Mathematics Problem Solving Official Scoring Guide

Apply mathematics in a variety of settings. Build new mathematical knowledge through problem solving. Solve problems that arise in mathematics and in other contexts. Apply and adapt a variety of appropriate strategies to solve problems. Monitor and reflect on the process of mathematical problem solving.

Process Dimensions	**6/ 5	4	3	*2 / 1
Making Sense of the Task *Interpret the concepts of the task and translate them into mathematics.*	The interpretation and/or translation of the task are • thoroughly developed and/or • enhanced through connections and/or extensions to other mathematical ideas or other contexts.	The interpretation and translation of the task are • adequately developed and • adequately displayed.	The interpretation and/or translation of the task are • partially developed, and/or • partially displayed.	The interpretation and/or translation of the task are • underdeveloped, • sketchy, • using inappropriate concepts, • minimal, and/or • not evident.
Representing and Solving the Task *Use models, pictures, diagrams, and/or symbols to represent and solve the task situation and select an effective strategy to solve the task.*	The strategy and representations used are • elegant (insightful), • complex, • enhanced through comparisons to other representations and/or generalizations.	The strategy that has been selected and applied and the representations used are • effective and • complete.	The strategy that has been selected and applied and the representations used are • partially effective and/or • partially complete.	The strategy selected and representations used are • underdeveloped, • sketchy, • not useful, • minimal, • not evident, and/or • in conflict with the solution/outcome.
Communicating Reasoning *Coherently communicate mathematical reasoning and clearly use mathematical language.*	The use of mathematical language and communication of the reasoning are • elegant (insightful) and/or • enhanced with graphics or examples to allow the reader to move easily from one thought to another.	The use of mathematical language and communication of the reasoning • follow a clear and coherent path throughout the entire work sample and • lead to a clearly identified solution/outcome.	The use of mathematical language and communication of the reasoning • are partially displayed with significant gaps and/or • do not clearly lead to a solution/outcome.	The use of mathematical language and communication of the reasoning are • underdeveloped, • sketchy, • inappropriate, • minimal, and/or • not evident.
Accuracy *Support the solution/outcome.*	The solution/outcome is correct and enhanced by • extensions, • connections, • generalizations, and/or • asking new questions leading to new problems.	The solution/outcome given is • correct, • mathematically justified, and • supported by the work.	The solution/outcome given is • incorrect due to minor error(s), or • a correct answer but work contains minor error(s) • partially complete, and/or • partially correct	The solution/outcome given is • incorrect and/or • incomplete, or • correct, but o conflicts with the work, or o not supported by the work.
Reflecting and Evaluating *State the solution/outcome in the context of the task.* *Defend the process, evaluate and interpret the reasonableness of the solution/outcome.*	Justifying the solution/outcome completely, the student reflection also includes • reworking the task using a different method, • evaluating the relative effectiveness and/or efficiency of different approaches taken, and/or • providing evidence of considering other possible solution/outcomes and/or interpretations.	The solution/outcome is stated within the context of the task, and the reflection justifies the solution/outcome completely by reviewing • the interpretation of the task • concepts, • strategies, • calculations, and • reasonableness.	The solution/outcome is not stated clearly within the context of the task, and/or the reflection only partially justifies the solution/outcome by reviewing • the task situation, • concepts, • strategies, • calculations, and/or • reasonableness.	The solution/outcome is not clearly identified and/or the justification is • underdeveloped, • sketchy, • ineffective, • minimal, • not evident, and/or • inappropriate.

****6 for a given dimension would have most attributes in the list; 5 would have some of those attributes.**

***2 for a given dimension would be underdeveloped or sketchy, while a 1 would be minimal or nonexistent.**

Guide to Writing Quality Mathematics Work Samples

Effective tasks must provide an opportunity for scoring across all five process dimensions of the Mathematics Problem Solving Official Scoring Guide. Tasks must elicit developmentally appropriate problem solving skills and be tied to grade level content standards. A good task must be a non-familiar application requiring multiple steps and, ideally, have more than one method of solution. When appropriate, work samples should be embedded in the curriculum and may be used as a culminating assessment.

Task Writing Process	
	Select the standard(s) to be addressed. Students working toward a solution may be required to apply standards from earlier grades.
	Determine a real-world context that students have previous experience with. Ideas may come from textbooks, online resources, etc.
	Write a task that provides an opportunity for students to demonstrate proficiency in the selected standard(s).
	Determine the solution.
	Determine if there are implied assumptions or interpretations that may vary between students.
	Consider alternative solution paths; try to solve the task using a variety of different problem solving strategies and approaches.
	Determine what a proficient student response would look like. Determine what a "6" student response would look like.
	Apply the Matrix for Evaluating Mathematics Work Sample Tasks.
	Make edits and re-evaluate.
	Ask a colleague to solve it, and suggest edits as needed.

Matrix for Evaluating Mathematics Work Sample Tasks

In designing a task, writers may consider the following matrix. Task writers may use the matrix to reflect on and revise their work, or as a training tool for use in developing tasks in teams.

