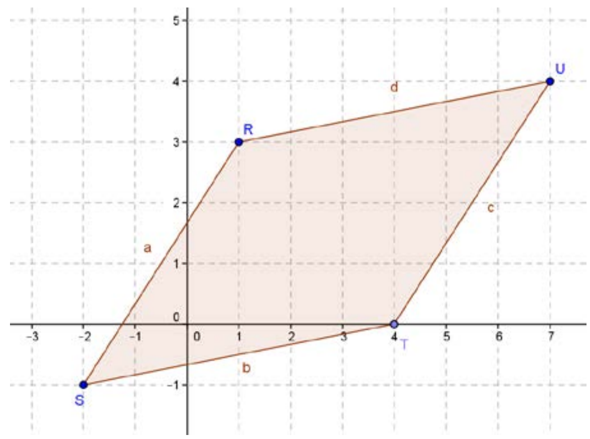
Name ____ Date ______________________

For problems that require rounding, round answers to the nearest hundredth unless otherwise stated.

1. Given parallelogram $RSTU$ with vertices $R(1, 3)$, $S(-2, -1)$, $T(4, 0)$, and $U(7, 4)$:

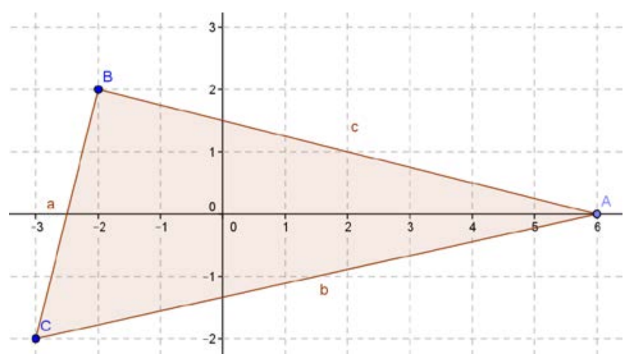
   a. Find the perimeter of the parallelogram; round to the nearest hundredth.



   b. Find the area of the parallelogram.

2. Given triangle ABC with vertices $A(6, 0)$, $B(-2, 2)$, and $C(-3, -2)$:

   a. Find the perimeter of the triangle, round to the nearest hundredth.

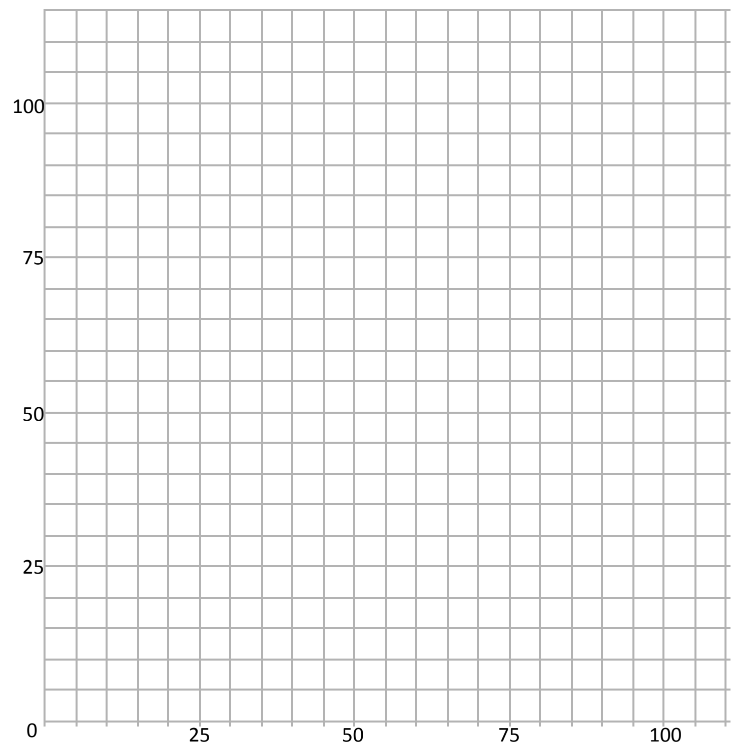


   b. Find the area of the triangle.

