Cars on a Ramp

Sabrina and Joel are measuring how far their cars roll down a ramp. Sabrina's car rolls forty-eight inches. Joel's car rolls seventy-two inches. Sabrina says her car rolls four times as far as one foot. Joel says his car rolls two times as far as one yard. Who is correct, Sabrina or Joel? Show all your mathematical thinking.

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Planning Sheet

Cars on a Ramp

Common Core Task Alignments

Mathematical Practices: MP.1 MP.2 MP.3 MP.4 MP.5 MP.6 MP.7

Grade 4 Content Standards: 4.OA.A.2

Common Core Standards and Evidence

4.OA.A.2

Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.

Exemplars Task-Specific Evidence

This task requires students to use multiplication in comparison situations. The students also need to know that one foot is 12 inches and one yard is 36 inches.

Underlying Mathematical Concepts

- Multiplicative comparison
- Linear measurement: 12" = 1', 36" = 1 yard
- Number sense to 72

Possible Problem-Solving Strategies

- Model (manipulatives)
- Diagram/Key
- Chart
- Number line

Formal Mathematical Language/Symbolic Representation

- Model
- Diagram/Key
- Chart
- Number line
- Inch, in.,"
- Foot, ft., '
- Yard, yd.
- Total/Sum
- Amount
- Greater than (>)/Less than (<)
- Most/Least
- Distance
- Per
- Angle
- Degrees

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Possible Solutions

Sabrina and Joel are both correct.

Friend	Car Rolls in Inches	Car Rolls in Feet
Sabrina	48	4
Joel	72	6

6 feet = 2 yards

4 x ☐" = 48"

4 x 1' = 4'

☐ x 36" = 72"

2 x 36" = 72"

$$\begin{array}{r|l} & 12 \\ 4 & 48 \\ -\,40 & 10 \\ \hline 8 & \\ -\,8 & 2 \\ \hline 0 & 12 \end{array}$$

Possible Connections

Below are some examples of mathematical connections. Your students may discover some that are not on this list.

- The cars roll a total of 120 inches or 10 feet.
- Joel's car travels the most, 2 more feet than Sabrina's car.
- Sabrina's car travels $1\frac{1}{3}$ yards or 1 yard and 12 inches.
- Relate to a similar task and state a math link.
- Solve more than one way to verify the answer.
- Using the same ramp makes the distance traveled per car fair as the slope is the same.
- If you raise the ramp, the cars could go faster.
- Angle/ramp/degrees are discussed.

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ANCHOR PAPERS

Novice Scoring Rationale

Criteria and Performance Level	Rationales
Problem Solving *Novice*	The student's multiplication would not work to solve this task. The student's answer, "I think they are both correct," does not match the calculations that show 96 for Sabrina and 288 for Joel.
Reasoning & Proof *Novice*	The student does not demonstrate correct reasoning. It appears that the student uses the numbers 48 and 72 from the task and multiplies them by the two and four mentioned in the task. This reasoning would not lead to a correct answer.
Communication *Novice*	The student does not use any mathematical language or notation.
Connections *Novice*	The student does not make a mathematically relevant connection. The statement, "I see Joel goes fast," is not linked to any numbers in the problem: One has to assume the student means Joel's car goes fast.
Representation *Novice*	The student does not use any mathematical representation in their solution.

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Novice

P/S	R/P	Com	Con	Rep	A/Level
N	N	N	N	N	N

Is Joel correct or Is Sabrina correct?

Sabrina goes 48. Joel goes 72.

48 x 2 = 96
40 x 2 = 80
8 x 2 = +16
96

72 x 4 = 288
70 x 4 = 280
2 x 4 = + 8
288

I think they are both correct.

I see Joel goes fast.