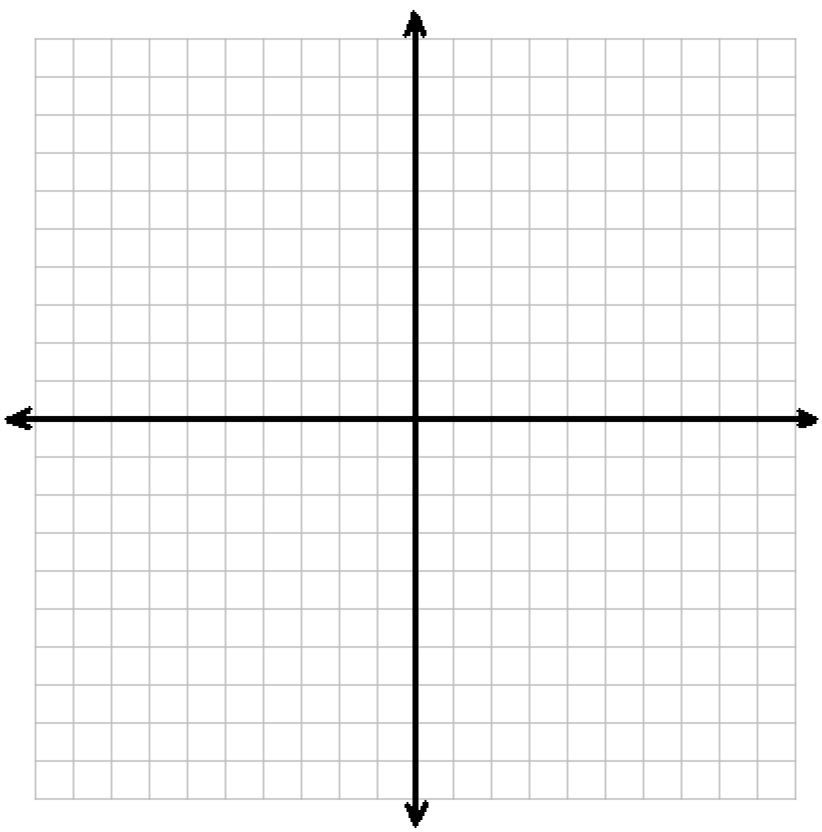
Process Dimension	Questions	Yes/No Ideas for Revision
Making Sense of the Task	Does the task ask students to change important information into mathematical ideas?	☐
Representing and Solving the Task	Are there clear math strategies students can use to solve this problem?	☐
Communicating Reasoning	Does the task require a logical chain of reasoning that is robust enough for the student to demonstrate communication?	☐
Accuracy	Is there one answer? Does the task allow students to make their own connections and determine which steps to take?	☐ ☐
Reflecting and Evaluating	Is there a reasonable way for the student to rework the problem by solving with an alternate method, by working backwards or double-checking the result?	☐
Characteristic	**Questions**	**Yes/No Ideas for Revision**
Grade level standards are addressed	Will the task be used to demonstrate Essential Skills? Does the complexity of the task deter students from addressing below grade level standards?	☐ ☐
Non-routine	Does the task deviate from a standard mathematical template? Does the task suggest an approach that is neither automatic nor routine?	☐ ☐
Appropriate level of rigor	Is the task too hard, too easy, not enough steps?	☐
Bias, Sensitivity and Accessibility	Is the language clear and straightforward? Is the task culturally equitable, free of stereotypes, and within the students' realm of experience?	☐ ☐

Quadrilateral ABCD

Quadrilateral ABCD has the points A(1,1), B(3,3), C(3,5), D(1,6). If ABCD is reflected across the y-axis and then the x-axis, what is the location of the points A’, B’, C’, and D’?

El cuadrilátero ABCD tiene los puntos A(1,1), B(3,3), C(3,5), D(1,6). Si ABCD se refleja a travéz del eje “y” y después el eje “x”, ¿cuál es la ubicación de los puntos A’, B’, C’ y D’?

Четырёхугольник ABCD имеет вершины в точках A(1,1), B(3,3), C(3,5), D(1,6). Какие координаты будут у точек A’, B’, C’, и D’, если поначалу отразить четырёхугольник ABCD относительно оси y, а затем - относительно оси x?



Guide to Writing Quality Mathematics Work Samples

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	Determine the solution.
	Determine if there are implied assumptions or interpretations that may vary between students.
	Consider alternative solution paths; try to solve the task using a variety of different problem solving strategies and approaches.
	Determine what a proficient student response would look like. Determine what a "6" student response would look like.
	Apply the Matrix for Evaluating Mathematics Work Sample Tasks.
	Make edits and re-evaluate.
	Ask a colleague to solve it, and suggest edits as needed.

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Accuracy	Is there one answer? Does the task allow students to make their own connections and determine which steps to take?	☐ ☐
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Grade level standards are addressed	Will the task be used to demonstrate Essential Skills? Does the complexity of the task deter students from addressing below grade level standards?	☐ ☐
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Appropriate level of rigor	Is the task too hard, too easy, not enough steps?	☐
Bias, Sensitivity and Accessibility	Is the language clear and straightforward? Is the task culturally equitable, free of stereotypes, and within the students' realm of experience?	☐ ☐

Gopher Security

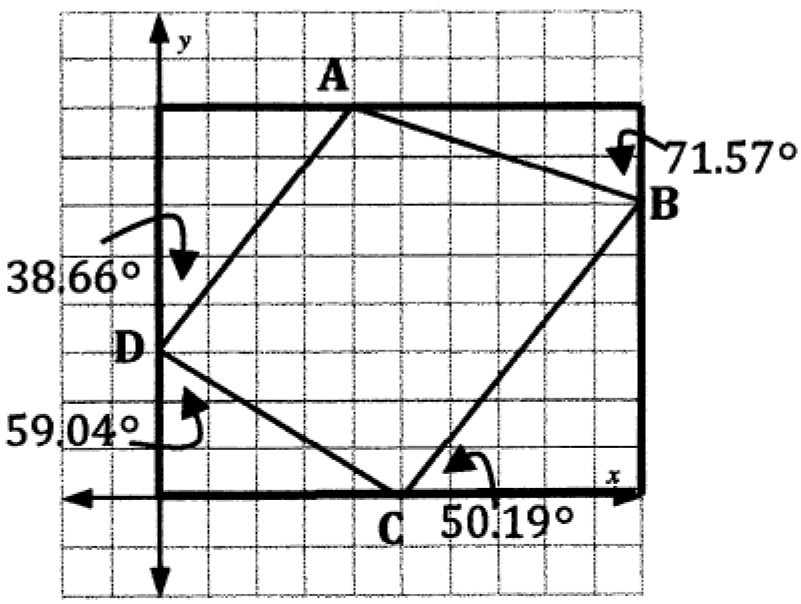
Gopher Security Company has been hired to create a security system for the Portland Museum to guard the famous Hope Diamond. They will be installing a laser bean triggered security system. You will help them determine the distance the beam will travel around the room to protect the diamond. If the beam is broken, the alarm will be triggered.

The display box will be placed in the center of the room.

The beam travels from the sensor at point A to sensor B to sensor C to sensor D and back to sensor A.

What is the total distance the beam will travel around the room?

Show all work and reasoning to complete the task.



Calibration Packet

Overview:

This packet contains a series of papers completed by students during a mathematics field test. The purpose of this calibration activity is to ensure that papers scored across the state are looked at similarly and scored comparably.

Directions:

- Solve the task "Roads In Prezville"
- Determine the solution and key concepts, first individually and then as a table.
- Establish key concepts for the score site.
- Score paper J-5 and J-I2 individually and then as a table. Record key points or scoring considerations.
- As a score site check table scores against key scores. If you are somewhat lenient or severe based on this comparison, adjust your scoring appropriately so that you are "calibrated" to the expectations that all raters are being asked to match as reflected in the keys scores.
- Individually score paper J-15, J-27 and J-28.
- With your table lead check the key scores to see how your scores compare. If you are off by one score point discuss with your table lead the rational for that score point. If you are off by more than two score points on two or more process dimensions please see the scoring director to score additional papers.