3. You are a member of your school's robotics team and are in charge of programming a robot that will pick up ping pong balls. The competition arena is a rectangle with height 90 feet and width 95 feet.

   On graph paper, you sketch the arena as a square on the coordinate plane with sides that are parallel to the coordinate axes and with the southwest corner of the arena set at the origin. Each unit width on the paper grid corresponds to 5 feet of length of the arena. You initially set the robot to move along a straight path at a constant speed. In the sketch, the robot's position corresponds to the point $(10, 30)$ in the coordinate plane at time $t = 2$ seconds and to the point $(40, 75)$ at time $t = 8$ seconds.

   a. Sketch the arena on the graph paper below, and write a system of inequalities that describes the region in the sketch.



   b. Show that at the start, that is, at time $t = 0$, the robot was located at a point on the west wall of the arena. How many feet from the southwest corner was it?

   c. What is the speed of the robot? Round to the nearest whole number.

   d. Write down an equation for the line along which the robot moves.

e. At some time the robot will hit a wall. Which wall will it hit? What are the coordinates of that point of impact?

f. How far does the robot move between time $t = 0$ seconds and the time of this impact? What is the time for the impact? Round distance to the nearest hundredth and time to the nearest second.

At the time of impact, you have the robot come to a gentle halt, and then turn and head in a direction perpendicular to the wall. Just as the robot reaches the opposite wall, it gently halts, turns, and then returns to start. (We are assuming that the robot does not slow down when it hits a wall.) The robot thus completes of journey composed of three line segments forming a triangle within the arena. Sketch the path of the robot's motion.

g. What are the coordinates where it hits the east wall?

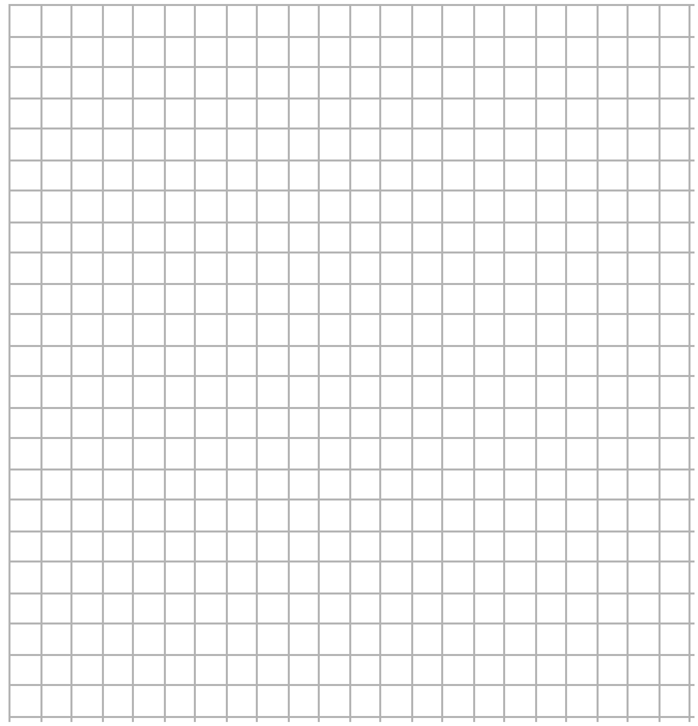
h. What is the perimeter of that triangle rounded to the nearest hundredth?

i. What is the area of the triangle rounded to the nearest tenth?

j. If the count of ping-pong balls in the arena is large and the balls are spread more or less evenly across the whole arena, what approximate percentage of balls do you expect to lie within the triangle the robot traced? (Assume the robot encountered no balls along any legs of its motion.)

4. Consider the triangular region in the plane given by the triangle $(1, 6)$, $(6, -1)$, and $(1, -4)$.

   a. Sketch the region and write a system of inequalities to describe the region bounded by the triangle.



   b. The vertical line $x = 3$ intersects this region. What are the coordinates of the two boundary points it intersects? What is the length of the vertical segment within the region between these two boundary points?

   c. The line $x = 3$ divides the region into a quadrilateral and a triangle. Find the perimeter of the quadrilateral and the area of the triangle.

