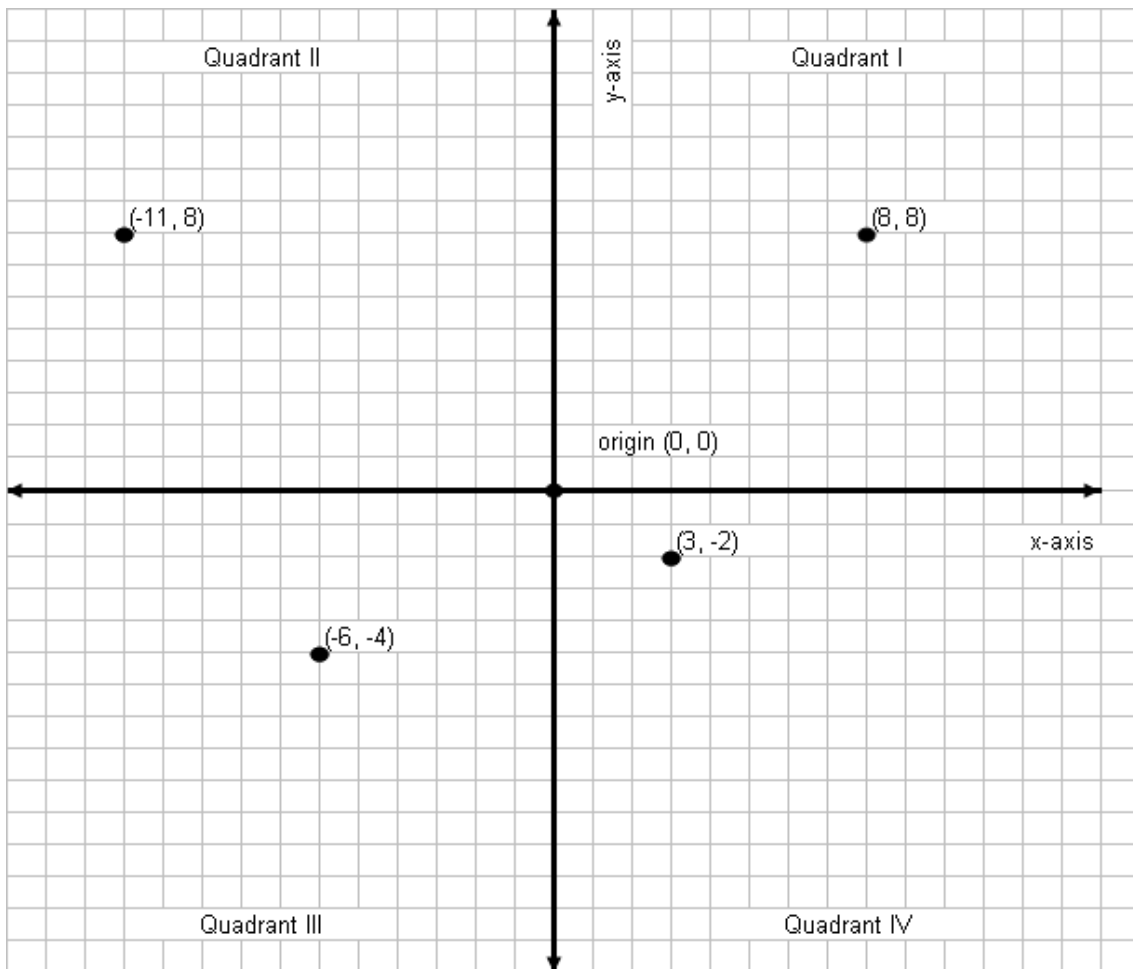


Looking for Pythagoras Investigation 1

1a. The coordinate plane is found on page 8 of the student book. A coordinate plane is used for graphing points in an orderly manner. Coordinate points are found in the form (x, y) . These are called coordinates or ordered pairs. The first number is the location on the x -axis and the second number is the location on the y -axis. For example, if we needed the coordinates for the stadium, we find the stadium on the coordinate plane and look straight down to see where it is located on the x -axis (-2). We then look to see where it is located on the y -axis (3). The ordered pair would be $(-2, 3)$. For this problem, find the art museum and locate where it is on each axis to write the ordered pair.



1b. The coordinate plane is found on page 8 of the student book. A coordinate plane is used for graphing points in an orderly manner. Coordinate points are found in the form (x, y) . These are called coordinates or ordered pairs. The first number is the location on the x -axis and the second number is the location on the y -axis. For example, if we needed the coordinates for the stadium, we find the stadium on the coordinate plane and look straight down to see where it is located

on the x-axis (-2). We then look to see where it is located on the y-axis (3). The ordered pair would be (-2, 3). For this problem, find the hospital and locate where it is on each axis to write the ordered pair.

1c. The coordinate plane is found on page 8 of the student book. A coordinate plane is used for graphing points in an orderly manner. Coordinate points are found in the form (x, y) . These are called coordinates or ordered pairs. The first number is the location on the x-axis and the second number is the location on the y-axis. For example, if we needed the coordinates for the stadium, we find the stadium on the coordinate plane and look straight down to see where it is located on the x-axis (-2). We then look to see where it is located on the y-axis (3). The ordered pair would be (-2, 3). For this problem, find the greenhouse and locate where it is on each axis to write the ordered pair.

2. Imagine the gray lines as roads. How would you drive to get from the animal shelter to the stadium? Use north, south, east, and west to describe the direction and tell how many blocks each way. Don't forget you want the shortest route.

3. Imagine the gray lines as roads. How would you drive to get from the hospital to the gas station? Use north, south, east, and west to describe the direction and tell how many blocks each way. Don't forget you want the shortest route.

4. Find the shortest route from City Hall to the hospital. Count how many blocks this trip would be. Find how many blocks would be halfway. Find this halfway point on the coordinate plane. Write an ordered pair to describe this point. Is there a different route that is the same distance? What would be this halfway point?

5. One way to find this distance is to measure the distance with a piece of paper and then lay the paper next to a line in the coordinate grid. How many blocks long is this distance? We need to know the halfway point of this distance. How can you find halfway? Once you know half of the distance, can you find the point on the coordinate plane that is halfway between City Hall and hospital?

6a. Count how many blocks it would take to walk to each landmark. This doesn't have to be a straight line. There is more than one landmark so look for more than one answer.

6b. Use directional words such as north, south, east, and west. Tell how many blocks you would go in each direction. Once you have written your directions, have someone try your directions to see if they work. If they don't work, make changes to your directions.

7a. How many blocks is the hospital from the greenhouse? Which points on the map are that many blocks from the gas station? There are ten possible points so make sure you look for all of them.

7b. Use a paper strip to measure the distance from the gas station to each point you found in problem 7a. Lay this next to a line on the coordinate grid to find out about how many blocks is each distance. Remember, you had 10 points in problem 7a, so you should have 10 distances in this answer.

8. Plot the points $(0, 0)$ and $(3, 2)$ on a coordinate grid. To prove the 90° angle, try using a corner of a sheet of paper. This will help you decide where the next side must be. Remember that we are looking for integer coordinates, so we know the vertices (corners) of the square must fall directly on coordinate points. Which coordinate point lies next to the paper and creates a vertex (corner) of the square? Repeat this process to help you find the last vertex. Once you have the last two points, draw the square to see if it looks like a square. If it doesn't look like a square, adjust your points accordingly.

9. Plot the points $(0, 0)$ and $(3, 2)$ on a coordinate grid. A parallelogram must have opposite sides that will never touch, in other words, the opposite sides must be parallel. Choose a third vertex (corner) for the parallelogram. Can you find a fourth vertex easily? If you don't see the fourth point easily, try a different third point. Once you think you have found the last two points, draw the parallelogram to see if it looks like a parallelogram. Are the opposite sides parallel? Are the opposite the same length? Are the corresponding angles the same size?

