

Rubric: Packing Predicament

Key APS Mathematics Performance Standards:

Target Performance Standards

Grade 8 Standards:

1. **Develops and evaluates** arguments involving real numbers, their patterns and operations.

Grade 7 Standards:

2. **Finds** length, area, volume, and angle measures to appropriate levels of precision selecting appropriate techniques and tools.
3. **Translates** problem-solving strategies into formulas for surface area and volume using appropriate mathematical symbols (e.g., cubic feet = ft^3).
4. **Selects and applies** appropriate formulas to solve problems.

- If the student does not attempt to solve the task or the work on the problem is completely unrelated to the task, the student's work for the task is considered "**Unscorable**" and should not be assigned a performance level of Novice, Apprentice, Practitioner, or Expert.

Level	Understanding	Strategies, Reasoning, & Procedures	Communication
Novice	<ul style="list-style-type: none"> ❖ The student understands that the task is a multiple step problem, but does not have the mathematical knowledge to complete the task and will only attempt to solve 1 or 2 aspects of the problem. ❖ The student understands that s/he needs to: <ul style="list-style-type: none"> • Determine if all of the contents will fit into the car's trunk. • Calculate the volume of the trunk. • Calculate the volume for each of the objects, but does not understand enough mathematics to use the formulas to find the volume for each object. • Justify their decision with math facts, but uses inaccurate calculations to base their decision. ❖ The student does not understand that the measurements for the objects and the trunk need to be converted from feet to inches or inches to feet and just multiplies the numbers given to find the volume. 	<ul style="list-style-type: none"> ❖ The student has started the task by using manipulatives and representations, but does not address all of the steps needed to solve the task. ❖ The student does not use an effective strategy to solve the problem or makes errors in their calculations. <p>Sample Strategy: Step 1: Trunk Volume: $3.5' \times 5' \times 2' = 35 \text{ feet}^3$ Step 2: Object Volume The student uses the numbers given to find the volume for each object. Suitcase: $3 \times 2 \times .75 = 4.5$ Bike: $70 \times 36 \times 9 = 7,776$ etc.... No units are given. The student uses these calculations to total the volume for the objects. Step 3: the student uses the inaccurate calculations to base their decision on whether or on the objects can fit into the trunk.</p>	<ul style="list-style-type: none"> ❖ There is little or no communication, the student did not label the work, and/or their thinking is difficult to follow. ❖ Summary: The student does not write his/her final answer. The student uses little or no mathematical language and symbols to explain (in writing) how s/he converted the measurements for the trunk and objects; calculated the volume for the trunk and each of the objects; and mathematically justifies their solution. ❖ Representations: The student has no system (charts/t-tables/graphs) to track the calculations needed for the measurement conversions of the trunk and each of the objects and the volume calculations for the trunk and each of the objects.

<p>Apprentice</p>	<ul style="list-style-type: none"> ❖ The student understands that the task is a multiple step problem, but cannot use the information at each of the steps to progress the problem. ❖ The student understands that s/he needs to: <ul style="list-style-type: none"> • Determine if all of the contents will fit into the car’s trunk. • Convert the measurements of the objects and the trunk from feet to inches or inches to feet, but makes calculation errors in the conversions. • Calculate the volume of the trunk. • Calculate the volume for each of the objects, but makes calculation errors using the formulas (i.e., volume of sphere or cylinder.) • Justify their decision with math facts, but bases his/her decision on inaccurate data. 	<ul style="list-style-type: none"> ❖ The student has started the task using manipulatives or representations, has chosen a strategy to solve the task, but does not achieve a correct solution. ❖ Task calculations include: <ul style="list-style-type: none"> • Calculating the volume of the trunk. • Converting the measurements for the trunk and each of the objects to inches (or feet depending on their strategy). • Calculating the volume for each object. • Comparing the volume of the trunk to the total volume of the objects. <p>Sample Strategy: Step 1: The student converts and calculates the trunk volume accurately, but makes errors when converting some of the objects from feet to inches (i.e., the tennis racket is .1feet wide and is converted to 1”). Step 2: There will also be errors with the volume calculations for some of the objects (i.e., volume of the volleyballs). Step 3: The student’s final decision will be based on erroneous calculations.</p>	<ul style="list-style-type: none"> ❖ The student has communicated his/her understanding of the task by labeling their work, but the task is not clearly organized and the student’s thinking is hard to follow. ❖ Summary: The student states his/her final answer. The student uses some mathematical language and symbols to explain (in writing) how s/he converted the measurements for the trunk and objects; calculated the volume for the trunk and each of the objects; and mathematically justifies their solution. ❖ Representations: The student has not established an accurate system (charts/t-tables/graphs) to track the calculations needed for the measurement conversions of the trunk and each of the objects and the volume calculations for the trunk and each of the objects.
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Scoring Note: The difference between the score of Practitioner and Apprentice on this task will depend on the accuracy of the student’s measurement conversions and volume calculations. The practitioner will have a well organized system for tracking the conversions and calculations and show how the objects will fit into the trunk of the car.

