Name _____ Class _____ Date _____

The Geometry of Ancient Egypt's Pyramids

For a preindustrial society, the construction of Egypt's pyramids was a gigantic undertaking of construction and design. Even today, archaeologists are not absolutely certain how the ancient Egyptians accomplished this engineering achievement. But structures such as the Great Pyramid at Giza stand as testimony to Egyptian genius and geometry. To learn how the Egyptians first put this field of mathematics to practical use, study the following information and answer the questions.

The word "geometry" comes from the Greek words for "Earth" and "measure." However, the Egyptians first used geometry some 5,000 years ago—long before the Greeks coined the word—to re-establish the boundaries of fields that had been destroyed by the annual flooding of the Nile River. They soon applied its principles to building the pyramids.

For religious reasons, pyramids were located on the west side of the Nile, in the direction of the setting sun. They had to be located on rocky ground to support the tremendous weight of the finished structure. The pyramid was laid out so that its sides faced north, south, east, and west.

The first step in building a pyramid was establishing a square base. The square was marked out with stakes, using a measuring cord made from palm fiber. The ancient Egyptians were able to lay out the bases of these giant structures with such accuracy that there is only eight inches difference in the lengths of the Great Pyramid's 755-foot sides.

1. The fact that a rectangle's sides are of equal length does not mean that its sides form right angles. Draw a rectangle that is a square. Label the four corners A, B, C, and D. What two distances can you measure to determine if it is square? How would the Egyptians have known when a perfect square had been achieved?

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The pyramid rose as progressively smaller squares of blocks were layered on top of each other. As each layer was completed, it had to be carefully checked to be sure that it too formed a perfect square. This was especially important on the pyramid's lower layers. A small error there could grow into a large error by the time the top was reached.

To build the pyramid, workers had to get heavy slabs of stone, each weighing two tons or more, from the ground to the level where they were working. To do this they built ramps along which they pulled the slabs up the pyramid. A ramp that was too steep made it impossible to

drag the heavy stone up it. So these ramps had a gradient of 1 to 12.
This means that for every foot the ramp rose in height it stretched
12 feet in length. The following diagram illustrates the principle.
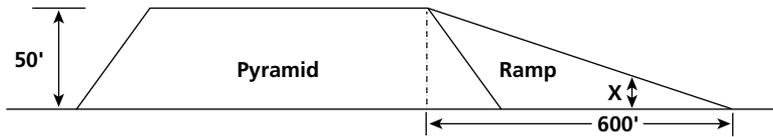
2. How many times longer is the ramp than the height of the pyramid at this point
in construction?

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The surface of the ramp was covered with wooden logs. Water was
poured over these logs if the workers wanted the sleds that carried the
slabs to move smoothly. As the pyramid's height grew, so did the height
of the ramp. The drawing below shows a later stage in the construction
process.
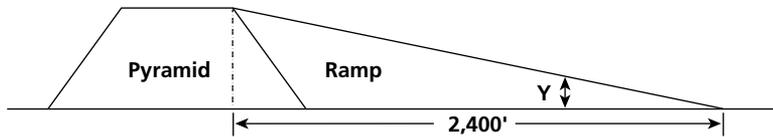
3. How high is the pyramid at this point in its construction? How do you know?

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4. How does the size of angle *Y* in this ramp compare with the size of angle *X*, when
the ramp was only 50 feet high? Explain the reason for your answer.

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