10. What do you know about right triangles? Are any angles special? What tools have we used to help us find these angles? Refer to back to problem 8 if you can't think of any tools. Once you have found the special angle, can you find a point that will work for the third vertex (corner)?

11. What do you know about right triangles? Are any angles special? What tools have we used to help us find these angles? Refer to back to problem 8 if you can't think of any tools. Once you have found the special angle, can you find a point that will work for the third vertex (corner)?

12. What do you know about right triangles? Are any angles special? What tools have we used to help us find these angles? Refer to back to problem 8 if you can't think of any tools. Once you have found the special angle, can you find a point that will work for the third vertex (corner)?

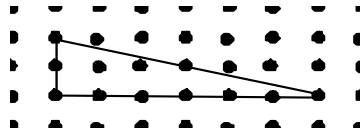
13. If you aren't sure how many there are, try making points that are possible for the third vertex (corner). Mark as many points as possible. What do you notice about the possible third vertex? How many points are possible?

14. Try plotting the points and connecting them to see if they form a parallelogram.

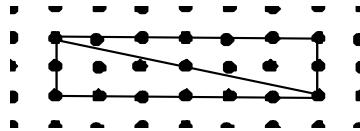
15. Since we know how to find the area of a rectangle, it might be helpful to find a rectangle around the triangle. What fractional part of the rectangle is the triangle? Can you find the area of the triangle?

Example:

Find the area of the triangle below.



Draw a rectangle around the triangle.

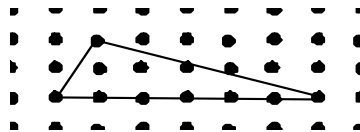


Find the area of the rectangle. It is two units by six units, so it is $2 \cdot 6 = 12 \text{ un}^2$. The original triangle is half of the rectangle, so the area of the triangle must be half of the area of the rectangle which is $12 \div 2 = 6 \text{ un}^2$.

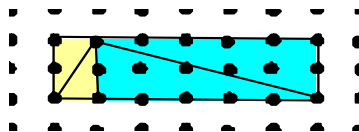
16. Draw a rectangle around the triangle. You may need to break the rectangle into two rectangles. Can you find the areas of the smaller rectangles? Can you find the areas of the smaller triangles? Can you find the area of the entire triangle?

Example:

Find the area of the triangle below:



Draw a rectangle around the triangle. You may need to break the rectangle into two rectangles.



What is the area of the yellow rectangle? The rectangle is 2 units by 1 unit so $2 \cdot 1 = 2 \text{ un}^2$. Since the rectangle has an area of 2, the yellow triangle must be half of this, so it has an area of 1 un^2 .

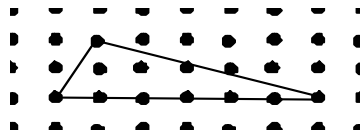
What is the area of the blue rectangle? The rectangle is 2 units by 5 units so $2 \cdot 5 = 10 \text{ un}^2$. Since the rectangle has an area of 10, the blue triangle must be half of this so it has an area of 5 un^2 .

We need the area of the large triangle (yellow and blue triangles together). The yellow triangle had an area of 1 un^2 and the blue triangle had an area of 5 un^2 , and we need to add these amounts to find the area of the large triangle (yellow and blue triangles together). Therefore, the area of the large triangle is $5 + 1 = 6 \text{ un}^2$.

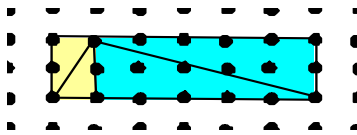
17. Draw a rectangle around the triangle. You may need to break the rectangle into two rectangles. Can you find the areas of the smaller rectangles? Can you find the areas of the smaller triangles? Can you find the area of the entire triangle?

Example:

Find the area of the triangle below:



Draw a rectangle around the triangle. You may need to break the rectangle into two rectangles.



What is the area of the yellow rectangle? The rectangle is 2 units by 1 unit so $2 \cdot 1 = 2 \text{ un}^2$. Since the rectangle has an area of 2, the yellow triangle must be half of this, so it has an area of 1 un^2 .

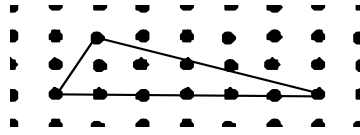
What is the area of the blue rectangle? The rectangle is 2 units by 5 units so $2 \cdot 5 = 10 \text{ un}^2$. Since the rectangle has an area of 10, the blue triangle must be half of this so it has an area of 5 un^2 .

We need the area of the large triangle (yellow and blue triangles together). The yellow triangle had an area of 1 un^2 and the blue triangle had an area of 5 un^2 , and we need to add these amounts to find the area of the large triangle (yellow and blue triangles together). Therefore, the area of the large triangle is $5 + 1 = 6 \text{ un}^2$.

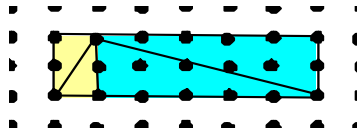
18. Draw a rectangle around the triangle. You may need to break the rectangle into two rectangles. Can you find the areas of the smaller rectangles? Can you find the areas of the smaller triangles? Can you find the area of the entire triangle?

Example:

Find the area of the triangle below:



Draw a rectangle around the triangle. You may need to break the rectangle into two rectangles.



What is the area of the yellow rectangle? The rectangle is 2 units by 1 unit so $2 \cdot 1 = 2 \text{ un}^2$. Since the rectangle has an area of 2, the yellow triangle must be half of this, so it has an area of 1 un^2 .

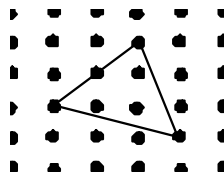
What is the area of the blue rectangle? The rectangle is 2 units by 5 units so $2 \cdot 5 = 10 \text{ un}^2$. Since the rectangle has an area of 10, the blue triangle must be half of this so it has an area of 5 un^2 .

We need the area of the large triangle (yellow and blue triangles together). The yellow triangle had an area of 1 un^2 and the blue triangle had an area of 5 un^2 , and we need to add these amounts to find the area of the large triangle (yellow and blue triangles together). Therefore, the area of the large triangle is $5 + 1 = 6 \text{ un}^2$.

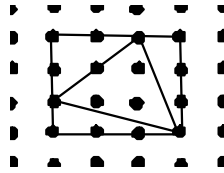
19. One way is to use what you learned in problems 15 – 18 to help you find the area. Another way is to draw a rectangle around the shaded triangle. Then find the area of the non-shaded parts and subtract these parts from the rectangle.

Example:

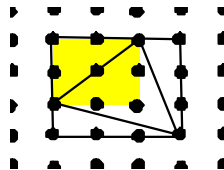
Find the area of the triangle below:



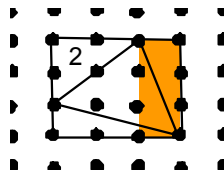
Place a rectangle around the triangle.



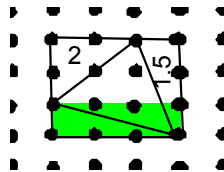
Find the area of the outer triangles by making a rectangle around each triangle and taking half of the area of the rectangle.



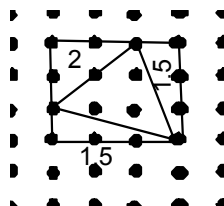
The yellow rectangle is 4 units, so the yellow triangle is 2 units.



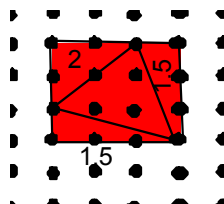
The orange rectangle is 3 units, so the orange triangle is $1\frac{1}{2}$ units.



The green rectangle is 3 units, so the green triangle is $1\frac{1}{2}$ units.



Now we need to see how much space is in the large rectangle.

