Name:

Questions 1 and 2 refer to the following:

The three New York State snow fall maps below represent three different winter seasons. The isolines show the total inches of snowfall received each winter season. Some western New York State counties are labeled on each map. The dotted line AB has been drawn on the 1991-1992 winter season map.



 Calculate the average snowfall gradient along the dotted line between points A and B on the 1991-1992 winter season map, and label your answer with the correct units.  The map below shows the total inches of snowfall received at various locations for the 1984-1985 winter season. On this map, draw the 120-inch snowfall isoline.



Questions 3 and 4 refer to the following:

The cross section below shows a portion of Earth's interior. Layer X is part of Earth's interior.



(not drawn to scale)

3) Identify the part of Earth's lithosphere represented by layer *X* in the cross section shown.

- Identify the texture and relative density of the granitic bedrock of the continental crust and the basaltic bedrock of the oceanic crust.
- 5) The map below shows a portion of southwestern United States. On January 17, 1994, an earthquake occurred with an epicenter at Northridge, California.



State the latitude and longitude of Northridge, California on the given map. [Include the correct units and compass directions in your answer.]

Questions 6 through 8 refer to the following:

The field map below shows an area of a state park where an underground gasoline tank leaked and contaminated the groundwater. Groundwater monitoring wells were installed to determine the extent of the contamination. The concentration of contaminants in parts per million (ppm) in each of the wells is indicated on the map.



- 6) Park officials do *not* want to see another incident of groundwater contamination from gasoline tanks like the incident described. State *one* action that park officials could take to prevent gasoline from contaminating the groundwater in the future.
- 7) State the relationship between the distance from the gasoline tank in the given diagram and the concentration of contaminants in the groundwater.
- 8) On the field map provided, draw the 50-ppm, 100-ppm, and 150-ppm isolines. The 0-ppm isoline has been drawn for you.



9) The United States map below shows recorded temperatures in degrees Fahrenheit for October 2, 2004. The 60°F isotherm has been drawn on the map.

On the map provided, draw the 70  $^{\circ}$  F isotherm, extending the isotherm to the edges of the continent.

10) The passage describes the New Madrid fault system. The numbers on the map show the predicted relative damage at various locations if a large earthquake occurs along the New Madrid fault system. The higher the number, the greater the relative damage.

### THE NEW MADRID FAULT SYSTEM:

The greatest earthquake risk area east of the Rocky Mountains is along the New Madrid fault system. The New Madrid fault system consists of a series of faults along a weak zone in the continental crust in the midwestern United States. Earthquakes occur in the Midwest less often than in California, but when they do happen, the damage is spread over a wider area due to the underlying bedrock.

In 1811 and 1812, the New Madrid fault system experienced three major earthquakes. Large land areas sank, new lakes formed, the course of the Mississippi River changed, and 150,000 acres of forests were destroyed.



(a) On the map below, draw the 4, 6, and 8 isolines indicating relative damage.

(b) Using the predicted damage numbers plotted in *part (a)*, place an X on the map to indicate where the New Madrid fault system mentioned in the reading passage most likely exists. Questions 11 through 13 refer to the following:

The map below shows ocean depths, measured in meters, off the coast of Massachusetts. Points A, B, and C represent locations on the ocean floor. The Stellwagen Bank discussed in the following reading passage is lightly shaded and labeled on the map.



### THE STELLWAGEN BANK

One of the most exciting adventures for a visitor to Cape Cod, Massachusetts, is going on a whale watch. Large boats leave port two to three times each day carrying passengers to a specific location in the Atlantic Ocean to see the whales. How do the captains of the boats know where to find the whales?

The answer is simple. They look for the whales over an area known as the Stellwagen Bank, which is a large undersea deposit of unsorted sand and gravel. The Stellwagen Bank is inferred by scientists to have formed during the Pleistocene Epoch from the slow retreat of massive Ice Age glaciers across this area. Today, cool ocean currents come from the north and flow up and over the Stellwagen Bank. These currents bring nutrients to the surface from deep in the ocean, providing food for oceanic phytoplankton (small plants). Small ocean creatures and fish feed on the phytoplankton. Whales can be found in abundance at the Stellwagen Bank feeding on the many ocean life-forms.

- 11) Calculate the average ocean-floor gradient 12)
  between point A and point B on the map shown. Label your answer with the correct units.
- 2) What evidence indicates that the ocean floor has a steep slope at point *C* in the map shown?
  - 13) Most whale watching takes place at 42° 25′ N and 70° 25′ W. Place an X on the given map at this location.

