

Inspect

CCR Performance Task

**Geometry: Extended Performance Task
Plan for Backyard Oasis**

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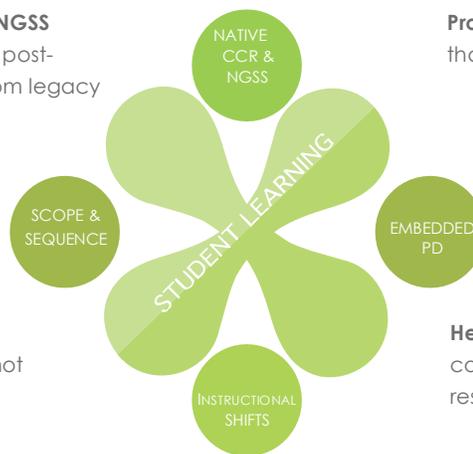
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Content that addresses your scope and sequence so that your assessments do not waste valuable instruction time



Professional development embedded within content that

- shows the relationship between specific skills and higher-order thinking
- includes authentic, permissioned texts of appropriate complexity
- and documents student progress using DOK and learning progressions

Help for teachers addressing the instructional shifts with content that elicits evidence of learning from each response

CCR Performance Tasks

Geometry: Extended Performance Task Plan for Backyard Oasis

Student Test Booklet

Name:

Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

Complete all the tasks in the test booklet.

You are working as an intern at a landscape company. Your first assignment is to help design a backyard oasis for potential new clients, Mr. and Mrs. Sullivan. The land behind the Sullivans' home is rectangular with dimensions of 125 feet by 180 feet.

During the consultation with the Sullivans, they discussed the essential items that are on their wish list. Here are the notes taken during the meeting:

Notes from Initial Consultation:
• No more than 50% of the total area should be allocated for grass
• A circular garden must be included
• An elliptical pool should be a part of the design
• A rectangular concrete border around the pool
• A circular fire pit across from the garden
• Two walkways with parallel edges connecting the garden to the fire pit and the fire pit to the pool area
• The pool should have one water fountain that shoots a stream of water in a parabolic shape from one side of the pool into the water
• The budget is \$50,000

The management team has asked that you develop a plan and a potential design for a wonderful backyard oasis that you will present to the Sullivans. The team believes that your creativity and mathematical background will allow you to develop something spectacular that will represent the company well.

Part A: Plan the Design of Each Part of the Oasis

The clients' backyard will be represented by a Cartesian coordinate grid with four quadrants. This will give the Sullivans an accurate representation of the proposed plan for their backyard and will aid the rest of the team in implementing the plan should the Sullivans decide to move forward. You will need to also plan an oral presentation for the team that will allow you to practice before your formal presentation with the Sullivans. Therefore, you should be prepared to explain your process and your reasoning behind all of the decisions you have made for the design of the oasis.

Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

Now that you have a wish list from the Sullivans, you are ready to begin designing the backyard.

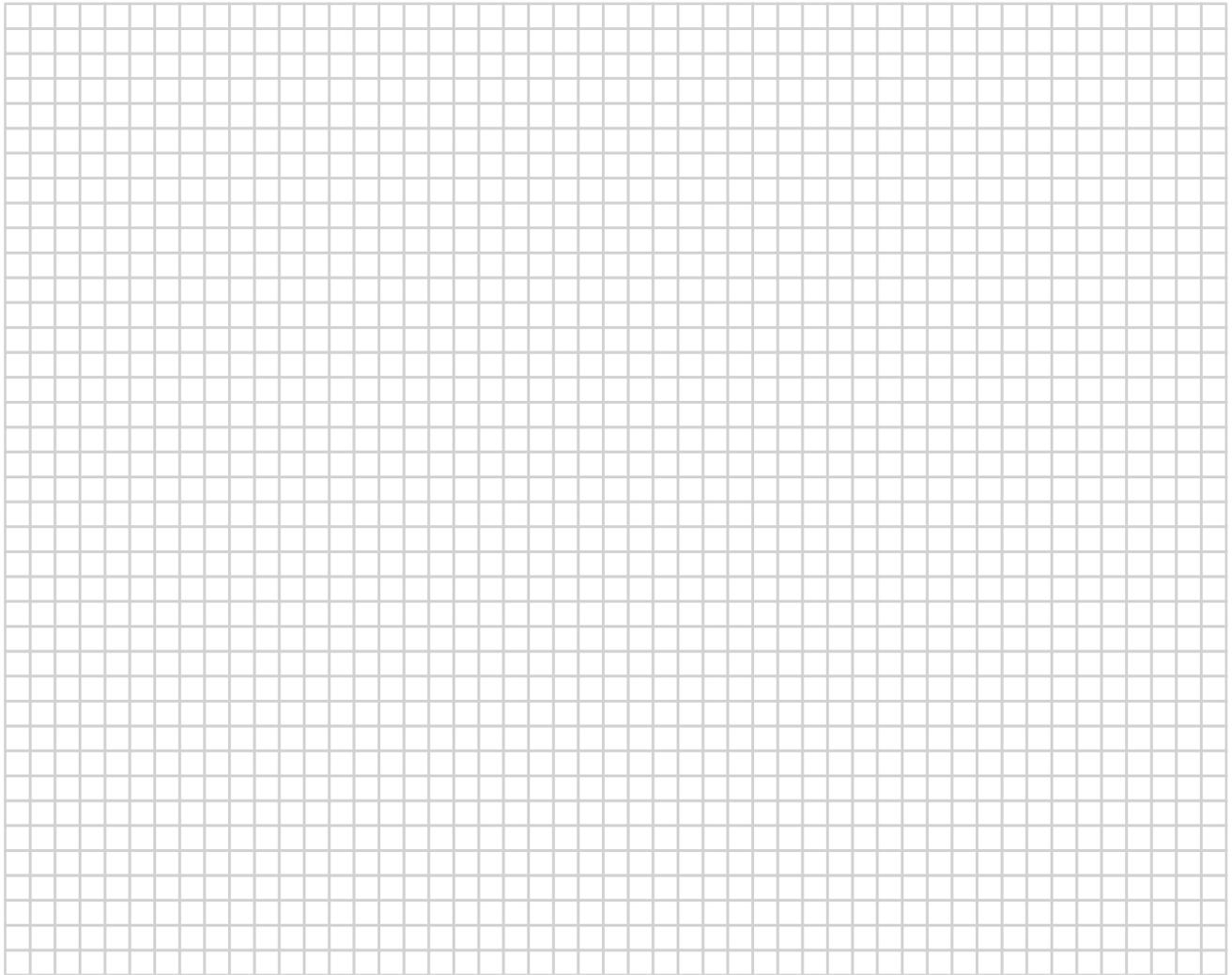
1. Fill in the table below with the area for each feature and the equations needed for graphing.

Feature	Area	Equation(s)
Circular garden		
Circular fire pit		
Elliptical pool		
Rectangular border		
Linear walkway #1		
Linear walkway #2		

Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

2. Use the graph paper below to sketch your design.



Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

3. What is the area of the backyard that will need sod for new grass? Explain how you found your answer.



Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

Support Worksheet for Part A: Questions 1, 2, and 3

Where will you place the elliptical pool? Use the response box below to explain how and where you will place the pool. What is the equation for the elliptical pool? What are the steps that you used to find your answers? Show your work as a reference point for the other members of the landscaping team. Be sure to include the appropriate dimensions for each calculation.

Where will you place the circular garden? Use the response box below to explain how and where you will place the circular garden. What is the equation for the circular garden? What are the mathematical steps you took to determine the equation of the shape of the garden in order to justify your placement of it on the graph?

Name: _____

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Where will you place the circular fire pit? Use the response box below to explain how and where you will place the circular fire pit. What is the equation for the circular fire pit? What are the mathematical steps you took to determine the equation of the shape of the fire pit in order to justify your placement of it on the graph?

Use the response box below to explain how and where you will place the rectangular concrete border to the pool. Decide how long and how wide the area should be, and justify these dimensions. What are the equations for the line segments that make up the border?

Name: _____

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Now that you have decided on the placement and equations needed for the garden, the fire pit, and the pool area (including the border), you are ready for the next step. Determine the placement of the two walkways. Where will you place the walkway that connects the garden to the fire pit area? Where will you place the walkway that connects the fire pit to the pool area? Write a set of equations to model the set of parallel lines bordering both of the walkways.