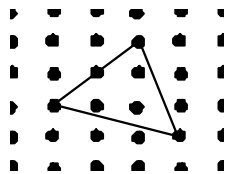


The red rectangle is 3 units by 3 units, so it has an area of 9 un^2 . The total area of the corners that we don't want is $2 + 1.5 + 1.5 = 5 \text{ un}^2$. If we want to find the area of the red triangle, we can subtract these corners out the rectangle which is $9 - 5 = 4 \text{ un}^2$. Therefore, the red triangle must be 4 un^2 .

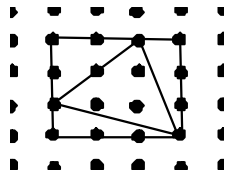
20. One way is to use what you learned in problems 15 – 18 to help you find the area. Another way is to draw a rectangle around the shaded triangle. Then find the area of the non-shaded parts and subtract these parts from the rectangle.

Example:

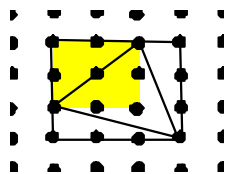
Find the area of the triangle below:



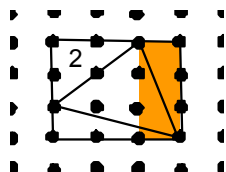
Place a rectangle around the triangle.



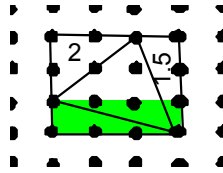
Find the area of the outer triangles by making a rectangle around each triangle and taking half of the area of the rectangle.



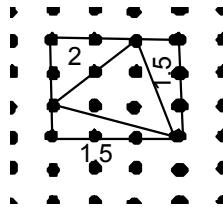
The yellow rectangle is 4 units, so the yellow triangle is 2 units.



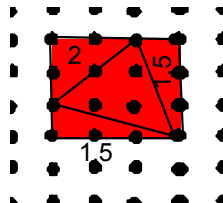
The orange rectangle is 3 units, so the orange triangle is $1\frac{1}{2}$ units.



The green rectangle is 3 units, so the green triangle is $1\frac{1}{2}$ units.



Now we need to see how much space is in the large rectangle.



The red rectangle is 3 units by 3 units, so it has an area of 9 un^2 . The total area of the corners that we don't want is $2 + 1.5 + 1.5 = 5 \text{ un}^2$. If we want to find the area of the red triangle, we can subtract these corners out the rectangle which is $9 - 5 = 4 \text{ un}^2$. Therefore, the red triangle must be 4 un^2 .

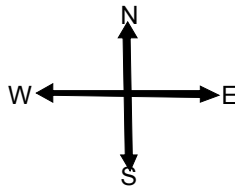
21. Use methods you learned in problems 15-20 to help you find the areas.
22. Use methods you learned in problems 15-20 to help you find the areas.
23. Use methods you learned in problems 15-20 to help you find the areas.
24. Use methods you learned in problems 15-20 to help you find the areas.
25. Use methods you learned in problems 15-20 to help you find the areas.
26. How many blocks is it to drive from City Hall to the animal shelter? The directions tell us each block is 150 m. What do you need to do with this information to find the distance? Don't forget to label your answer.
27. How many blocks is it to drive from the police station to the gas station? The directions tell us each block is 150 m. What do you need to do with this information to find the distance? Don't forget to label your answer.

28. How many blocks is 750 m? Which two landmarks are that many blocks apart?

29a. What do you know about the sides of a square? What does this tell you about the slopes of these sides?

29b. What do you know about opposite sides of a parallelogram? What does this tell you about the slopes of these sides?

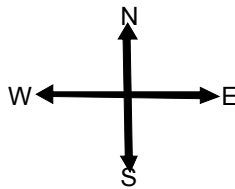
30a. The map uses the following directions:



Start at the police station and travel 2 blocks west and 3 blocks north. What are the coordinates of the point you land on? Remember to find the number for the x-axis first and then the y-axis (x, y).

30b. Find City Hall where Cassandra is located. Count the number of blocks she needs to travel to meet Matsu. Is that the only route she could've taken that would be the shortest route?

30c. The map uses the following directions:



Start at the stadium and travel 3 blocks east, then 3 blocks south, 2 blocks west and then 4 blocks north. What are the coordinates of the point you land on? Remember to find the number for the x-axis first and then the y-axis (x, y).

30d. Find City Hall where Aida is located. Count the number of blocks she needs to travel to meet Lei. Is that the only route she could've taken that would be the shortest route?

30e. Think about the easiest way to describe the shortest route.

31a. What did you learn about the slopes of parallel lines in Moving Straight Ahead? Where is the slope found in an equation? (Remember, $y = mx + b$!)

31b. What did you learn about the slopes of perpendicular lines in Moving Straight Ahead? Where is the slope found in an equation? (Remember, $y = mx + b$!)

32a. What does total tell you to do with the numbers?

32b. What would $\frac{1}{2} \cdot 3$ mean? Remember that multiplication can be read as

“of”. So, this would mean $\frac{1}{2}$ of 3. Could you draw a figure with an area of 3?

Could you take half of it? The rest of her expression has $\frac{1}{2}$, $\frac{1}{2}$, and 1. Could you draw figures that have these areas? Could you put these figures together to show one figure?

33a. To find area of a circle we use $A = \pi r^2$. This means we need to multiply pi (3.14) times the radius times the radius. Do you know the diameter of the circle? Can you use this to find the radius? Once you know the radius, can you find the area? Don't forget to square your answer because you are finding area.

33b. Could you find the area of the square? Remember, the area of a rectangle can be found using $A = lw$. You don't want the entire square. What part of the square do you need to eliminate? Do you know the area of this part? If you are eliminating this part from the area of the square, what operation would you need? Don't forget to square your label because you are finding area.

34a. Which axis tells us information for right and left? Which number in the ordered pair corresponds to this axis? What numbers are further to the right, positive or negative on this axis? What numbers are further to the right, larger or smaller on this axis? If you still aren't sure, try plotting the points and then looking at this information again.

34b. Which axis tells us information for right and left? Which number in the ordered pair corresponds to this axis? What numbers are further to the right, positive or negative on this axis? What numbers are further to the right, larger or smaller on this axis? If you still aren't sure, try plotting the points and then looking at this information again.

34c. Which axis tells us information for up and down? Which number in the ordered pair corresponds to this axis? What numbers are higher, positive or negative on this axis? What numbers are higher, larger or smaller on this axis? If you still aren't sure, try plotting the points and then looking at this information again.

34d. Which axis tells us information for up and down? Which number in the ordered pair corresponds to this axis? What numbers are higher, positive or negative on this axis? What numbers are higher, larger or smaller on this axis? If you still aren't sure, try plotting the points and then looking at this information again.

35. Try describing a point on both a coordinate plane and a road map. Look for differences and similarities.

36. Include compass directions and distances. Include starting points and ending points. For example, "Starting at the airport at Grand Rapids, go south 47 miles to the Kalamazoo airport. From there, go northeast 60 miles to the airport at Lansing. From Lansing, go 80 miles to the Detroit airport." If you really want to be more specific, you could use degree measures to tell direction.

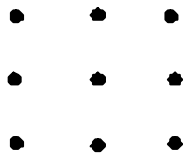
37. Draw two perpendicular lines and then draw the parallelogram around these diagonals, by connecting the endpoints. Repeat this a few times using different lengths for the perpendicular lines. What do you notice about the sides of the parallelograms? Is there a special name for these parallelograms?

38. What is the base and height of each triangle? How do you use this information to help you find the area of a triangle?

39. What is the base and height of each triangle? How do you use this information to help you find the area of a triangle?

Investigation 2

1. First find all of the different squares on a 3 by 3 dot grid like below:



Make sure you find all of them! There are three possible squares! Use what you learned in the previous investigation to help you find the area of each square. See problem 18 in Investigation 1 if you get stuck!

2. Remember that a hexagon has 6 sides. Try drawing a hexagon and finding the area. If it has too much area, make the hexagon smaller. If it has too little area, make the hexagon bigger. Find the area again to make sure the area is 16 square units.

