Performance Based Learning and Assessment Task

Distance and Midpoint Formulas in a Mall

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:
In this task, Geometry students will investigate midpoint to find a location and the distance formula to find how far someone traveled in a mall.

II. UNIT AUTHOR:
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III. COURSE:
Geometry

IV. CONTENT STRAND:
Geometry

V. OBJECTIVES:
Students will be able to calculate midpoint and distance from two endpoints of a line

VI. REFERENCE/RESOURCE MATERIALS:
Students will use: colored pencils or markers, Activity worksheet, assessment sheet, assessment list, calculator

VII. PRIMARY ASSESSMENT STRATEGIES:
Activity Worksheet, Distance and Midpoint Worksheet, Rubric

VIII. EVALUATION CRITERIA:
Self-Assessment and Teacher Assessment Rubric

IX. INSTRUCTIONAL TIME:
One ninety-minute class session

Distance and Midpoint Formulas in a Mall

Strand
Geometry, Reasoning, Lines and Transformations

Mathematical Objective(s)

1. Students will be able to calculate midpoint and distance from two endpoints of a line.

Related SOL

- G.3 (The student will use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation)

NCTM Standards

- Find the distance between two points on a number line and between two points in a coordinate plane. Use the Pythagorean Theorem to find the length of the hypotenuse.
- Find the midpoint of a segment. Complete proofs involving segment theorems.

Materials/Resources
Students will need: colored pencils or markers, Activity worksheet, assessment sheet, assessment list, calculator

Assumption of Prior Knowledge
Students should:

- know the parts of a right triangle and to create and identify a right triangle.
- be able substitute values into a formula and evaluate.
- know how to solve equations.
- know the Pythagorean Theorem.
- know how to use the midpoint and distance formulas.
- know how to plot points and write an order pair of a point on a graph.
- be operating on Analysis level on van Hiele scale with respect to solving equations and using formulas.

Introduction: Setting Up the Mathematical Task

- In this task, Geometry students will investigate midpoint to find a location and the distance formula to find how far someone traveled.

- For the students to complete the Activity worksheet and the assessment it will take 2 class periods. The Activity worksheet is to help students connect midpoint and distance to the real world by using an application problem. The assessment sheet is for the teacher to assess their understanding of the midpoint and distance.
- Students will practice using the formulas and how to apply them to a real world application prior to the assessment.
- To introduce the task students will asked to define what distance and midpoint means to them
- To help the students with the task, ask the following questions:
    - Give an example of when it is helpful to find a distance. How can we use distance to help make other calculations, such as how much gas to buy?
    - Give an example of when it is helpful to know midpoints.
    - What do you need to use the midpoint and distance formula?
- The students will complete the Activity worksheet using think/pair/share strategy. However, they will think with a partner, pair with another group of two and share with the class as a whole. The students will complete the assessment on their own.

Student Exploration

Student/Teacher Actions

The Activity worksheet is for the students to work with a partner to explore the use of midpoint and distance through a real world problem. After working on the assignment for 20 minutes the students will share their results with another group and finish what had not been completed. After completing the task groups will be asked to share their results with the class. The students are to complete the assessment on their own. The teacher needs to walk around and help students with questions they may have. The teacher is to direct the students and not give answers.

Monitoring Student Responses

- Students will communicate their new knowledge with the class by presenting about a question that is assigned.
- If students are having difficulties with expressing their thoughts the teacher is to use questions to prompt the students.
- After completing activity 2 the teacher will lead the students through a series of questions to pull everything together. The students will then complete the assessment
    - What are the distance and midpoint formulas?
    - How did these formulas come about?
    - What do we need to use these formulas?
    - How would you find the total distance traveled when going to two different locations?

Assessment List and Benchmarks

Assessment List, Rubric and Benchmarks attached.