What is the area of the elliptical pool? Show your work.

Name: _____

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What is the area of the circular garden? What is the area of the circular fire pit? Show your work.

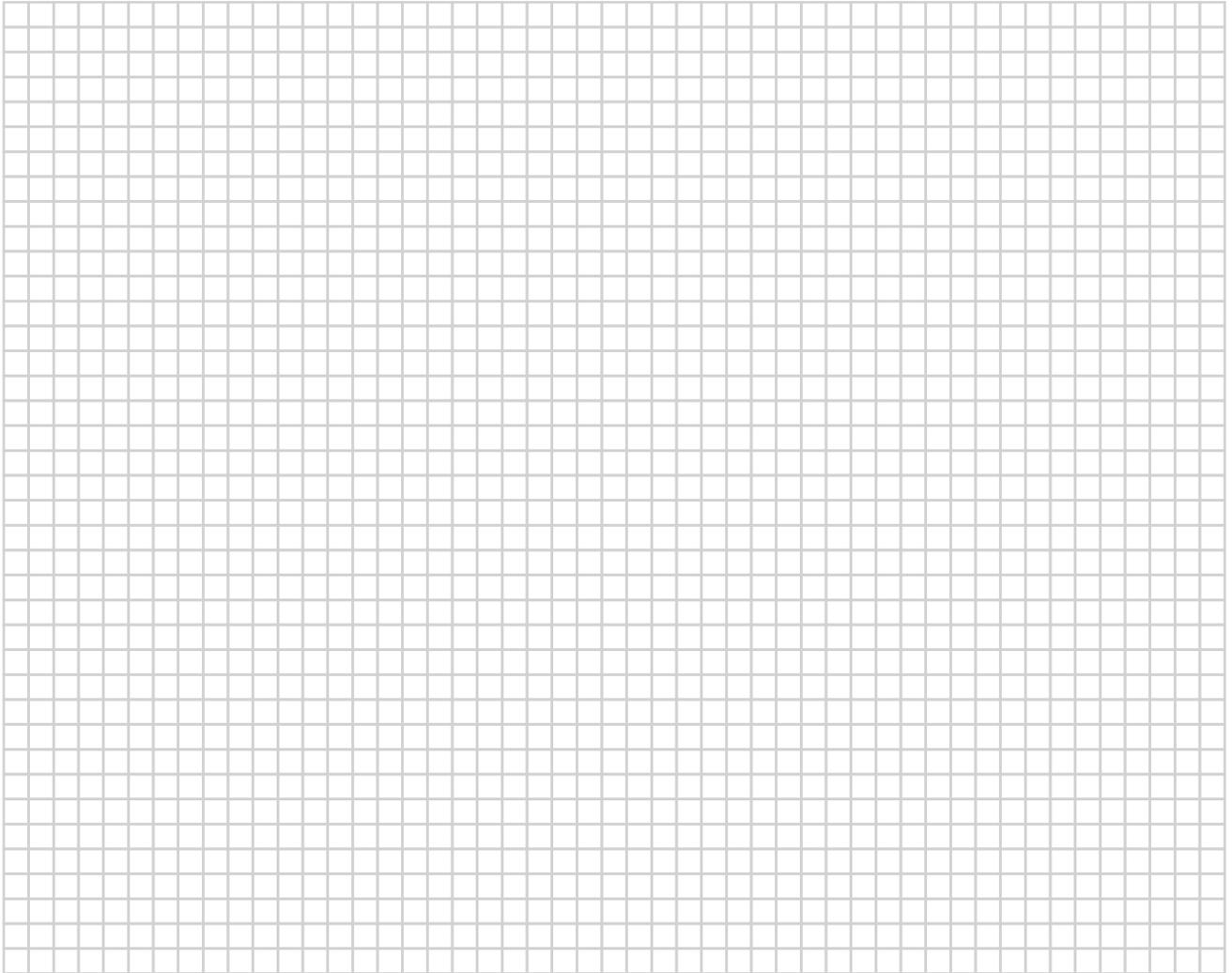
What is the area of the rectangular concrete border around the pool? Show your work.

What is the area of the walkways? Show your work.

Name: _____

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Graph each feature on the graph paper below. Outline the dimensions of the backyard. Make sure to label each feature. Give a key for the scale.



Name: _____

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What is the total area for all the features that will be included in backyard? Show your work.

How much area of the backyard will not be covered with a feature? Show your work.

This area will need to be covered with sod so that new grass will grow. Sod is normally sold on pallets that contain, on average, 50 square yards per pallet. How many pallets will you need to cover the open space with sod?

Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

Part B: Backyard Details

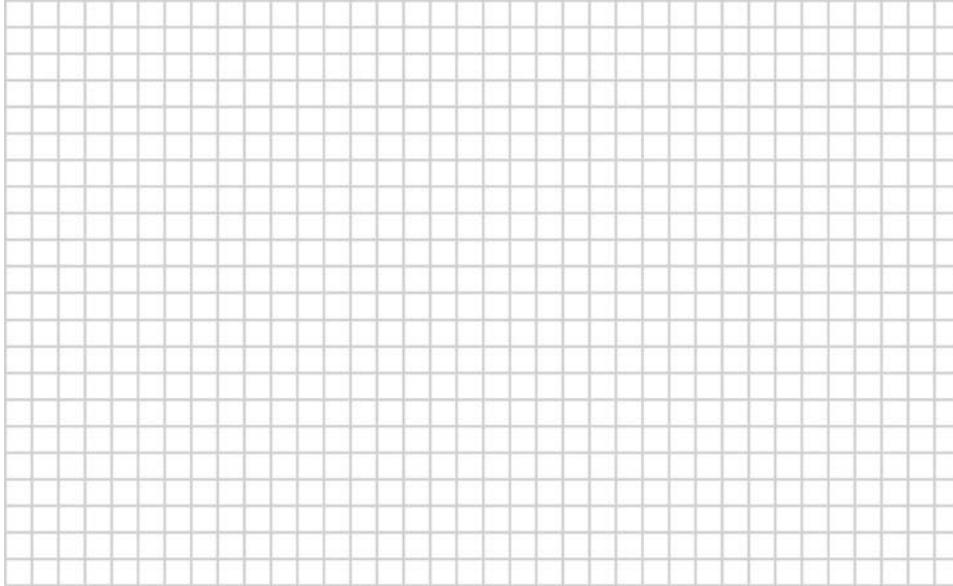
Another feature the Sullivans would like to include is a water fountain in the pool. They would like the fountain to shoot a steady stream of water from one side of the pool to just past the middle of the pool. The path of the water will be in a parabolic shape.

4. Explain how to write an equation for the height of the water shooting out from the fountain, in feet above ground level, as a function of the fountain's distance from the origin. What is the equation of the path of the water? How high will the water shoot up? What is the distance, in feet, from the start of the fountain to where the water stream lands in the pool?

Name: _____

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5. Graph the cross section of the pool to show the water shooting from the fountain into the pool. Label the axes with an appropriate scale.



Name: _____

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Support Worksheet for Part B: Questions 4 and 5

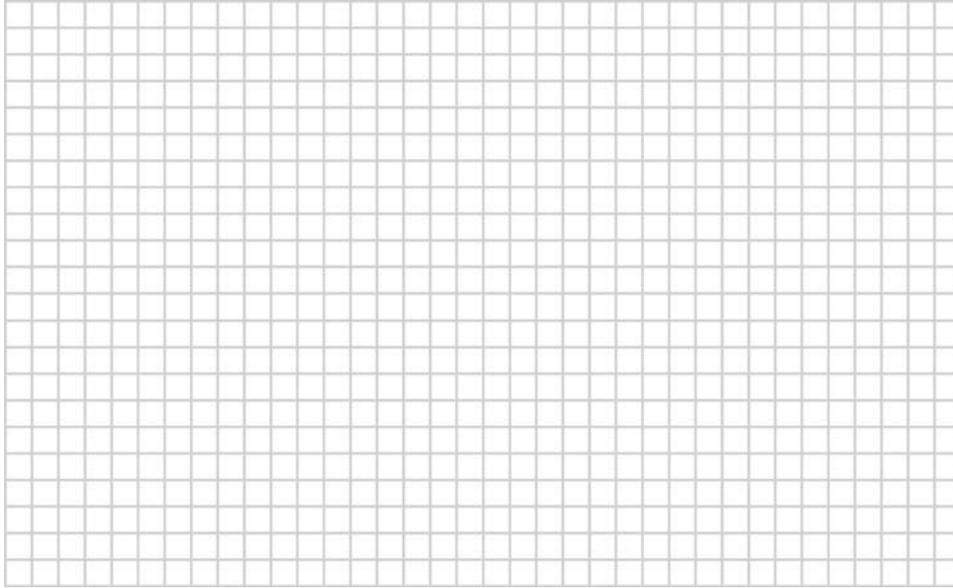
At what point will the fountain originate? Is this point located on the perimeter of the pool? Where will the stream of water land in the pool? Is this point located past the middle of the pool? What is the distance, in feet, from the start of the fountain to where the water stream lands in the pool? Show your work, and explain each answer.

