Performance Based Learning and Assessment Task
The Roanoke Adventure!

I. ASSESSMENT TASK OVERVIEW & PURPOSE:
The activity will allow students to use their knowledge of distance and midpoint to solve real world problems. Students will use pictorial representations and they must explain their reasoning with work.

II. UNIT AUTHOR:
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III. COURSE: Geometry

IV. CONTENT STRAND:
Geometry - Reasoning, Lines, and Transformations

V. OBJECTIVES:
The learner will be able to look at a map and use their knowledge of geometry to solve problems involving distance and midpoint.

VI. REFERENCE/RESOURCE MATERIALS:
Supplemental Task Materials (directions, map, rubric), Calculator, Paper, Pencil, Technology with Internet access

VII. PRIMARY ASSESSMENT STRATEGIES:
The performance task includes an assessment component for the student and for the teacher. Performance tasks include problem solving and reasoning, representing and connecting, and communication. The assessment list will be designed to also act as a rubric where the student can use as a checklist and then self-assess. The teacher will use the rubric as a guide to assess student performance. Each is provided.

VIII. EVALUATION CRITERIA:
Student assessment list for the assessment and corresponding assessment rubrics are

included.

IX. INSTRUCTIONAL TIME:

This task/activity will require 60 minutes of time (2/3 block).

Activity/Task Title: The Roanoke Adventure!

Strand
Geometry - Reasoning, Lines, and Transformations

Mathematical Goals and Objective(s)
The student will be able to use the distance and midpoint formulas. Using a coordinate plane, students will find the distance and midpoint for given coordinates. Students will also use their world geography skills of identifying locations and roads on a map of a given city. Students will be able to validate and justify their solutions.

Related SOL
G.3 The student will use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include
a) *investigating and using formulas for finding distance and midpoint*

NCTM Standards
Geometry (Grades 9 - 12) Use visualization, spatial reasoning, and geometric modeling to solve problems

- visualize three-dimensional objects and spaces from different perspectives;
- use geometric models to gain insights into, and answer questions in, other areas of mathematics;
- use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.

Additional Objectives for Student Learning (include if relevant; may not be math-related):

- Apply and adapt a variety of appropriate strategies to solve problems
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others
- SOL outside of mathematics:
  WG.1 The student will use maps, globes, satellite images, photographs, or diagrams to
  a) obtain geographical information about the world's countries, cities, and environments;
  b) apply the concepts of location, scale, map projection, or orientation

Materials/Resources
Supplemental Performance Task Materials (directions, map, rubric), Calculator, Paper, Pencil, Technology with Internet access

Assumption of Prior Knowledge

- Students must be able to plot a point on the coordinate plane.
- Students must be able to give ordered pairs for points on a coordinate plane.
- Students must be able to read a map.
- Students must be able to convert unit measures.
- Students must be able to use the distance formula to find the distance between two points.
- Students must be able to use the midpoint formula to find the midpoint between two points.
- Students must be able to round decimals.
- Students must be able to verify and interpret their solutions.
- Students should be operating on level 3 on the Van Hiele scale.

Introduction: Setting Up the Mathematical Task

- In this performance task, you will explore the city of Roanoke using a map and your geometric knowledge of distance and midpoints to solve problems. Based on this activity, you should recognize how distance and midpoint can be used in the real-world. This will give you an introduction to the formulas and the foundation to solve more complex equations such as the formula for a circle or finding an endpoint given the midpoint.
- The activity should take you approximately 60 minutes and is useful to help you connect distance and midpoint to the real-world by using an application problem. The performance based assessment sheet is for the teacher to assess your understanding of distance and midpoint.
- Have you ever wondered about the shortest route from home to school? What if you were trying to meet your friends at the movies but you were across town, what would be the fastest route to take?
- Have you ever determined the distance between your house and your best friend's house? What are some methods that you could use to determine the distance between them?
- In a previous lesson distance and midpoint were discussed. Remind students that the shortest distance between two points is always a straight line. However, it isn't always possible to travel in a straight line in the real world. The teacher may have a discussion as to why and when this could be true. The teacher will conduct a whole class review of the distance and midpoint formulas.
- The students will work together on The Roanoke Adventure! activity in partners so that they may share ideas, check thought processes, and solutions.
- Once the activity has been graded and returned, students/partners will review their work and present solutions they have found to the class. Members of the class will share, compare, and defend solutions as each question is discussed.