Questions

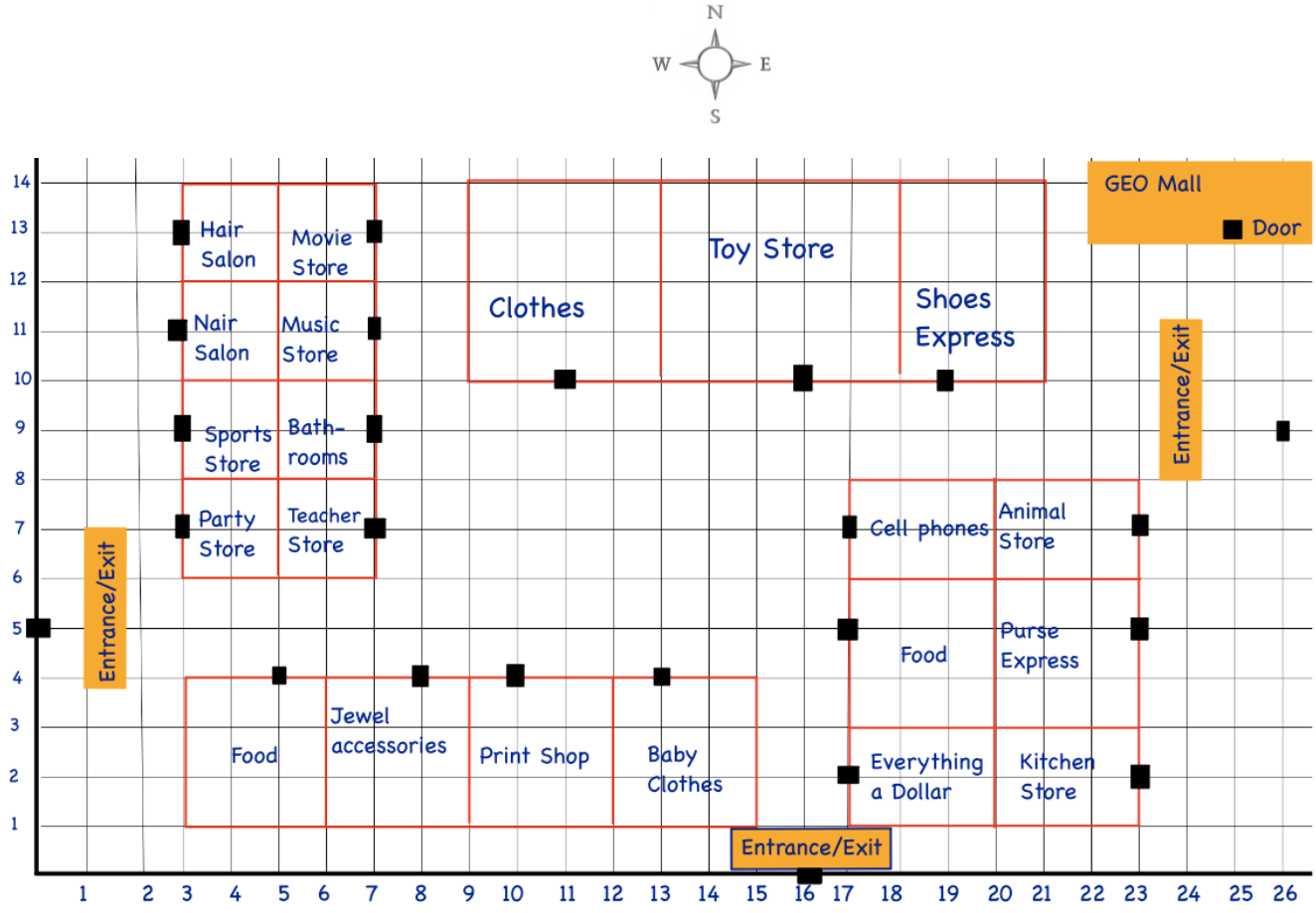
- If the midpoint of a line is (2, 3), and one endpoint of the line is the origin find the other endpoint. Show the computations to justify your solution.
- What are the endpoints of a line that has a midpoint of (-1, -3) and a distance of 8. Show the computations to justify your solution.

Journal/writing prompts

Give another real world example for using midpoint and distance.

Activity Worksheet: Distance and Midpoint Exploration

Travis and Janelle want to take a trip to the mall to buy a toy for a friend who is moving. However, they have a very short time to shop for their friend. Janelle printed a layout of the mall to map out their route. Use the map to answer the following questions. The black dots represent the doors to the mall or stores. You must use straight lines to answer the questions. Show all computations that lead up to your solutions.



