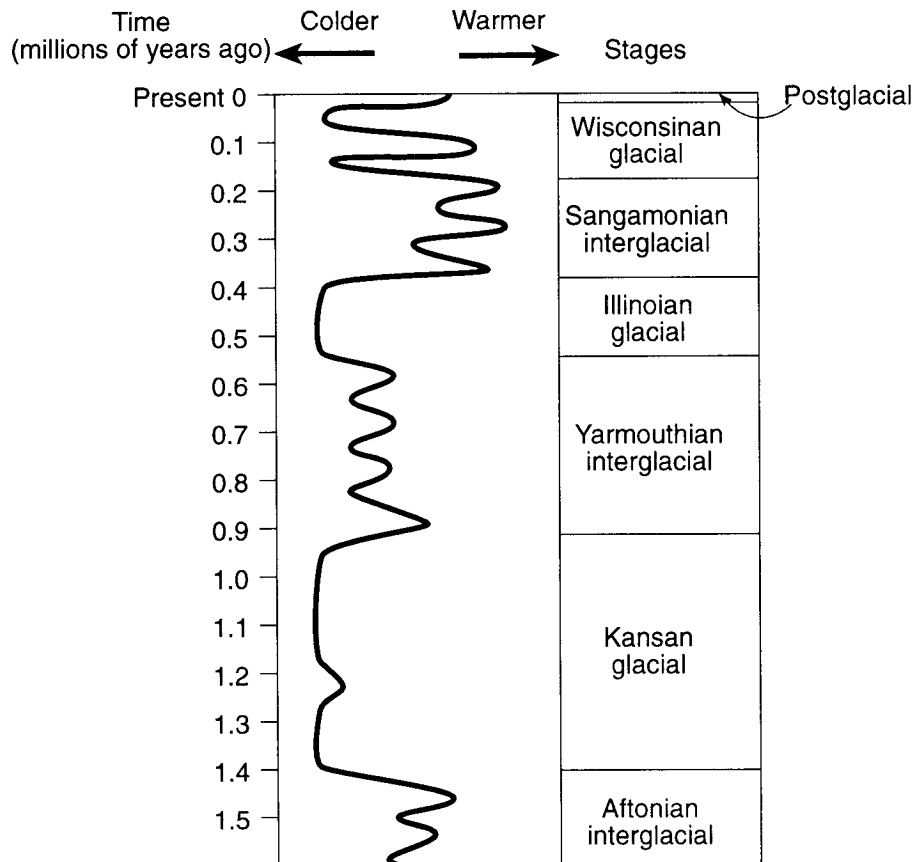
If you choose this group, be sure to answer questions 56–60.

Base your answers to questions 56 and 57 on the three maps below, which show the ice movement and changes at the ice front of an alpine glacier from the years 1874 to 1882. Points A, B, C, D, and E represent the positions of large markers placed on the glacial ice and left there for a period of eight years.



- 56 The changing positions of markers A, B, C, D, and E show that the glacial ice is
- 1 slowly becoming thicker
 - 2 forming smaller crystals
 - 3 gradually shifting northward
 - 4 moving fastest near the middle
- 57 Which statement best describes the changes happening to this glacier between 1874 and 1882?
- 1 The ice front was advancing, and the ice within the glacier was advancing.
 - 2 The ice front was advancing, and the ice within the glacier was retreating.
 - 3 The ice front was retreating, and the ice within the glacier was advancing.
 - 4 The ice front was retreating, and the ice within the glacier was retreating.
-
- 58 As a result of glaciation, New York State has
- 1 few lakes
 - 2 many V-shaped valleys
 - 3 many sand and gravel deposits
 - 4 thick soils formed "in place" from underlying bedrock

Base your answers to questions 59 and 60 on the chart below, which shows the changing climatic conditions that led to alternating glacial and interglacial periods.



- 59 The interglacial stages were most likely caused by
- 1 a drop in worldwide sea levels
 - 2 an increase in average worldwide temperature
 - 3 crustal plate movement
 - 4 a large increase in the amount of snowfall

- 60 The chart represents climatic conditions that occurred mostly during which geological time period?
- | | |
|---------------------|---------------------|
| 1 Triassic Period | 3 Quaternary Period |
| 2 Ordovician Period | 4 Cretaceous Period |

Group E — Atmospheric Energy

If you choose this group, be sure to answer questions 61–65.