Paper #	Task Title	Making Sense of the Task	Representing and Solving the Task	Communicating Reasoning	Accuracy	Reflecting and Evaluating
J-5	Roads in Prezville					
J-12	Roads in Prezville					
J-15	Roads in Prezville					
J-27	Roads in Prezville					
J-28	Roads in Prezville					

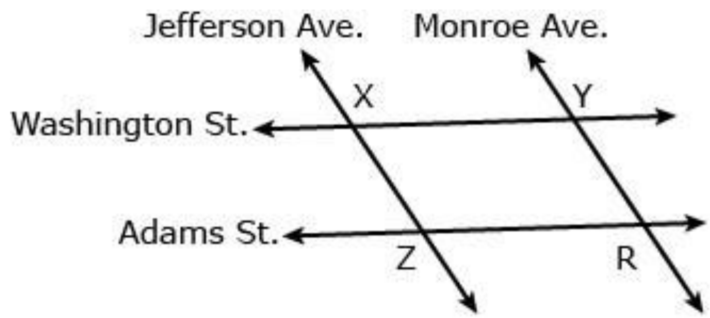
Mathematics Work Sample Assessment

Roads in Prezville

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

Student: ______________________________ **Teacher:** ______________________________
SSID: ______________________________ **School:** ______________________________

In the city of Prezville, Adams Street and Washington Street both cross Jefferson Avenue and Monroe Avenue at intersections labeled X, Y, Z and R, as shown. The distance from X to Y along Washington Street is equal to the distance from Z to R along Adams Street AND equal to the distance from Y to Z along the diagonal. Two of the angles formed by the diagonal $\overline{YZ}$, $\angle XYZ$ and $\angle RZY$ are congruent. Prove that Washington St. is parallel to Adams St. AND Jefferson Ave. is parallel to Monroe Ave.



Note: Figures not drawn to scale.

J

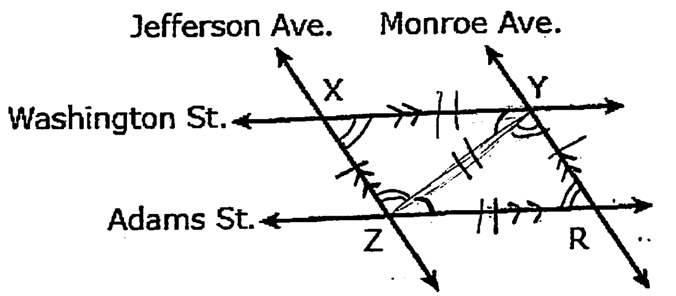
Mathematics Work Sample Assessment

Roads in Prezville

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#J5

In the city of Prezville, Adams Street and Washington Street both cross Jefferson Avenue and Monroe Avenue at intersections labeled X, Y, Z and R, as shown. The distance from X to Y along Washington Street is equal to the distance from Z to R along Adams Street AND equal to the distance from Y to Z along the diagonal. Two of the angles formed by the diagonal $\overline{YZ}$, $\angle XYZ$ and $\angle RZY$ are congruent. Prove that Washington St. is parallel to Adams St. AND Jefferson Ave. is parallel to Monroe Ave.



Note: Figures not drawn to scale.

$\triangle RZY \cong \triangle XYZ$ by SAS and are isoscles $\triangle$'s, because they are isoscles $\triangle$ $\angle ZYR \cong \angle YZX$ and $\angle YRZ \cong \angle ZXY$, also, that means $\overline{XZ} \cong \overline{YR}$.

Because $\triangle RZY \cong \triangle XYZ$ and are isoscles $\triangle$ this makes it a parallelogram because there are two pairs of opposite $\cong$ sides which are Washington, Adams st. + Jefferson, Monroe Ave. and there are two pairs of opposite $\cong$ angles.

2nd way:

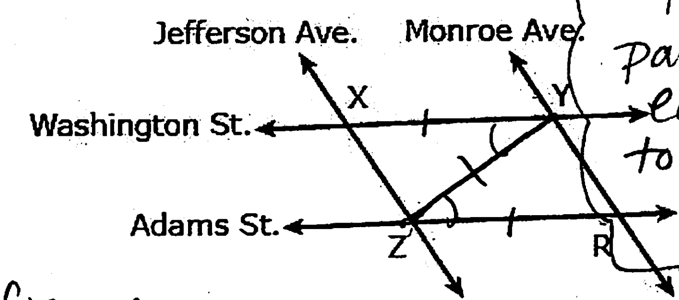
Because $\triangle RZY \cong \triangle XYZ$ by SAS, SSS, AAA, ASA, and form a parallelogram with 2 pairs of opp. $\cong$ angles + 2 pairs of opp. $\cong$ sides, washington st., Adams st. + Monroe Ave., Jefferson Ave. are parallel by CPCTC.

Mathematics Work Sample Assessment
Roads in Prezville

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#J12

In the city of Prezville, Adams Street and Washington Street both cross Jefferson Avenue and Monroe Avenue at intersections labeled X, Y, Z and R, as shown. The distance from X to Y along Washington Street is equal to the distance from Z to R along Adams Street AND equal to the distance from Y to Z along the diagonal. Two of the angles formed by the diagonal $\overline{YZ}$, ∠XYZ and ∠RZY are congruent. Prove that Washington St. is parallel to Adams St. AND Jefferson Ave. is parallel to Monroe Ave.



The numbers in parentheses after each reason refer to the previous steps that support the statement

Note: Figures not drawn to scale.

Given: the figure,
$\angle XYZ \cong \angle RZY$
$\overline{XY} = \overline{ZR} = \overline{YZ}$
Prove: $\overleftrightarrow{XY} \parallel \overleftrightarrow{ZR}$, $\overleftrightarrow{XZ} \parallel \overleftrightarrow{YR}$

I included segment YZ because 2 distinct points determine a unique line segment

Statements	Reasons
1. $\angle XYZ \cong \angle RZY$	1. Given
2. $\overline{XY} = \overline{ZR} = \overline{YZ}$	2. Given
3. $\overline{XY} \cong \overline{ZR} \cong \overline{YZ}$	3. Dfn ≅ line segments of equal length are congruent (2)
3.5 $\overline{ZY} \cong \overline{ZY}$	3.5 Reflexive Prop of ≅
4. $\triangle XYZ \cong \triangle RZY$	4. SAS (side-angle-side) (1,3,3.5)
5. $\angle XZY \cong \angle RYZ$	5. CPCTC (corresponding parts of congruent triangles are congruent) (4)
6. $\angle XYZ$ and $\angle RZY$ are alternate interior ∠'s	6. Dfn of alt. int. ∠'s
*7. $\overleftrightarrow{XY} \parallel \overleftrightarrow{ZR}$	7. When alternate interior angles are congruent, lines are parallel (excl. transversal) (1,6)

8. $\angle XZY$ and $\angle RYZ$ are alternate interior $\angle$'s

8. Dfn alt. int. $\angle$'s

* 9. $\overleftrightarrow{XZ} \parallel \overleftrightarrow{YR}$

9. When alt. int. $\angle$'s are $\cong$, the lines are parallel that form them (excl. transversal) (5,8)

I could have also proven that $\overleftrightarrow{XZ} \parallel \overleftrightarrow{YR}$ by first proving that $\square XYRZ$ is a parallelogram because → a quadrilateral with one pair of sides that are both parallel <u>and</u> congruent is a parallelogram.