Janelle wants to not only go to the toy store but wants to stop at a couple other stores. She goes to the mall before Travis to meet up with him later. Janelle enters the mall at the East entrance to go to the Animal Store. After looking around for a while at the Animal store Travis calls her to make arrangements to meet.

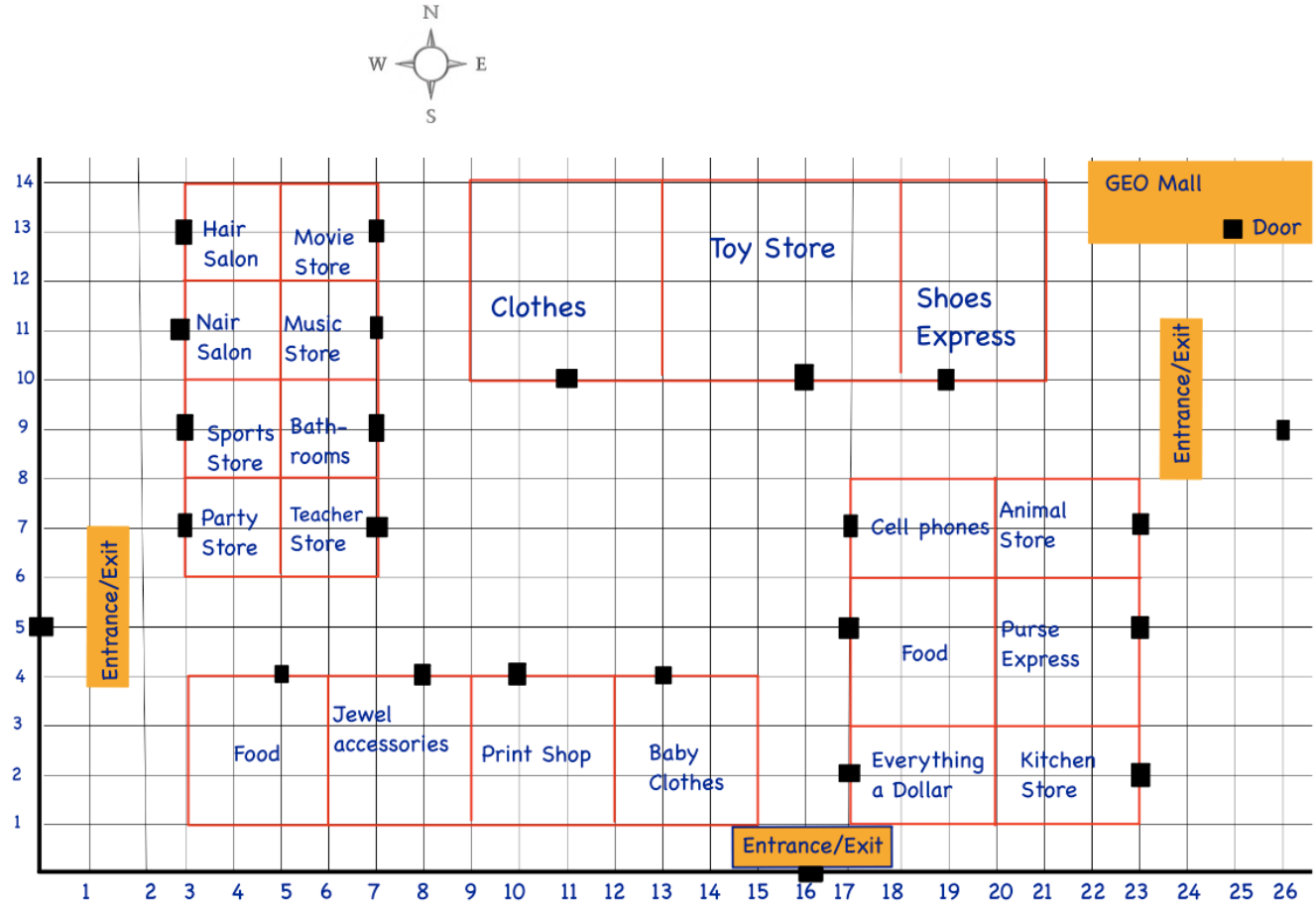
a. Travis is at the West entrance and wants to meet Janelle at the midpoint of their two locations. Where would they meet? Use order pairs to represent their meeting location. After meeting, are they closer to the Toy store or Music store? Include mathematical computations to justify your answer.