Student Exploration

The order and components of exploration:

Student/Teacher Actions:

- Students should be working through the performance task using the given map of Roanoke, to determine the solutions of each question posed. Students should be able to use the distance and midpoint formulas appropriately (when and how) and with minimal error.
- If students are having difficulties with the Performance Task while working in partner groups, the teacher will use appropriate questioning to guide the students.
- Students will communicate their new knowledge based on the Performance Task to the class by presenting a question that is assigned. During student presentations, there may be some mathematical misunderstandings, such as using the wrong formula or using the coordinate grid inappropriately. For those who use the wrong formula, the teacher will describe other instances or examples of when each formula is appropriate and remind students of other verbiage related to the terms distance and midpoint (length, measure; middle, bisect, center). For those students who use the coordinate grid inappropriately, the teacher will remind them of where and how to find the axes and the correct manner in which to name or find an ordered pair. In addition, the teacher will guide the students and clear up any other misconceptions. The teacher could also ask the class if they are in agreement with student responses so as to get more student participation and engagement but to also ensure that all students walk away with a better understanding.

Monitoring Student Responses During the Performance Based Assessment

- The teacher should walk around and address each pair of students to give limited guidance on steps to set up and solve problems as needed. The teacher should ask guided questions in order to move students through each question and to correct any misunderstood ideas or assumptions.
- The teacher will direct students without giving answers. However, when necessary, the teacher will remind students what each formula is used for and their meanings.
- Remind students to round to the hundredths place and to use their graphing calculators to check their computations.

Monitoring Student Responses

- The teacher expects that:
    - Students should use correct geometric vocabulary.
    - Students will be respectful of each other's opinions and input.
    - Students will show their mathematical processes through their work.
    - Students will be reminded to use their partner to get assistance and clarify misunderstandings.
    - For those student pairs who have completed their performance task early and correctly, they will begin creating their own questions using the given map.
- To summarize the activity:
    - The teacher will ask the students:
        - How was the activity relevant to you? How do you verify and interpret your results? When and how would you be able to use the skills presented at a later time?
    - To wrap-up the lesson, the teacher will ask the class what other terms reference distance (length or measure) and midpoint (middle, bisect). How would those terms assist in answering the questions on the performance task? Ask students if they found alternate methods to solve the problems? Inform students that there will be a final wrap-up during the next class period. Next class, and after the student partner presentations, the teacher will close by answering all of the questions on The Roanoke Adventure! activity. The teacher will also incorporate "creative" answers that the students provided.

- For those student pairs who completed their performance task early and correctly, they may present their created questions from the given map and have other students attempt to answer them.

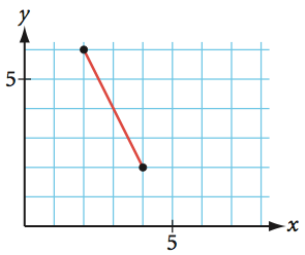
Assessment List and Benchmarks

- Student Assessment list, Teacher Rubric, and Benchmark are attached
  - **Extension Questions**
    - What are some hazards that may occur when selecting the midpoint of two locations as your meeting place?
    - If you were to go over budget, how would you convince the committee that your ideas were the best, albeit the most expensive?
    - Is it possible to extend upon the activity by having students use Google Maps to find the actual walking/driving distances between two landmarks, rather than the "as the crow flies" distances?
    - It might be also appropriate to include a discussion of taxicab geometry a related extension idea: https://en.wikipedia.org/wiki/Taxicab_geometry
  - **Possible Journal/Writing prompts**
    - Write a convincing argument for the need of a cable car system in Roanoke.

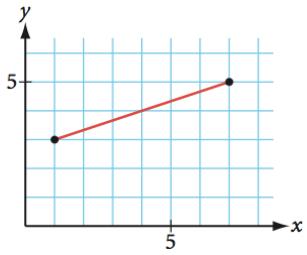
Distance and Midpoint Review

1. Find the length of the given line segments.

a.

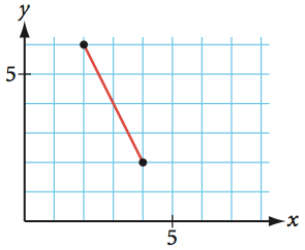


b.

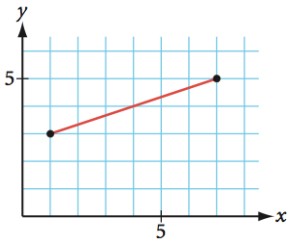


2. Find the midpoint of the given line segments.

a.



b.