Explain how to write an equation for the height of the water spouting from the fountain, in feet above ground level, as a function of the fountain's distance from the origin. What is the highest point (height) of the path of the water? Is the height realistic? What is the equation of the path of the water?

Name: _____

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Graph the cross section of the pool to show the water shooting from the fountain spout into the pool. Label the axes with an appropriate scale. Check to make sure the equation of the path of the fountain's water matches your graph. Label the height and the distance of the fountain's water path.



Name: _____

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Part B (optional): Group Work

Switch your design plan with another student in your group.

Each partner should review the other's design. Check the equation(s) and area for each feature to ensure accuracy. Then check that all features are shown on the design graph and that they are placed in the correct positions per the equations created to represent them. Each person should make notes for corrections and edits that are needed in the response area below.

Once you have reviewed your partner's work, decide on a new feature that they can add to their design. The feature can be in the shape of a circle, parabola, rectangle, or intersecting lines. Describe the feature in detail that you would like your partner to add to their design. Be prepared to answer questions about this addition.

Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

Exchange papers back. Take the time to read any comments that your partner made about your equations, area values, or design. If you have any questions about their notes, discuss those with your partner. Make any edits needed to your previous work.

Read the described new feature that your partner wants you to add to your design. Determine the placement of the new feature and its area and equation. Show your work in the response box below. Add the new feature to your design that you graphed in Question 2.

Name: _____

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Rectangular Pool Border Materials:

Material to Buy	Total Area (in square feet)	Cost of Material (per square foot)	Total Cost for Materials	Lowest (L) Midrange (M) Highest (H)

Circular Fire Pit Materials:

Material to Buy	Total Area (in square feet)	Cost of Material (per square foot)	Total Cost for Materials	Lowest (L) Midrange (M) Highest (H)

Linear Walkways Materials:

Material to Buy	Total Area (in square feet)	Cost of Material (per square foot)	Total Cost for Materials	Lowest (L) Midrange (M) Highest (H)

Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

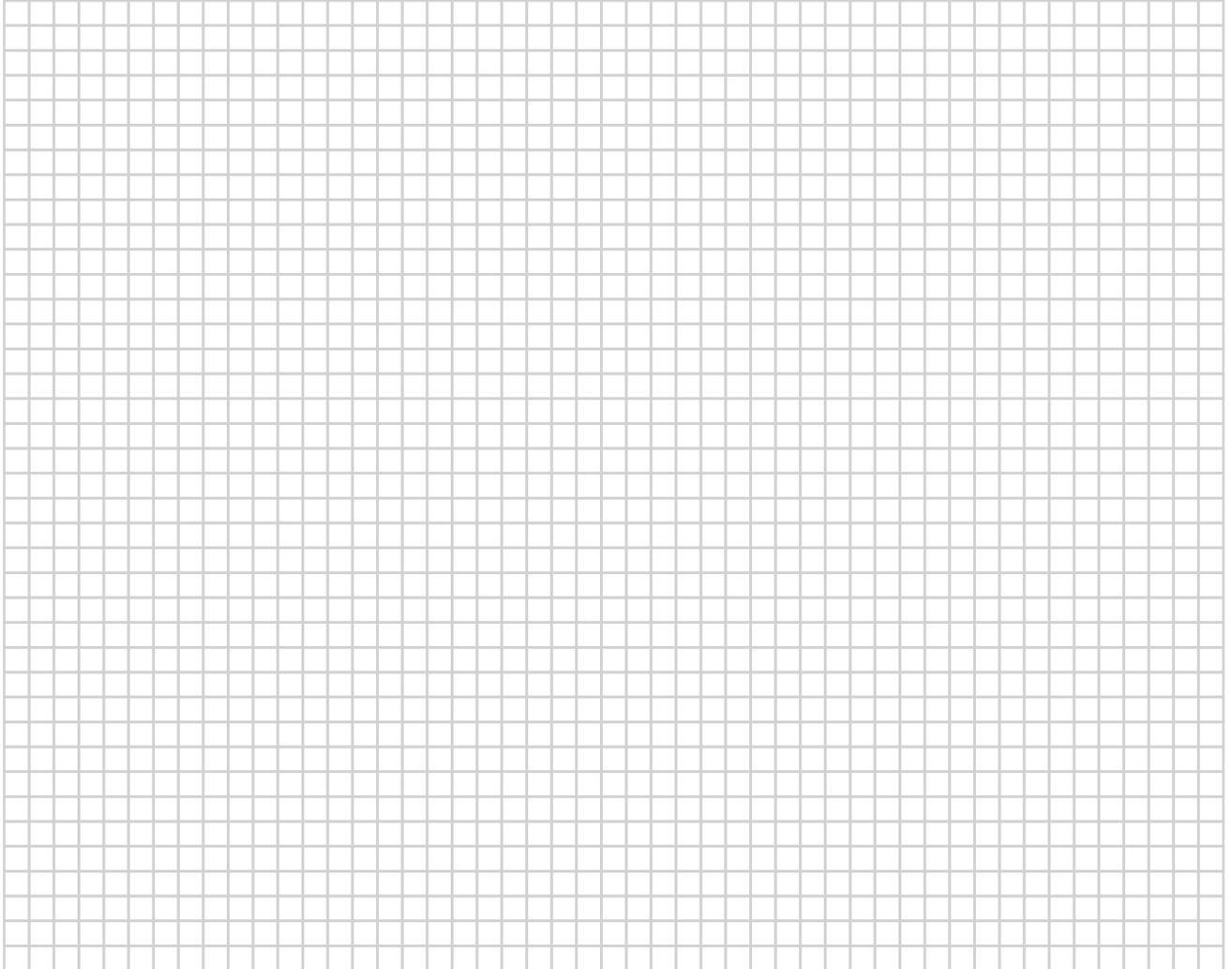
A large rectangular box containing 25 horizontal lines for writing.