5. Is triangle RST, where $R(1, 5)$, $S(5, 1)$, $T(-1, -1)$, a right triangle? If so, which angle is the right angle? Justify your answer.

6. Consider the points $A(-1, 3)$ and $B(6, 2)$ in the coordinate plane. Let $O(0, 0)$ be the origin.

   a. Find the coordinates of a point, C, away from the origin on the line $y = x$ that make triangle ABC a right triangle with right angle at C.

   b. Find the coordinates of a point, D, on the line $y = x$ that make triangle OBD a right triangle with right angle at B.

7. Consider the quadrilateral with vertices $(-2, -1)$, $(2, 2)$, $(5, -2)$, and $(1, -5)$.

   a. Show that the quadrilateral is a rectangle.

   b. Is the quadrilateral a square? Explain.

   c. What is the area of the quadrilateral?

d. What is the area of the region of the quadrilateral that lies to the right of the y-axis?

e. What is the equation of the perpendicular bisector of the side of the quadrilateral that lies in the fourth quadrant?

8. Using the general formula for perpendicularity of segments with one endpoint at the origin, determine if the segments from the given points to the origin are perpendicular.

   a. $(4, 10)$, $(5, -2)$

   b. $(-7, 0)$, $(0, -4)$

   c. Using the information from part (a), are the segments through the points $(-3, -2)$, $(1, 8)$, and $(2, -4)$ perpendicular? Explain.

9. Write the equation of the line that contains the point $(-2, 7)$ and is

   a. Parallel to $x = 3$.

   b. Perpendicular to $x = -3$.

   c. Parallel to $y = 6x - 13$.

   d. Perpendicular to $y = 6x - 13$.

10. Line A contains points $(p - 4, 2)$ and $(-2, 9)$. Line B contains points $(p, -1)$ and $(-1, 1)$.

    a. Find the value of p if the lines are parallel.

    b. Find the value(s) of p if the lines are perpendicular.

A Progression Toward Mastery					
Assessment Task Item		**STEP 1** Missing or incorrect answer and little evidence of reasoning or application of mathematics to solve the problem.	**STEP 2** Missing or incorrect answer but evidence of some reasoning or application of mathematics to solve the problem.	**STEP 3** A correct answer with some evidence of reasoning or application of mathematics to solve the problem, <u>or</u> an incorrect answer with substantial evidence of solid reasoning or application of mathematics to solve the problem.	**STEP 4** A correct answer supported by substantial evidence of solid reasoning or application of mathematics to solve the problem.
1	**a** G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student gives an incorrect answer but work shows use of the distance formula.	Student gives correct answer with supporting work but does not round to the hundredths.	Student gives correct answer with supporting work and answer is properly rounded.
	b G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use a formula or decomposition to find area but makes many errors leading to an incorrect answer.	Student shows knowledge of using a formula or decomposition to find error but makes minor errors leading to an incorrect answer.	Student has correct answer with accurate supporting work.
2	**a** G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student gives an incorrect answer but work shows use of the distance formula.	Student gives a correct answer with supporting work but not rounded to the hundredths.	Student gives correct answer with supporting work, and it is properly rounded.
	b G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use a formula or decomposition to find area but makes many errors leading to an incorrect answer.	Student shows knowledge of using a formula or decomposition to find error but makes minor errors leading to an incorrect answer.	Student has correct answer with accurate supporting work.
3	**a** G-GPE.B.5	Student does not sketch the region nor is the system of inequalities written.	Student sketches the region correctly, but the system of inequalities is either not written or are both incorrect.	Student sketches the region correctly, and one inequality is written correctly.	Student sketches the region correctly, and the system of inequalities is correct.