<p>Practitioner</p>	<p style="text-align: center;">Proficiency</p> <ul style="list-style-type: none"> ❖ The student understands that the task is a multiple step problem and that the answer at each step, progresses the problem. ❖ The student understands that s/he needs to: <ul style="list-style-type: none"> • Determine if all of the contents will fit into the car's trunk. • Convert the measurements of the objects and the trunk from feet to inches or inches to feet. • Calculate the volume of the trunk. • Calculate the volume for each of the objects. • Justify their decision with math facts. 	<p style="text-align: center;">Proficiency</p> <ul style="list-style-type: none"> ❖ The student uses one effective strategy to correctly solve all of the steps of the task. ❖ Task calculations include: <ul style="list-style-type: none"> • Calculating the volume of the trunk. • Converting the measurements for the trunk and each of the objects to inches (or feet depending on their strategy). • Calculating the volume for each object. • Comparing the volume of the trunk to the total volume of the objects. <p>Sample Strategy: Step 1: Trunk Conversion & Volume: $3.5' \times 5' \times 2' = 35 \text{ feet}^3$ or $42'' \times 60'' \times 24'' = 60,480 \text{ inches}^3$ Step 2: Object Conversions & Volume Suitcase: $36'' \times 24'' \times 9'' = 7,776 \text{ in}^3$ Bike: $70'' \times 36'' \times 9'' = 22,680 \text{ in}^3$ Folded Beach Chair: $30'' \times 36'' \times 6'' = 6,480 \text{ in}^3$ 2-Volleyballs: See Teacher Instructions for the entire solution. $v = 2 \left(\frac{4}{3} \pi r^3\right)$ $v = 2 \left(\frac{4}{3} \times 3.14 \times 5^3\right) = 1,046.6 \text{ in}^3$ (rounded) Tennis Racket: $30'' \times 12'' \times 1.2'' = 432 \text{ in}^3$ 2-Cans of Tennis Balls: See Teacher Instructions for the entire solution. $v = 2 (\pi r^2 h)$ $v = 2 (3.14 \times 1.75^2 \times 10'') = 192.3 \text{ in}^3$ (rounded) Skates: $18'' \times 12'' \times 6'' = 1,296 \text{ in}^3$ Tent: $60'' \times 12'' \times 12'' = 8,640 \text{ in}^3$ Day Pack: $12'' \times 18'' \times 6'' = 1,296 \text{ in}^3$ Total object volume: $49,840 \text{ in}^3$ (rounded) Step 3: Student compares the volume of the trunk to the volume of the objects and mathematically determines that the contents will easily fit into the trunk.</p>	<p style="text-align: center;">Proficiency</p> <ul style="list-style-type: none"> ❖ The student can represent his/her work in a clear, organized manner. ❖ Summary: The student states his/her final answer. The student uses appropriate mathematical language and symbols to explain (in writing) how s/he converted the measurements for the trunk and objects; calculated the volume for the trunk and each of the objects; and mathematically justifies their solution. ❖ Representations: The student has created an efficient system (charts/t-tables/graphs) to track the calculations needed for the measurement conversions of the trunk and each of the objects and the volume calculations for the trunk and each of the objects.
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<p>Expert</p>	<ul style="list-style-type: none"> ❖ The student understands that the task is a multiple step problem and that the answer at each step, progresses the problem. ❖ The student understands that s/he needs to: <ul style="list-style-type: none"> • Determine if all of the contents will fit into the car’s trunk. • Convert the measurements of the objects and the trunk from feet to inches or inches to feet. • Calculate the volume of the trunk. • Calculate the volume for each of the objects. • Justify their decision with math facts. ❖ Task Extension: The student includes a written rule, equation, generalization, and/or observation about their mathematical insights about geometric concepts related to volume. 	<ul style="list-style-type: none"> ❖ The student uses more than one accurate and appropriate strategy to solve all of the steps of the task. ❖ Task calculations include: <ul style="list-style-type: none"> • Calculating the volume of the trunk. • Converting the measurements for the trunk and each of the objects to inches (or feet depending on their strategy). • Calculating the volume for each object. • Comparing the volume of the trunk to the total volume of the objects. Sample Strategy: See the Practitioner’s Strategy for solving the task. The student also includes a visual representation for arranging the objects into the trunk ❖ Task Extension: The student realizes that the conversion from cubic inches to cubic feet is a factor of $12 \times 12 \times 12 = 1,728$ and multiplies the inches cubed by 1,728 to convert to feet cubed. For Example: Total Object Volume $\cong 49,839 \text{ in}^3 \div 1,728 \cong 28.8$ or 29 ft^3. Trunk Volume = $35 \text{ ft}^3 \times 1,728 = 60,480 \text{ in}^3$ or 	<ul style="list-style-type: none"> ❖ The student can represent his/her work in a clear, organized manner. ❖ Summary: The student states his/her final answer. The student uses appropriate mathematical language and symbols to explain (in writing) how s/he converted the measurements for the trunk and objects; calculated the volume for the trunk and each of the objects; and mathematically justifies their solution. ❖ Representations: The student has created an efficient system (charts/t-tables/graphs) to track the calculations needed for the measurement conversions of the trunk and each of the objects and the volume calculations for the trunk and each of the objects. ❖ Task Extension: The student includes a written rule, equation, generalization, and/or observation about their mathematical insights about geometric concepts related to volume.
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