Then I could have said that in a parallelogram, opposite sides are congruent.

#J12 cont.

J

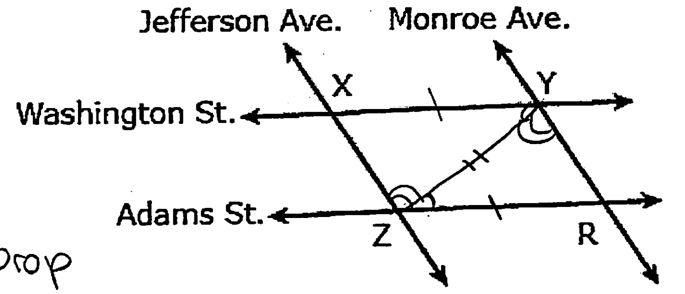
Mathematics Work Sample Assessment

Roads in Prezville

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#J15

In the city of Prezville, Adams Street and Washington Street both cross Jefferson Avenue and Monroe Avenue at intersections labeled X, Y, Z and R, as shown. The distance from X to Y along Washington Street is equal to the distance from Z to R along Adams Street AND equal to the distance from Y to Z along the diagonal. Two of the angles formed by the diagonal $\overline{YZ}$, ∠XYZ and ∠RZY are congruent. Prove that Washington St. is parallel to Adams St. AND Jefferson Ave. is parallel to Monroe Ave.



Note: Figures not drawn to scale.

Given $\overline{XY} \cong ZR$

Given $\angle XYZ \cong \angle RZY$

$\overline{ZY} \cong \overline{ZY}$ by reflexive prop

$\triangle XYZ \cong \triangle RZY$ by ASA

If $\angle XYZ \cong \angle RZY$ and are alternate interior ∠'s, and $\overline{XY} \cong \overline{ZR}$, then $\overline{XY}$ and $\overline{ZR}$ are Parallel.

$\triangle XYZ \cong \triangle RZY$ by ASA

$\angle XZY \cong \angle RYZ$ by alternate exterior ∠'s

then $\overline{XZ} \cong \overline{RY}$ and is also parallel

J

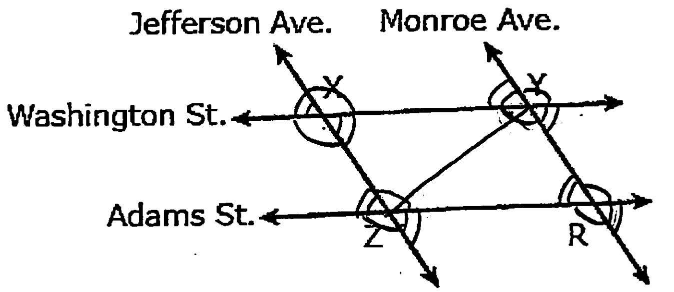
Mathematics Work Sample Assessment

Roads in Prezville

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#J27

In the city of Prezville, Adams Street and Washington Street both cross Jefferson Avenue and Monroe Avenue at intersections labeled X, Y, Z and R, as shown. The distance from X to Y along Washington Street is equal to the distance from Z to R along Adams Street AND equal to the distance from Y to Z along the diagonal. Two of the angles formed by the diagonal $\overline{YZ}$, ∠XYZ and ∠RZY are congruent. Prove that Washington St. is parallel to Adams St. AND Jefferson Ave. is parallel to Monroe Ave.



Note: Figures not drawn to scale.

Because ∠XYZ and ∠RZY is congruent, then ∠Y is congruent to ∠Z. ∠X is congruent to ∠Z and ∠Y is congruent to ∠R. Therefore, Washington Street is parallel to Adams Street, and Jefferson Avenue is parallel to Monroe Avenue.

J

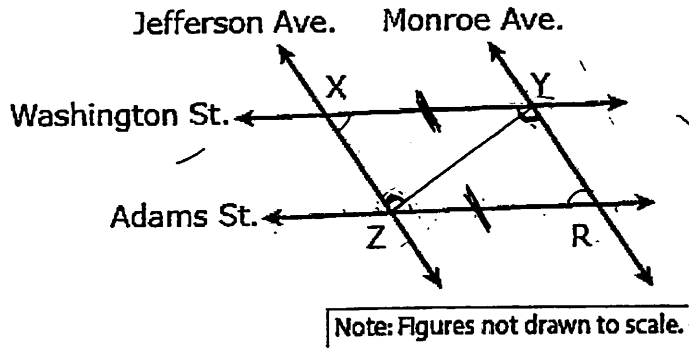
Mathematics Work Sample Assessment

Roads in Prezville

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#J28

In the city of Prezville, Adams Street and Washington Street both cross Jefferson Avenue and Monroe Avenue at intersections labeled X, Y, Z and R, as shown. The distance from X to Y along Washington Street is equal to the distance from Z to R along Adams Street AND equal to the distance from Y to Z along the diagonal. Two of the angles formed by the diagonal $\overline{YZ}$, ∠XYZ and ∠RZY are congruent. Prove that Washington St. is parallel to Adams St. AND Jefferson Ave. is parallel to Monroe Ave.



Note: Figures not drawn to scale.

∠X ≅ ∠R

YZ ≅ YZ by line of reflection of congruence

<Y and <Z are both Alternate interior Angles

ΔXYZ ≅ ΔRZY because of Side Angle Side therefore Washington St is parallell to Adam St.

∠XYZ ≅ ∠RZY

$\overline{XY} \cong \overline{RZ}$

Jefferson Ave. and monroe Ave. are parralell because it's a parallelogram and from (CPCTC) Congruence Parts Connect to congruence.

Calibration Packet

Overview:

This packet contains a series of papers completed by students during a mathematics field test. The purpose of this calibration activity is to ensure that papers scored across the state are looked at similarly and scored comparably.