b. After meeting up, Janelle and Travis decide to get some food before shopping for a toy. What is the distance they will travel to get to the door of the closest food place?

c. After they finished eating they went to the Toy Store bought a great toy for their friend, then left the mall. After leaving the Toy store, Travis when back to the orginial meeting place then to the entrance he came in. What was Travis' total distance that he traveled from door to door? (Not to include any walking time while in the stores.) Illustrate Travis' route on the map provided.

Distance and Midpoint Assessment:

Use the mall layout to answer the following questions. Use the given grid to find order pairs that can be used to show all computations that led you to your solutions. Appropriate formulas must be used as part of mathematical computations. The black dots represent doorways



1. Select a store of your choice. Calculate how far that store is from each entrance. Explain which entrance you would use to enter the mall and why.

2. You want to open a Pretzel shop somewhere in the rectangular space of the mall that has vertices (9, 6), (9, 9), (15, 9) and (15,6). Identify the coordinates of the doorway of your Pretzel shop by selecting two stores that would give you a midpoint that would fall in the region of the rectangular area. Be sure to include mathematical computations that lead your answer.

3. Creating a route:

a. Your total distance traveled from an entrance, to three stores and to an exit while at the mall was between 20 and 65 units. Create a route using lines, which could include diagonal, vertical or horizontal lines. Keep in mind you cannot cut through stores to get to another store. The total distance does not include shopping within the store.

Your route should include:

I. Which entrance you started at, the three stores you visited and the exit you left the mall

II. The calculated distance between each stop

III. The total distance traveled

b. What is the midpoint from two of the stores that you visited?

c. Draw your route on the mall layout above.