61 At which latitudes do currents of dry, sinking air cause the dry conditions of Earth's major deserts?

- (1) 0° and 30° N (3) 30° N and 30° S
(2) 60° N and 60° S (4) 60° S and 90° S

62 At what approximate altitude would clouds begin to form when the surface air temperature is 30°C and the dewpoint is 14°C?

- (1) 1.1 km (3) 2.5 km
(2) 2.0 km (4) 3.7 km

63 A large amount of latent heat is absorbed by water during

- 1 evaporation 3 condensation
2 freezing 4 precipitation

64 When would the water in a New York State pond evaporate fastest?

- 1 in January, when the pond is frozen
2 in March, when the pond ice is melting
3 in May on a calm, sunny day
4 in July on a hot, windy day

Note that question 65 has only three choices.

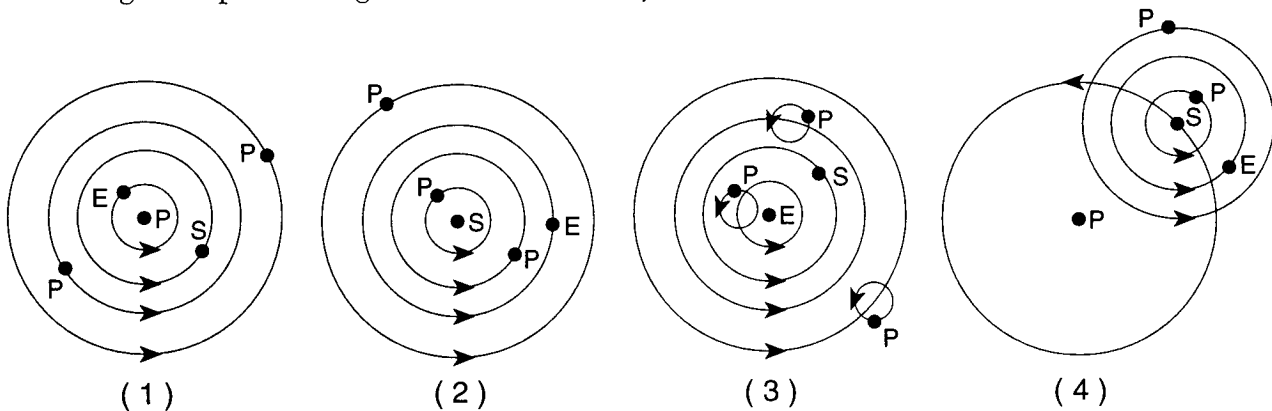
65 Compared to the accuracy of the 24-hour weather forecasts of the 1930's, the 24-hour weather forecasts of the 1990's are usually

- 1 less accurate
2 more accurate
3 equally accurate

Group F — Astronomy

If you choose this group, be sure to answer questions 66–70.

66 Which diagram represents a geocentric model? [Key: *E* = Earth, *P* = Planet, *S* = Sun]



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

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

68 Major ocean and air currents appear to curve to the right in the Northern Hemisphere because

- 1 Earth has seasons
- 2 Earth's axis is tilted
- 3 Earth rotates on its axis
- 4 Earth revolves around the Sun

69 Why are impact structures more obvious on the Moon than on Earth?

- 1 The Moon's gravity is stronger than Earth's gravity.
- 2 The Moon has little or no atmosphere.
- 3 The rocks on the Moon are weaker than those on Earth.
- 4 The Moon rotates at a slower rate than Earth does.

70 If the amount of greenhouse gases were to increase for a very long time, the atmosphere on Earth would become most like the atmosphere of

- | | |
|-----------|-----------|
| 1 Mercury | 3 Jupiter |
| 2 Venus | 4 Saturn |