3. Remember, your figure must be a square. When you are trying to write the argument, explain how you know it is 2 square units. What did you do to find out if it had an area of 2 square units?

4a. Dot paper can be printed from this website. Go to “Homework Tools” to find the dot paper. Use what you learned in the previous investigation to help you find the area of the square. See problem 18 in Investigation 1 if you get stuck!

4b. You know the area of the square that has this side length from problem 4a. We also know that area of a square is found by multiplying the side times the side. You need to figure out what number times itself will equal this area. To do this, guess what you think it might be and multiply this by itself. Are you too high or too low? Adjust the amount and multiply this by itself. Are you too high or too low? Continue to adjust and check the amount. Try to find this amount to the nearest thousandth.

5a. Dot paper can be printed from this website. Go to “Homework Tools” to find the dot paper. Use what you learned in the previous investigation to help you find the area of square. See problem 18 in Investigation 1 if you get stuck!

5b. You know the area of the square that has this side length from problem 5a. We also know that area of a square is found by multiplying the side times the side. You need to figure out what number times itself will equal this area. To do this, guess what you think it might be and multiply this by itself. Are you too high or too low? Adjust the amount and multiply this by itself. Are you too high or too low? Continue to adjust and check the amount. Try to find this amount to the nearest thousandth.

6. Dot paper can be printed from this website. Go to “Homework Tools” to find the dot paper. Use what you learned in the previous investigation to help you find the area of square. See problem 18 in Investigation 1 if you get stuck! Once you have found the area of the square, you need to figure out what number times itself will equal this area. To do this, you can use a calculator to help you estimate the amount or you can write the amount as a square root. It is easier to write the amount as a square root. For example, if the area of the square was 15, then the side length must be $\sqrt{15}$. If the area of the square was 24, then the side length must be $\sqrt{24}$.

7. You need to figure out what number times itself will equal this area ($\sqrt{11}$). To do this, guess what you think it might be and multiply this by itself. Are you too high or too low? Adjust the amount and multiply this by itself. Are you too high or too low? Continue to adjust and check the amount. Try to find this amount to the nearest tenth.

8. You need to figure out what number times itself will equal this area ($\sqrt{30}$). To do this, guess what you think it might be and multiply this by itself. Are you too high or too low? Adjust the amount and multiply this by itself. Are you too high or too low? Continue to adjust and check the amount. Try to find this amount to the nearest tenth.

9. You need to figure out what number times itself will equal this area ($\sqrt{172}$). To do this, guess what you think it might be and multiply this by itself. Are you too high or too low? Adjust the amount and multiply this by itself. Are you too high or too low? Continue to adjust and check the amount. Try to find this amount to the nearest tenth.

10. Try multiplying the first number by itself. You should end up with something smaller than 15. Then multiply the second number by itself. You should end up with something greater than 15. See if you can use your number sense skills to eliminate any of the choices.

11. What times itself equals 144? For example, $\sqrt{49} = 7$ because $7 \cdot 7 = 49$.

12. What times itself equals 0.36? For example, $\sqrt{49} = 7$ because $7 \cdot 7 = 49$. Be careful with your decimal! Double check your answer to see if it works!

13. What times itself equals 961? For example, $\sqrt{49} = 7$ because $7 \cdot 7 = 49$.

14. We know that $\sqrt{27}$ can't be between 2 and 3 because both of these numbers squared are smaller than 27. 2^2 is 4 and 3^2 is 9. One of the amounts must be smaller than 27 and the other amount must be larger than 27 when you square the amounts. For example, $\sqrt{45}$ is between 6 and 7 because $6^2 = 36$ (smaller than 45) and 7^2 is 49 (larger than 45).

15. We know that $\sqrt{1000}$ can't be between 20 and 25 because both of these numbers squared are smaller than 1000. 20^2 is 400 and 25^2 is 625. One of the amounts must be smaller than 1000 and the other amount must be larger than 1000 when you square the amounts. For example, $\sqrt{45}$ is between 6 and 7 because $6^2 = 36$ (smaller than 45) and 7^2 is 49 (larger than 45).

16. Does 6 times itself equal 36?

17. Does 1.5 times itself equal 2.25?

18. Does 11 times itself equal 101?

19. Use these examples to help guide you: $\sqrt{16} = 4$, $\sqrt{121} = 11$, $\sqrt{10.24} = 3.2$,
and $\sqrt{\frac{4}{9}} = \frac{2}{3}$.

20. Use these examples to help guide you: $\sqrt{16} = 4$, $\sqrt{121} = 11$, $\sqrt{10.24} = 3.2$,
and $\sqrt{\frac{4}{9}} = \frac{2}{3}$.

21. Use these examples to help guide you: $\sqrt{16} = 4$, $\sqrt{121} = 11$, $\sqrt{10.24} = 3.2$,
and $\sqrt{\frac{4}{9}} = \frac{2}{3}$.

22. Use these examples to help guide you: $\sqrt{16} = 4$, $\sqrt{121} = 11$, $\sqrt{10.24} = 3.2$,
and $\sqrt{\frac{4}{9}} = \frac{2}{3}$.

23. Use these examples to help guide you: $\sqrt{16} = 4$, $\sqrt{121} = 11$, $\sqrt{10.24} = 3.2$,
and $\sqrt{\frac{4}{9}} = \frac{2}{3}$.

24. Use these examples to help guide you: $\sqrt{16} = 4$, $\sqrt{121} = 11$, $\sqrt{10.24} = 3.2$,
and $\sqrt{\frac{4}{9}} = \frac{2}{3}$.

25. Hint: $\sqrt{39} \cdot \sqrt{39} = 39!$

26. Hint: $\sqrt{39} \cdot \sqrt{39} = 39!$

27. Hint: $\sqrt{39} \cdot \sqrt{39} = 39!$

28. Hint: $\sqrt{39} \cdot \sqrt{39} = 39!$

29. What number times itself equals 1? This amount can be positive or negative, because the product of two positives is positive and the product of two negatives is also positive. For example, the positive and negative square roots of 36 are 6 and -6 because 6 times 6 = 36 and -6 times -6 = 36.

30. What number times itself equals 4? This amount can be positive or negative, because the product of two positives is positive and the product of two negatives is also positive. For example, the positive and negative square roots of 36 are 6 and -6 because 6 times 6 = 36 and -6 times -6 = 36.

31. What number times itself equals 2? This amount can be positive or negative, because the product of two positives is positive and the product of two negatives is also positive. For example, the positive and negative square roots of 36 are 6 and -6 because $6 \times 6 = 36$ and $-6 \times -6 = 36$. This amount may be a decimal amount!

32. What number times itself equals 16? This amount can be positive or negative, because the product of two positives is positive and the product of two negatives is also positive. For example, the positive and negative square roots of 36 are 6 and -6 because $6 \times 6 = 36$ and $-6 \times -6 = 36$.

33. What number times itself equals 25? This amount can be positive or negative, because the product of two positives is positive and the product of two negatives is also positive. For example, the positive and negative square roots of 36 are 6 and -6 because $6 \times 6 = 36$ and $-6 \times -6 = 36$.

34. What number times itself equals 5? This amount can be positive or negative, because the product of two positives is positive and the product of two negatives is also positive. For example, the positive and negative square roots of 36 are 6 and -6 because $6 \times 6 = 36$ and $-6 \times -6 = 36$. This amount may be a decimal amount!

35. Dot paper can be printed from this website. Go to "Homework Tools" to find the dot paper. Be sure to find all of the line segments. There are five different sizes of segments. Once you have the segments, create the square for the segment. Find the area of the square. The side length must be the square root of the area.

36a. It may be helpful to draw the segment on dot paper and then create the square for the segment. Find the area of the square. The side length must be the square root of the area.

36b. One of the amounts must be smaller and the other amount must be larger than the amount under the root sign when you square the amounts. For example, $\sqrt{45}$ is between 6 and 7 because $6^2 = 36$ (smaller than 45) and 7^2 is 49 (larger than 45).

