

MeTEOR Performance Task

Eighth Grade

Mathematics
Scientific Notation

Performance Task Item: Scientific Notation

Grade Level: 8th grade

Focus Area: Scientific Notation

Essential Question: How can scientific notation be used to represent very large or very small numbers in the real world?

Core Ideas:

- Understands how to demonstrate the purpose of scientific notation.
- Understands how to write numbers using scientific notation.
- Understands how to convert numbers between scientific notation and standard form.
- Understands how to perform different operations within equations.

Learning Targets:

- Students will express numbers using scientific notation.
- Students will recognize the difference between scientific notation and standard form.
- Students will distinguish the difference between different numbers written in scientific notation.
- Students will solve equations with addition, subtraction, multiplication, and division using numbers in scientific notation.

STANDARDS

Domain: Expressions and Equations

Content Standards:

- Know and apply the properties of integer exponents to generate equivalent numerical expressions.
- Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
- Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.
- Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities.

Supporting Standard:

- Perform different operations within equations.

Math Practice Standards:

MP 1: Make sense of problems and persevere in solving them.

MP 2: Reason abstractly and quantitatively.

MP 3: Construct viable arguments and critique the reasoning of others.

MP 4: Model with mathematics.

MP 6: Attend to precision.

MP 7: Look for and make use of structure.

Materials:

- Performance Task
- Pencil
- Calculator

Task/Question 1:

DOK Level 1: Recall & Reproduction

Math Practice Standards:

- MP.6: Attend to precision.
- MP.7 Look for and make use of structure.

A. What is the purpose of scientific notation?

B. How do you convert between standard form and scientific notation?

Task/Question 2:

DOK Level 2: Basic Application of Skills and Concepts

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 4: Model with mathematics.
- MP 6: Attend to precision.

Write each number in Scientific Notation:

A. 0.000006

B. 54000000

C. 60

D. .009

Write each number in Standard Notation:

E. 0.9×10^{-1}

F. 2×10^{-1}

G. 2×10^5

H. 804×10^2

Task/Question 3:

DOK Level 3: Strategic Thinking and Complex Reasoning

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 2: Reason abstractly and quantitatively.
- MP 4: Model with mathematics.
- MP 6: Attend to precision.

Below is a table that shows the amount of soda consumed by the United States and 10 other countries.

- A.** Complete the table, showing scientific notation rounded to two decimal places. The first one is done for you.

Country	Liters of Soda Consumed Annually	Liters of Soda Consumed Annually (Scientific Notation)
United States	54,087,370,000	5.41×10^{10}
Australia	1,998,698,500	
Canada		3.57×10^9
China		1.23×10^{10}
India	3,734,940,000	
Japan	4,067,200,000	
Mexico		1.75×10^{10}
Norway	532,935,832	
Russia	4,311,000,000	
Sweden		6.87×10^8
United Kingdom	5,351,220,000	

- B.** Which country outside of the United States consumes the most soda? How do you know?
- C.** Which country outside of the United States consumes the least soda? How do you know?

- D.** Approximately how many more times is the soda consumption of the United States per year compared to the countries above? Choose three countries and show how you know for each.

Task/Question 4:

DOK Level 3: Strategic Thinking and Complex Reasoning

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 7: Look for and make use of structure.

A. To better compare the consumption of soda in each country, you must look at how much soda is consumed per capita in each country. Complete the table below. If the Per Capita Consumption is not in liters, be sure to convert it first. The first one is done for you.

Country	Liters of Soda Consumed Yearly In Scientific Notation (From Page 1)	Population	Per Capita Consumption (Amount Per Person)
United States	5.41×10^{10}	318,161,000	170 liters
Australia		23,514,100	
Canada		35,344,962	101 liters
China		1,364,840,000	
India		1,244,980,000	
Japan			32 liters
Mexico		119,713,203	
Norway		5,124,383	
Russia			30 liters
Sweden		9,675,885	
United Kingdom			84 liters

B. Which country consumes the most soda per capita? How do you know?

C. Which country consumes the least amount of soda per capita? How do you know?

D. Choose three countries and compare the soda consumption of each to the United States. What do you notice?

E. Which of the 10 countries do you think that a company should expand into? Be prepared to defend and justify your answer.

Task/Question 5:

DOK Level 3: Strategic Thinking and Complex Reasoning

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 7: Look for and make use of structure.

In the United States about 148 million liters of soda are consumed per day, or a little less than half a liter per day, per person.

- A.** Using the completed chart in Task 4 choose 5 of the countries (including the country with the least consumption) and determine how much soda is consumed by each country per day, and how much is consumed per person per day. Please express your answer in scientific notation.
- B.** What is the advantage of looking at the amount consumed per person per day instead of the total amount of soda?
- C.** What does this number tell us about how much soda people consume? Do all people drink the same amount, or do some drink more and some less? Discuss how soda consumption might vary from person to person.

Task/Question 6:

DOK Level 4: Extended Thinking

Math Practices:

- MP 1: Make sense of problems and persevere in solving them.
- MP 2: Reason abstractly and quantitatively.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 5: Use appropriate tools strategically.
- MP 6: Attend to precision.
- MP 7: Look for and make use of structure.

NOTE: Teacher may choose which task(s) below students will complete:

- A.** Why would a country have a low amount of soda consumption? Carry out further research on a few of the 10 countries to determine why. Consider population, other beverages that are consumed, the economy of the country, and other factors. Prepare a presentation to give to the class with your results.

- B.** Choose a favorite soda or one that you've heard of. Complete further research to find out more about this product and where the company that manufactures it has expanded in the world. Where is the company located? Where do they sell their soda? How much soda do they sell per year? How does this compare to the numbers you've seen in this worksheet? Create an info graphic or other visual representation to show your results. Be prepared to share this information with your classmates.