	b G-GPE.B.5	Student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use an up and over triangle to determine the starting position, but the position is incorrect.	Student shows correct work to determine starting point but transposes the coordinates $(15, 0)$.	Student has accurate work and the correct starting position.
	c G-GPE.B.5	Student does not calculate distance traveled nor the speed, or both are calculated incorrectly.	Student calculates the distance correctly but does not divide by time to arrive at speed.	Student calculates the speed correctly, but units are incorrect or answer is incorrectly rounded.	Student calculates the speed correctly with appropriate units and rounding.
	d G-GPE.B.5	Student gives no answer, or an incorrect answer is given with no supporting work.	Student calculates slope correctly, but does not attempt to use a point to write the equation of the line.	Student calculates slope correctly and uses a point to write the equation of the line but makes minor errors.	Student calculates the equation of the line of motion correctly.
	e G-GPE.B.5	Student gives no answer, or an incorrect answer with no supporting work is given.	Student realizes the robot will hit the wall at $y = 90$ but finds the x-coordinate incorrectly.	Student uses the equation from part (d) and the y-value of 90 to find the x-coordinate but makes mathematical errors.	Student identifies the correct point of intersection with supporting work.
	f G-GPE.B.5	Student has no answer or an incorrect answer with no supporting work.	Student uses the distance formula to find distance but with the wrong set of points.	Student finds the correct distance but does not find time or does not round correctly.	Student finds the correct distance and time of impact, rounding correctly.
	g G-GPE.B.5	Student gives no answer, or an incorrect answer with no supporting work is given.	Student realizes the robot will hit the wall at $x = 95$ but has an incorrect y-coordinate with no supporting work or no y-coordinate.	Student uses $x = 95$ and shows proper work to find the y-coordinate but makes a slight error.	Student identifies the correct location of impact with supporting work.
	h G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student gives an incorrect answer but work shows use of the distance formula using correct points.	Student gives a correct answer with supporting work but not rounded to the hundredths.	Student gives a correct answer with supporting work that is properly rounded.
	i G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use a formula or decomposition to find area with correct points but made many errors leading to an incorrect answer.	Student shows knowledge of using a formula or decomposition to find error but made minor errors leading to an incorrect answer.	Student has correct answer with accurate supporting work.

	j G-GPE.B.7	Student gives no answer, or an incorrect answer given with no supporting work.	Student attempts to set up a ratio of areas but with major errors.	Student set up a ratio of correct areas but did not round correctly and/or did not write as a percent.	Student calculated the percent of balls and rounded correctly with accurate supporting work.
4	a G-GPE.B.7	Student does not sketch the region, nor is the system of inequalities written.	The student sketches the region correctly, but the system of inequalities is either not written or are both incorrect.	The student sketches the region correctly, and one inequality is written correctly.	The student sketches the region correctly, and the system of inequalities is correct.
	b G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student shows knowledge of solving a system of equations to find the intersection points but makes errors and does not find segment length.	Student shows knowledge of solving a system of equations to find the intersection points and uses those points to find the segment length, but both are incorrect.	Student finds the correct points of intersection and the length of the segment.
	c G-GPE.B.7	Student gives no answer, or an incorrect answer is given with no supporting work.	Student shows the correct formulas or methods to find the area and perimeter but both are calculated incorrectly.	Student shows the correct formulas or methods to find area and perimeter and only one is calculated correctly.	Student shows the correct formulas or methods to find area and perimeter and both are calculated correctly.
5	G-GPE.B.4	Student gives no answer, or an incorrect answer is given with no supporting work.	Student uses either slopes or the Pythagorean theorem to determine if the triangle is right but makes errors leading to an incorrect answer.	Student uses either slopes or the Pythagorean theorem and determines that the triangle is right but does not or incorrectly identifies the right angle.	Student uses either slopes or the Pythagorean theorem and determines that the triangle is right and correctly identifies the right angle.
6	a G-GPE.B.5	Student gives no answer, or an incorrect answer is given with no supporting work.	Student shows some knowledge of determining perpendicularity but does not consider the line $y = x$.	Student shows knowledge of perpendicularity and uses the equation of the line $y = x$ but finds the wrong point.	Student shows knowledge of perpendicularity, uses the equation of the line $y = x$, and identifies the correct point.
	b G-GPE.B.5	Student gives no answer, or an incorrect answer is given with no supporting work.	Student shows some knowledge of determining perpendicularity but does not consider the line $y = x$.	Student shows knowledge of perpendicularity and uses the equation of the line $y = x$ but finds the wrong point.	Student shows knowledge of perpendicularity, uses the equation of the line $y = x$, and identifies the correct point.