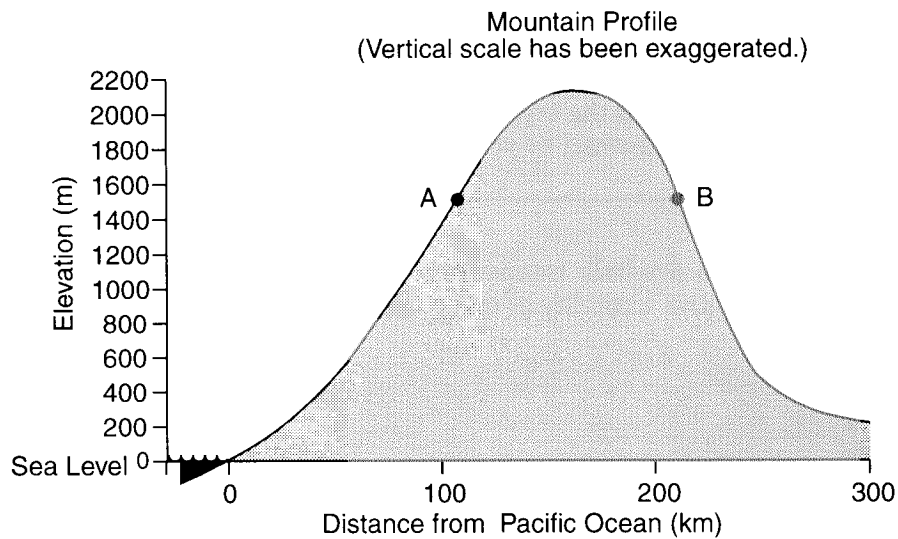
Part III

This part consists of questions 71 through 88. Be sure that you answer *all* questions in this part. Record your answers in the spaces provided on the separate answer paper. You may use pen or pencil. Some questions may require the use of the *Earth Science Reference Tables*. [25]

Base your answers to questions 71 and 72 on the data table and profile below. The data table gives the average annual precipitation for locations A and B. The profile represents a mountain in the western United States. Points A and B are locations on different sides of the mountain.

Data Table

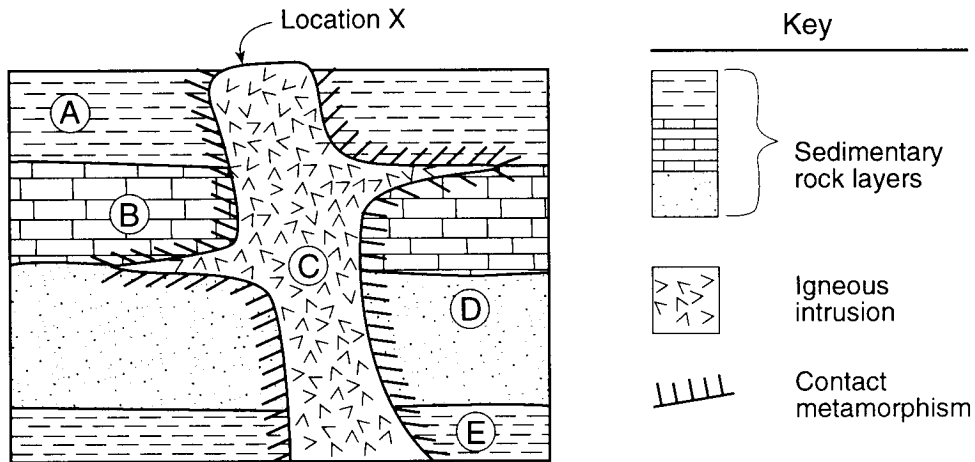
Location	Average Annual Precipitation (cm)
A	120
B	35



- 71 State the elevation of location A. [1]
- 72 State one probable reason for the difference in average annual precipitation between location A and location B. [1]
-

- 73 State one way in which a hurricane differs from a tornado. [1]

Base your answers to questions 74 through 76 on the geologic cross section below. The cross section shows an outcrop in which the layers have not been overturned. Rock units are labeled A through E.