Rubric for Midpoint and Distance

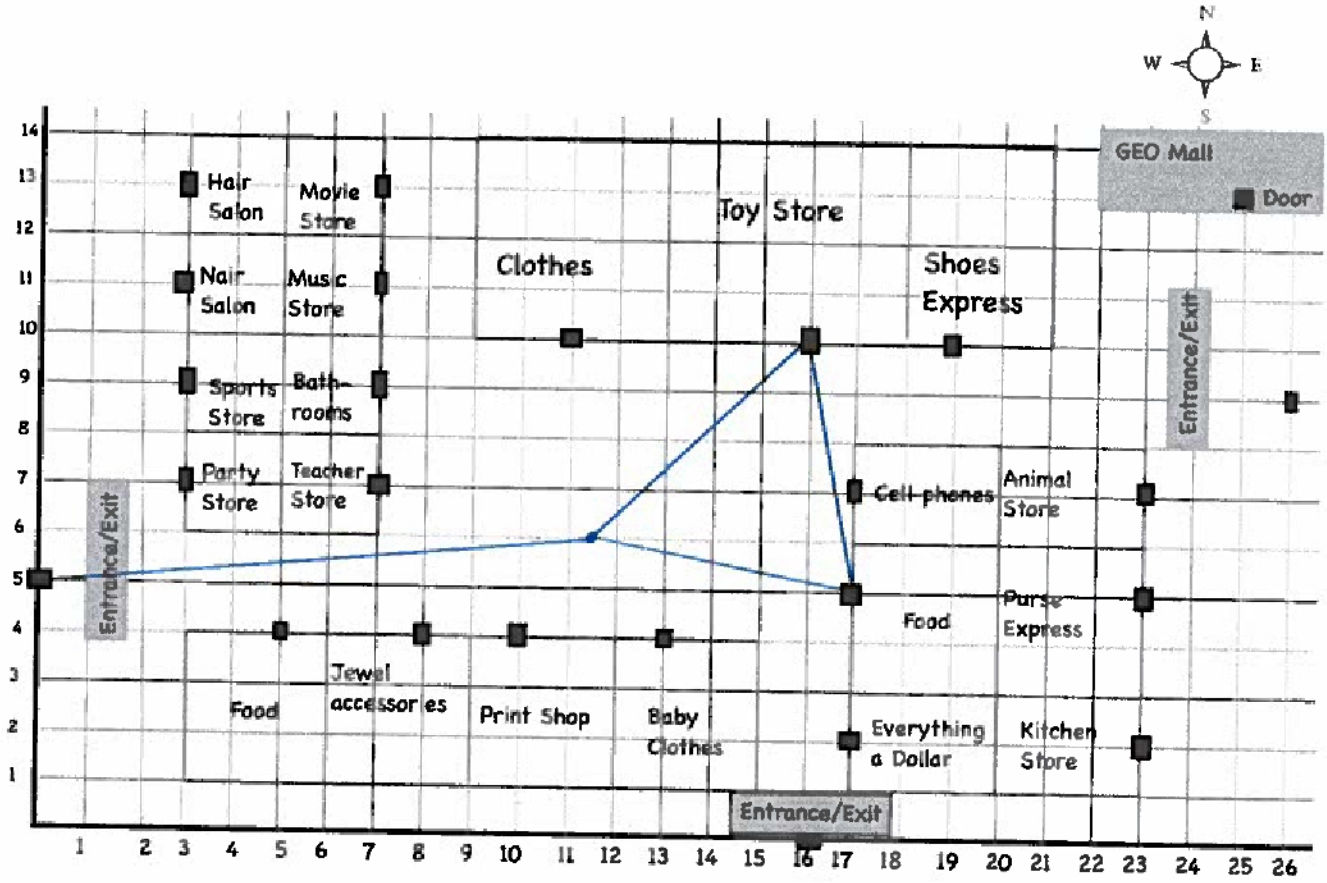
#	2	1	0
1.	Correctly calculated the distance from one store to all three entrances and an explanation of which entrance they would enter the mall .	Calculated the distance from one store to all three entrances with some minor error.	Did not use distance formula correctly or at all.
2.	Correctly used the midpoint formula to find coordinates that fall in the rectangular area.	Used the midpoint formula with some error to find coordinates that fall in the rectangular area.	Does not use formula or use is correctly.
3.	Correctly including order pairs of doorways being used, using order pairs in distance formula and the total distance traveled based off the solutions. Must show the use of the distance formula at least three times.	Correctly uses distance formula 2 times and gives total distance traveled (Even if the student uses the wrong order pairs)	Does not use formula.
4b.	Correctly including order pairs of entrances being used, using order pairs in midpoint formula and the conclusion based off the solutions.	Correctly uses midpoint formula. (Even if the student uses the wrong order pairs)	Does not use formula.
4c.	Uses a straight line correctly to connect the route. The route does not go through stores to get to another stop.	If the route goes through one store to get to the next stop.	If the route goes through more than one store.

Assessment List

Element	Assessment points		
	Points Possible	Earned Assessment	
		Self	Teacher
1. Included order pairs of doorways being used, using order pairs in distance formula and the conclusion based off the solutions.	2		
2. Included order pairs of entrances being used, using order pairs in midpoint formula and the conclusion based off the solutions.	2		
3a. Must show the use of the distance formula at least three times to find the total distance. Includes the order pairs of the doorways being used for the route.	2		
3b. Included order pairs of entrances being used, using order pairs in midpoint formula and the conclusion based off the solutions.	2		
3c. Uses a straight edge to correctly draw the route.	2		

Activity: Distance and Midpoint Exploration

Travis and Janelle wants to take a trip to the mall to buy a toy for a friend who is moving. However, they have a very short time to shop for their friend. Janelle printed a layout of the mall to map out their route. Use the map to answer the following questions. The black dots represent the doors to the mall or stores. You must use straight lines to answer the questions. Show all computations that lead up to your solutions.



Janelle wants to not only go to the toy store but wants to stop at a couple other stores. She goes to the mall before Travis to meet up with him later. Janelle enters the mall at the East entrance to go to the Animal Store. After looking around for a while at the Animal store Travis calls her to make arrangements to meet.

a. Travis is at the West entrance and wants to meet Janelle at the midpoint of their two locations. Where would they meet? Use order pairs to represent their meeting location. After meeting, are they closer to the Toy store or Music store? Include mathematical computations to justify your answer.