7	**a** **G-GPE.B.4**	Student gives no answer, or an incorrect answer is given with no supporting work.	Student shows knowledge of the properties of a rectangle and attempts to prove both pairs of opposite sides are parallel or the quadrilateral has four right angles but makes errors leading to an incorrect answer.	Student shows knowledge of the properties of a rectangle and proves both pairs of opposite sides are parallel or the quadrilateral has four right angles but does not explain the reasoning.	Student shows knowledge of the properties of a rectangle and proves both pairs of opposite sides are parallel or the quadrilateral has four right angles and writes an explanation of reasoning.
	b **G-GPE.B.4**	Student gives no answer, or an incorrect answer is given with no supporting work.	Student shows knowledge of the properties of a square and finds the lengths of the sides but makes errors leading to an incorrect answer.	Student shows knowledge of the properties of a square and proves all sides are equal in length but does not explain the reasoning.	Student shows knowledge of the properties of a square, proves all sides are equal in length, and writes an explanation of reasoning.
	c **G-GPE.B.7**	Student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use a formula or decomposition to find the area but makes major errors.	Student uses a formula or decomposition to find the area but makes a small error.	Student finds the correct area with accurate supporting work.
	d **G-GPE.B.7**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use a formula or decomposition to find the area but makes major errors.	Student uses a formula or decomposition to find the area but makes a small error.	Student finds the correct area with accurate supporting work.
	e **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to find the midpoint and slope of the perpendicular bisector, but both are incorrect.	Student finds the correct slope of the perpendicular bisector and the midpoint but does not write an equation.	Student writes the correct equation of the perpendicular bisector with accurate supporting work.
8	**a** **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use the general formula for perpendicularity but uses it incorrectly.	Student uses the general formula for perpendicularity but makes a slight error leading to an incorrect answer.	Student uses the general formula for perpendicularity correctly and arrives at the correct answer.
	b **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use the general formula for perpendicularity but uses it incorrectly.	Student uses the general formula for perpendicularity but makes a slight error leading to an incorrect answer.	Student uses the general formula for perpendicularity correctly and arrives at the correct answer.

	c **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use the general formula for perpendicularity but uses it incorrectly and does not use part (a) at all.	Student uses the general formula for perpendicularity and gets the correct answer, but does not use part (a).	Student shows that the segments are perpendicular because they are translations of the segments in part (a).
9	**a** **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student writes the equation of the perpendicular line, $y = 7$.	Student writes a parallel equation but with a wrong constant (i.e., $x = 4$).	Student writes the correct equation of the parallel line.
	b **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student writes the equation of the parallel line, $x = -2$.	Student writes a perpendicular equation, but with a wrong constant (i.e., $y = 4$).	Student writes the correct equation of the perpendicular line.
	c **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student writes the equation of the perpendicular line.	Student uses the correct slope but the wrong point or no point to write the equation of the parallel line.	Student writes the correct equation of the parallel line.
	d **G-GPE.B.5**	The student gives no answer, or an incorrect answer is given with no supporting work.	Student writes the equation of the parallel line.	Student uses the correct slope but the wrong point or no point to write the equation of the perpendicular line.	Student writes the correct equation of the perpendicular line.
10	**a** **G-GPE.B.5**	Student gives no answer, or an incorrect answer is given with no supporting work.	Student attempts to use the general formula for parallel slopes but uses it incorrectly.	Student uses the general formula for parallel slopes but makes a slight error leading to an incorrect answer.	Student uses the general formula for parallel slopes correctly and arrives at the correct answer.
	b **G-GPE.B.5**	Student gives no answer, or an incorrect answer is given with no supporting work.	Students attempts to use the general formula for perpendicular slopes but uses it incorrectly.	Student uses the general formula for perpendicular slopes but makes a slight error leading to an incorrect error or provides one correct and one incorrect answer.	Students uses the general formula for perpendicular slopes correctly and arrives at both correct answers.

