SOLAR SYSTEM

Performance Standard (6A/6D/7C).G

Convert large numbers into scientific notation, compute and compare ratios to explain why drawing completely accurate scale drawings of the solar system is not feasible:

- *Mathematical knowledge:* represent large numbers using scientific notation, compare diameters and distances using ratios;
- *Strategic Knowledge:* convert to scientific notation correctly, use correct units when comparing ratios; and
- *Explanation:* explain completely what was done and why it was done.

Procedures

1. Provide students with sufficient learning opportunities to develop the following skills in order to (6A) demonstrate knowledge and use of numbers and their many representations in a broad range of theoretical and practical settings, (6D) solve problems using comparison of quantities, ratios, proportions, and percents, and (7C) select and use appropriate technology, instruments, and formulas to solve problems, interpret results, and communicate findings.
    - Represent any large number using scientific notation.
    - Create and explain ratios and proportions the represent quantitative relationships.
    - Solve problems involving mixed units of the same attribute, including time, money, length, and area.
2. Provide each student with the assessment sheet and data sheet. Students should be allowed to use scientific calculators, if they desire. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Use the standard scoring rubric. Give each student a score in each of the three categories. A score of 4 should indicate completely correct solutions to all parts of the problem, with complete and correct justifications of their reasoning. A three should represent correct or nearly correct solutions to all parts, with only minor computational errors making their solutions inaccurate, there rationale should be sound, but may not be completely explained. A two would indicate that students have some idea about how to answer the questions, but make major errors in computation and or reasoning that effects their answers. A one may have a correct answer for one part, but generally shows little understanding in their rationale for their procedures and processes. A score of zero generally reflects no correct responses and no logical rationale for their procedures and processes.
4. Minor errors in computation include making errors in the actual addition or multiplication, rounding incorrectly. Major errors include using the wrong operations or formulas to relate terms.
5. Part A and Part B should be scored separately. Part A should be used to judge the student's ability to meet standard 6A. Part B addresses the student's ability to compare ratios. The key point is that the ratios have to be in the same unit before they can be compared. You cannot compare a ratio between millions of km and thousands of km in reduced form, without considering the impact of the unit. When considering the unit needed to make a scale drawing of the distance between planets, the ratio of the greatest to the least distant planet may help determine an appropriate scale. When considering a scale appropriate for comparing sizes of the planets, the ratio of the largest to the smallest may also be useful. However, when making an accurate scale drawing of the entire solar system, the same scale must be used for both distance between planets and for size of planets. This is not feasible, because of the difference in size of the appropriate scaling factors. If you select a scaling factor based on the size of the planet, the distances will not fit on a sheet of paper or even in your classroom. If the scale factor is based on the distances between planets, then it will be impossible to draw appropriate sized representations of the planets, since some will be less than the thickness of their pencil lead. A student who receives a four on this part should include accurate numerical ratios in their description of the scaling problem, and include a clear rationale for why the scaling is problematic. A student who receives a three may discuss the scaling problem, but does not present clear numerical evidence of the problem. Students who do not recognize the discrepancy in the units represented by the ratios as it relates to the scaling problem should receive no more than a 2 on part B.
6. Evaluate each student's work using the rubric and its guide to determine the performance level.

Examples of Student Work not available

Time Requirements

- 30 - 45 minutes

Resources

- Paper and pencil
- Calculators
- Copies of the “Solar System” task sheet
- Copies of the data sheet
- Mathematics Rubric

NAME _____ DATE _____

THE SOLAR SYSTEM

Student Task Sheet

Part A. Use the data sheet on the solar system to help answer the following questions.

1. Represent the diameters of each planet, and the distance from the sun for each planet in scientific notation using kilometers.

2. Write a ratio comparing the diameters of the largest planet to the smallest planet. Write an equivalent ratio in simplest form.

3. Write a ratio comparing the distance from the sun of the most distant to the closest planet. Write an equivalent ratio in simplest form.

Part B. Use the ratios calculated above and your knowledge of what they represent.

1. Explain why it is hard to make a completely accurate scale drawing of our solar system. Be sure to justify your reasoning with numerical information and comparisons, as well as a written explanation.

THE SOLAR SYSTEM

Data Sheet

Planets in our Solar System

Planet	Distance from the sun in millions of kilometers.	Diameter in thousands of kilometers.
Mercury	57.9	4.9
Venus	108.2	12.1
Earth	149.6	12.8
Mars	227.9	6.,8
Jupiter	778.3	143.2
Saturn	1,427	120.0
Uranus	2,871	51.8
Neptune	4,497	49.5
Pluto	5,914	2.3