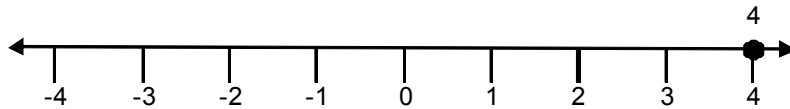
37. This problem sounds more difficult than it really is. Don't let the question scare you!!! First, find the length of \overline{AB} by drawing the square with this side length. Find the area and then find the side length of \overline{AB} . Once you found the side length for \overline{AB} , would you know the length of \overline{BC} ? Now find the length of \overline{AC} by drawing the square with this side length. Find the area of this square and use the area to find the length of \overline{AC} . Compare the answers you got for these lengths. Does this help you prove that $2\sqrt{5} = \sqrt{20}$?

38. Choose one of the lengths. Draw the square with that side length. Find the area of the square. What is the side length? Was that length too big or too small? Should you try a bigger segment or smaller segment next?

39. Try drawing one side at a time on dot paper. Draw the square with that side length. Find the area of the square and use this amount to find the length of the side. Remember, you need to find the lengths for all four sides. Be sure to label each length with the appropriate side.

40. Try drawing one side at a time on dot paper. Draw the square with that side length. Find the area of the square and use this amount to find the length of the side. Remember, you need to find the lengths for all seven sides. Be sure to label each length with the appropriate side.

41. Start with a number line from -4 to 4. Mark and label the amounts that you know. For the square roots, try finding out the two consecutive whole numbers the square root is between. Would it be closer to one of the numbers? About where should the point be placed? Use your estimation skills to help.



42a. What do you know about right triangles? Are there any tools that can help you determine if these triangles are right triangles?

42b. Use what you learned about finding the area of a triangle on dot paper from Investigation 1 Problems 15-20.

43a. Eight different squares were drawn in problem 2.1. You know how to find the length of a side on dot paper by taking the square root of the area. If you can find the length of a side, can you find the perimeter?

43b. What did you do on problem 43a to find the perimeter?

44a. If square PQRS has an area of 10 square units, how big is the side of the square? This amount would be between which two whole numbers? Now that you know about how big the side is, try a possible side and then check to see if the square with this side has an area of 10. If the area is too small, the side must need to be bigger. If the area is too big, the side must need to be smaller.

44b. What is the length of a side of the square?

44c. These points don't have to be part of the square. Another way is to measure the side of the square using a piece of paper. Then try to find other points using this paper as a reference.

45. There were 14 lengths in problem 2.3. Be sure you include all of the fourteen lengths. For the square roots, try finding out the two consecutive whole numbers the square root is between. Would it be closer to one of the numbers? About where should the point be placed? Use your estimation skills to help.

46a. Similar figures must be the same shape but not necessarily the same size. There will be a scale factor associated with the figures if they are similar. Look at the sides, do the sides change in the same manner (twice as big, three times as big, four times as big, etc.)?

46b. Try writing down the coordinate points for all of the vertices (corners). How did the coordinates change from the smaller square to the larger square?

46c. Find the area of each square. The larger square is how many times bigger than the smaller square?

46d. Try writing down the coordinate points for all of the vertices (corners). How did the coordinates change from the smaller square to the larger square?

47. If the area is 6 square units, what could the base and height be? If you know the base and height could you draw a parallelogram?

48. If the area of the triangle is 5 square units, what could the base and height be? If you know the base and height, could you draw the triangle?

49. $\sqrt{8}$ is about how much? It would be between which two whole numbers? Which whole number would it be closer to? $\sqrt{16}$ is equal to how much?

50a. Try drawing the side on dot paper. Draw the square with that side length. Find the area of the square. Use this area to find the length of the side.

50b. Try drawing a triangle on dot paper. Use what you learned about finding area of triangles on dot paper from Investigation 1, problems 15 – 20 to help you find the area. Are the areas the same? Are the rectangles around the triangles the same?

51. Simplify the problem into one square root like below and then simplify the root into a decimal or whole number.

$$\sqrt{3} \cdot \sqrt{8} = \sqrt{3 \cdot 8} = \sqrt{24} \approx 4.9$$

$$\sqrt{5} \cdot \sqrt{3} = \sqrt{5 \cdot 3} = \sqrt{15} \approx 3.9$$

$$\sqrt{20} \cdot \sqrt{5} = \sqrt{20 \cdot 5} = \sqrt{100} = 10$$

52. Simplify the problem into one square root like below and then simplify the root into a decimal or whole number.

$$\sqrt{3} \cdot \sqrt{8} = \sqrt{3 \cdot 8} = \sqrt{24} \approx 4.9$$

$$\sqrt{5} \cdot \sqrt{3} = \sqrt{5 \cdot 3} = \sqrt{15} \approx 3.9$$

$$\sqrt{20} \cdot \sqrt{5} = \sqrt{20 \cdot 5} = \sqrt{100} = 10$$

53. Simplify the problem into one square root like below and then simplify the root into a decimal or whole number.

$$\sqrt{3} \cdot \sqrt{8} = \sqrt{3 \cdot 8} = \sqrt{24} \approx 4.9$$

$$\sqrt{5} \cdot \sqrt{3} = \sqrt{5 \cdot 3} = \sqrt{15} \approx 3.9$$

$$\sqrt{20} \cdot \sqrt{5} = \sqrt{20 \cdot 5} = \sqrt{100} = 10$$

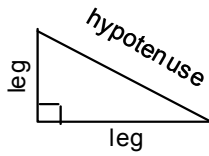
Investigation 3

1a. It may be helpful to use the information you learned in class. Use the chart you completed in class (below).

Length of Leg 1 (units)	Length of Leg 2 (units)	Area of Square on Leg 1 (square units)	Area of Square on Leg 2 (square units)	Area of Square on Hypotenuse (square units)
1	1	1	1	2
1	2			
2	2			
1	3			
2	3			
3	3			
3	4			

1b. You found the area of the square on the hypotenuse in problem 1a. Can you use that information to find the side length? Don't forget to label your answer!

2. The Pythagorean Theorem is $a^2 + b^2 = c^2$ where a stands for one of the legs of the triangle and b stands for the other leg of the triangle. The hypotenuse is side c . The legs of the triangle are always the sides next to the right angle. The hypotenuse is always the side across the triangle from the right angle. The Pythagorean Theorem states that if you take the legs and square these amounts, then add them, you will get the hypotenuse squared.



For example:

If the legs of the triangle are 3 units and 4 units, we would use the Pythagorean Theorem to help us find the hypotenuse.

$$a^2 + b^2 = c^2$$

$$3^2 + 4^2 = c^2$$

$$9 + 16 = c^2$$

$$25 = c^2$$

(25 is the area of the square)

$$\sqrt{25} = \sqrt{c^2}$$

$$5 = c$$

(5 is the length of the hypotenuse)

Another example:

If the legs of the triangle are 6 units and 8 units, we would use the Pythagorean Theorem to help us find the hypotenuse.

$$a^2 + b^2 = c^2$$

$$6^2 + 8^2 = c^2$$

$$36 + 64 = c^2$$

$$100 = c^2$$

(100 is the area of the square)

$$\sqrt{100} = \sqrt{c^2}$$

$$10 = c$$

(10 is the length of the hypotenuse)

3. \overline{WX} must be $\sqrt{17}$ units. What do you know about how long $\sqrt{17}$ is? Can you use what you know about square roots to help you figure out about how big the segment is? You can also use what you learned about segments and the squares next to these segments. Try looking at problems you did in Investigation 2 to help you explain how you know the distance is correct.

4. \overline{YZ} must be $\sqrt{20}$ units. What do you know about how long $\sqrt{20}$ is? Can you use what you know about square roots to help you figure out about how big the segment is? You can also use what you learned about segments and the squares next to these segments. Try looking at problems you did in Investigation 2 to help you explain how you know the distance is correct.