Name: _____

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Extra Graphs

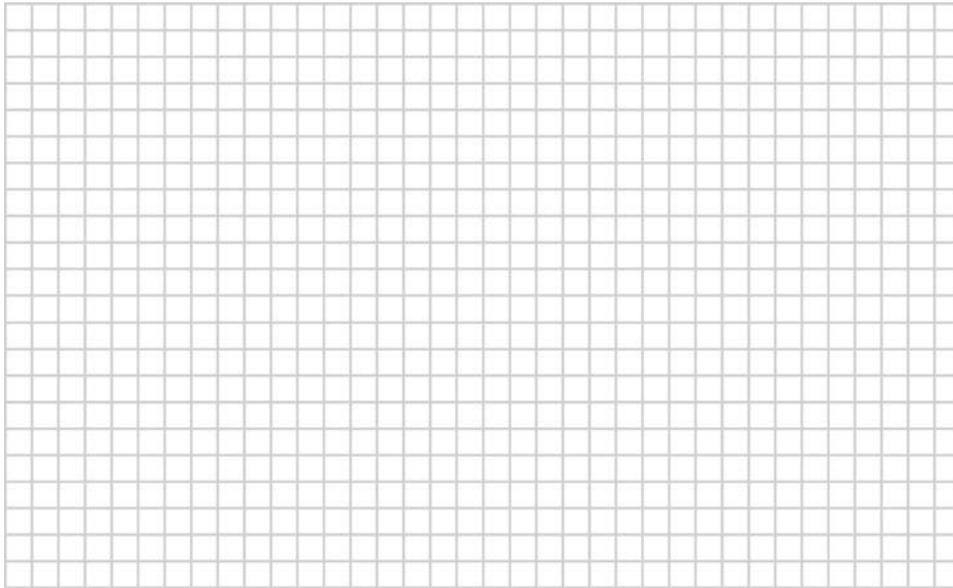
Question 2



Name: _____

Geometry: Extended Performance Task: Plan for Backyard Oasis

Question 5



CCR Performance Tasks

Geometry: Extended Performance Task Plan for Backyard Oasis

Teacher Guide

Task Specifications

Content Area	Mathematics
Title	Plan for Backyard Oasis
Grade Level	Geometry/Algebra 2
Problem Type	Extended Performance Task
Standards for Mathematical Practices	<p>Mathematical Practice 1 (MP.1): Make sense of problems and persevere in solving them. Mathematically proficient students:</p> <ul style="list-style-type: none"> • Explain to themselves the meaning of a problem and look for entry points to its solution. • Analyze givens, constraints, relationships, and goals. • Make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. • Consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. • Monitor and evaluate their progress and change course if necessary. • Explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. • Check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” • Understand the approaches of others to solving complex problems and identify correspondences between different approaches. <p>Mathematical Practice 4 (MP.4): Model with mathematics. Mathematically proficient students:</p> <ul style="list-style-type: none"> • Apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. • Apply what they know and make assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. • Identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flow-charts, and formulas. • Analyze relationships mathematically to draw conclusions. • Interpret mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
Common Core State Standards	<p>G.GPE.1 Translate between the geometric description and the equation for a conic section. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.</p> <p>G.GPE.2 Translate between the geometric description and the equation for a conic section. Derive the equation of a parabola given a focus and a directrix.</p> <p>G.GPE.3 Translate between the geometric description and the equation for a conic section. Derive the equation of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.</p> <p>G.GPE.5 Use coordinates to prove simple geometric theorems algebraically. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</p> <p>G.GPE.7 Use coordinates to prove simple geometric theorems algebraically. Use</p>

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	<p>coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.</p> <p>G.MG.3 Apply geometric concepts in modeling situations. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize costs; working with typographic grid systems based on ratios).</p>
CCSS Literacy in Writing-Grade 9-10	<p>W.9-10.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.</p> <p>a) Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.</p> <p>W.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>
SBAC Assessment Claims	Claim 4: Modeling and Data Analysis —Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.
PARCC Assessment Claims	Sub-Claim D: Highlighted Practice MP.4 with Connections to Content (modeling/application) —The student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice.
Depth of Knowledge	Level 4: Extended Strategic Thinking —Curricular elements assigned to this level demand extended use of higher order thinking processes such as synthesis, reflection, assessment and adjustment of plans over time. Students are engaged in conducting investigations to solve real-world problems with unpredictable outcomes. Employing and sustaining strategic thinking processes over a longer period of time to solve the problem is a key feature of curricular objectives that are assigned to this level. Key strategic thinking processes that denote this particular level include: synthesize, reflect, conduct, and manage.
Task Overview	In this task you will be asked to create a plan for a backyard oasis with the specifications required by a potential client for a landscaping company. You will give a written and oral presentation on the layout of the backyard oasis, including a cost analysis, and explain your determinations using mathematical modeling.

Geometry: Extended Performance Task: Plan for Backyard Oasis

Student Task

You are working as an intern at a landscape company. Your first assignment is to help design a backyard oasis for potential new clients, Mr. and Mrs. Sullivan. The land behind the Sullivans' home is rectangular with dimensions of 125 feet by 180 feet.

During the consultation with the Sullivans, they discussed the essential items that are on their wish list. Here are the notes taken during the meeting:

	Notes from Initial Consultation:
	• No more than 50% of the total area should be allocated for grass
	• A circular garden must be included
	• An elliptical pool should be a part of the design
	• A rectangular concrete border around the pool
	• A circular fire pit across from the garden
	• Two walkways with parallel edges connecting the garden to the fire pit and the fire pit to the pool area
	• The pool should have one water fountain that shoots a stream of water in a parabolic shape from one side of the pool into the water
	• The budget is \$50,000

The management team has asked that you develop a plan and a potential design for a wonderful backyard oasis that you will present to the Sullivans. The team believes that your creativity and mathematical background will allow you to develop something spectacular that will represent the company well.

Part A: Plan the Design of Each Part of the Oasis

The clients' backyard will be represented by a Cartesian coordinate grid with four quadrants. This will give the Sullivans an accurate representation of the proposed plan for their backyard and will aid the rest of the team in implementing the plan should the Sullivans decide to move forward. You will need to also plan an oral presentation for the team that will allow you to practice before your formal presentation with the Sullivans. Therefore, you should be prepared to explain your process and your reasoning behind all of the decisions you have made for the design of the oasis.

Now that you have a wish list from the Sullivans, you are ready to begin designing the backyard.

1. Fill in the table below with the area for each feature and the equations needed for graphing.

Feature	Area	Equation(s)
Circular garden		
Circular fire pit		
Elliptical pool		
Rectangular border		
Linear walkway #1		
Linear walkway #2		

2. Use the graph paper below to sketch your design.

3. What is the area of the backyard that will need sod for new grass? Explain how you found your answer.

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Part B: Backyard Details

Another feature the Sullivans would like to include is a water fountain in the pool. They would like the fountain to shoot a steady stream of water from one side of the pool to just past the middle of the pool. The path of the water will be in a parabolic shape.

4. Explain how to write an equation for the height of the water shooting out from the fountain, in feet above ground level, as a function of the fountain's distance from the origin. What is the equation of the path of the water? How high will the water shoot up? What is the distance, in feet, from the start of the fountain to where the water stream lands in the pool?

5. Graph the cross section of the pool to show the water shooting from the fountain into the pool. Label the axes with an appropriate scale.

Part B (optional): Group Work

Switch your design plan with another student in your group.

Each partner should review the other's design. Check the equation(s) and area for each feature to ensure accuracy. Then check that all features are shown on the design graph and that they are placed in the correct positions per the equations created to represent them. Each person should make notes for corrections and edits that are needed in the response area below.

Once you have reviewed your partner's work, decide on a new feature that they can add to their design. The feature can be in the shape of a circle, parabola, rectangle, or intersecting lines. Describe the feature in detail that you would like your partner to add to their design. Be prepared to answer questions about this addition.

Exchange papers back. Take the time to read any comments that your partner made about your equations, area values, or design. If you have any questions about their notes, discuss those with your partner. Make any edits needed to your previous work.

Read the described new feature that your partner wants you to add to your design. Determine the placement of the new feature and its area and equation. Show your work in the response box below. Add the new feature to your design that you graphed in Question 2.

Work together as a group to answer the following questions:

How did each member divide the coordinate grid in placing each feature of the Sullivans' wish list on their design for the backyard oasis? How did this affect the equation for the position of the garden?

How does the area of your pool compare to each pool designed by the other members of your group? What about the fire pit?

Whose design has the lowest square footage of grass?

Part C: Outline the Costs for the Backyard Oasis

At the end of an oral presentation for a potential client, the landscape company presents a cost analysis for the project. This outline will be handed to the Sullivans at the end of the presentation, and they will be invited to review it and ask any questions about the project at that point or after they have had a chance to think about it. You will need to prepare the outline as part of your presentation.

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Midrange Estimated Cost:

Oasis Feature	Total Area (in square feet)	Material to Buy	Cost of Material (per square foot)	Total Cost for Materials
Total				

Make any notes you may need for your final presentation to explain the details about the materials associated with the midrange estimated cost information.

Highest Estimated Cost:

Oasis Feature	Total Area (in square feet)	Material to Buy	Cost of Material (per square foot)	Total Cost for Materials
Total				

Make any notes you may need for your final presentation to explain the details about the materials associated with the highest estimated cost information.

8. What is the best option to select in order to stay within the Sullivans' budget? Explain your answer.

Part D: Write Your Final Presentation

In this section, you will need to use all of the information that you gathered in the previous sections to write the complete presentation that you will give to the Sullivans. The presentation should contain at least 10 sentences that include the points listed below. The plan should be written clearly and contain correct calculations.