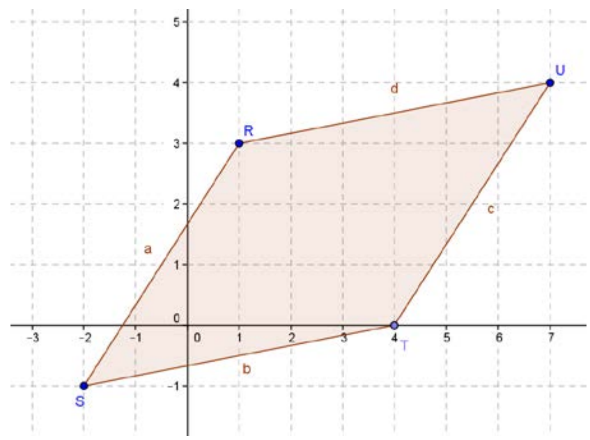
Name ____ Date ____________________

For problems that require rounding, round answers to the nearest hundredth unless otherwise stated.

1. Given parallelogram $RSTU$ with vertices $R(1,3)$, $S(-2,-1)$, $T(4,0)$, and $U(7,4)$:

   a. Find the perimeter of the parallelogram; round to the nearest hundredth.

   22.17 units



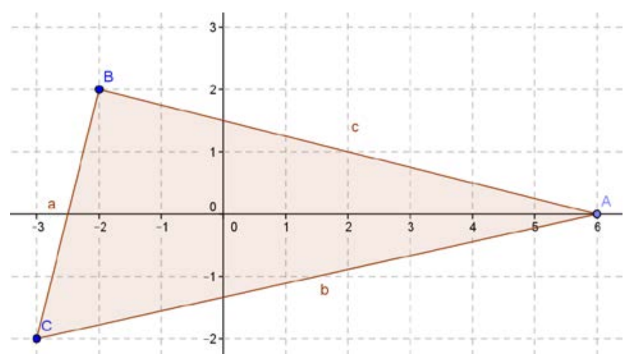
   b. Find the area of the parallelogram.

   18 square units

2. Given triangle ABC with vertices $A(6,0)$, $B(-2,2)$, and $C(-3,-2)$:

   a. Find the perimeter of the triangle; round to the nearest hundredth.

   21.60 units



   b. Find the area of the triangle.

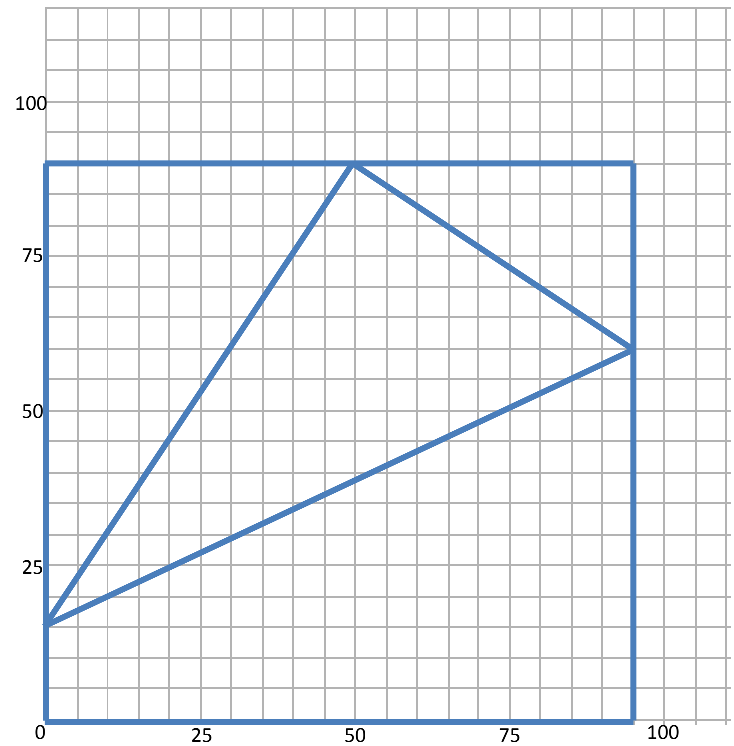
   17 square units

3. You are a member of your school's robotics team and are in charge of programming a robot that will pick up ping pong balls. The competition arena is a rectangle with height 90 feet and width 95 feet.

