Lesson 1: Searching a Region in the Plane

Classwork

**Exploratory Challenge**

Students in a robotics class must program a robot to move about an empty rectangular warehouse. The program specifies location at a given time,$ t$, seconds. The room is twice as long as it is wide. Locations are represented as points in a coordinate plane with the southwest corner of the room deemed the origin, $(0,0)$, and the northeast corner deemed the point $(2000 ft., 1000 ft.)$, as shown in the diagram below.

$$(0,0)$$

$$(2000 ft.,1000 ft.)$$

The first program written has the robot moving at a constant speed in a straight line. At time $t=1$ second, the robot is at position $(30, 45)$, and at $t=3$ seconds, it is at position $(50, 75)$. Complete the exercises and answer the questions below to program the robot’s motion.

* 1. Where is the location of impact?
	2. At what speed will the robot hit the wall?
	3. At what time will the robot hit the wall?

Exercises 1–8

1. Plot the points on a coordinate plane.
2. Draw the line connecting the segments.
3. How much did the $x$-coordinate change in $2$ seconds?
4. How much did the $y$-coordinate change in $2$ seconds?
5. What is the ratio of change in $y$ to change in $x$?

1. What is the equation of the line of motion?

1. What theorem could be used to find the distance between the points?
2. How far did the robot travel in $2$ seconds?

Problem Set

1. The robot in the video is moving around an empty $100$ ft. by $100$ ft. storage room at a constant speed. If the robot crosses $(10, 10)$ at $1$ second and $(30, 30)$ at $6$ seconds:
	1. Plot the points and draw the segment connecting the points.
	2. What was the change in the $x$-coordinate?
	3. What was the change in the $y$-coordinate?
	4. What is the ratio of the change in $y$ to the change in $x$?
	5. How far did the robot travel between the two points?
	6. What was the speed of the robot?
	7. Where did the robot start?
2. Your mother received a robot vacuum cleaner as a gift and wants you to help her program it to clean a vacant $30$ ft. by $30$ ft. room. If the vacuum is at position $(12, 9) $at time $t=2$ seconds and at position $(24, 18)$ at $t=5 $seconds, answer the following:
	1. How far did the robot travel over $3$ seconds?
	2. What is the speed?
	3. What is the ratio of the change in the $x$-coordinate to the change in the $y$-coordinate?
	4. Where did the robot start?
	5. Where will the robot be at $t=3$ seconds? Explain how you know.
	6. What is the location of impact?
	7. At what time will the robot hit the wall?
3. A baseball player hits a ball at home plate at position $(0, 0)$. It travels at a constant speed across first base at position $(90, 0)$ in $2$ seconds.
	1. What was the speed of the ball?
	2. When will it cross the fence at position $(300, 0)$? Explain how you know.
4. The tennis team has a robot that picks up tennis balls. The tennis court is $36$ feet wide and $78$ feet long. The robot starts at position $(8, 10) $and is at position $(16, 20) $at $t=4$ seconds. When will it pick up the ball located at position $(28, 35)$?