Directions:

- Solve the task "Homework & Grades"
- Determine the solution and key concepts, first individually and then as a table.
- Establish key concepts for the score site.
- Score paper M-6 and M-8 individually and then as a table. Record key points or scoring considerations.
- As a score site check table scores against key scores. If you are somewhat lenient or severe based on this comparison, adjust your scoring appropriately so that you are "calibrated" to the expectations that all raters are being asked to match as reflected in the keys scores.
- Individually score paper M-10, M-22 and M-29.
- With your table lead check the key scores to see how your scores compare. If you are off by one score point discuss with your table lead the rational for that score point. If you are off by more than two score points on two or more process dimensions please see the scoring director to score additional papers.

Paper #	Task Title	Making Sense of the Task	Representing and Solving the Task	Communicating Reasoning	Accuracy	Reflecting and Evaluating
M-6	**Homework & Grades**					
M-8	**Homework & Grades**					
M-10	**Homework & Grades**					
M-22	**Homework & Grades**					
M-29	**Homework & Grades**					

Mathematics Work Sample Assessment

Homework & Grades

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Student: ______________________________ **Teacher:** ______________________________
SSID: ______________________________ **School:** ______________________________

Math teachers always claim that doing homework helps students get better grades in their math classes. To test this theory a survey of high school math students was conducted and the following results were obtained:

- 48% complete math homework regularly
- 55% have a B average or better in math class
- 40% do not complete math homework regularly AND have less than a B average in math class.

Using this data, does it appear that students who complete math homework regularly are more likely to have an average of B or better in math class? Justify your answer using mathematics.

Mathematics Work Sample Assessment

Homework & Grades

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#M6

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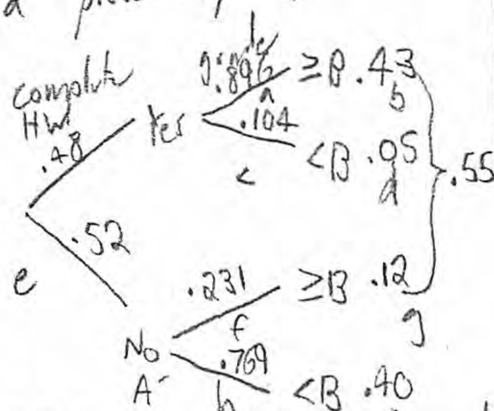
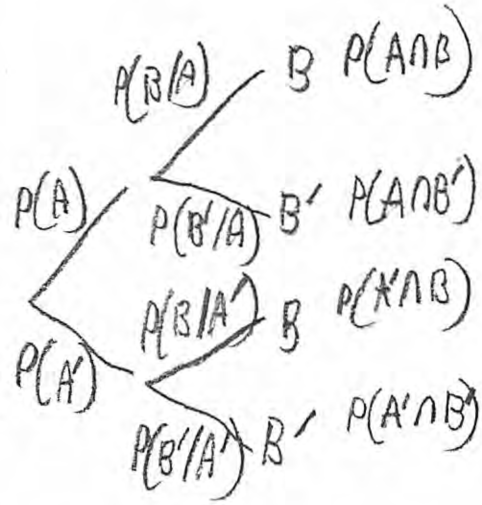
Solution 1

I decided to make a probability tree



$$P(B/A) = \frac{.43}{.43+.05} \doteq .896$$



label all missing branches (parts) a-h

$e = 1 - .48 = .52$

$h = .40 \div .52 \doteq .769$

$f = 1 - .769 = .231$

$g = .52(.231) \doteq .12$

$b = .55 - .12 = .43$

$a = .43 \div .48 = .896$

$c = 1 - .896 = .104$

$d = 1 - (.43 + .12 + .40) = .05$

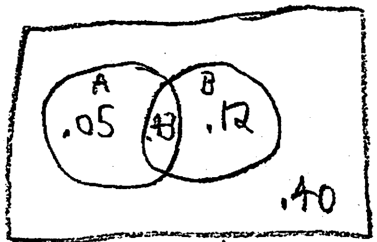
The evidence is overwhelming of those who complete HW regularly, 89.6% get a B or better compared to 10.4% who do worse.

Of those who DONT Complete HW Regularly, 76.9% get below a B compared to a mere 23.1% who do better

The answer is YES. It appears that students who do math HW regularly are more likely to earn a B or better →

Reflection

Here is a Venn diagram - which is an easier way.



A = Students who do homework regularly
B = Students who get a B or better

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$.6 = .48 + .55 - P(A \cap B)$
or
~~$P(A \cap B) = .48 + .55 - .6$~~
$P(A \cap B) = .43$
$.48 - .43 = .05$
$.55 - .43 = .12$

43% Do homework AND have a B or better
40% Don't do homework AND have less than a B
only 12% have a B or better ~~AND~~ don't do homework
5% do homework AND have less than a B
My conclusion Stands! Do your homework if you want a good grade in Math!

#M6 cont.

Mathematics Work Sample Assessment
Homework & Grades

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#M8

Math teachers always claim that doing homework helps students get better grades in their math classes. To test this theory a survey of high school math students was conducted and the following results were obtained:

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- 55% have a B average or better in math class
- 40% do not complete math homework regularly AND have less than a B average in math class.

Using this data, does it appear that students who complete math homework regularly are more likely to have an average of B or better in math class? Justify your answer using mathematics.

→ 5% do not complete hw and have b average or above

$\frac{4}{30} = .12$

Sample Classroom size: 30 students

$\frac{14}{30} = .48$

- 14 students do homework.

$\frac{12}{30} = .40$

- 12 students don't do homework

- 4 students inaccounted for.

$\frac{17}{30} = .55$

17 students have b average or above.

This means some students (approx. 3) do not regularly do homework and still recieve b avg. or above.

Yes, it proves that the students who do homework average better scores there is a small gap but is too small to make a difference

Mathematics Work Sample Assessment
Homework & Grades

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#M10

Math teachers always claim that doing homework helps students get better grades in their math classes. To test this theory a survey of high school math students was conducted and the following results were obtained:

- 48% complete math homework regularly
- 55% have a B average or better in math class
- 40% do not complete math homework regularly AND have less than a B average in math class.

Using this data, does it appear that students who complete math homework regularly are more likely to have an average of B or better in math class? Justify your answer using mathematics.

- 40% of class < B no h-work
- 55% of class > B
- 48% complete h-work

	Do	Don't	
B↓	$\frac{5}{100}$	$\frac{40}{100}$	$\frac{45}{100}$
B↑	$\frac{43}{100}$	$\frac{12}{100}$	$\frac{55}{100}$
	$\frac{48}{100}$	$\frac{52}{100}$	

$100 - 55 = 45$
$100 - 48 = 52$
$52 - 40 = 12$
$55 - 12 = 43$

For Example
100 students

Yes it does! First only 12% of students who don't do h-work have a B average or better. Then if you look at the 48% of students who do h-work 43% of them B's or better compared to the 5% that do h-work with less than B's. If you look at it a second way you get the same answer. Take a look at the students with B's 43% do their h-work and only 12% can get a B without h-work.