3. The diameter of a circle has endpoints at (2, 8) and (4, 12). What are the coordinates of the center of the circle?

4. If M is the midpoint of CD, CM = 4x – 5, and MD = 2x + 5, what is x?

5. The coordinates of the endpoint of a segment are given. What is the length

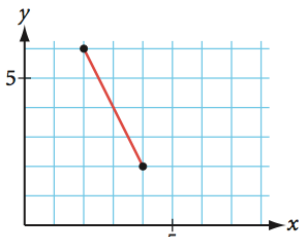
6. The diameter of a circle has endpoints at (2, 8) and (4, 12). What is the length

of the segment? Q(1, -3), R(11, 5) of the diameter of the circle?

Distance and Midpoint Review (Benchmark)

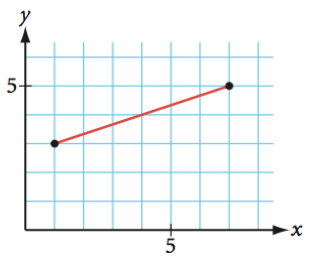
1. Find the length of the given line segments.

a.



d = √20 = 4.47

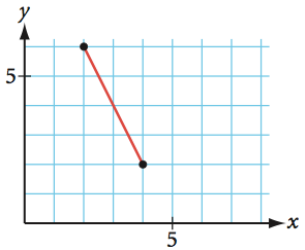
b.



d = √40 = 6.32

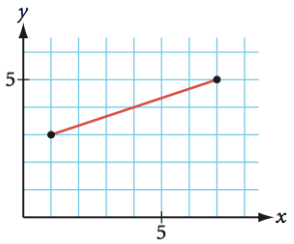
2. Find the midpoint of the given line segments.

a.



(3, 4)

b.



(4, 4)

3. The diameter of a circle has endpoints at (2, 8) and (4, 12). What are the coordinates of the center of the circle?

((2 + 4)/2, (8 + 12)/2)
(6/2, 20/2)
(3, 10)

4. If M is the midpoint of CD, CM = 4x – 5, and MD = 2x + 5, what is x?

4x – 5 = 2x + 5
2x – 5 = 5
2x = 10
x = 5

5. The coordinates of the endpoint of a segment are given. What is the length of the segment? Q(1, -3), R(11, 5)

d = √164 = 12.81

6. The diameter of a circle has endpoints at (2, 8) and (4, 12). What is the length of the diameter of the circle?

d = √20 = 4.47

The Roanoke Adventure!

Today you will explore the city of Roanoke a little more carefully. A map has been provided with four key locations marked; the Taubman Museum of Art, the Hotel Roanoke, McDonald's and the Roanoke Civic Center. Use the attached map and your geometric knowledge to solve the problems below. Be sure to show your work and explain your reasoning. (*Each unit on the map = 100 ft.)

1. You are at McDonald's and your friend is at the Hotel Roanoke and you wish to meet each other at the exact halfway point between the two locations.

a. What are the coordinates of this location? Would you still recommend meeting here?

b. Give the coordinates of a better location to meet. Justify your answer.

2. Of the four given locations (McDonalds, Hotel Roanoke, Taubman Museum, and Roanoke Civic Center), which two are closest to one another? Explain your reasoning.