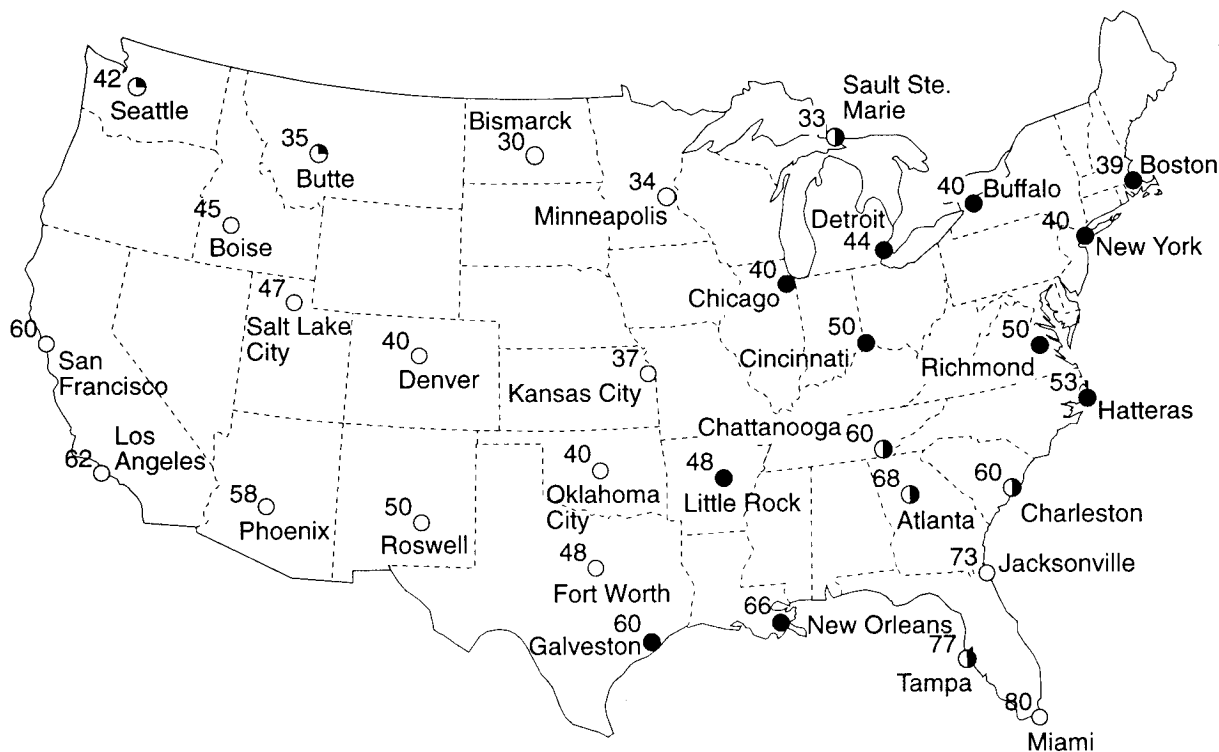
74 Using letters A through E, list the rock units in order from oldest to youngest. [2]

75 State the name of the sediment that was compacted to form rock unit A. [1]

76 State one observation about the crystals at location X that would provide evidence that igneous rock unit C was formed by very slow cooling of magma. [1]

77 A parcel of air has a dry-bulb temperature of 18°C and a wet-bulb temperature of 10°C. State the relative humidity of this parcel of air. [1]

Base your answers to questions 78 through 80 on the weather map below. The map shows temperature readings at weather stations in the continental United States.



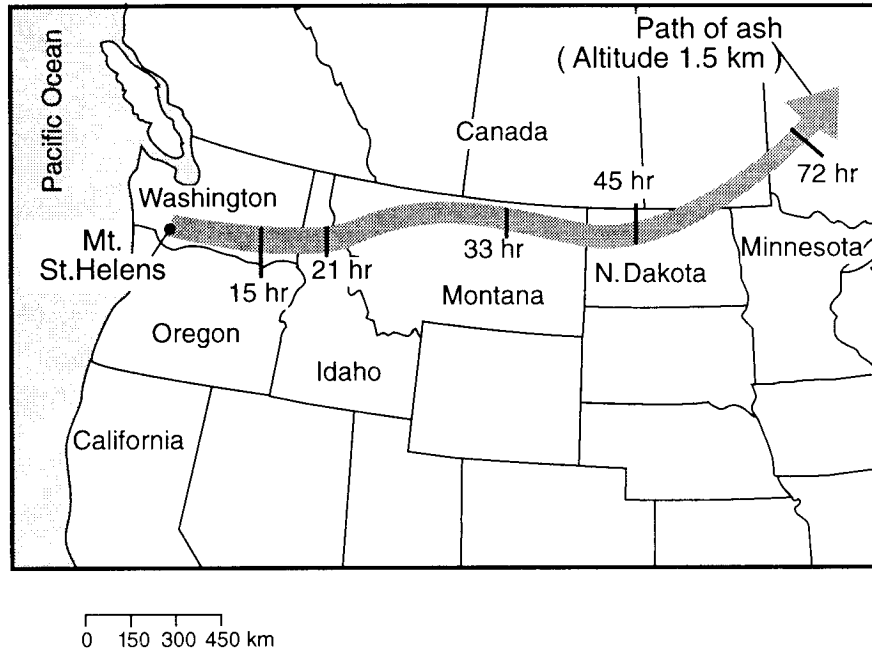
78 On the weather map provided *on your answer paper*, draw three isotherms: the 40°F isotherm, the 50°F isotherm, and the 60°F isotherm. [2]