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Apprentice Scoring Rationale

Criteria and Performance Level	Rationales
Problem Solving *Practitioner*	The student's strategy of using a chart and division to determine that Sabrina's car does roll four times as far as one foot and Joel's car does roll two times as far as one yard works to solve the task. The student's answer, "Joel is correct," and, "Sabrina is correct," is correct.
Reasoning & Proof *Practitioner*	The student demonstrates understanding of the underlying concepts of the task. The student correctly uses division to differentiate multiplicative comparison from additive comparison.
Communication *Apprentice*	*The student correctly uses the mathematical term "in." (inch) from the task. The student does not include any other mathematical terms in their solution.*
Connections *Apprentice*	The student attempts a mathematical connection by deciding to determine the sum of the inches traveled by the two cars. The student makes a computational error that leads to an incorrect connection of "110 in. – how much they roll together."
Representation *Practitioner*	The student's use of a chart is appropriate to the task and accurate. Each column is labeled correctly and all entered data is correct.

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Apprentice

P/S	R/P	Com	Con	Rep	A/Level
P	P	A	A	P	A

I have to find out who is correct- Sabrina or Joel. I am going to show the rolls.

cars	roll
Joels	72 in.
Sabrinas	48 in.

2 times
36 | 72
−72
0

4 times
12 | 48
−48
0

Joel is correct
Sabrina is correct

72 in.
+ 48 in.
110 in. – how much they roll together

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Practitioner Scoring Rationale

Criteria and Performance Level	Rationales
Problem Solving *Practitioner*	The student's strategy of using a diagram, multiplication and division to determine that Sabrina's car does roll four times as far as one foot and Joel's car does roll two times as far as one yard works to solve the task. The student's answer, "Both are right," is correct.
Reasoning & Proof *Practitioner*	The student demonstrates understanding of the underlying concepts of the task. The student correctly uses division and multiplication to differentiate multiplicative comparison from additive comparison.
Communication *Practitioner*	The student correctly uses the mathematical terms *inches, foot, yard* from the task. The student also correctly uses terms *diagram, more than.*
Connections *Practitioner*	The student makes a mathematical connection by determining that "Joels car went 24 inches more than Sabrina," and includes the computation "72 – 48 = 24."
Representation *Practitioner*	The student's use of a diagram is appropriate to the task and accurate. The cars are correctly labeled and the inch notation is correct.

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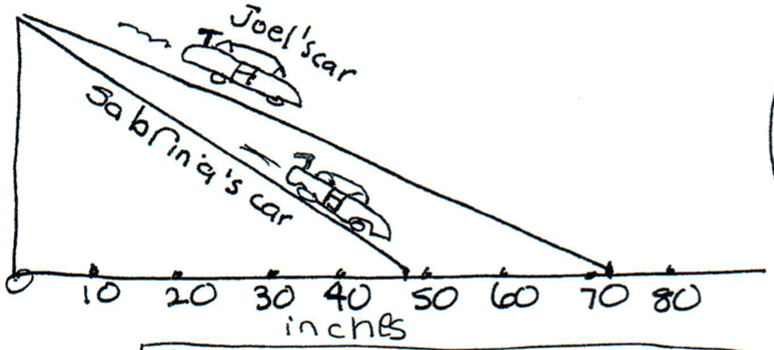
Practitioner

P/S	R/P	Com	Con	Rep	A/Level
P	P	P	P	P	P

I need to find out who is correct.
I will make a diagram.