Questions 14 through 16 refer to the following:

The topographic map below shows points A, B, X, and Y, which are locations on Earth's surface.



14) Calculate the gradient between points X and Y in the given topographic map.[Units must be included in your answer.] 15) On the grid below, construct a topographic profile of the land surface along line *AB* on the given map by plotting an **X** for the elevation of each contour line that crosses line *AB*. Connect the **X**s with a smooth, curved line to complete the profile.



16) Toward which compass direction is Snapper Creek in the topographic map flowing? 17) The map below shows a portion of the continent of Antarctica. The size and shape of the West Antarctic Ice Sheet depends on many factors, including melting and freezing beneath the glacier, the amount of snowfall, snow removal by wind, iceberg formation, and the rate of ice flow. Glacial moraines are found in the Executive Committee Mountains shown on the map. Moraines are located up to 100 meters in elevation above the present ice sheet surface, which indicates that a thicker ice sheet existed 20,000 years ago.

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



State the latitude and longitude of Byrd Station shown on the given map. [Your answer must include both the units and the compass directions.]

Questions 18 through 20 refer to the following:

Points A and B are reference points on the topographic map below. The  $\triangle$  symbols show the highest elevations on Eagle Hill and Timony Hill. Elevations are shown in feet.



18) Identify the general compass direction toward which Auroro Creek is flowing in the given topographical map. 19) State a possible elevation of the top of Patriot Hill in the given topographical map.

20) On the grid provided below, construct a topographic profile along line *AB* on the grid by plotting an **X** for the elevation of each contour line that crosses line *AB* in the given topographic map. Connect the plotted **X**s with a smooth, curved line to complete the profile. Points *A* and *B* have been plotted for you.



21) Iridium is an element rarely found in Earth's lithosphere but commonly found in asteroids. The data table below shows the abundance of iridium, in parts per billion (ppb), found in a rock core sample taken in Carlsbad, New Mexico.



On the grid provided, construct a line graph of iridium abundance at various depths. Place an  $\mathbf{X}$  to show the iridium abundance at each depth shown on the data table. Connect the  $\mathbf{X}$ s with a line.

22) The diagram below shows the inferred internal structure of the four terrestrial planets, drawn to scale.



How are the diagramed crusts of Mars, Mercury, Venus, and Earth similar in composition? Questions 23 and 24 refer to the following:

The field map below shows temperatures, in degrees Fahrenheit, taken at several locations on a blacktop parking lot in New York State. The temperatures were recorded at 11:00 a.m. in early June.



23) Explain why the surface of the given parking lot usually becomes warmer from 11:00 a.m. to 12 noon each day.

24) On the field map provided, draw the 70°F and 80°F isotherms. The isotherms should be extended to the edges of the map.

Questions 25 through 28 refer to the following:

The topographic map below shows a small ocean island. Points *A*, *B*, *C*, and *D* represent surface locations and the symbol  $\triangle 134$  represents a hilltop elevation. Elevations are measured in feet and distances are measured in miles.



- 25) State the compass direction toward which Mud Creek flows in the given topographic map.
- 26) Calculate the gradient of Mud Creek between points *C* and *D* on the topographic map shown and label your answer with the correct units.
- 27) Explain how the contour lines on the topographic map shown indicate that the north side of the island has the *steepest* slope.

28) On the grid provided, construct a profile along line AB by plotting an **X** for the elevation of each contour line that crosses line AB in the given topographic map. Connect the **X**s with a smooth, curved line to complete the profile.



Questions 29 and 30 refer to the following:

The diagram below shows the latitude-longitude grid on a model of Earth. Point Y is a location on Earth's surface.



- 29) What is Earth's rate of rotation at point *Y* in the diagram shown (in degrees per hour)?
- 30) Place an **X** at 15° S 30° W on the diagram shown.

Questions 31 and 32 refer to the following:

The diagram below represents a north polar view of Earth on a specific day of the year. Solar times at selected longitude lines are shown. Letter *A* represents a location on Earth's surface.



- 31) State the altitude of *Polaris* as seen by the observer at the North Pole shown in the diagram.
- 32) How many degrees apart are the longitude lines shown in the diagram?

33) The map below shows the water depth, measured in feet, at the north end of one of the Finger Lakes. Points *A* and *B* are locations at the lake's shoreline. Points *X* and *Y* are locations on the bottom of the lake.