79 In Richmond, Virginia, the wind direction is from the east at a speed of 20 knots. On the station model provided *on your answer paper*, draw the correct symbols for wind direction and windspeed. [2]

80 In addition to temperature, one other weather variable for each weather station is shown on the map. State the other weather variable. [1]

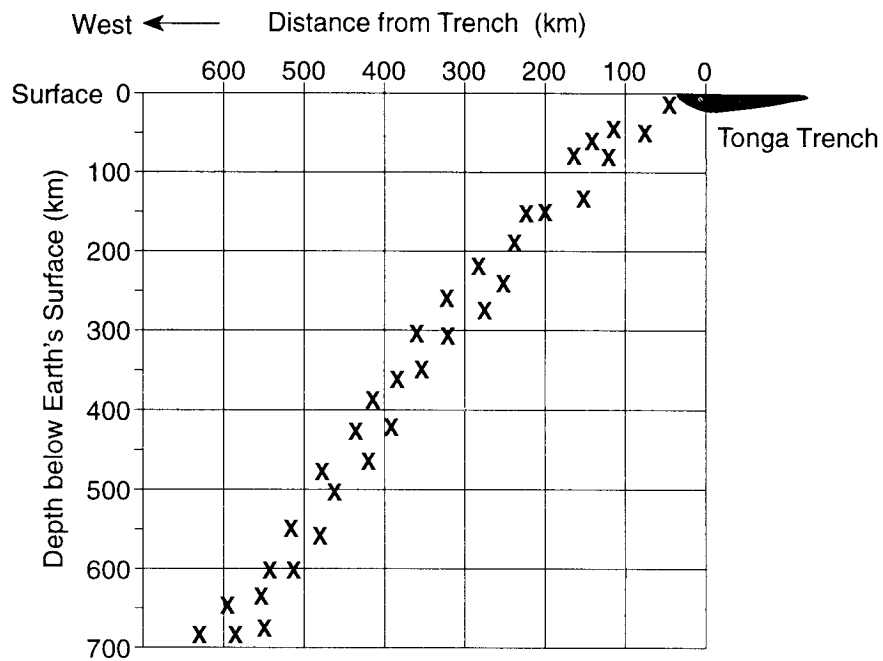
Base your answers to questions 81 and 82 on the information and map below.

The eruption of Mt. St. Helens in 1980 resulted in the movement of volcanic ash across the northwestern United States. The movement of the ash at 1.5 kilometers above sea level is shown as a shaded path on the map. The times marked on the path indicate the length of time the leading edge of the ash cloud took to travel from Mt. St. Helens to each location.



- 81 Calculate the average *rate* of movement of the volcanic ash for the first 15 hours, following the directions below.
- a Write the equation used to determine the average rate of the volcanic ash movement. [1]
 - b Substitute values into the equation. [1]
 - c Solve the equation and label the answer with the correct units. [2]
- 82 The movement of the ash occurred at an altitude of 1.5 kilometers. State the name of the layer of Earth's atmosphere in which the ash cloud traveled. [1]
-

Base your answers to questions 83 through 85 on the cross section of a portion of Earth's interior below. The cross section shows the focal depth of some earthquakes that occurred west of the Tonga Trench. Data were collected along the 22° S parallel of latitude.



- 83 State the relationship between the depth of an earthquake's focus and the earthquake's distance from the Tonga Trench. [1]
- 84 The Tonga Trench is the crustal surface boundary between two tectonic plates. State the names of the two plates. [1]
- 85 The focal depth pattern shown on the cross section represents the location of the sub-surface boundary between the two tectonic plates. Describe the relative motion of the plates along this boundary. [1]
-

Base your answers to questions 86 through 88 on the tables below. Table 1 shows the average distance from the Sun in astronomical units (AU) and the average orbital speed in kilometers per second (km/s) of the nine planets in our solar system. Table 2 lists five large asteroids and their average distances from the Sun.