9. Your presentation should consist of your design plan and cost analysis, containing detailed information to justify your determinations, including: 1) the dimensions, including area, of the circular garden, 2) the area of the elliptical pool and its border, 3) the area of the circular fire pit, 4) the area and the positions of the lines representing the borders of the walkway, 5) the area of the open space

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that will be filled in with grass and the percentage it represents of the backyard area, 6) the position, height, and distance of the path of the water leaving the fountain, 7) the various costs of all the materials required for creating the oasis, including the three cost options for the project, 8) a visual representation of the design for the backyard that includes all of the features, and 9) a visual representation of the water fountain in the pool and the path of the water coming out of the fountain.

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Teacher Instructions

This performance task is designed to assess student understanding of a variety of standards and claims. Students are challenged to use and apply knowledge of geometry for the real-world task of creating a design plan for a backyard oasis with the specifications required by a potential client for a landscaping company. The task includes a written and oral presentation on the layout of the backyard oasis, including a cost analysis, and explanations using mathematical modeling. The task was designed with the understanding that all classrooms and students are different. Some students may need an extension activity, some may need to reduce the number of days planned for this task, and some may need to omit or simplify certain parts depending on what time during the school year this task is given.

Test Definition File

Item	Correct Answer	Practice Standard	Common Core Standards
1	See scoring rubric	Mathematical Practice 2 and 4	G.GPE.1, G.GPE.2, G.GPE.3, G.GPE.5, G.GPE.7, G.MG.3
			CCSS ELA-Literacy Standards
			W.9-10.2 and W.9-10.7

SBAC Claims	PARCC Sub-Claims
4	D

Before the task:

- Students should know how to find the equation of a parabola, circle, and ellipse and then use those equations to graph them.
- Students should review how to find a linear equation and how to prove lines are parallel.
- Students should review basic measurement conversions involving length.
- Students should review how to find area and perimeter of rectangles and circles. The formula for finding the area of an ellipse should be given.

Vocabulary:

Area
Parabola
Ellipse
Parallel Lines

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Setting the Context:

Teacher: “If you won a contest where you were given \$50,000 to design and construct your dream backyard, what would you want to include?”

[Let students respond. Keep a list of the features the students suggest.]

Teacher: “Other than this list of features, what other costs will need to be considered?”

[Labor, other materials, tax, etc.]

Give an introduction to the task. A suggested introduction is below. Some of the information may need to be repeated each day.

Teacher: “You will be working to help a family plan a design for a new backyard oasis. You will need to figure out how to graph each of the features together on a grid to create a visual representation. You will also need to research materials that will be needed to complete your design and must stay within a budget.”

Timeline:

There are two different options to choose.

Option 1: This option should take 3 to 4 days (or 3–4 hours with the assumption that math lessons/activities take up an hour during a school day).

Day 1: The students should complete Part A.*

Day 2: The students should complete Part B and begin the research for Part C. In Part B the optional group work activity is omitted.

Day 3: The students should complete Parts C and D.**

*Some students may need extra time to complete Part A. This time could either be given as outside work (homework) or an extra day could be added to the timeline.

**Some students may need extra time in writing the plan for Part D. This time could either be given as outside work (homework) or an extra 15-20 minutes could be given on the following day (Day 4).

Option 2: This option should take 4 to 5 days (or 4–5 hours with the assumption that math lessons/activities take up an hour during a school day).

Day 1: The students should complete Part A.*

Day 2: The students should complete Part B with the group activity.

Day 3: The students should complete Part C.**

Day 4: The students should complete Part D.***

*Some students may need extra time to complete Part A. This time could either be given as outside work (homework) or an extra 15-20 minutes could be given on Day 2 before Part B is started.

** Some students may need extra time to complete Part C with all the research involved. This time could either be given as outside work (homework) or an extra 15-20 minutes could be given on Day 4 before Part D is started.

*** Some students may need extra time in writing the plan for Part D. This time could either be given as outside work (homework) or an extra 15-20 minutes could be given on the following day (Day 5).

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Other suggestions:

- Some students may require more support in answering the questions. Support worksheets are also included within this task to assist in breaking down the question that is being asked in a more organized manner. Consider reviewing the worksheets with the whole class as a model for how to organize the information in a multi-step problem. Then students may be able to create their own organizational systems or re-create the table model themselves.
- In Part B of this task, there is an optional collaborative activity. The students should be divided into groups of 3–4 students. They should be given about 15–30 minutes to look at each other’s designs and the questions given. After they have had a chance to look at each of the patterns, they will need to reflect on what they designed and compare that to the other designs. Encourage them to take detailed notes. The information they gather during this part will be useful when they go to write their plan in question 9. This optional activity includes the addition of a new feature to the plan, which should be included in the subsequent activity sections.
- Suggestions for additions during the optional group work activity in Part B: fence around pool area, bird house, parabolic-shaped bench, circular table, picnic table, additional garden (rectangular, parabolic-shape along the backyard perimeter), slide/diving board combo, fenced-in dog run, circular bird bath, swing (swing set), hot tub.
- In Part B, the students will need to research the costs of the materials. Websites to suggest for most of the materials:
 - www.homedepot.com
 - www.lowes.com
 - Local gardening websites (such as www.highlandgardens.com)
- In Part C, students may want to research what plants grow in your area. Explain (or research) perennials, annuals, and mulch so that they can decide how many of which kind to buy.
- This website <http://customoutdoortrends.com/pool-calculator/#> allows you to go in and select different features to get a final cost on an in-ground pool.

Extension Activity

After completion of the initial task, students can be told that the Sullivans had to use \$10,000 of the budget to buy a new roof. They also asked that the amount of grass be 30% or less instead of the original amount of no more than 50%. If their original design already fits these parameters, then instead give them the situation that the Sullivans saved up \$5,000 more than the original \$50,000 and would like 3–4 new features added to their backyard oasis. Have students figure out a plan to edit their designs so that they stay within the new parameters given by their clients. Students should clearly show the changes and include the mathematical models to show how the changes were made and that they fit the new constraints. They should be able to get into their groups and have a partner look over their work before writing out a final plan.

Geometry: Extended Performance Task: Plan for Backyard Oasis

Scoring Rubric

Part A

4 Point Response:

The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to adjust the solution to a problem when one of the constraints changes or additions are made;
- A strong ability to check work and communicate reasoning in a clear and precise way;
- A strong ability to calculate accurately with an appropriate degree of precision;
- A strong understanding of how to use area, measurement, and geometric concepts to solve real-world problems.

A level 4 response should include:

- In Question 1, a completed table with area and equations for each feature;
- The correct calculations for area and the equations that represent each feature (if the optional support worksheet is used by the student it should not be scored unless it was used by the student as the only method of showing their work);
- In Question 2, a complete and correct design of the backyard with all of the features labeled;
- All features correctly drawn per the equations given and all correctly drawn to scale (if the optional support worksheet is used by the student, it should not be scored unless it was used by the student as the only method of showing their work);
- In Question 3, the total area for the grass section(s), with a clear and correct explanation or work shown to find the total (if the optional support worksheet is used by the student, it should not be scored unless it was used by the student as the only method of showing their work).