   On graph paper, you sketch the arena as a square on the coordinate plane with sides that are parallel to the coordinate axes and with southwest corner of the arena set at the origin. Each unit width on the paper grid corresponds to 5 feet of length of the arena. You initially set the robot to move along a straight path at a constant speed. In the sketch, the robot's position corresponds to the point $(10, 30)$ in the coordinate plane at time $t = 2$ seconds and to the point $(40, 75)$ at time $t = 8$ seconds.

   a. Sketch the arena on the graph paper below, and write a system of inequalities that describes the region in the sketch.

   $0 \leq x \leq 95$
   $0 \leq y \leq 90$



   b. Show that at the start, that is, at time $t = 0$, the robot was located at a point on the west wall of the arena. How many feet from the southwest corner was it?

   $(0, 15)$, 15 feet North
   Each second, the robot travels 5 feet right and 7.5 feet up. If at 2 seconds the robot is at $(10, 30)$, so moving left 10 and down 15 brings it to $(0, 15)$.

   c. What is the speed of the robot? Round to the nearest whole number.

   9 feet/second

   d. Write down an equation for the line along which the robot moves.

   $y = \frac{3}{2}x + 15$

e. At some time the robot will hit a wall. Which wall will it hit? What are the coordinates of that point of impact?

North (top) wall at (50, 90)

f. How far does the robot move between time $t = 0$ seconds and the time of this impact? What is the time for the impact? Round distance to the nearest hundredth and time to the nearest second.

Distance of 90.14 feet at time 10 seconds.

At the time of impact, you have the robot come to a gentle halt, and then turn and head in a direction perpendicular to the wall. Just as the robot reaches the opposite wall, it gently halts, turns, and then returns to start. (We assume that the robot does not slow down when it hits the wall.) The robot thus completes of journey composed of three line segments forming a triangle within the arena. Sketch the path of the robot's motion.

g. What are the coordinates where it hits the east wall?

(95, 60)

h. What is the perimeter of that triangle; round to the nearest hundredth?

249.34 feet

i. What is the area of the triangle; round to the nearest hundredth?

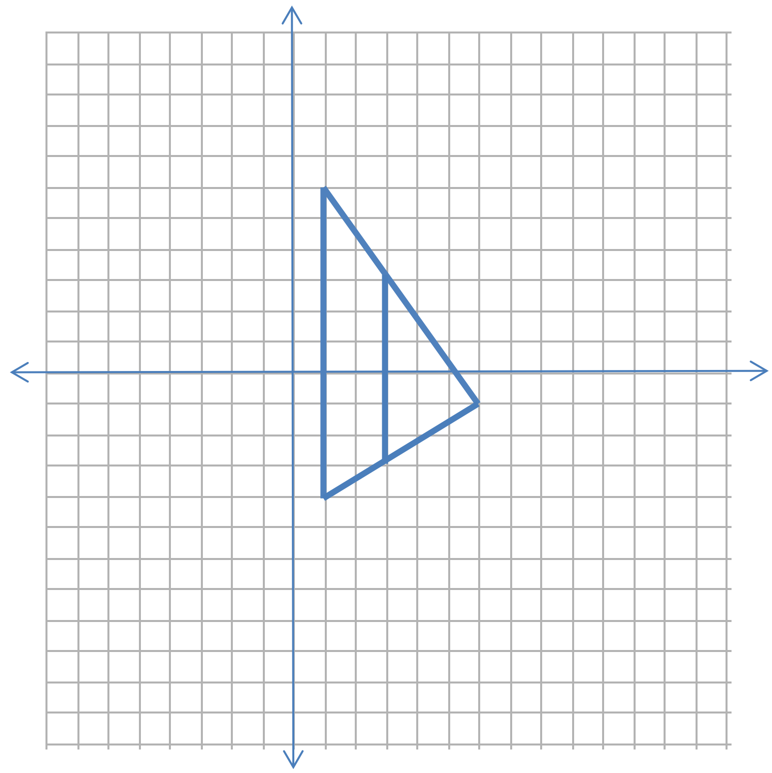
2437.5 square feet

j. If the count of ping-pong balls in the arena is large and the balls are spread more or less evenly across the whole arena, what approximate percentage of balls do you expect to lie within the triangle the robot traced? (Assume the robot encountered no balls along any legs of its motion.)