5. Use the Pythagorean Theorem to help you find h. If you aren't sure how to use the Pythagorean Theorem, see problem 2 for help.

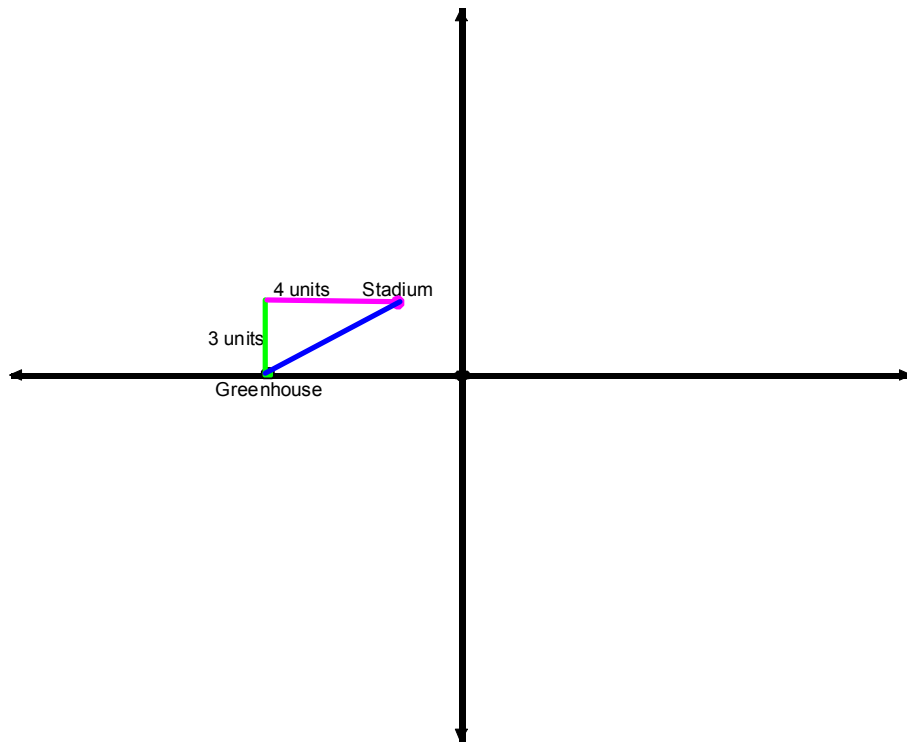
6. Use the Pythagorean Theorem to help you find k. If you aren't sure how to use the Pythagorean Theorem, see problem 2 for help.

7. These problems are a little different than problem 2 because you know the hypotenuse and you are trying to find a leg instead. We can still use the Pythagorean Theorem to help you find the missing side. In the triangle on the left, you know the hypotenuse is 7m and one of the legs is 4m. Following is an example of a similar situation.

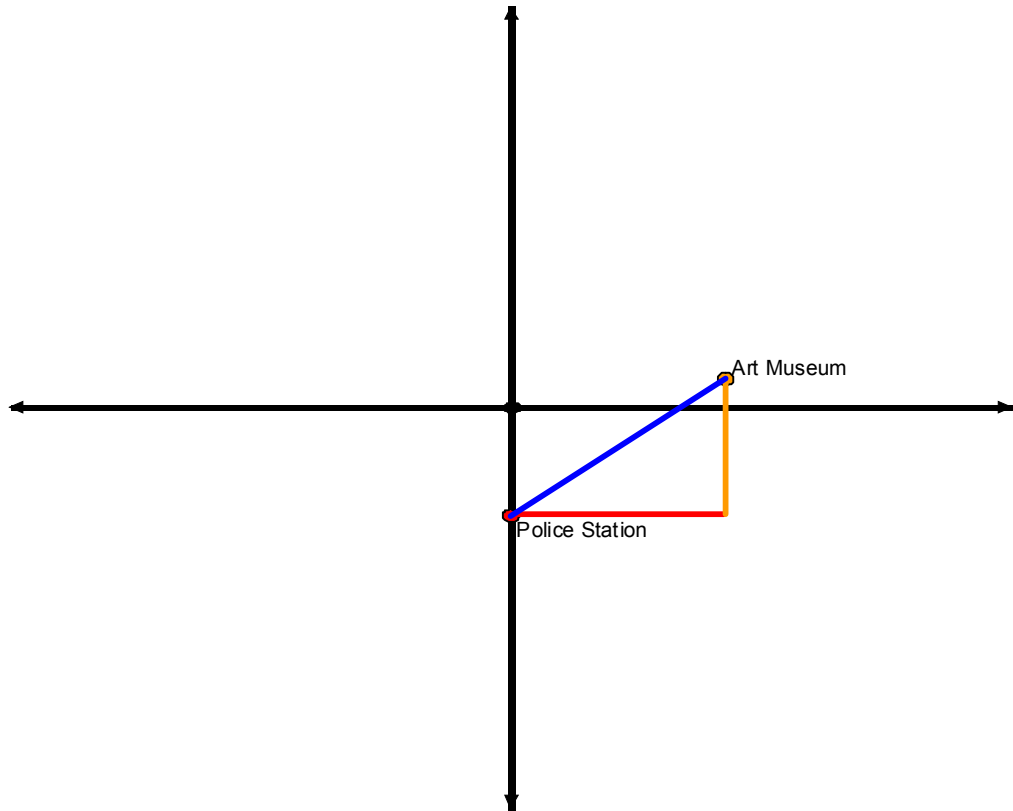
In a right triangle, one leg is 5m and the hypotenuse is 9m. Find the missing side.

$$\begin{aligned}
 a^2 + b^2 &= c^2 \\
 5^2 + b^2 &= 9^2 \\
 25 + b^2 &= 81 \\
 \underline{-25} \quad \underline{-25} & \\
 b^2 &= 56 \\
 b &= \sqrt{56} \approx 7.5\text{m}
 \end{aligned}$$

8. Try to make a right triangle to connect the two landmarks. Then you can use the Pythagorean Theorem to find the hypotenuse (which would be the flying distance between the two landmarks). For example:



9. Try to make a right triangle to connect the two landmarks. Then you can use the Pythagorean Theorem to find the hypotenuse (which would be the flying distance between the two landmarks). For example:



10. Not all problems are hard! This one really is as simple as it seems!
11. Try to make a right triangle to connect the two landmarks. Then you can use the Pythagorean Theorem to find the hypotenuse (which would be the flying distance between the two landmarks). See problems 8 and 9 for help.
12. About how much is $\sqrt{40}$? Are any of the choices about this far apart? Can you eliminate any of the choices? You already found the distance from the greenhouse to the stadium in problem 8. Once you have the answers narrowed down, can use what you know about the area of the square to help you find out if you have the right answer?
- 13a. One way to find the area is to divide the square into triangles that are $\frac{1}{2}$ square unit each. Add the halves together to find the area. Another way is to use what you learned in Investigation 1, problems 15-20 to help you find the area.
- 13b. You found the area of each square in problem 13a. Use the area to find the sides of the triangle. Remember, a side of the square is the square root of the area. Put these side lengths into the Pythagorean Theorem and see if they work.

14. Draw the triangle on dot paper. Create the squares next to each side. Find the area of each square. Find the side of each square by taking the square root of the area. Once you know the side of each square, you also know the sides of the triangle. Put these lengths into the Pythagorean Theorem and see if it works.

15. We know that the sides of any right triangle will satisfy the Pythagorean Theorem, so try putting the side lengths into the Pythagorean Theorem to see if the numbers will work.

16. We know that the sides of any right triangle will satisfy the Pythagorean Theorem, so try putting the side lengths into the Pythagorean Theorem to see if the numbers will work.

17. We know that the sides of any right triangle will satisfy the Pythagorean Theorem, so try putting the side lengths into the Pythagorean Theorem to see if the numbers will work.

18a. The side of the prism is a right triangle with side lengths of 2.5 cm, 6cm and "a". Use the Pythagorean Theorem to find "a".