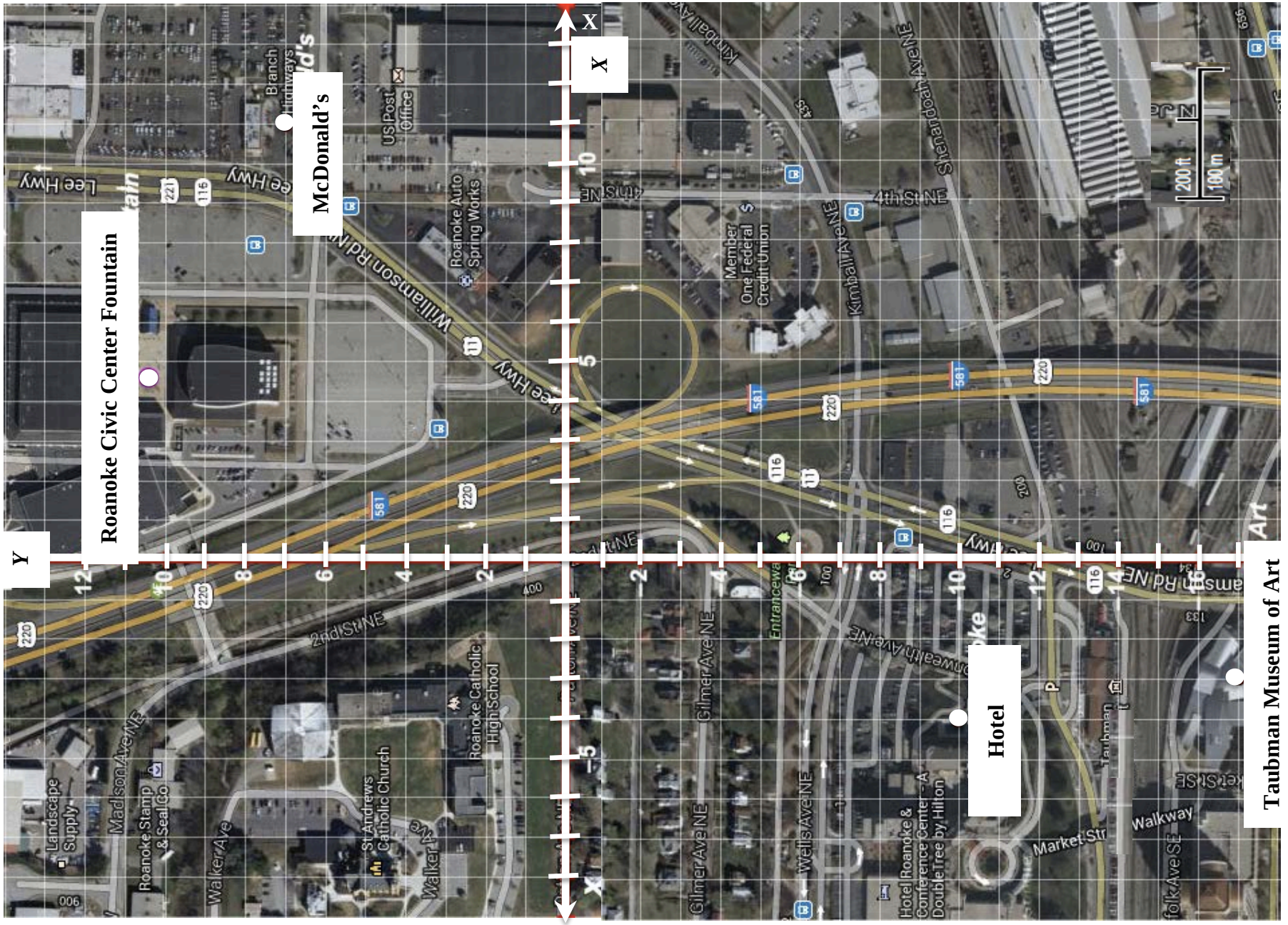
3. Choose any 2 locations on the map to drive between, would it be the same distance as using the distance formula on the map? What method(s) could you use to determine the answer? How did the distance change, if at all? How do you account for these changes?

4. Your friend calls from her house and asks to meet for lunch. You tell her that you are at the Taubman Museum, and she suggests you meet at the Hotel Roanoke because it is exactly halfway between your location and her house. On what street does she live?

5. Are there two locations that have a midpoint close to the origin? Yes or no? If so, provide the locations and the midpoint coordinate.

6. A special committee on transportation and tourism has decided to explore the installation of a cable-car system to transport passengers between locations throughout the city. Cable cars can provide a safe mode of transportation while offering a 360-degree view of the Roanoke Valley. The committee has allotted $2,352,000 for the project. The cable car (gondola) costs approximately $648,000. If the track costs $568 per foot to construct, develop a plan that connects as many points of interest as possible while keeping within the committee's budget. Explain your reasoning.

7. After you have developed your plan, determine which streets would benefit most from the cable-car system. Justify your answer.



Benchmark:

1. You are at McDonald's and your friend is at the Hotel Roanoke and you wish to meet each other at the exact halfway point between the two locations.

a. What are the coordinates of this location? (3.5, -1.5) Would you still recommend meeting here? No

b. Is this a good location? If not, give the coordinates of a better location to meet. Justify your answer.
No, because you end up on Interstate 581 (answers may vary). Each friend will need to travel approx 11.3 units or 1130 ft.

2. Of the four given locations (McDonalds, Hotel Roanoke, Taubman Museum, and Roanoke Civic Center), which two are closest to one another? Explain your reasoning.
The Hotel Roanoke and the Taubman Museum of Art are the closest. Here are the distances students should logically compare:
Hotel Roanoke to Taubman Museum – 7.07 units or 707 ft.
Civic Center Fountain to McDonald's – 7.38 units or 738 ft.