48 do their h-work and 43 would have B's
55 have B's the majority 43 do h-work.

Mathematics Work Sample Assessment

Homework & Grades

M

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#m22

Math teachers always claim that doing homework helps students get better grades in their math classes. To test this theory a survey of high school math students was conducted and the following results were obtained:

- 48% complete math homework regularly
- 55% have a B average or better in math class
- 40% do not complete math homework regularly AND have less than a B average in math class.

Using this data, does it appear that students who complete math homework regularly are more likely to have an average of B or better in math class? Justify your answer using mathematics.

48% - complete
40% - don't complete
12% - sometimes

40% - B↓
55% - B↑
5% - other

100% - 55% = 45%

45% do not have B's, 40% of them don't do homework, 5% do.
55% have B's, 48% of students do homework.

ratios:

$\frac{45}{40} = 1.125$

$\frac{55}{48} = 1.146$

← more students do homework and pass with B's or higher.

M

Mathematics Work Sample Assessment

Homework & Grades

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#M29

Math teachers always claim that doing homework helps students get better grades in their math classes. To test this theory a survey of high school math students was conducted and the following results were obtained:

- 48% complete math homework regularly
- 55% have a B average or better in math class
- 40% do not complete math homework regularly AND have less than a B average in math class.

Using this data, does it appear that students who complete math homework regularly are more likely to have an average of B or better in math class? Justify your answer using mathematics.

do not hw + $<$B = 40%
do not hw + $\geq$B = 12%
do hw + $<$B = 5%
do hw + $\geq$ B = 43%

It is right, but there are some kids, who don't do homework and have good grades, and some kids, who ~~make~~ do homework and don't have good grades

do complete m.homework r. : 48%
do not complete m.homework r: 100-48= 52%
hw

$\geq$ B : 55%
$<$ B : 45%
grade

① do not complet. mhwr + $<$B : 40%
~~do complete mhwr + $\geq$B : 40%~~
② do not complet mhwr + $\geq$R : X
③ do complete mhwr + $\geq$B : 4
④ do complete mhwr + $<$B : 2

both 52% 55%
① ② ③ 52% 55%

① Not $<$B
② Not $\geq$B
③ do $<$B
④ do $\geq$B

1 + 2 → 52%
1 + 3 → 45%
2 + 4 → 55%
3 + 4 → 48%

1 = 40% 2 = 12%
1 = 40% 3 = 5%
2 = 12% 4 = 48%
3 = 5% 4 = 43%

Calibration Packet

Overview:

This packet contains a series of papers completed by students during a mathematics field test. The purpose of this calibration activity is to ensure that papers scored across the state are looked at similarly and scored comparably.

Directions:

- Solve the task "Don't Hit the Ceiling"
- Determine the solution and key concepts, first individually and then as a table.
- Establish key concepts for the score site.
- Score paper B-1 and B-7 individually and then as a table. Record key points or scoring considerations.
- As a score site check table scores against key scores. If you are somewhat lenient or severe based on this comparison, adjust your scoring appropriately so that you are "calibrated" to the expectations that all raters are being asked to match as reflected in the keys scores.
- Individually score paper B-11, B-24 and B-28.
- With your table lead check the key scores to see how your scores compare. If you are off by one score point discuss with your table lead the rational for that score point. If you are off by more than two score points on two or more process dimensions please see the scoring director to score additional papers.

Paper #	Task Title	Making Sense of the Task	Representing and Solving the Task	Communicating Reasoning	Accuracy	Reflecting and Evaluating
B-1	**Don't Hit the Ceiling**					
B-7	**Don't Hit the Ceiling**					
B-11	**Don't Hit the Ceiling**					
B-24	**Don't Hit the Ceiling**					
B-28	**Don't Hit the Ceiling**					

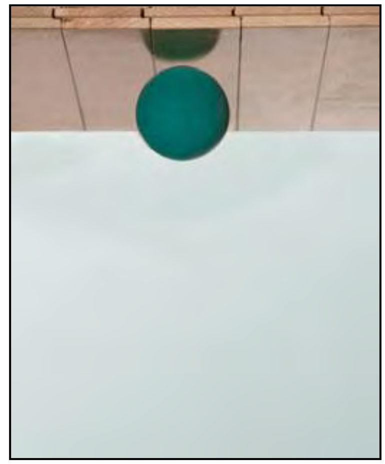
Mathematics Work Sample Assessment

Don't Hit the Ceiling

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

Student: ___________________________________ **Teacher:** ___________________________________

SSID: ______________________________________ **School:** ______________________________________



A group of friends have made up a game to play in the gym. Each person throws a ball toward the ceiling and the one who comes closest to the ceiling without touching it is the winner. After everyone has a turn, Hannah and Jake, with the two best tosses, go again.

The ceiling of the gym is 30 feet high. Hannah stands in the middle of the gym and throws the ball straight up. Jake stands near the gym door and throws the ball at an angle toward the ceiling.
Each equation represents the height of the ball (h), in feet, after *t* seconds.

Who wins?

Hannah: $h = -28t^2 + 56t + 4$ **Jake:** $h = -6t^2 + 24t + 5$

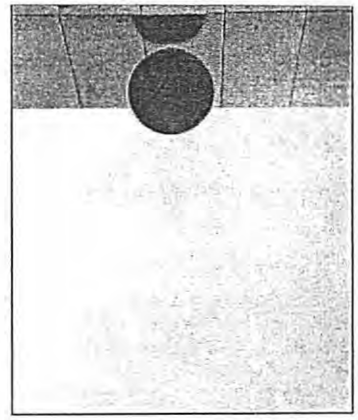
B

Mathematics Work Sample Assessment

Don't Hit the Ceiling

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#B1



A group of friends have made up a game to play in the gym. Each person throws a ball toward the ceiling and the one who comes closest to the ceiling without touching it is the winner. After everyone has a turn, Hannah and Jake, with the two best tosses, go again.

The ceiling of the gym is 30 feet high. Hannah stands in the middle of the gym and throws the ball straight up. Jake stands near the gym door and throws the ball at an angle toward the ceiling.
Each equation represents the height of the ball (h), in feet, after *t* seconds.