18b. What information do you need to find volume? The formula for finding volume of any prism is $V = Bh$. What does V, B, and h stand for? (V is the Volume, B is the area of the base, and h is the height.) Why is the B a capital B? (It is the area of the Base.) Would you need to find "a" to find volume?

What information do you need to find surface area? Remember, surface area is the total of the area of every surface. You would find the area of each surface and then add them all together. Would you need to find "a" to find the surface area?

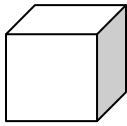
18c. The formula for the volume of a prism is $V = Bh$. Since "B" stands for the amount of space in the Base of the prism, and the Base is a triangle, you need to find the area of the triangle ($A = bh/2$) by multiplying the base times height and then dividing by 2. The base and height of the triangle are what amounts? Remember that the base and height of a triangle are always perpendicular (form right angles) to each other. Once you know the Base, you can find the volume of the prism using ($V = Bh$). Multiply the Base (area of the triangle) by the height of the prism. The height of the prism is the distance between the two bases. Don't forget to cube your label because you are finding volume.

18d. Surface area is the area of every surface. This means you need to find the area of each face and add them all together. You already found the area of the bases of the prism (triangles) in problem 18c. How many sides are this size? The top face in the picture is a rectangle. What are the dimensions (length and width) of the rectangle? Find the area of this rectangle by multiplying the length and width ($A = lw$). There are two more sides that are not shown in the picture – the back and the bottom. What shape is the back side? What are the

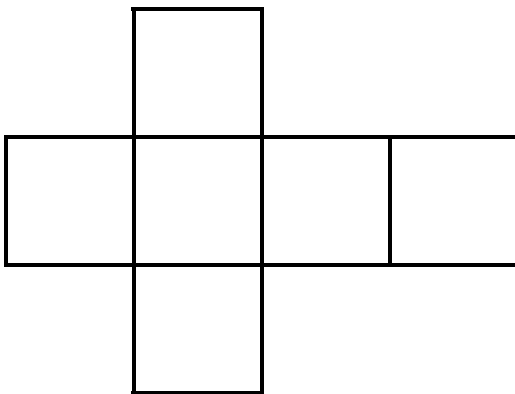
dimensions of the back side? How do you find the area for this shape? What shape is the bottom face? What are the dimensions of the bottom face? How do you find the area of this shape? You should have areas for all five faces of the prism at this point. Since surface area means to find the total of all of the faces, what should you do with these five amounts? Don't forget to square your label because you are finding area (surface area).

18e. A net is a drawing of a three-dimensional figure that shows what the shape would look like if the sides were cut and the figure was flattened out. A net for a cube would look like this:

Cube:



Net for the cube:



It is sometimes helpful to sketch each face of the prism and cut them out. Lay them next to each other and tape the sides that touch. Does the net fold into the prism? If it does create the prism, sketch what the net looks like. If it doesn't create the prism, double check where you placed the faces in the net and if you have all of the faces of the prism in your net.

Another way to draw the net, is to lay the net in the center of a large sheet of paper. Trace around the prism. Roll the net to the next side and trace around this side. Continue to trace around the sides until you have traced every side once. It may be helpful to put a little sticker on each side once you have traced the side so you know you have that side traced. You only want to trace each side once. Once you have all of the sides traced, cut out the net and fold it to see if it creates the prism. If it does create the prism, sketch what the net looks like. If it doesn't create the prism, double check where you placed the faces in the net and if you have all of the faces of the prism in your net.

19. The volume of a cylinder is found by multiplying the area of the circular Base (B) times the height (h) of the cylinder ($V = Bh$). What shape is the base? How do you find the area of this shape? Since volume is found using the formula $V = Bh$, substitute this area formula in place of B and see what you get.

20. The volume of a cone is found with the formula $V = \frac{Bh}{3}$ or $V = \frac{1}{3}Bh$. The area of the Base is "B". What shape is the Base? What shape is the Base of a cone? How do you find the area of that shape? Since volume is found with $V = \frac{1}{3}Bh$, substitute this area formula in place of "B" and see what you get.

21. The volume of a prism is found with the formula $V=Bh$. The area of the Base is "B". What shape is the Base? What shape is the Base of the prism? How do you find the area of that shape? Since volume is found with $V = Bh$, substitute this area formula in place of "B" and see what you get.

22. The volume of a pyramid is found with the formula $V = \frac{Bh}{3}$ or $V = \frac{1}{3}Bh$. The area of the Base is "B". What shape is the Base? What shape is the Base of the pyramid? How do you find the area of that shape? Since volume is found with $V = \frac{1}{3}Bh$, substitute this area formula in place of "B" and see what you get.

23. How far would you have to walk east or west to go from one house to the other? Which axis would represent an east/west direction? Which numbers in the ordered pairs should you look at to help you determine the number of blocks in an east/west direction between the two homes?

How far would you have to walk north or south to go from one house to the other? Which axis would represent a north/south direction? Which numbers in the ordered pairs should you look at to help you determine the number of blocks in a north/south direction between the two homes?

24. Find the distance from point A to point B by drawing a right triangle with points A and B. Segment AB will be the hypotenuse. What is the length of each leg of the right triangle? Put these leg lengths into the Pythagorean Theorem to find the distance of \overline{AB} . Which point is this distance from point A?

Another way to do this, is to measure the distance from point A to point B with a piece of paper. Use this measurement to find which point is the same distance from point A.

25a. Do you see a right triangle? Do you know the hypotenuse? Do you know a leg of the triangle? If you know the lengths of two sides of a right triangle, you can always use the Pythagorean Theorem ($a^2 + b^2 = c^2$) to find the third side. Plug in

the lengths you do know – make sure the hypotenuse is plugged in for “c” and solve for the other leg. Don’t forget to label your answer.

25b. The volume of a cone is found using the formula $V = \frac{Bh}{3}$. “B” is the area of the Base. What shape is the Base? What formula do you use to find the area of this shape? Find the area of the Base using this formula. You already found the height in problem 25a. Substitute these amounts into the volume formula. Multiply the area of the Base times the height and then divide this amount by 3. Don’t forget to cube your label because you are finding volume.

26a. The volume of a prism is found using the formula $V = Bh$. “B” is the area of the Base. What shape is the Base? What formula do you use to find the area of this shape? Once you know the area of the Base, you need to multiply this by the height to find the volume. Since it is a cube, how tall is the cube? Don’t forget to cube your label because you are finding volume.

26b. Your answer will need to have variables in it because we don’t know the value of x. Use what you learned about finding volume of a cube in problem 26a. Don’t forget to cube your label, because you are finding volume.

27a. This is just an addition table like you worked with in elementary school. Add the yellow numbers at the top and left to fill in each square. “2” was filled in because $1 + 1 = 2$. “5” was filled in because $1 + 4 = 5$.

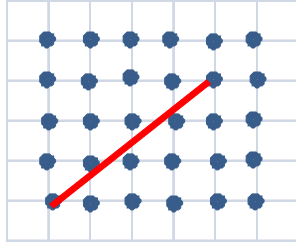
27b. Use the addition table you created in problem 27a to help you find the yellow square numbers that totaled 10.

27c. Use the addition table you created in problem 27a to help you find the yellow square numbers that totaled 25.

27d. Use the addition table you created in problem 27a to help you find the yellow square numbers that totaled 89.

27e. Find 26 in the addition table in problem 27a. Find the yellow square numbers that make up that sum. The square numbers (yellow numbers) tell you the area of the squares on the legs of the triangle, so the square of those sides must be the side length of the legs. If you know the side lengths, you will know how far to count up and over to draw the segment.