Foot = 12 inches
Yard = 36 inches

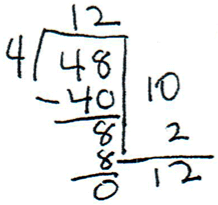
Answer
Both are right

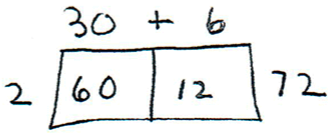


Sabrina work
48 ÷ 4 = 12
Right

Joel work
36 x 2 = 72
Right

Joels car went 24 inches more than Sabrina
72 - 48 = 24





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Expert Scoring Rationale

Criteria and Performance Level	Rationales
Problem Solving *Expert*	The student's strategy of using number lines and multiplication to determine that Sabrina's car does roll four times as far as one foot and Joel's car does roll two times as far as one yard works to solve the task. The student's answer, "Both Joel and Sabrina are correct exactley," is correct. The student also uses an alternate strategy of a chart and division. The student also brings prior knowledge of mixed fractions to the task.
Reasoning & Proof *Expert*	The student demonstrates understanding of the underlying concepts of the task. The student correctly uses multiplication to differentiate multiplicative comparison from additive comparison. The student justifies their answer by using an alternate strategy of a chart and division to arrive at the same answer.
Communication *Expert*	The student correctly uses the mathematical terms *inches, foot, yard* from the task. The student also correctly uses terms *number line, distance, key, "tabe," (table), division, even.* The student correctly uses the mathematical notation *", ', 3 1/3, 3 12/36.*
Connections *Expert*	The student makes the mathematical connections, "Sabrina was only 24 inches away from Joel's car roll," "or 2 feet away from Joel's car roll," and, "all numbers are even." The student uses arrows to point to the even numbers 48", 4', 72", 6'. The student makes the Expert connection of verifying that their answer is correct by using division and a chart. The student states, "I get 4 and 2 again for times so it is correct." The student also determines that ten feet is equivalent to 3 1/3 yards and 120 inches is equivalent to 3 and 1/3 yards.
Representation *Expert*	The student's use of number lines is appropriate to the task and accurate. Each number line is titled and correctly labeled. 72 and 48 inches are correctly indicated. The student's chart is also appropriate to the task and accurate. All labels are indicated and the entered data is correct. The student uses their chart to verify that the data on the number lines and their answer is correct.

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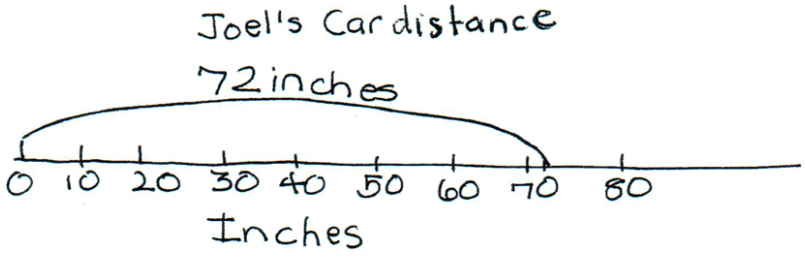
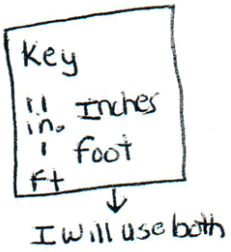
Expert

P/S	R/P	Com	Con	Rep	A/Level
E	E	E	E	E	E

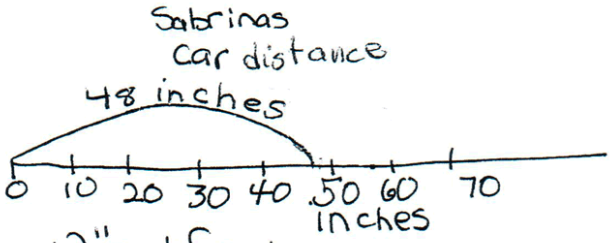
I need to figure who is correct.
I will make a number line.





a yard = 36 in.

Joel says his car rolled 2 times as far as one yard
36"
× 2
72"



a foot = 12 in.

12" = 1 foot

4
× 48" Sabrina said hers rolled 4 times as far as 1 foot.

Answer-Both Joel and Sabrina are correct- exactley

Connection-Sabrina was only 24 inches away from Joel's car roll.
72
-48
24 or 2 feet away from Joel's car roll

(Continued on next page)

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I have to justify I am correct. I will use a tabe and division this time.

$12\text{in} \overline{)48\text{in}}$ 4 → 4 times

-48

0

$36\text{in} \overline{)72\text{in}}$ 2 → 2 times

-72

0

1 yard = 36in.

all numbers are even ↓ ↓

Person's car	Sabrina	Joel
" car rolls	48"	72"
1 car rolls	4'	6'

I get 4 and 2 again for times so it is correct.

$4' + 6' = 10'$

$3' \overline{)10'}$ 3 $= 3\frac{1}{3}$ yds.

-9

1

↓

1 yd.

$48" + 72" = 120"$

$36" \overline{)120"}$ 3

-108

12

This is $3\frac{12}{36} = 3\frac{1}{3}$ yds

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