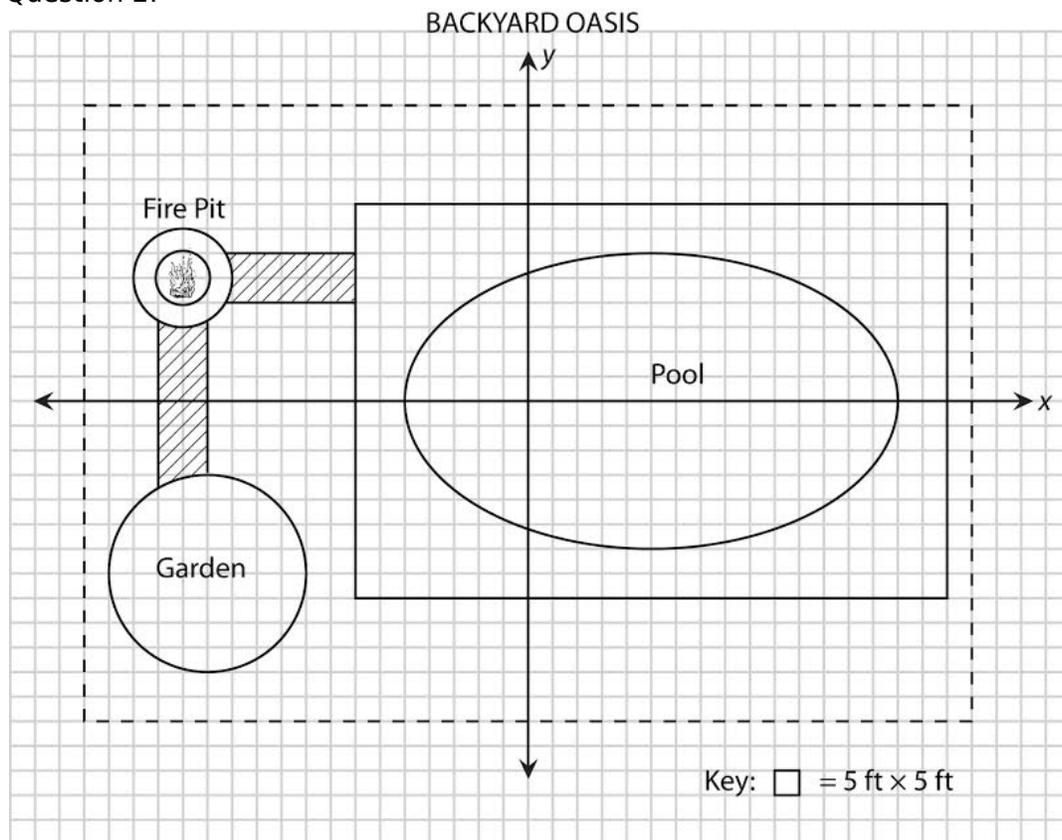
Sample Response for Part A

Question 1:

Feature	Area	Equation(s)
Circular garden	1,256.6 ft ²	$(x + 65)^2 + (y + 35)^2 = 400$
Circular fire pit	314.2 ft ²	$(x + 70)^2 + (y - 25)^2 = 100$
Elliptical pool	4,712.4 ft ²	$\frac{(x - 25)^2}{2500} + \frac{y^2}{900} = 1$
Rectangular pool border	4,887.6 ft ²	$y = 40, y = -40, x = -35, \text{ and } x = 85$
Linear walkway #1	300 ft ²	$x = -65 \text{ and } x = -75$
Linear walkway #2	250 ft ²	$y = 20 \text{ and } y = 30$

Geometry: Extended Performance Task: Plan for Backyard Oasis

Question 2:



Question 3:

The backyard is 125 feet by 180 feet, which is an area of 22,500 square feet. I will subtract the area of the concrete border around the pool, the area of the circular garden, and the fire pit. Then I will subtract the area of the walkways. The area left over will need sod so that it is all covered in grass. The concrete border creates a rectangle that has a length of 120 feet and a width of 80 feet. This would give an area of 9,600 square feet (though the pool is inside this rectangular shape, there will not be any grass placed inside the rectangular area so I will just use the area of the rectangle to subtract from the area of backyard). The area of the larger circle of the fire pit is 314 square feet (the inside of the pit will not need grass so I will use this area to subtract from the area of the backyard). The area of the garden is 1,256 square feet. The walkways are rectangular shaped so the area for both will be length times width. The area of the walkway from the garden to the fire pit is about 300 square feet (it is a little more since the walkway intersects the circles at the curve). The area of the walkway from the fire pit to the pool area is about 250 square feet. So the total area that is covered with a feature (no grass) is: $9,600 + 314 + 1,256 + 300 + 250 = 11,720$. If I subtract this amount from 22,500, then I will need 10,780 square feet of sod for the grass.

Geometry: Extended Performance Task: Plan for Backyard Oasis

3 Point Response:

The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- In Question 1, a completed table with area and equations for each feature;
- The area and equations for all the features, but there may be 1–2 that is/are incorrect because of a minor error made in the calculations;
- In Question 2, a design of the backyard with all of the features labeled;
- A strong understanding of how to create and graph the equations that are associated with each feature, but a minor calculation or conceptual error is made either in writing the equation or in determining the correct scale that causes the graph of a feature to be incorrect;
- A strategy for answering Question 3 that shows a strong understanding of how to find the total area for the grass section(s), but a minor calculation error is made or the work shown is incomplete.

2 Point Response:

The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- In Question 1, a completed table with area and equations for each feature;
- The area and equations for all the features, but there may be 3–4 that are incorrect because of two or more minor errors made in the calculations or one major calculation or conceptual error;
- In Question 2, a design of the backyard, but 1–2 of the features are missing;
- A basic understanding of how to create and graph the equations that are associated with each feature, but two or more minor calculation errors or one major calculation or conceptual error is made either in writing the equation or in determining the correct scale that causes the graph of a feature to be incorrect;
- A strategy for answering Question 3 that shows a basic understanding of how to find the total area for the grass section(s), but two or more minor calculation errors or one major error is made.

1 Point Response:

The response demonstrates minimal understanding.

A level 1 response is characterized by:

- In Question 1, a table with area and equations, but some of the information is missing;
- The area and equations for some of the features, but there may be 5 or more that are incorrect because of two or more major calculation and/or conceptual errors that are made;
- In Question 2, a design of the backyard, but 1–2 of the features are missing;
- A weak understanding of how to create and graph the equations that are associated with each feature, but two or more major calculation or conceptual errors are made in writing the equation and in determining the correct scale that causes the graph of a feature to be incorrect or missing;
- A strategy for answering Question 3 that shows a weak understanding of how to find the total area for the grass section(s), but two or more major calculation or conceptual errors are made.

0 Point Response:

There is no response, or the response is off topic.

Geometry: Extended Performance Task: Plan for Backyard Oasis

Part B

4 Point Response:

The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to adjust the solution to a problem when one of the constraints changes or additions are made;
- A strong ability to check work and communicate reasoning in a clear and precise way;
- A strong ability to calculate accurately with an appropriate degree of precision;
- A strong understanding of how to use area, measurement, and geometric concepts to solve real-world problems.

A level 4 response should include:

- An explanation that shows a strong understanding of how to find the correct equation that represents the path of the water and the relationship between the distance and the height; the correct height and distance of the water's path;
- An example drawn on the grid that shows a correct parabola;
- A strong understanding of how to represent the equation as a graph, demonstrated with an example that contains important information such as the height and distance of the water and an appropriate scale.

Sample Response for Part B

Question 4:

The fountain spout should be placed on the inside perimeter of the pool, preferably at one of the ends. I want my fountain to start at the deep end and shoot in a parabolic path just past the middle of the pool into the shallow end. I don't think that it is appropriate to have the water shoot too far above the pool so I figured 16 feet was a good height for the path of the water. I used the same coordinates for my pool's perimeter that I used in Part A. The length of the pool (in the middle) goes from $(-25, 0)$ to $(75, 0)$, so I started my water path at $(-25, 0)$. This represents the deep end side of my pool, and it is on the perimeter of it. The instructions for the water path from the clients were to have the water shoot into the pool, so I thought it would be cool to have the water shoot towards the shallow end. I have the water ending at the point $(55, 0)$. The starting and ending point represent the solutions for my equation, which is in the form $y = ax^2 + bx + c$. I want to start with the factored form of the equation which is $y = a(x + 25)(x - 55)$. I need to figure out what "a" is, so I will need to substitute another point on the parabola in for x and y . Since I know 16 feet is my height or my y -coordinate, I need to figure out the x -coordinate. This would be the vertex point, and the x -coordinate of the vertex is halfway between the two endpoints: so $(25 + 55)/2 = 80/2 = 40$ feet. Forty feet from either point gives the x -coordinate at 15. So the vertex is $(15, 16)$. I will substitute this point in to my factored equation to find "a":

$$16 = a(15 + 25)(15 - 55)$$

$$16 = -1600a$$

$$a = -(1/100)$$

I can use vertex form to write the final equation in standard form: $y = (-1/100)(x - 15)^2 + 16$