- (a) On the map provided, draw the 20-foot-depth isoline. The isoline must extend to the edge of the map.
- (b) On the grid provided, construct a profile along the line from point A to point B. Plot the depth along line AB by marking an X at each numbered point where a water depth is shown. Complete the profile by connecting the Xs with a smooth, curved line. The Xs for point A and point B have been plotted.
- (c) Calculate the gradient between point X and point Y on the given map. [Label your answer with the correct units.]

Questions 34 through 36 refer to the following:

The map below shows partially drawn contour lines. Xs indicate elevations in meters. Letters A, B, C, and D represent locations on the map.



- 34) On the grid provided, construct a topographic profile along line *CD*. Plot with an X the elevation of each contour line that crosses line *CD*. Connect the Xs from *C* to *D* with a smooth, curved line to complete the profile. Elevations *C* and *D* have already been plotted.
- 35) Calculate the stream gradient from elevation A to elevation B on the contour map provided. [Label your answer with the correct units.]

- 36) (a) On the map provided, complete the 250-meter contour line.
  - (b) On the portion of the map showing contour lines, place an X in an area where an elevation of 55 meters is located.

Questions 37 and 38 refer to the following:

# EARTH'S EARLY ATMOSPHERE:

Early in Earth's history, the molten outer layers of Earth released gases to form an early atmosphere. Cooling and solidification of that molten surface formed the early lithosphere approximately 4.4 billion years ago. Around 3.3 billion years ago, photosynthetic organisms appeared on Earth and removed large amounts of carbon dioxide from the atmosphere, which allowed Earth to cool even faster. In addition, they introduced oxygen into Earth's atmosphere, as a by-product of photosynthesis. Much of the first oxygen that was produced reacted with natural Earth elements, such as iron, in the lithosphere and produced new varieties of rocks and minerals. Eventually, photosynthetic organisms produced enough oxygen so that it began to accumulate in Earth's atmosphere. About 450 million years ago, there was enough oxygen in the atmosphere to allow for the development of an ozone layer 30 to 50 kilometers above Earth's surface. This layer was thick enough to protect organisms developing on land from the ultraviolet radiation from the Sun.

37) Based on the reading passage, identify the temperature zone of the atmosphere in which the ozone layer developed.

38) Complete the pie graph below to show the percent by volume of nitrogen and oxygen gases currently found in Earth's troposphere. Label each section of the graph with the name of the gas. The percentage of other gases is shown.



Questions 39 and 40 refer to the following:

# **OZONE IN EARTH'S ATMOSPHERE**:

Ozone is a special form of oxygen. Unlike the oxygen we breathe, which is composed of two atoms of oxygen, ozone is composed of three atoms of oxygen. A concentrated ozone layer between 10 and 30 miles above Earth's surface absorbs some of the harmful ultraviolet radiation coming from the Sun. The amount of ultraviolet light reaching Earth's surface is directly related to the angle of incoming solar radiation. The greater the Sun's angle of insolation, the greater the amount of ultraviolet light that reaches Earth's surface. If the ozone layer were completely destroyed, the ultraviolet light reaching Earth's surface would most likely increase human health problems, such as skin cancer and eye damage.

- 39) Based on the reading passage, explain how the concentrated ozone layer above Earth's surface is beneficial to humans.
- 40) State the name of the temperature zone of Earth's atmosphere where the concentrated layer of ozone gas exists.

Questions 41 and 42 refer to the following:

The top diagram below shows a depression and hill on a gently sloping area. The bottom diagram is a topographic map of the same area. Points A, X, and Y are locations on Earth's surface. A dashed line connects points X and Y. Elevation is indicated in feet.



- 41) What is a possible elevation of point A in the diagram?
- 42) On the grid below, construct a topographic profile along line *XY* by plotting a point for the elevation of each contour line on the map that crosses line *XY*. Points *X* and *Y* have already been plotted on the grid. Connect the points with a smooth, curved line to complete the profile.





43) The map provided shows weather station models and some weather variables for a portion of the United States. Selected weather stations are labeled *A*, *B*, and *C*.

On the map provided, draw the 50 ° F isotherm. [The isotherm must extend to the edges of the map.]

Questions 44 through 47 refer to the following:

Letters A, B, C, D, and E on the topographic map shown below represent locations on Earth's surface. Letters K, L, M, and N are locations along Copper Creek. Elevations are measured in meters.