3. Choose any 2 locations on the map to drive between, would it be the same distance as using the distance formula on the map? What method(s) could you use to determine the answer? How did the distance change, if at all? How do you account for these changes?
Answers will vary. Possible solution: No, when driving between Hotel Roanoke and the Taubman Museum, the distance is .5 mi or 2640 ft. We could use Google Maps to determine the answer. The distance was longer by driving and we can account for the changes because in the real world we may have to go around buildings, etc., so there isn't a straight path between the 2 locations.

4. Your friend calls from her house and asks to meet for lunch. You tell her that you are at the Taubman Museum, and she suggests you meet at the Hotel Roanoke because it is exactly halfway between your location and her house. On what street does she live?
(-5, -3) Gilmer Ave

5. Are there two locations that have a midpoint close to the origin? Yes or no? If so, provide the locations and the midpoint coordinate.
Answers will vary. Possible solution: Yes. The Roanoke Civic Center Fountain and Hotel Roanoke at (.25, .25).

6. A special committee on transportation and tourism has decided to explore the installation of a cable-car system to transport passengers between locations throughout the city. Cable cars can provide a safe mode of transportation while offering a 360-

degree view of the Roanoke Valley. The committee has allotted $2,352,000 for the project. The cable car (gondola) costs approximately $648,000. If the track costs $568 per foot to construct, develop a plan that connects as many points of interest as possible while keeping within the committee's budget. Explain the reasoning behind your decisions.
$2,352,000 – Cost of Car ($648,000) = $1,704,000 for construction of the track.
$1,704,000 / $568 per foot = 3000 ft. of track available.

Answers will vary, but the suggested solution would be to connect the Civic Center Fountain to the Hotel Roanoke = 2,219 feet, and The Hotel Roanoke to the Taubman Museum of Art = 707 feet. This would bring the total cost of the suggested project to $2,309,968 and connects three major tourist attractions.

7. After you have developed your plan, determine which streets would benefit most from the cable-car system. Justify your answer. Answers will vary. Possible solution - Lee Highway/Williamson Rd because the following businesses would be easily accessible: Roanoke Civic Center, McDonald's, Roanoke Auto Spring Works, US Post Office, Roanoke Member One Federal Credit Union, Hotel Roanoke, Taubman Museum of Art, and Hotel Roanoke.

Student Assessment List

	Assessment points		
Element	Points Possible	Earned Assessment	
		Self	Teacher
1. Naming Ordered Pairs	4		
2. Rounding	4		
3. Problem Solving and Reasoning a. Proper Formulas Used b. Strategies and Solutions	 4 4		
4. Representations and Connections	4		
5. Communication	4		
Total Points	24		

Mathematics Performance Task Rubric - The Roanoke Adventure!				
Process Goals for Students	**4**	**3**	**2**	**1**
Naming Ordered Pairs	- I can name ordered pairs of a given point correctly for every problem.	- I can name ordered pairs of a given point correctly for 4 or 5 of the problems.	- I can name ordered pairs of a given point correctly for 2 or 3 of the problems.	- I can name ordered pairs of a given point for 1 problem **OR** - I can partially name ordered pairs of a given point.
Rounding	- I correctly rounded all 7 solutions.	- I correctly rounded in 5 or 6 of the problems.	- I correctly rounded in 2 to 4 of the problems.	- I correctly rounded in 0 to 1 of the problems.
Problem Solving and Reasoning	- I showed an extensive use of the distance and midpoint formulas. - I adapted and extended one or more efficient strategies that led to a correct solution.	- I showed satisfactory use of the distance and midpoint formulas. - I chose a strategy that led to a satisfactory solution.	- I showed partial understanding or minor mistakes in the use of the distance and midpoint formulas. - I chose a strategy that led to a partial solution.	- I showed no understanding or major mistakes in the use of the distance and midpoint formulas. - I chose a strategy that did not match the problem and/or lead to a solution.
Representations and Connections	- I used an extended representation to explain my work and I made connections between my work, the problem, and my representation.	- I used satisfactory representations to explain my work and I made connections between my work, the problem, and my representation.	- I used partially correct representations to explain my work or to make connections.	- I used an incorrect or minimal representation or made incorrect connections.
Communication	- I used precise mathematical language to clearly communicate process and thinking.	- I communicated process and thinking in an organized and clear manner.	- I provided a partial communication of process or thinking.	- I showed little or no communication of process or thinking.