Part 1 Multiple Choice [+20]  Place your final answer on the answer sheet.

Base your answers to questions 1 through 4 on the map below, which shows a portion of the continent of North America and outlines the Mississippi River watershed.

1. The entire land area drained by the Mississippi River system is referred to as a drainage basin or a
   (1) levee  (2) watershed  (3) meander belt  (4) floodplain

2. At which location would the Mississippi River’s discharge most likely be the greatest?
   (1) A  (2) B  (3) C  (4) D

3. Sediments deposited by the river at location B are best described as
   (1) sorted and layered  (3) unsorted and layered
   (2) sorted and not layered  (4) unsorted and not layered

4. Which landform is produced at location E where the Mississippi River enters the Gulf of Mexico?
   (1) a delta  (2) a drumlin  (3) an escarpment  (4) an outwash plain

5. U-shaped valleys, drumlins, finger lakes, and parallel grooves in bedrock are characteristics of erosion by
   (1) mass movement  (2) wave action  (3) running water  (4) glacial ice
6. Glaciers often form parallel scratches and grooves in bedrock because glaciers
(1) deposit sediment in unsorted piles.  (3) continually melt and refreeze.
(2) deposit rounded sand in V-shaped valleys.  (4) drag loose rocks over Earth’s surface.

7. The large waterfall at Niagara Falls, New York, was originally located at the Niagara Escarpment.
Which term best describes an escarpment?
(1) U-shaped valley  (2) V-shaped valley  (3) cliff  (4) drumlin

8. The photograph below shows a valley.

Which agent of erosion most likely produced this valley’s shape?
(1) blowing wind  (2) ocean waves  (3) moving ice  (4) running water

9. The photograph below shows a large boulder of metamorphic rock in a field in the Allegheny Plateau region of New York State.

What is the best evidence that this boulder has been transported by a glacier?
(1) It is located at a high elevation in a mountainous area.
(2) It is less than 25 centimeters in diameter.
(3) Its composition is different from that of the bedrock under it.
(4) It appears to have been intensely metamorphosed.

10. The narrow, sandy, barrier islands in the ocean along the south coast of Long Island were deposited by
(1) wind  (2) streams  (3) landslides  (4) wave action

11. Which statement best describes sediments deposited by glaciers and rivers?
(1) Glacial deposits and river deposits are both sorted.
(2) Glacial deposits are sorted, and river deposits are unsorted.
(3) Glacial deposits are unsorted, and river deposits are sorted.
(4) Glacial deposits and river deposits are both unsorted.
Base your answers to questions 12 through 14 on the diagram below, which shows the edge of a continental glacier that is receding. R indicates elongated hills. The ridge of sediments from X to Y represents a landscape feature.

12. The elongated hills labeled R are most useful in determining the
   (1) age of the glacier  (3) thickness of the glacier
   (2) direction the glacier has moved  (4) rate at which the glacier is melting

13. Which feature will most likely form when the partially buried ice block melts?
   (1) drumlin  (2) moraine  (3) kettle lake  (4) finger lake

14. The ridge of sediments from X to Y can best be described as
   (1) sorted and deposited by ice  (3) unsorted and deposited by ice
   (2) sorted and deposited by meltwater  (4) unsorted and deposited by meltwater

15. The block diagram below shows a volcano.

Which map shows the stream drainage pattern that most likely formed on the surface of this volcano?
16. The cross section below shows a V-shaped valley and the bedrock beneath the valley.

![Image of a V-shaped valley]

Which agent of erosion is responsible for cutting most V-shaped valleys into bedrock?
(1) surface winds   (2) running water   (3) glacial ice   (4) ocean waves

17. In which New York State landscape region is Elmira located?
(1) Tug Hill Plateau   (3) Allegheny Plateau
(2) St. Lawrence Lowlands   (4) Erie-Ontario Lowlands

18. The Catskills landscape region is classified as a plateau because it has
(1) low elevations and mostly faulted or folded bedrock
(2) low elevations and mostly horizontal bedrock
(3) high elevations and mostly faulted or folded bedrock
(4) high elevations and mostly horizontal bedrock

19. The diagram below represents three identical beakers filled to the same level with spherical beads.

![Diagram of beakers with different bead sizes]

If the packing of the beads within each beaker is the same, which graph correctly represents the porosity of the beads in the beakers?