Who wins?

a b c

Hannah: $h = -28t^2 + 56t + 4$

$t = \frac{56}{2(-28)}$

$t = \frac{56}{-56}$

$\boxed{t = -1}$

$H = -28(-1)^2 + 56(-1) + 4$

$H = -28 - 56 + 4$

$\boxed{H = -80}$

Jake: $h = -6t^2 + 24t + 5$

$t = \frac{24}{2(-6)}$

$t = \frac{24}{-12}$

$\boxed{t = -2}$

$H = -6(-2)^2 + 24(-2) + 5$

$H = -24 - 48 + 5$

$\boxed{H = -67}$

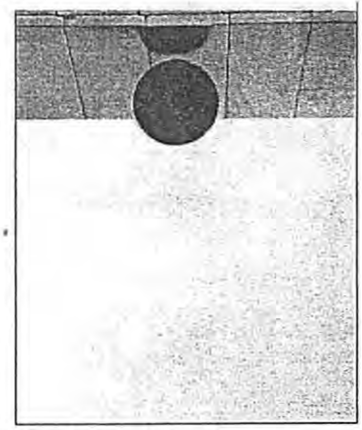
Mathematics Work Sample Assessment

B

Don't Hit the Ceiling

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#B7



A group of friends have made up a game to play in the gym. Each person throws a ball toward the ceiling and the one who comes closest to the ceiling without touching it is the winner. After everyone has a turn, Hannah and Jake, with the two best tosses, go again.

The ceiling of the gym is 30 feet high. Hannah stands in the middle of the gym and throws the ball straight up. Jake stands near the gym door and throws the ball at an angle toward the ceiling.

Each equation represents the height of the ball (h), in feet, after *t* seconds.

Who wins? Equation #1 $X=\frac{-b}{2a}$ equation #2

Finding the Min/Max (vertex)

Hannah: $h = \overset{A}{-28}t^2 + \overset{B}{56}t + \overset{C}{4}$ **Jake:** $h = \overset{A}{-6}t^2 + \overset{B}{24}t + \overset{C}{5}$

Height = 1 ft
Seconds = 32 se

$h=\frac{-56}{2(-28)}$

$h=1$

$-28(1)^2+56(1)+4$

$t=32$

$h=\frac{-24}{2(-6)}$

$h=2$

$-6(2)^2+24(2)+5$

$t=29$

Height = 2 ft
Seconds = 29 sec

In order for me to find the Maximum/minimum I need to find the vertex, Y.
for me to find the vertex I need to use the equation $X=\frac{-b}{2a}$. In the
equation for the height of the ball "$h=-28t^2+56t+4$" label the number Sections
A, B, C and then fill out the vertex equation, Do that for both Jake and
Hannah. When you find the height plug the number 1 back into
Hannah's equation and solve for "t". Then do the same thing for
Jake. You should come out with Jake being the winner.

Hannah	Jake
Height = 1 ft	Height = 2 ft
Seconds = 32	Seconds = 29

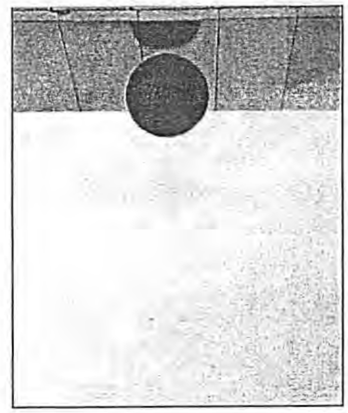
Mathematics Work Sample Assessment

B

Don't Hit the Ceiling

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#B11



A group of friends have made up a game to play in the gym. Each person throws a ball toward the ceiling and the one who comes closest to the ceiling without touching it is the winner. After everyone has a turn, Hannah and Jake, with the two best tosses, go again.

The ceiling of the gym is 30 feet high. Hannah stands in the middle of the gym and throws the ball straight up. Jake stands near the gym door and throws the ball at an angle toward the ceiling.
Each equation represents the height of the ball (h), in feet, after *t* seconds.

Who wins? analyze, solve, answer, prove

Hannah: $h = -28t^2 + 56t + 4$

Jake: $h = -6t^2 + 24t + 5$

I need to find the maximums of both of the equations. Assuming the ball is really infentesimally small, the size of a point, then at 30 feet or higher the ball has touched the ceiling. Using $-b/2a$ will give me the x values of the vertices. Hannah's x value was 1, Jake's was 2.

I plug those values back into the original equations to find y values and the maximum values.

Answer: Hannah's ball would hit the ceiling because the y value of her throw is higher than 30 ft. Jake's throw wins because he does not hit the ceiling.

Check: Graph the two functions on a calculator. Hannah's graph has a vertex at (1, 32) which exceeds the ceiling height. Jake's was at (2, 29) which does not exceed the ceiling height.

$-28t^2 + 56t + 4$

$\frac{-56}{2\cdot(-28)} = \boxed{1} = x$

$-28\cdot 1^2 + 56\cdot 1 + 4$

$-28\cdot 1 + 56 + 4$

$-28 + 60$

$\boxed{32} = y$

$-6t^2 + 24t + 5$

$\frac{-24}{2\cdot(-6)} = \frac{-24}{-12} = \boxed{2} = x$

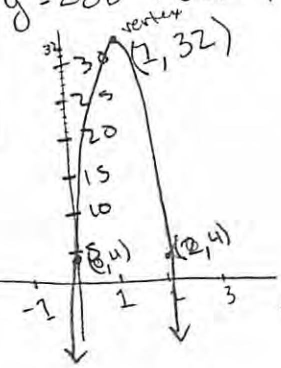
$-6\cdot 2^2 + 24\cdot 2 + 5$

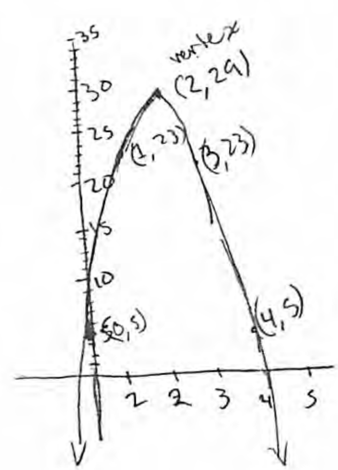
$-6\cdot 4 + 48 + 5$

$-24 + 53$

$\boxed{29} = y$

$y = 28t^2 + 56t + 4$





Mathematics Work Sample Assessment

Don't Hit the Ceiling

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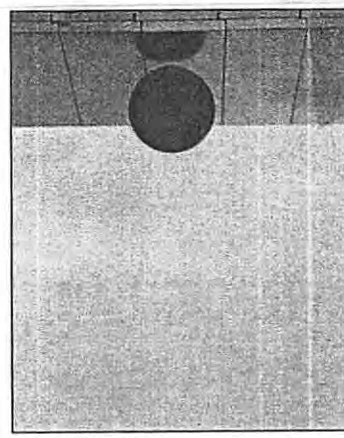
#B24



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The ceiling of the gym is 30 feet high. Hannah stands in the middle of the gym and throws the ball straight up. Jake stands near the gym door and throws the ball at an angle toward the ceiling.
Each equation represents the height of the ball (h), in feet, after *t* seconds.

