

**Ohio Graduation Test for Mathematics – Spring 2008
Annotated Item 40**

Standard and Benchmark Assessed:

Standard: Number, Number Sense and Operations

Benchmark: A. Use scientific notation to express large numbers and numbers less than one.
E. Compare, order and determine equivalent forms of real numbers.

Standard: Mathematical Processes

Benchmark: F. Use precise mathematical language and notations to represent problem situations and mathematical ideas.

Short Answer Question:

40. Selena was given five different cells to measure.
The table below shows Selena's results.

Cell Sizes

Sample Number	Type of Cell	Diameter of Cell in millimeters
1	<i>Escherichia coli</i> bacterium	1.5×10^{-3}
2	red blood cell	0.008
3	<i>Haemophilus Influenzae</i> bacterium	0.0012
4	<i>Bacillus megaterium</i> bacterium	4.0×10^{-3}
5	<i>Staphylococcus aureus</i> bacterium	0.0009

In your **Answer Document**, write all of the measurements in scientific notation.

Order the values from smallest to largest.

For question 40, respond completely in your **Answer Document**. (2 points)

Commentary:

This short-answer item (2-points) asks students to write all of the measurements in scientific notation and then order them from smallest to largest. The student must know the proper form for writing a number in scientific notation. The significand is the number which is multiplied by 10 to a power. The unit's digit (to the left of the decimal point) of the significand is a number from 1 to 9 inclusive. The power of 10 is determined by the number of places by which the decimal point has been relocated.

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For example, Sample Number 2 from the table, 0.008, is written in scientific notation as 8.0×10^{-3} . The decimal point in the original number, which is less than one, has been moved three places so the power of 10 is -3. Sample Number 3 from the table, 0.0012, is written as 1.2×10^{-3} . Again, the decimal point in the original number, which is less than one, has been moved three places so the power of 10 is -3. Sample Number 5 from the table, 0.0009, is written as 9.0×10^{-4} . The decimal point in the original number, which is less than one, has been moved four places so the power of 10 is -4. To determine the order from least to greatest of the Sample Numbers, first compare the exponents of the 10's; 9.0×10^{-4} is the smallest value so it will be listed first. Since the rest of the numbers all have 10^{-3} , look at the significand to determine the order of the numbers. Based on the remaining significands, the correct order is listed as follows: 9.0×10^{-4} , 1.2×10^{-3} , 1.5×10^{-3} , 4.0×10^{-3} , and 8.0×10^{-3} . The level of complexity for this item is Moderate Complexity, as it requires the student to retrieve information from a table and use it to solve a problem requiring multiple steps.

Performance Data:

The percent of public school students earning each score point for question 40 on the March 2008 Ohio Graduation Test:

Percent at Each Score Point				
0	0.5	1	1.5	2
42%	5%	26%	2%	20%

Sample Response for Item 40 (Short Answer):

Exemplar:

9.0×10^{-4} , 1.2×10^{-3} , 1.5×10^{-3} , 4.0×10^{-3} , 8.0×10^{-3}

Scoring Guidelines for Item 40

Score Point Description

2 points The response contains diameters 2, 3 and 5 written correctly in scientific notation. The five diameters are correctly ordered from smallest to largest.

1 point The response provides a partial solution.

For example, the response may:

- Diameters 2, 3 and 5 may be correctly written in scientific notation. The order may be incorrect or missing.

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- The scientific notation for the three diameters is incorrect or missing, but the five original values are correctly ordered.
- The response contains errors in scientific notation, but the student's values obtained are correctly ordered.
- The response contains a combination of some correct scientific notation and some correct ordering that indicate some understanding of the concepts involved.

0 points The response fails to demonstrate minimal understanding of the task.

For example, the response may:

- Be blank or give irrelevant information.
- Fail to demonstrate minimal understanding of the task.

Keywords: scientific notation, order, values