![Graph options for porosity]
20. The diagram below represents the setup for an experiment for studying groundwater. Tubes A, B, C, and D contain equal volumes of sediments. Within each tube, the sediments are uniform in size, shape, and packing. A test for water retention was conducted by first filling each tube with water and then draining the water into beakers.

Which graph represents the general relationship between the sediment size and the amount of water Retained (kept in) by the sediments after the tubes had drained?

- [Water Retained vs. Sediment Size: Linear Increase](1)
- [Water Retained vs. Sediment Size: Linear Decrease](2)
- [Water Retained vs. Sediment Size: Constant](3)
- [Water Retained vs. Sediment Size: Curved Decrease to Increase](4)
Part 2: Short Answer [+8]

Base your answers to questions 21 through 23 on the diagram below, which shows several different landscape features. Points X and Y indicate locations on the streambank.

21. Explain why the upper valley in the mountains is U-shaped and the lower valley is V-shaped. [1]

22. Identify which point, X or Y, has more stream erosion and explain why the amounts of erosion are different. [1]

23. Explain why the stream meanders on the floodplain, but not in the mountains. [1]
Base your answers to questions 24 through 27 on the map below and on your knowledge of Earth science. The map shows a retreating valley glacier and the features that have formed because of the advance and retreat of the glacier.

24. Describe one piece of evidence likely to be found on the exposed bedrock surfaces that could indicate the direction this glacier moved. [1]

25. Describe one difference between the arrangement of sediment in the moraines and the arrangement of sediment in the outwash plain. [1]

26. Describe the most likely shape of the valley being formed due to erosion by this glacier. [1]

27. Explain why the glacial ice absorbs less solar radiation than the surrounding exposed bedrock and soil. [1]
28. The diagram \textit{below} shows a partial cross section of a valley near location \textit{A} on map \textit{III}. On this diagram, draw a line beginning at \textit{X} and ending at \textit{Y} to show the shape of this valley after it was eroded by glacial ice that flowed down the valley. [1]
Part 3 Bonus Questions [+5]

Base your answers to questions 29 through 31 on maps A, B, and C below, which show evidence that much of New York State was once covered by a glacial ice sheet. Map A shows the location of the Finger Lakes Region in New York State. The boxed areas on map A were enlarged to create maps B and C. Map B shows a portion of a drumlin field near Oswego, New York. Map C shows the locations of glacial moraines and outwash plains on Long Island, New York.

29. The arrangement of the drumlins on map B indicates that a large ice sheet advanced across New York State in which compass direction? [1]

30. The drawing below shows a glacial erratic found on the beach of the north shore of Long Island near the Harbor Hill moraine. This boulder is composed of one-billion-year-old gneiss.

Which New York State landscape region has surface bedrock similar in age to this erratic? [1]
31. The diagrams below represent three sediment samples labeled X, Y, and Z. These samples were collected from three locations marked with empty boxes, □, on map C.

On map C, write the letter of each sample in the correct box to indicate the location from which each sample was most likely collected. [1]

32. Explain how the effect of global warming on present-day continental glaciers could affect New York City and Long Island. [1]

33. The map on the answer sheet shows the stream drainage patterns for a region of Earth’s surface. On the map on the answer sheet, draw the two divides that determine the direction in which the streams will flow. [1]
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<tr>
<th><strong>Part 1:</strong></th>
<th><strong>Answer Sheet</strong></th>
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**Part 1 (20) = _____**

**Part 2 (8) = _____**

**Total (28) = _____**

**Bonus (5) = _____**

**% = _____**
28.

Map C

29.

30.

31.

32.