- C.** How has the consumption of soda changed over time; either world-wide or in the United States? Conduct further research to see how the consumption of soda has changed over the past 10 to 100 years. Prepare a line graph or other visual representation to display your results. Be prepared to share this information with your classmates.

Complete Performance Task Scoring Rubric *Scientific Notation*

65-106 Proficient 50-64 Good 30-49 Satisfactory 10-29 Poor 0-9 Unsatisfactory

	Depth of Knowledge Level	Points	Total Possible Points for Task	Total Points Earned by Student
<p>Task 1:</p> <p>A. To make very large and very small numbers easier to read and write.</p> <p>B. Answers will vary. Possible Explanations: Scientific to Standard: Write the coefficient-Add the number of zeros equal to the exponent-Move the decimal the number of places indicated by the exponent.</p> <p>Standard to Scientific: Write the number without the decimal point-Place the decimal so that the first number is greater than one but less than 10-Count how many places you moved the decimal point; use this as the exponent.</p>	1	1 2	3	
<p>Task 2:</p> <p>A. 6.0×10^{-6}</p> <p>B. 5.4×10^7</p> <p>C. 6.0×10^2</p> <p>D. 9.0×10^3</p> <p>E. 0.09</p> <p>F. 0.2</p> <p>G. 200,000</p> <p>H. 80,400</p>	2	1 1 1 1 1 1 1	8	

Task 3:	2	10	15																																																																						
<p>A.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 20px;"> <thead> <tr> <th style="width: 20%;">Country</th> <th style="width: 30%;">Liters of Soda Consumed Yearly</th> <th style="width: 50%;">Liters of Soda Consumed Yearly (Scientific Notation)</th> </tr> </thead> <tbody> <tr><td>United States</td><td>54,087,370,000</td><td>5.41×10^{10}</td></tr> <tr><td>Australia</td><td>1,998,698,500</td><td>2.00×10^9</td></tr> <tr><td>Canada</td><td>3,569,841,162</td><td>3.57×10^9</td></tr> <tr><td>China</td><td>12,283,560,000</td><td>1.23×10^{10}</td></tr> <tr><td>India</td><td>3,734,940,000</td><td>3.73×10^9</td></tr> <tr><td>Japan</td><td>4,067,200,000</td><td>4.07×10^9</td></tr> <tr><td>Mexico</td><td>17,478,127,638</td><td>1.75×10^{10}</td></tr> <tr><td>Norway</td><td>532,935,832</td><td>5.33×10^8</td></tr> <tr><td>Russia</td><td>4,311,000,000</td><td>4.31×10^9</td></tr> <tr><td>Sweden</td><td>686,987,835</td><td>6.87×10^8</td></tr> <tr><td>United Kingdom</td><td>5,351,220,000</td><td>5.35×10^9</td></tr> </tbody> </table> <p>B. Mexico, largest value</p> <p>C. Norway consumes the least soda. It has the smallest exponent and the smallest coefficient.</p> <p>D. Answers will Vary. Students should be dividing numbers in scientific notation in the following form (this is a comparison between the United States and Norway): Approximately 100 times: $(5.41 \times 10^{10}) \div (5.33 \times 10^8) = (5.41 \div 5.33) \times (10^{10} \div 10^8) \approx 1 \times 10^2 = 100$</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 20px;"> <thead> <tr> <th style="width: 20%;">Country</th> <th style="width: 30%;">Liters of Soda Consumed Yearly (Scientific Notation)</th> <th style="width: 50%;">How many more times the consumption of the US</th> </tr> </thead> <tbody> <tr><td>Australia</td><td>2.00×10^9</td><td>27.06</td></tr> <tr><td>Canada</td><td>3.57×10^9</td><td>15.15</td></tr> <tr><td>China</td><td>1.23×10^{10}</td><td>4.40</td></tr> <tr><td>India</td><td>3.73×10^9</td><td>14.48</td></tr> <tr><td>Japan</td><td>4.07×10^9</td><td>13.30</td></tr> <tr><td>Mexico</td><td>1.75×10^{10}</td><td>3.09</td></tr> <tr><td>Norway</td><td>5.33×10^8</td><td>101.49</td></tr> <tr><td>Russia</td><td>4.31×10^9</td><td>12.55</td></tr> <tr><td>Sweden</td><td>6.87×10^8</td><td>78.73</td></tr> <tr><td>United Kingdom</td><td>5.35×10^9</td><td>10.11</td></tr> </tbody> </table>	Country	Liters of Soda Consumed Yearly	Liters of Soda Consumed Yearly (Scientific Notation)	United States	54,087,370,000	5.41×10^{10}	Australia	1,998,698,500	2.00×10^9	Canada	3,569,841,162	3.57×10^9	China	12,283,560,000	1.23×10^{10}	India	3,734,940,000	3.73×10^9	Japan	4,067,200,000	4.07×10^9	Mexico	17,478,127,638	1.75×10^{10}	Norway	532,935,832	5.33×10^8	Russia	4,311,000,000	4.31×10^9	Sweden	686,987,835	6.87×10^8	United Kingdom	5,351,220,000	5.35×10^9	Country	Liters of Soda Consumed Yearly (Scientific Notation)	How many more times the consumption of the US	Australia	2.00×10^9	27.06	Canada	3.57×10^9	15.15	China	1.23×10^{10}	4.40	India	3.73×10^9	14.48	Japan	4.07×10^9	13.30	Mexico	1.75×10^{10}	3.09	Norway	5.33×10^8	101.49	Russia	4.31×10^9	12.55	Sweden	6.87×10^8	78.73	United Kingdom	5.35×10^9	10.11	<p>1</p> <p>1</p> <p>3</p>			
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