Table 1

Planet	Average Distance from Sun (AU)	Average Orbital Speed (km/s)
Mercury	0.4	48.0
Venus	0.7	35.0
Earth	1.0	30.0
Mars	1.5	24.0
Jupiter	5.2	13.0
Saturn	9.6	10.0
Uranus	19.0	7.0
Neptune	30.0	5.1
Pluto	39.0	4.7

Table 2

Asteroid	Average Distance from Sun (AU)
Ceres	2.8
Pallas	2.8
Vesta	2.4
Hygiea	3.2
Juno	2.7

- 86 On the grid provided *on your answer paper*, plot the average distance from the Sun and the average orbital speed for each of the nine planets listed in table 1. Connect the nine points with a line. [2]
- 87 State the relationship between a planet's average distance from the Sun and the planet's average orbital speed. [1]
- 88 The orbits of the asteroids listed in table 2 are located between two adjacent planetary orbits. State the names of the two planets. [1]
-

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

EARTH SCIENCE
PROGRAM MODIFICATION EDITION

Friday, June 18, 1999 — 1:15 to 4:15 p.m., only

ANSWER PAPER

Part I Credits	.....	.....
Part II Credits	.....	.....
Part III Credits	.....	.....
Performance Test Credits	....	.....
Local Project Credits	.....	<u>.....</u>
Total (Official Regents)		
Examination Mark	.....	.....
Reviewer's Initials:	_____	

Student Sex: Male Female

Teacher School

Grade (circle one) 8 9 10 11 12

Record all of your answers on this answer paper in accordance with the instructions on the front cover of the test booklet.

Part I (40 credits)

- | | | | | | | | | | | | | | | |
|----|---|---|---|---|----|---|---|---|---|----|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 15 | 1 | 2 | 3 | 4 | 29 | 1 | 2 | 3 | 4 |
| 2 | 1 | 2 | 3 | 4 | 16 | 1 | 2 | 3 | 4 | 30 | 1 | 2 | 3 | 4 |
| 3 | 1 | 2 | 3 | 4 | 17 | 1 | 2 | 3 | 4 | 31 | 1 | 2 | 3 | 4 |
| 4 | 1 | 2 | 3 | 4 | 18 | 1 | 2 | 3 | 4 | 32 | 1 | 2 | 3 | 4 |
| 5 | 1 | 2 | 3 | 4 | 19 | 1 | 2 | 3 | 4 | 33 | 1 | 2 | 3 | 4 |
| 6 | 1 | 2 | 3 | 4 | 20 | 1 | 2 | 3 | 4 | 34 | 1 | 2 | 3 | 4 |
| 7 | 1 | 2 | 3 | 4 | 21 | 1 | 2 | 3 | 4 | 35 | 1 | 2 | 3 | 4 |
| 8 | 1 | 2 | 3 | 4 | 22 | 1 | 2 | 3 | 4 | 36 | 1 | 2 | 3 | 4 |
| 9 | 1 | 2 | 3 | 4 | 23 | 1 | 2 | 3 | 4 | 37 | 1 | 2 | 3 | 4 |
| 10 | 1 | 2 | 3 | 4 | 24 | 1 | 2 | 3 | 4 | 38 | 1 | 2 | 3 | 4 |
| 11 | 1 | 2 | 3 | 4 | 25 | 1 | 2 | 3 | 4 | 39 | 1 | 2 | 3 | 4 |
| 12 | 1 | 2 | 3 | 4 | 26 | 1 | 2 | 3 | 4 | 40 | 1 | 2 | 3 | 4 |
| 13 | 1 | 2 | 3 | 4 | 27 | 1 | 2 | 3 | 4 | | | | | |
| 14 | 1 | 2 | 3 | 4 | 28 | 1 | 2 | 3 | 4 | | | | | |

Part II (10 credits)

Answer the questions in two of the six groups in this part. Be sure to mark the answers to the groups you choose in accordance with the instructions on the front cover of the test booklet. Leave blank the spaces for the four groups of questions you do not choose to answer.