28.57%

4. Consider the triangular region in the plane given by the triangle $(1, 6)$, $(6, -1)$, and $(1, -4)$.

   a. Sketch the region and write a system of inequalities to describe the region bounded by the triangle.



$x \geq 1$

$7x + 5y \geq 37$

$3x - 5y \leq 23$

   b. The vertical line $x = 3$ intersects this region. What are the coordinates of the two boundary points it intersects? What is the length of the vertical segment within the region between these two boundary points?

$\left(3, \frac{16}{5}\right), \left(3, -\frac{14}{5}\right)$

Length of segment is 6 units.

   c. The line $x = 3$ divides the region into a quadrilateral and a triangle. Find the perimeter of the quadrilateral and the area of the triangle.

Perimeter of quadrilateral is 21.84 units.

Area of triangle is 9 square units.

5. Is triangle RST, where $R(1, 5)$, $S(5, 1)$, $T(-1, -1)$, a right triangle? If so, which angle is the right angle? Justify your answer.

The triangle is not a right triangle. The slopes of the segments are not negative reciprocals (-1, 3, and $\frac{1}{3}$), so none of the segments are perpendicular. The converse of the Pythagorean theorem is not true because the sides lengths are $\sqrt{40}$, $\sqrt{40}$, and $\sqrt{36}$.

6. Consider the points $A(-1, 3)$ and $B(6, 2)$ in the coordinate plane. Let $O(0, 0)$ be the origin.

   a. Find the coordinates of a point, C, away from the origin on the line $y = x$ that makes triangle ABC a right triangle with right angle at C.

   $(5, 5)$

   b. Find the coordinates of a point, D, on the line $y = x$ that makes triangle OBD a right triangle with right angle at B.

   $(5, 5)$

7. Consider the quadrilateral with vertices $(-2, -1)$, $(2, 2)$, $(5, -2)$, and $(1, -5)$.

   a. Show that the quadrilateral is a rectangle.

   Both pairs of opposite sides of the quadrilateral are parallel (slopes $\frac{3}{4}$ and $-\frac{4}{3}$) and the slopes are negative reciprocals so the sides are perpendicular to each other, meaning all angles are right angles.

   b. Is the quadrilateral a square? Explain.

   All sides have an equal length of 5 units. A rectangle with all sides of equal lengths is a square.

   c. What is the area of the quadrilateral?

   Area is 25 square units.

d. What is the area of the region of the quadrilateral that lies to the right of the y-axis?

Area is $\frac{14}{3}$ square units.

e. What is the equation of the perpendicular bisector of the side of the quadrilateral that lies in the fourth quadrant?

$y = -\frac{4}{3}x + \frac{1}{2}$

8. Using the general formula for perpendicularity of segments with one endpoint at the origin, determine if the segments from the given points to the origin are perpendicular.

a. $(4, 10)$, $(5, -2)$

$4 \cdot 5 + 10 \cdot (-2) = 0$, *the segments are perpendicular.*

b. $(-7, 0)$, $(0, -4)$

$-7 \cdot 0 + 0 \cdot (-4) = 0$; *the segments are perpendicular.*

c. Using the information from part (a), are the segments through the points $(-3, -2)$, $(1, 8)$, and $(2, -4)$ perpendicular? Explain.

The segments are perpendicular because they are a translation (right 3, up 2) of the segments in part (a) that are perpendicular.

9. Write the equation of the line that contains the point $(-2, 7)$ and is:

   a. Parallel to $x = 3$.

   $x = -2$

   b. Perpendicular to $x = -3$.

   $y = 7$

   c. Parallel to $y = 6x - 13$.

   $y = 6x + 19$

   d. Perpendicular to $y = 6x - 13$.

   $y = -\frac{1}{6}x + \frac{20}{3}$

10. Line A contains points $(p - 4, 2)$ and $(-2, 9)$. Line B contains points $(p, -1)$ and $(-1, 1)$.

   a. Find the value of p if the lines are parallel.

   $p = -\frac{11}{5}$

   b. Find the value(s) of p is the lines are perpendicular.

   $p = 4$, $p = -3$