$$y = (-1/100)(x^2 - 30x + 225) + 16$$

$$y = -0.01x^2 + 0.3x - 2.25 + 16$$

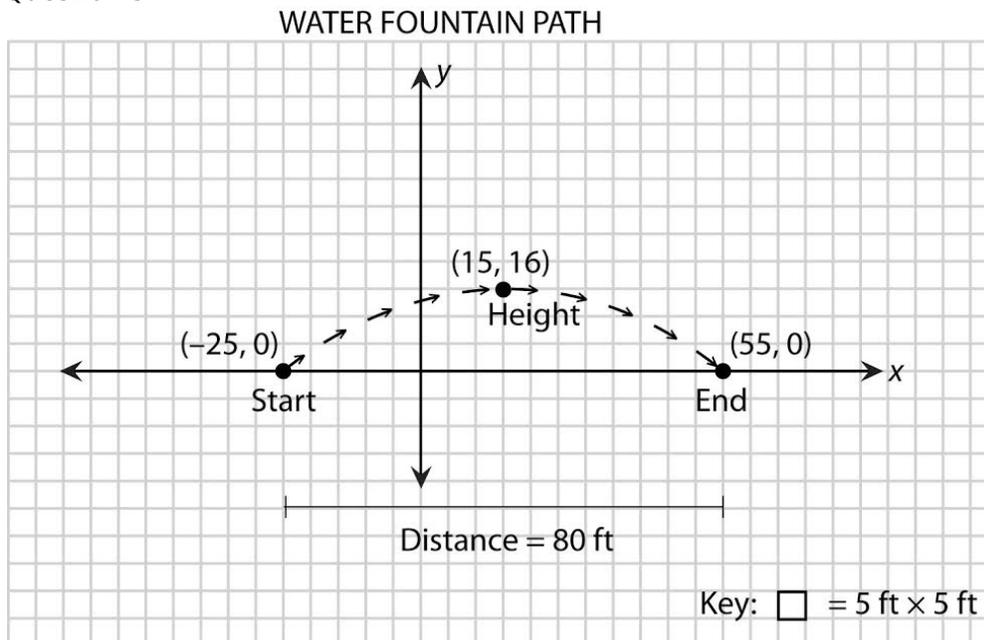
$$y = -0.01x^2 + 0.3x + 13.75$$

Since x represents the distance, in feet, of the water and y represents the height of the water, the equation that represents the path of the water can be written as a function: $f(x) = -0.01x^2 + 0.3x + 13.75$.

Since the vertex is $(15, 16)$, the water will reach its highest point at 16 feet. The water is going 80 feet from starting point to the ending point.

Geometry: Extended Performance Task: Plan for Backyard Oasis

Question 5:



3 Point Response:

The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- An explanation that shows a strong understanding of how to find the equation that represents the path of the water and the relationship between the distance and the height, but a minor calculation error is made;
- An example drawn on the grid that shows a parabola, but the drawing contains a minor counting or calculation error;
- A strong understanding of how to represent the equation as a graph, demonstrated with an example that contains important information such as the height and distance of the water and an appropriate scale, but the drawing may be incomplete; or the drawing may include this important information that correctly explains an incorrect equation given in Question 4.

2 Point Response:

The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- An explanation that shows a basic understanding of how to find the equation that represents the path of the water and the relationship between the distance and the height, but two or more minor calculation errors or one major calculation error is made;
- An example drawn on the grid that shows a parabola, but the drawing is incomplete or contains a major counting or calculation error;
- A basic understanding of how to represent the equation as a graph, demonstrated with an example that contains important information such as the height and distance of the water, but the drawing may be incorrect or incomplete due to calculation errors made in creating the equation in Question 4 or may be incorrect due to computational errors made because of an incorrect or missing scale.

Geometry: Extended Performance Task: Plan for Backyard Oasis

1 Point Response:

The response demonstrates minimal understanding.

A level 1 response is characterized by:

- An explanation that shows a weak understanding of how to find the equation that represents the path of the water and the relationship between the distance and the height, but two or more major calculation errors are made;
- An example drawn on the grid that shows a parabola, but the drawing is incomplete or incorrect due to two or more major counting or calculation errors;
- A weak understanding of how to represent the equation as a graph, demonstrated with an example that contains important information such as the height and distance of the water, but the drawing may be incorrect or incomplete due to calculation errors made in creating the equation in Question 4 or may be incorrect due to computational errors made because of an incorrect or missing scale.

0 Point Response:

There is no response, or the response is off topic.

Geometry: Extended Performance Task: Plan for Backyard Oasis

Part C

4 Point Response:

The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to adjust the solution to a problem when one of the constraints changes or additions are made;
- A strong ability to check work and communicate reasoning in a clear and precise way;
- A strong ability to use area, measurement, and geometric concepts to solve real-world problems.

A level 4 response should include:

- In Question 6, the required information completely and correctly filled in;
- In Question 7, the required information completely and correctly filled in for all three tables;
- A strong understanding of how to calculate cost involved with the area and perimeter of shapes, demonstrated by developing a solution strategy in calculating the correct total cost;
- A strong understanding of how to determine or adjust the solution in choosing materials/supplier that totals \$50,000 or less, demonstrated by an example or explanation that is correct.

Sample Response for Part C

Question 6:

Material Description	Supplier 1 Cost	Supplier 2 Cost	Supplier 3 Cost	Associated Oasis Feature
Brown Mulch	\$250 (1081 ft ²)	\$1180 (1350 ft ²)	\$262 (1260 ft ²)	Garden
Flowers: Perennial	\$100 (5)	\$300 (5)	\$96 (5)	Garden
Flowers: Perennial	\$70 (4)	\$225 (4)	\$74 (4)	Garden
Flowers: Perennial	\$110 (6)	\$270 (6)	\$100 (6)	Garden
Bushes/Shrubs	\$130 (4)	\$300 (4)	\$125 (4)	Garden
Bushes/Shrubs	\$70 (2)	\$225 (2)	\$75 (2)	Garden
Seeds	\$40 (4 bags)	\$28 (4 bags)	\$36 (4 bags)	Garden
Plants	\$200 (10)	\$375 (10)	\$200 (10)	Garden
Plants	\$80 (4)	\$275 (4)	\$90 (4)	Garden
Wall	\$1,045 (126 ft)	\$2,800 (126 ft)	\$1,200 (126 ft)	Garden
Installation of Pool	--	--	\$8,500	Pool
Pool	\$25,550 (includes labor)	\$31,550 (includes labor/concrete border)	\$19,950	Pool
Concrete	\$3,000	--	\$2,000	Pool Border
Bricks	\$859 (63 ft)	\$2,750 (63 ft)	\$999 (63 ft)	Fire Pit
Metal Liner	\$400 (62 ft)	included above	\$400 (62 ft)	Fire Pit
Pavers	\$2,516 (576 ft ²)	\$4,000 (550 ft ²)	\$2,800 (576 ft ²)	Walkways
Ground Cover	\$85 (600 ft ²)	\$150 (600 ft ²)	\$90 (600 ft ²)	Walkways
Sod	\$948 (2 pallets)	\$3,200 (2 pallets)	\$1,000 (2 pallets)	Grass
Grass Seed	\$90 (10,000 ft ²)	\$100 (10000 ft ²)	\$88 (10,000 ft ²)	Grass
Labor/Delivery	\$15,000	Included in prices above	\$18,000	all
Total	\$50,553	\$47,728	\$56,085	

Geometry: Extended Performance Task: Plan for Backyard Oasis

Question 7:

Lowest Estimated Cost:

Oasis Feature	Total Area (in square feet)	Material to Buy	Total Cost for Materials
Garden	1,256.6 ft ²	Brown Mulch	\$1,180 (1350 ft ²)
Garden	1,256.6 ft ²	Flowers: Perennial	\$300 (5)
Garden	1,256.6 ft ²	Flowers: Perennial	\$225 (4)
Garden	1,256.6 ft ²	Flowers: Perennial	\$270 (6)
Garden	1,256.6 ft ²	Bushes/Shrubs	\$300 (4)
Garden	1,256.6 ft ²	Bushes/Shrubs	\$225 (2)
Garden	1,256.6 ft ²	Seeds	\$28 (4 bags)
Garden	1,256.6 ft ²	Plants	\$375(10)
Garden	1,256.6 ft ²	Plants	\$275 (4)
Garden	1,256.6 ft ²	Wall	\$2,800 (126 ft)
Pool	4,712.4 ft ²	Installation of Pool	--
Pool	4,712.4 ft ²	Pool	\$31,550 (includes labor/concrete border)
Pool Border	4,887.6 ft ²	Concrete	--
Fire Pit	314.2 ft ²	Bricks	\$2,750 (63 ft)
Fire Pit	314.2 ft ²	Metal Liner	included above
Walkways	550 ft ²	Pavers	\$4,000 (550 ft ²)
Walkways	550 ft ²	Ground Cover	\$150 (600 ft ²)
Grass	10,780 ft ²	Sod	\$3,200 (2 pallets)
Grass	10,780 ft ²	Grass Seed	\$100 (10,000 ft ²)
all		Labor/Delivery	Included in prices above
Total			\$47,728

Initially, this supplier looked to be the most expensive. All of the labor costs are included in the price of the materials, which is stated in the table in Question 6. Since the labor costs are included with the materials that would mean the laborers work for this supply company. It would be a good idea to hire this company so that you only have to deal with this one company instead of 2–3 different companies (material supplier, labor, pool installation).