Group A					
Rocks and Minerals					
41	1	2	3	4	
42	1	2	3	4	
43	1	2	3	4	
44	1	2	3	4	
45	1	2	3	4	

Group B					
Plate Tectonics					
46	1	2	3	4	
47	1	2	3	4	
48	1	2	3	4	
49	1	2	3	4	
50	1	2	3	4	

Group C					
Oceanography					
51	1	2	3	4	
52	1	2	3	4	
53	1	2	3	4	
54	1	2	3	4	
55	1	2	3	4	

Group D					
Glacial Processes					
56	1	2	3	4	
57	1	2	3	4	
58	1	2	3	4	
59	1	2	3	4	
60	1	2	3	4	

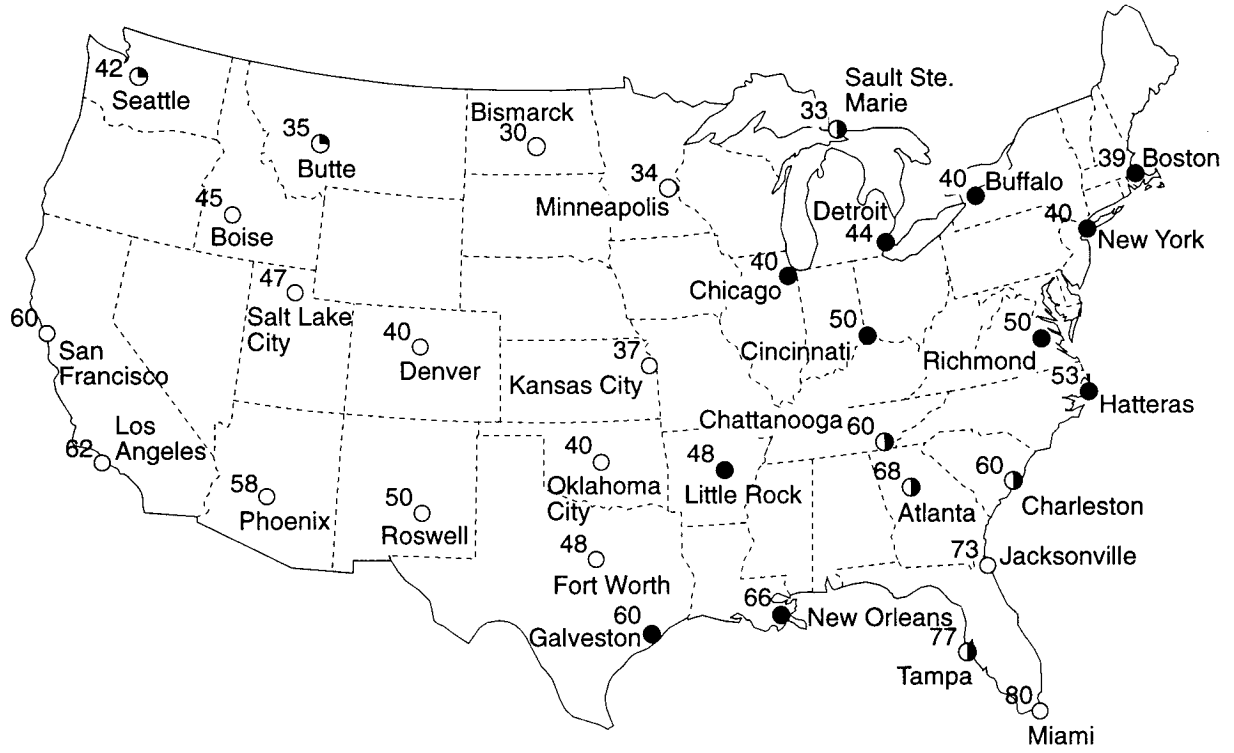
Group E					
Atmospheric Energy					
61	1	2	3	4	
62	1	2	3	4	
63	1	2	3	4	
64	1	2	3	4	
65	1	2	3		

Group F					
Astronomy					
66	1	2	3	4	
67	1	2	3	4	
68	1	2	3	4	
69	1	2	3	4	
70	1	2	3	4	

Part III (25 credits)

Answer *all* questions in this part.