- 44) Calculate the gradient between points B and C on the topographic map shown and label your answer with the correct units.
- 45) What is the elevation of location A on the topographic map shown?
- 46) Explain how the map shown indicates that Copper Creek flows faster between points N and M than between points L and K.
- 47) On the grid provided, construct a topographic profile along line *DE* of the map shown by plotting an X for the elevation of each contour line that crosses line *DE*. Connect the Xs with a smooth, curved line to complete the profile.





48) The map below shows the snowfall, measured in inches, at various locations in New York State, Pennsylvania, and New Jersey during a December snowstorm.

On the map above, draw the 30.0-inch snowfall isoline. [Assume that the decimal point for each snowfall depth marks the exact location where the snowfall was measured.]

Questions 49 and 50 refer to the following:



- 49) State the latitude and longitude of the epicenter of the earthquake described. [Include the units and compass directions in your answer.]
- 50) According to the given map, how long after this earthquake did the first tsunami wave arrive at Bengkulu, Sumatra?

Questions 51 through 53 refer to the following:

The map below shows the precipitation totals, in inches, from January 2003 through May 2003 for the North Carolina locations represented by dots. Precipitation totals for locations A and B are recorded on the map. The towns of Newport and Beaufort are labeled on the map.



- 51) On the map provided, use a smooth, curved line to draw the 25.00-inch precipitation isoline. [*The isoline must extend to the edges of the map.*]
- 52) Identify the city shown on the *Generalized* Bedrock Geology of New York State map in the Earth Science Reference Tables that is closest to the longitude of Newport, North Carolina.
- 53) Calculate the rainfall gradient between locations A and B on the map shown to the nearest hundredth. [Label your answer with the correct units.]

Questions 54 and 55 refer to the following:

The map shows the location of Birdsville and Bundaberg in Australia. Data Table 1 shows the average monthly high temperatures for Birdsville. Data Table 2 includes the latitude and longitude, elevation above sea level, and the average rainfall in January for Birdsville and Bundaberg.

Map of Australia	Data Table 1: Average Monthly High Temperatures for Birdsville, Australia		
INDIAN	Month	Temperature (°C)	
OCEAN CEAN	January	39	
	February	38	
Bundaberg	March	35	
$\int \Lambda_{\Lambda} \qquad \Lambda_{\Lambda}$ Birdsville $\Lambda_{\Lambda}$	April	30.5	
	May	25	
	June	22	
	July	21	
	August	23.5	
	September	28	
KEY:	October	32.5	
A Mountains	November	36	
	December	38	

Data Table 2: Information about Two Australian Cities

City	Latitude (° S)	Longitude (° E)	Elevation (m)	Average January Rainfall (mm)
Birdsville	25.9	139.4	47	25
Bundaberg	24.9	152.4	14	105

- 54) On the map of Australia shown, draw the 30° S latitude line.
- 55) Based on the data shown, explain why Bundaberg will experience solar noon before Birdsville each day.

Questions 56 and 57 refer to the following:

The topographic map below shows three glaciers found in Alaska. Dashed lines show the inferred location of the front edge of each glacier in 1948, 1964, and 1980. Solid lines show the location of the front edge of each glacier in 1998. Points *A* and *B* show the location of the front edge of the Taku Glacier in 1948 and 1998. Elevations are in feet.



- 56) What is the contour interval on the topographic map shown?
- 57) Determine the rate, in miles per year, that the front edge of the Taku Glacier moved between point A and point B in the given topographic map.

#### 58) Point F on the map below shows the location where an unusual mammal fossil was found.



#### FOSSIL JAW OF MAMMAL FOUND IN SOUTH AMERICA:

Paleontologists working in Patagonia have found the tiny fossil jaw that may be the first evidence of early mammals in South America.

The fossil, which measures less than a quarter-inch long, is believed to be from the middle or late Jurassic Period. Researchers said it suggests that mammals developed independently in the Southern Hemisphere.

The fossil, named *Asfaltomylos patagonicus*, was discovered in a shale formation in Patagonia. Dinosaurs were the dominant land animal at that time. Mammals were tiny, and hunted insects in the dense tropical vegetation. The now-arid region also has yielded some remarkable dinosaur fossils from the same period in a vast ancient boneyard covering hundreds of square miles.

State the latitude and longitude of point F in the given map, to the nearest degree, where the fossil Asfaltomylos patagonicus was discovered. [Include the correct units and compass directions in your answer.]