$(0,5)\ (23,7)$

$\left(\frac{23+0}{2}, \frac{7+5}{2}\right)$

$(11.5, 6)$

Distance to Toy store $(16, 10)$

$d = \sqrt{(11.5-16)^2 + (6-10)^2}$

$d = 6.02$

Distance to Music Store $(7, 11)$

$d = \sqrt{(11.5-7)^2 + (6-11)^2}$

$d = 6.73$

They are closer to the Toy store.

b. After meeting up, Janelle and Travis decide to get some food before shopping for a toy. What is the distance they will travel to get to the door of the closest food place?

Current location (11.5, 6)

Food (17, 5) or (5, 4)

$d = \sqrt{(11.5-17)^2 + (6-5)^2}$ $\quad$ $d = \sqrt{(11.5-5)^2 + (6-4)^2}$

$d = 5.6$ $\quad$ $d = 6.8$

It would be closer for them to go to the Food located at (17, 5) which is a distance of 5.6 units away.

c. After they finished eating they went to the Toy Store bought a great toy for their friend, then left the mall. After leaving the Toy store, Travis when back to the orginial meeting place then to the entrance he came in. What was Travis' total distance that he traveled from door to door? (Not to include any walking time while in the stores.) Illustrate Travis' route on the map provided.

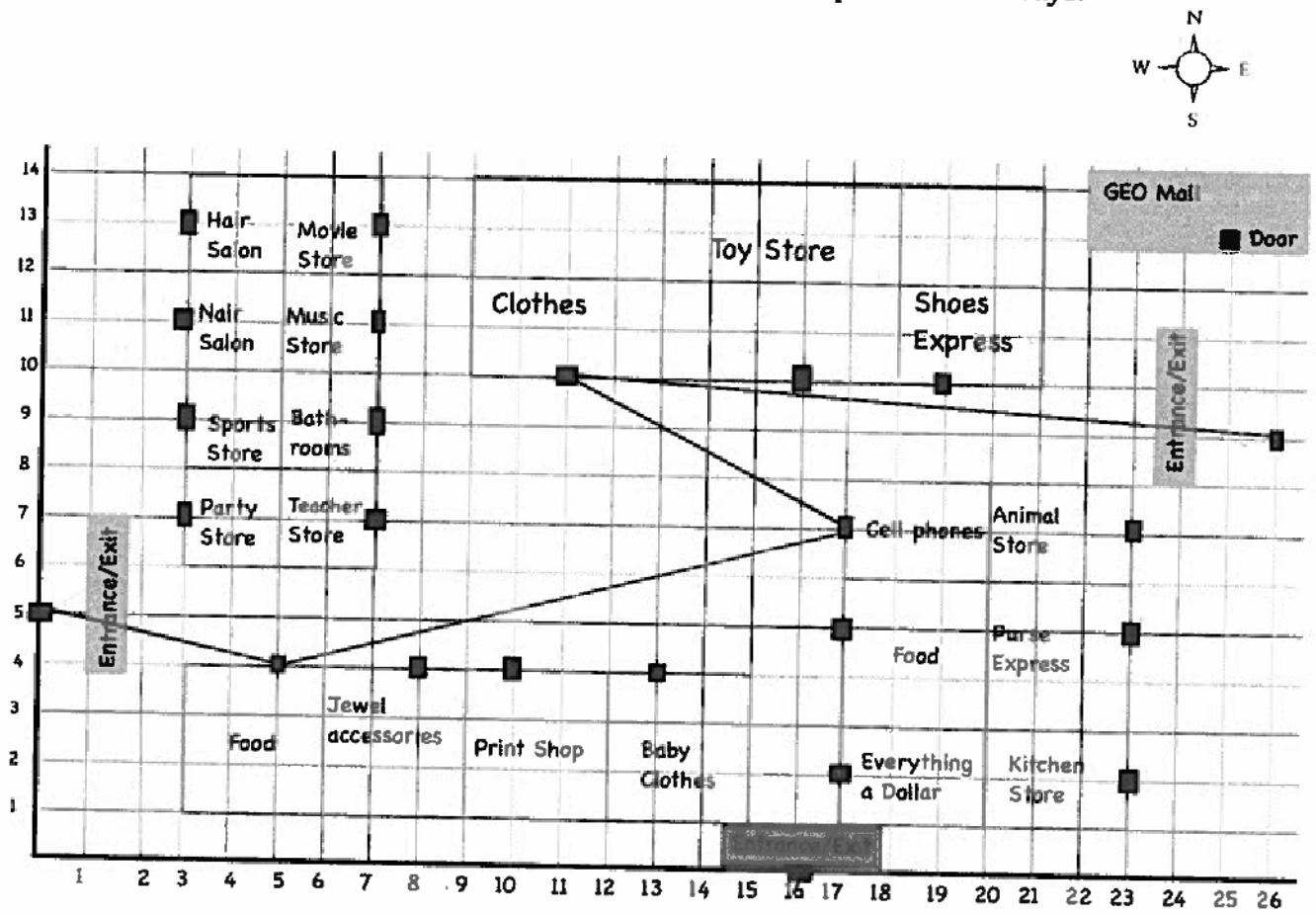
- Distance from entrance to meeting place
  (0, 5) (11.5, 6)
  $d = \sqrt{(11.5-0)^2 + (6-5)^2} = \boxed{11.5}$
- Meeting place to Food is $\boxed{5.6}$
- Food to Toy store: (17, 5) (16, 10)
  $d = \sqrt{(17-16)^2 + (5-10)^2} = \boxed{5.1}$
- Toy store to meeting place: (16, 10) (11.5, 6)
  $d = \sqrt{(16-11.5)^2 + (10-6)^2} = \boxed{6.02}$
- Meeting place to exit is $\boxed{11.5}$