<p>71 _____ meters</p> <p>72 _____</p> <p>_____</p> <p>_____</p>	<p>74 <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> </tr> </table></p> <p align="center">Oldest Youngest</p> <p>75 _____</p> <p>76 _____</p> <p>_____</p> <p>_____</p>					
<p>73 _____</p> <p>_____</p> <p>_____</p>	<p>77 _____ %</p>					



79

50



Richmond

80

81 a

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82

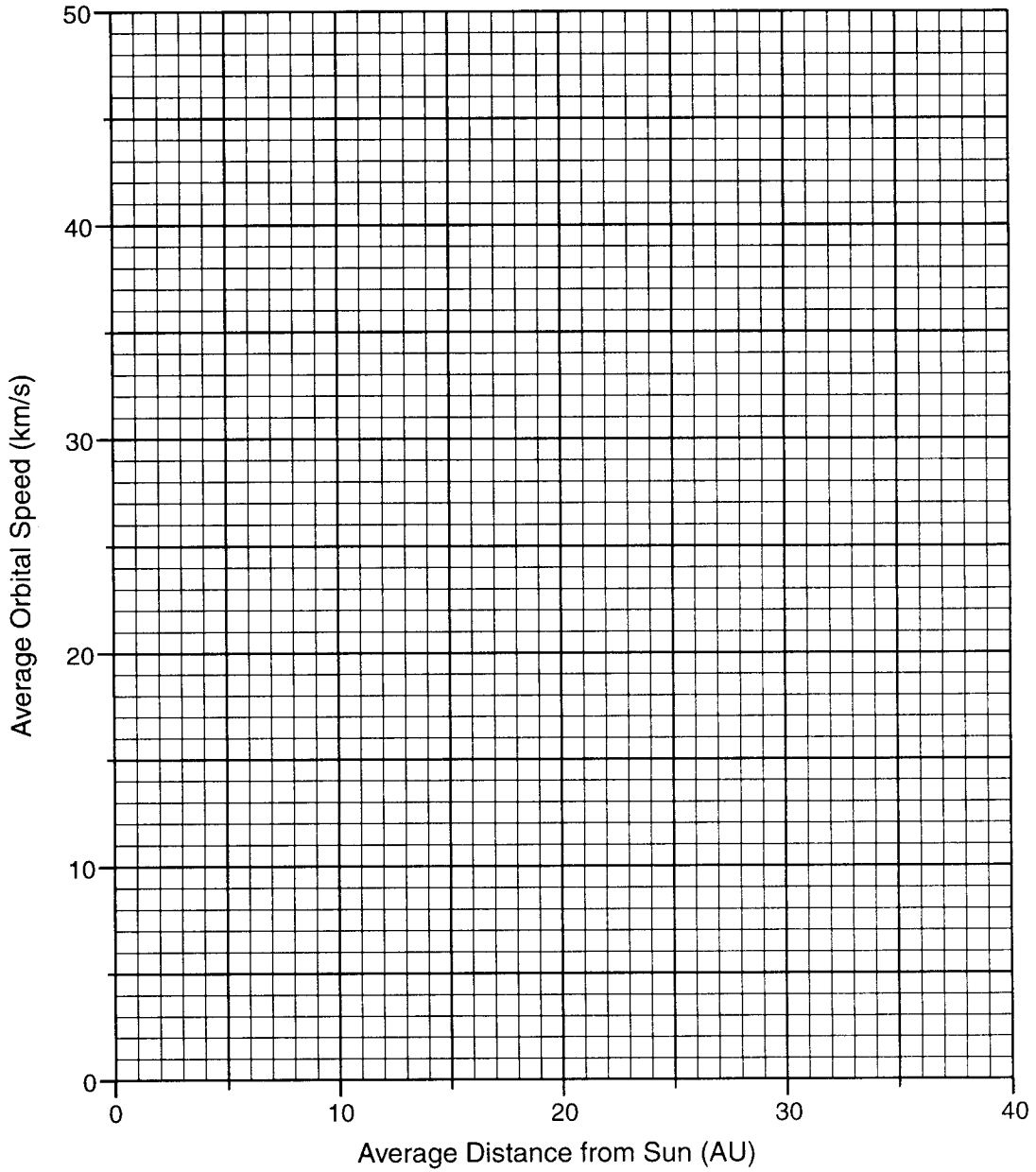
83

84

and

85

Planets' Average Orbital Speed vs. Average Distance from Sun



87 _____

88 _____ and _____

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

Signature