### 59) IS EARTH GAINING WEIGHT?

Scientists believe that Earth may gain more than 100 tons of dust from space every day. The dust comes from thawing comets as they orbit the Sun and from pieces of asteroids that collided with other asteroids. Most asteroids orbit the Sun between Mars and Jupiter. Each dust particle dates back to the days when our solar system was created. So in a way, each tiny speck of dust holds clues to how our solar system formed.

All the space dust produced by comets and asteroids in our solar system is drawn to the Sun by its gravitational force. However, space dust that passes within about 60 miles of Earth's surface may be slowed enough by friction with Earth's atmosphere to be pulled to the surface by Earth's gravity.

In which temperature zone of Earth's atmosphere is the space dust mentioned in the reading passage first slowed enough by friction to be pulled to Earth's surface? 1) 4 OR 4.0 (±0.2) inches/mile OR in/mi



2) SAMPLE ANSWER:

- 3) SAMPLE ANSWERS: rigid mantle OR uppermost part of the mantle
- SAMPLE ANSWERS: <u>Granitic bedrock</u>: Texture is coarse OR nonvesicular, Density is low density OR 2.7 g/cm<sup>3</sup>; <u>Basaltic bedrock</u>: Texture is fine OR vesicular OR nonvesicular, Density is high density OR 3.0 g/cm<sup>3</sup>
- 5) <u>Latitude</u>: 34° N <u>Longitude</u>: 118.5° W OR 118°30′ W
- 6) SAMPLE ANSWERS: Place the tank above ground to observe leaks more easily. OR Build an extra liner around the tank. OR Replace tanks regularly.
- 7) SAMPLE ANSWERS: As distance from the tank increases, the concentration of contaminants in the groundwater decreases. OR An inverse relationship exists between the distance from the tank and the concentration of contaminants in the groundwater.



8)



(b) An X anywhere in the hatched region is acceptable.

11)  $0.5 (\pm 0.02)$  OR  $.5 (\pm 0.02)$  meters/kilometer OR m/km

SAMPLE ANSWER: Isolines are close together. 12)



14) 277 to 313 ft/mi



16) SAMPLE ANSWERS: SE OR south southeast OR south

- 17) Latitude: 80° S; Longitude: 120° W
- 18) southeast OR SE
- 19) elevation between 680 feet and 700 feet





- 22) SAMPLE ANSWERS: The crusts have a silicate composition. OR The crusts contain the elements oxygen and silicon.
- 23) SAMPLE ANSWERS: The intensity of insolation increases from 11:00 a.m. to 12 noon. OR The Sun's energy becomes more concentrated. OR Sunlight becomes more direct. OR The Sun rises higher in the sky.



25) SAMPLE ANSWERS: southeast OR SE OR northwest to southeast

- 26) 18 to 22 ft/mi
- 27) SAMPLE ANSWERS: The contour lines are closer together. OR More closely spaced contour lines indicate a steeper gradient.



29) 15°/hr

30) The center of the X must fall within the circle shown below.



32) 15°





35) 28.0 to 29.0 m/km OR meters/kilometer



37) stratosphere

#### Gases in Earth's Troposphere (%)



- 39) SAMPLE ANSWERS: The ozone layer absorbs some of the harmful ultraviolet radiation from the Sun. OR The ozone layer decreases the amount of ultraviolet radiation reaching Earth. OR The ozone protects humans from skin cancer and eye damage.
- 40) stratosphere
- 41) any value above 20 ft but below 30 ft



- 44) any value from 18.9 to 21.1 m/km OR meters/km OR m/kilometer
- 45) 10 m
- 46) SAMPLE ANSWERS: Contour lines between *N* and *M* are closer together. OR There is a steeper slope between *N* and *M*. OR Where contour lines are far apart, there is a gentle slope and the stream velocity is less.



49) <u>Latitude</u>: 3.0° to 4.0° N <u>Longitude</u>: 95.5° to 96.5° E

50) 1 hr 32 min to 1 hr 42 min





53) 0.11 to 0.13 inches/mile



- 55) SAMPLE ANSWERS: Bundaberg is located east of Birdsville. OR Birdsville is west of Bundaberg. OR Earth rotates west to east.
- 56) 1,000 ft
- 57) 0.035 to 0.045 mi/yr
- 58) latitude from 40° S to 44° S AND longitude from 65° W to 69° W
- 59) thermosphere