Total Distance = 11.5 + 5.6 + 5.1 + 6.02 + 11.5

= 39.7 units

Distance and Midpoint Assessment:

Use the mall layout to answer the following questions. Use the given grid to find order pairs that can be used to show all computations that led you to your solutions. Appropriate formulas must be used as part of mathematical computations. The black dots represent doorways.



1. Select a store of your choice. Determine mathematical how far that store is from each entrance. (11,10) Explain which entrance you would use to enter the mall and why.

The Clothes store from west entrance $d = \sqrt{(11-0)^2 + (10-5)^2} = 12.08$

The Clothes store from south entrance $d = \sqrt{(11-16)^2 + (10-0)^2} = 11.18$

The Clothes store from east entrance $d = \sqrt{(11-20)^2 + (10-9)^2} = 15.03$

I would enter the mall using the south entrance because it is the entrance closest to the Clothes store.

2. You want to open a Pretzel shop somewhere in the rectangular space of the mall that has vertices (9, 6), (9, 9), (15, 9) and (15,6). Identify the coordinates of the doorway of your Pretzel shop by selecting two stores that would give you a midpoint that would fall in the region of the rectangular area. Be sure to include mathematical computations that lead your answer.

Music store and Everything a Dollar store

(7, 11) (17,2)

Midpoint $\left(\frac{7+17}{2}, \frac{11+2}{2}\right) = (12, 6.5)$ would be the coordinates of the doorway of my Pretzel shop.

3. Creating a route:

a. Your total distance traveled from an entrance, to three stores and to an exit while at the mall was between 20 and 65 units. Create a route using lines, which could include diagonal, vertical or horizontal lines. Keep in mind you cannot cut through stores to get to another store. The total distance does not include shopping within the store.
Your route should include:
I. Which entrance you started at, the three stores you visited and the exit you left the mall
II. The calculated distance between each stop
III. The total distance traveled

Enter west entrance to Food at (5,4) $d = \sqrt{(5-0)^2+(4-5)^2} = 5.1$

Food to cell Phones at (17,7) $d = \sqrt{(5-17)^2+(4-7)^2} = 12.4$

Cell Phones to clothes at (11,10) $d = \sqrt{(17-11)^2+(7-10)^2} = 6.7$

Clothes to East exit at (26,9) $d = \sqrt{(11-26)^2+(10-9)^2} = 15$

Total distanced traveled is 39.2 units

b. What is the midpoint from two of the stores that you visited?

Midpoint between cell phones and clothes is

$\left(\frac{17+11}{2}, \frac{7+10}{2}\right) = (14, 8.5)$

c. Draw your route on the mall layout above.