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Midrange Estimated Cost:

Oasis Feature	Total Area (in square feet)	Material to Buy	Total Cost for Materials
Garden	1,256.6 ft ²	Brown Mulch	\$250 (1081 ft ²)
Garden	1,256.6 ft ²	Flowers: Perennial	\$100 (5)
Garden	1,256.6 ft ²	Flowers: Perennial	\$70 (4)
Garden	1,256.6 ft ²	Flowers: Perennial	\$110 (6)
Garden	1,256.6 ft ²	Bushes/Shrubs	\$130 (4)
Garden	1,256.6 ft ²	Bushes/Shrubs	\$70 (2)
Garden	1,256.6 ft ²	Seeds	\$40 (4 bags)
Garden	1,256.6 ft ²	Plants	\$200 (10)
Garden	1,256.6 ft ²	Plants	\$80 (4)
Garden	1,256.6 ft ²	Wall	\$1,045 (126 ft)
Pool	4,712.4 ft ²	Installation of Pool	--
Pool	4,712.4 ft ²	Pool	\$25,550 (includes labor)
Pool Border	4,887.6 ft ²	Concrete	\$3,000
Fire Pit	314.2 ft ²	Bricks	\$859 (63 ft)
Fire Pit	314.2 ft ²	Metal Liner	\$400 (62 ft)
Walkways	550 ft ²	Pavers	\$2,516 (576 ft ²)
Walkways	550 ft ²	Ground Cover	\$85 (600 ft ²)
Grass	10,780 ft ²	Sod	\$948 (2 pallets)
Grass	10,780 ft ²	Grass Seed	\$90 (10,000 ft ²)
all		Labor/Delivery	\$15,000
Total			\$50,553

Highest Estimated Cost:

Oasis Feature	Total Area (in square feet)	Material to Buy	Total Cost for Materials
Garden	1,256.6 ft ²	Brown Mulch	\$262 (1260 ft ²)
Garden	1,256.6 ft ²	Flowers: Perennial	\$96 (5)
Garden	1,256.6 ft ²	Flowers: Perennial	\$74 (4)
Garden	1,256.6 ft ²	Flowers: Perennial	\$100 (6)
Garden	1,256.6 ft ²	Bushes/Shrubs	\$125 (4)
Garden	1,256.6 ft ²	Bushes/Shrubs	\$75 (2)
Garden	1,256.6 ft ²	Seeds	\$36 (4 bags)
Garden	1,256.6 ft ²	Plants	\$200 (10)
Garden	1,256.6 ft ²	Plants	\$90 (4)
Garden	1,256.6 ft ²	Wall	\$1,200 (126 ft)
Pool	4,712.4 ft ²	Installation of Pool	\$8,500
Pool	4,712.4 ft ²	Pool	\$19,950
Pool Border	4,887.6 ft ²	Concrete	\$2,000
Fire Pit	314.2 ft ²	Bricks	\$999 (63 ft)
Fire Pit	314.2 ft ²	Metal Liner	\$400 (62 ft)
Walkways	550 ft ²	Pavers	\$2,800 (576 ft ²)
Walkways	550 ft ²	Ground Cover	\$90 (600 ft ²)
Grass	10,780 ft ²	Sod	\$1,000 (2 pallets)
Grass	10,780 ft ²	Grass Seed	\$88 (10000 ft ²)
all		Labor/Delivery	\$18,000
Total			\$56,085

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Question 8:

I plan on suggesting that the Sullivans go with the Lowest Estimated Cost, which is Supplier 2. This supplier is the only one that is within their budget of \$50,000. Since the labor costs are included with the materials that would mean the laborers work for this supply company. It would be a good idea to hire this company so that you only have to deal with this one company instead of 2–3 different companies (material supplier, labor, pool installation).

3 Point Response:

The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- In Question 6, the required information completely filled in;
- In Question 7, the required information completely filled in for all three tables;
- A strong understanding of how to calculate cost involved with the area and perimeter of shapes, demonstrated by a solution strategy for calculating the total cost of the backyard, but a minor calculation error is made or the work shown is incomplete;
- A strong understanding of how to determine or adjust the solution in choosing materials/supplier that totals \$50,000 or less, demonstrated by a correct explanation, but the explanation may be incomplete or a minor calculation error is made in a given example.

2 Point Response:

The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- In Question 6, the required information mostly filled in;
- In Question 7, the required information mostly filled in for all three tables;
- A basic understanding of how to calculate cost involved with the area and perimeter of shapes, demonstrated by a solution strategy for calculating the total cost of the backyard, but two or more minor calculation errors or one major error are made or the work shown is incomplete;
- A basic understanding of how to determine or adjust the solution in choosing materials/supplier that totals \$50,000 or less, demonstrated by an example or explanation that is incorrect because two or more minor calculation errors or one major error is made.

1 Point Response:

The response demonstrates minimal understanding.

A level 1 response is characterized by:

- In Question 6, the required information mostly filled in;
- In Question 7, the required information mostly filled in for all three tables;
- A weak understanding of how to calculate cost involved with the area and perimeter of shapes, demonstrated by a solution strategy for calculating the total cost of the backyard, but two or more major calculation errors are made;
- A weak understanding of how to determine or adjust the solution in choosing materials/supplier that totals \$50,000 or less, demonstrated by an example or explanation that is incorrect because there are two or more major calculation errors.

0 Point Response:

There is no response, or the response is off topic.

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Part D

4 Point Response:

The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to use area, measurement, and geometric concepts to solve real-world problems;
- A strong ability to convey and support ideas and information clearly in a written plan.

A level 4 response should include:

- A plan that clearly explains the design the student made for the backyard oasis that includes all of the features and for the water fountain in the pool and the path of the water, and the explanation of the reasons of why the design was chosen are all given;
- A plan that contains the reasoning behind the choices made by the student and correct calculations for the areas and equations for the garden, pool, fire pit, border of the pool, and the walkways; the choices are strongly supported with at least 10 sentences that clearly demonstrate a strong understanding of the thought process involved in making these decisions.

3 Point Response:

The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- A plan that demonstrates a strong understanding of the design the student made for the backyard oasis that includes all of the features and for the water fountain in the pool and the path of the water and the explanation of the reasons of why the design was chosen, but 1–2 minor errors are made;
- A plan that contains the reasoning behind the choices made by the student, but 1–2 ideas are incomplete or incorrect due to minor errors made in the calculations; the choices are supported with 8–9 sentences that demonstrate a strong understanding of the thought process involved in making the decisions.

2 Point Response:

The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- A plan that demonstrates a basic understanding of the design the student made for the backyard oasis that includes all of the features and for the water fountain in the pool and the path of the water and the explanation of the reasons of why the design was chosen, but more than 2 minor errors or more than 1 major error is made;
- A plan that contains the reasoning behind the choices made by the student, but 3–4 ideas are incomplete or incorrect due to minor errors made in the calculations; the choices are supported with 7 sentences that demonstrate a basic understanding of the thought process involved in making the decisions.

1 Point Response:

The response demonstrates minimal understanding.

A level 1 response is characterized by:

- A plan that demonstrates minimal understanding of the design the student made for the backyard oasis that includes all of the features and for the water fountain in the pool and the path of the water and the explanation of the reasons of why the design was chosen, but with more than 2 major errors;

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- A plan that contains the reasoning behind the choices made by the student, but 2 major errors are made in the calculations given; the choices are supported with 6–8 sentences that demonstrate a minimal understanding of the thought process involved in making these decisions, but 2 or more ideas are incomplete or incorrect due to the errors made in the calculations.

0 Point Response:

There is no response, or the response is off topic.