Who wins?

A 2t a B C

Hannah: $h = -28t^2 + 56t + 4$

Hannahs work
You will need to x using the foumala $x = \frac{-B}{a \times 2}$

$x = \frac{-55}{-28 \times 2} = \frac{-56}{-56} = 1$

56 will be a negative because B will always be the oppisite of a positive or negative of the equcuion. Also A will always be times by 2 because of its square root.
second plug in x valucinto t in the original problem.

$H = -28(1)^2 + 56(1) + 4$

Find the square root first times all the numbers near a prendents. ( )

$H = -28(1) + 56(1) + 4$

$H = -28 + 56 + 4$

add or Subract

$H = 60 - 28$

Then you will find Hannahs Height of Kick $H = 32$

A B C

Jake: $h = -6t^2 + 24t + 5$

Jacks Height
Again you will need to find the foumala by using $x = \frac{-B}{a}$

$x = \frac{-24}{-6 \times 2} = \frac{-24}{-12} = 2$

24 will be a negative because b will always be the oppisite of the original equation. -6 will also be times by 2 because of its square root
Plug in x value into it in the original equation

$H = -6(2^2) + 24(2) + 5$

Times all the numbers near prenteic $H = -6(4) + 24(2) + 5$

$H = 24 + 48 + 5$

$H = 24 + 48 + 5$

add 48 and 5
53
Substact 24 from 53
Height = 29

Hannah Kick the highest

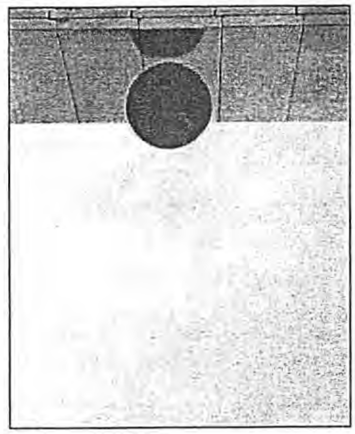
Mathematics Work Sample Assessment

Don't Hit the Ceiling

B

Use the information provided to solve the problem listed below. Be sure to show your work at all phases of problem solving. Refer to the **Mathematics Problem Solving Official Scoring Guide** to receive the highest score in each of the five process dimensions.

#B28



A group of friends have made up a game to play in the gym. Each person throws a ball toward the ceiling and the one who comes closest to the ceiling without touching it is the winner. After everyone has a turn, Hannah and Jake, with the two best tosses, go again.

The ceiling of the gym is 30 feet high. Hannah stands in the middle of the gym and throws the ball straight up. Jake stands near the gym door and throws the ball at an angle toward the ceiling.

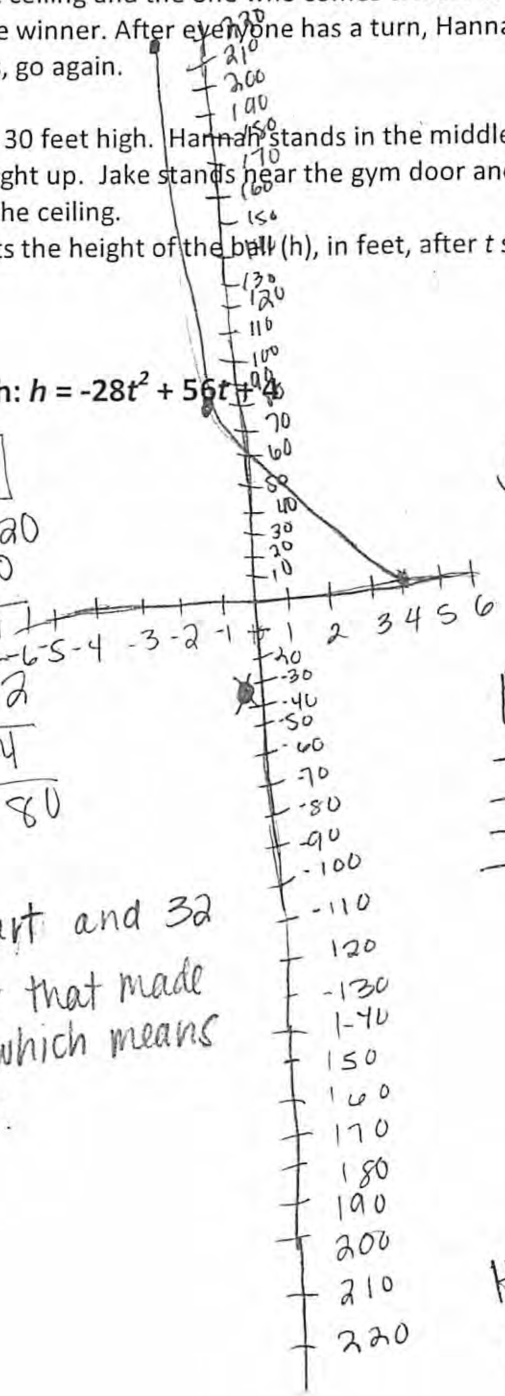
Each equation represents the height of the ball (h), in feet, after *t* seconds.

Who wins?

Hannah: $h = -28t^2 + 56t + 4$

Jake: $h = -6t^2 + 24t + 5$

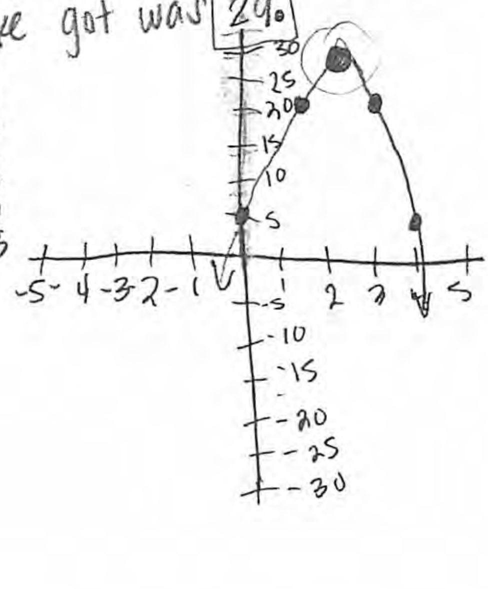
X	Y
-2	-220
-1	-80
0	4
1	32
2	4
3	-80



I made a chart and 32 was the number that made the graph off which means it equals 32ft.

I made a graph plotting these numbers but first I made a chart and the number Jake got was $\boxed{29.}$

X	Y
0	5
1	23
2	29
3	23
4	5



Hannah won because she got 3 more feet than Jake.