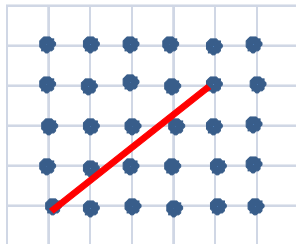
For example, if you had to draw the segment length of $\sqrt{41}$, you would find 41 in the chart. This would show you that 16 and 25 are the yellow square numbers. Since the $\sqrt{16} = 4$ and $\sqrt{25} = 5$, you would count up 4 and over 5 to draw the segment. The order of the numbers doesn’t matter – you could also have counted up 5 and over 4 to draw the segment. The segment drawn would look like this:



27f. When we use the table to help us draw the segment, we are looking for the square of the side. Since 10 is not in square root form, we need to find its square. Since $10^2 = 100$, we need to find $\sqrt{100}$ in the chart. Once you know this, you can use what you learned in problem 27e to help you draw the segment.

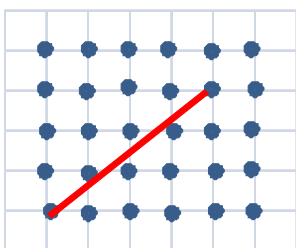
27g. Find 10 in the addition table in problem 27a. Find the yellow square numbers that make up that sum. The square numbers (yellow numbers) tell you the area of the squares on the legs of the triangle, so the square of those sides must be the side length of the legs. If you know the side lengths, you will know how far to count up and over to draw the segment.

For example, if you had to draw the segment length of $\sqrt{41}$, you would find 41 in the chart. This would show you that 16 and 25 are the yellow square numbers. Since the $\sqrt{16} = 4$ and $\sqrt{25} = 5$, you would count up 4 and over 5 to draw the segment. The order of the numbers doesn't matter – you could also have counted up 5 and over 4 to draw the segment. The segment would have drawn would look like this:



27h. Find 50 in the addition table in problem 27a. Find the yellow square numbers that make up that sum. The square numbers (yellow numbers) tell you the area of the squares on the legs of the triangle, so the square of those sides must be the side length of the legs. If you know the side lengths, you will know how far to count up and over to draw the segment.

For example, if you had to draw the segment length of $\sqrt{41}$, you would find 41 in the chart. This would show you that 16 and 25 are the yellow square numbers. Since the $\sqrt{16} = 4$ and $\sqrt{25} = 5$, you would count up 4 and over 5 to draw the segment. The order of the numbers doesn't matter – you could also have counted up 5 and over 4 to draw the segment. The segment would have drawn would look like this:



28. Any number found in the addition table from problem 27a would be able to be drawn on dot paper. Also, any number which is a perfect square can be drawn on dot paper, because we can draw it vertically or horizontally.

29. Any number found in the addition table from problem 27a would be able to be drawn on dot paper. Also, any number which is a perfect square can be drawn on dot paper, because we can draw it vertically or horizontally.

30. Any number found in the addition table from problem 27a would be able to be drawn on dot paper. Also, any number which is a perfect square can be drawn on dot paper, because we can draw it vertically or horizontally.

31. Any number found in the addition table from problem 27a would be able to be drawn on dot paper. Also, any number which is a perfect square can be drawn on dot paper, because we can draw it vertically or horizontally.

32. Any number found in the addition table from problem 27a would be able to be drawn on dot paper. Also, any number which is a perfect square can be drawn on dot paper, because we can draw it vertically or horizontally.

33. Any number found in the addition table from problem 27a would be able to be drawn on dot paper. Also, any number which is a perfect square can be drawn on dot paper, because we can draw it vertically or horizontally.

34a. Can you draw a right triangle using the point (3, 4) and the origin?

34b. Once you have a right triangle, you can use what you learned in problem 27e to help you find the hypotenuse.

35a. Remember to show the coordinates in the form (x, y).

35b. How can you use the coordinates to find the shortest drawing distance from J to K? Use what you learned in problem 23a to help you.

35c. If you know the lengths of the legs of the right triangle, can you use the Pythagorean Theorem to help you find the length of \overline{JK} ?

Investigation 4

1. Use the Pythagorean Theorem ($a^2 + b^2 = c^2$) to help you find the missing leg. Substitute 9 for either a or b. Substitute 15 for c since it is the hypotenuse. Solve for the missing leg. Don't forget to label your answer.

2a. You are always adding a side length of 1 in the new triangle. The hypotenuse will increase according to the pattern you found in problem 4.1A. Be sure to list all 3 sides for each new triangle.

2b. The area of a triangle is found using the formula $A = \frac{bh}{2}$ or $A = \frac{1}{2}bh$. The base and height are the legs of the triangle because they must be perpendicular (form 90° angles). It will be easier to use $A = \frac{1}{2}bh$ for this problem.

2c. It might be helpful to make a table to help you see the pattern.

Triangle number	1	2	3	4	5	6	7	
Hypotenuse length	$\sqrt{2}$	$\sqrt{3}$						

3. Fill in the hypotenuse and leg in the Pythagorean Theorem ($a^2 + b^2 = c^2$) and solve to find the missing leg. Don't forget to label your answer.

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5a. You know 2 sides of the triangle. Are they legs or a leg and a hypotenuse? Remember that legs must be perpendicular (form 90° angles). Fill in the information into the Pythagorean Theorem and solve. Don't forget to label your answer.

5b. What is the total distance of the usual route? What is the difference between the two routes? What do the clue words tell you to do? Don't forget to label your answer.

6a. Try tracing the square and cutting out the two triangles. Put the two triangles together. What do you notice? Is there a mathematical word to describe this?

6b. How big is every angle in any square? How were angles B and D cut? What does that tell you about the size of angles B and D?

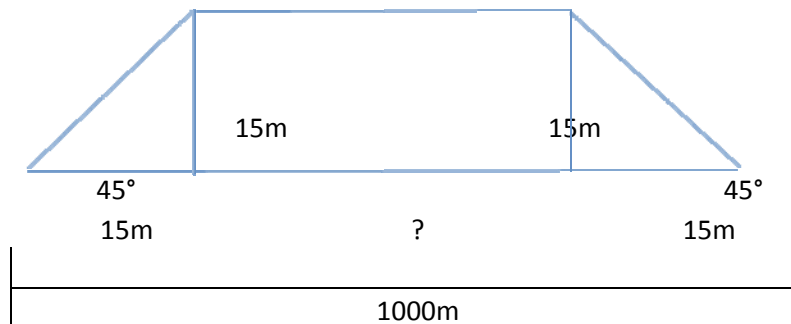
6c. The directions tell you the side lengths of the square are 1 unit. Use the Pythagorean Theorem ($a^2 + b^2 = c^2$) to help you find the hypotenuse. Don't forget to label your answer.

6d. Use what you learned in problems 6b and 6c to help you answer this question.

7a. Similar figures have equal corresponding angles and the sides must be in proportion. In other words, there is a scale factor. Try looking at the triangles formed in some different sized squares to see if they are similar.

7b. You already know the side lengths of the triangle from problem 6d. Use these to find the perimeter. Remember, perimeter is the distance around a figure, so add the sides to find the perimeter. Don't forget to label your answer.

8. The two legs of a $45^\circ - 45^\circ - 90^\circ$ triangle must be equal in length. Therefore, the legs on the ground must be 15m each.



This should help you find the length of the rectangle. You can use the Pythagorean Theorem to help you find the hypotenuse. Once you have found all of parts, you can find the length of the cable. Don't forget to label your answer.

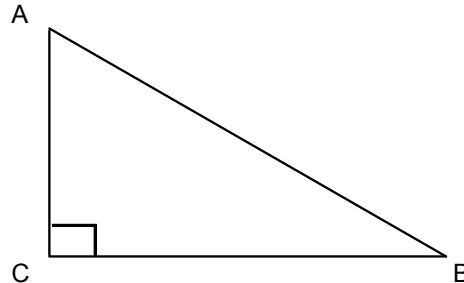
9. Use the Pythagorean Theorem to find the height of the tree to where the wire is attached. Don't forget that the tree still has 2 feet past the wire! Don't forget to label your answer.

10. The hypotenuse must be twice as big as the bottom leg of the triangle because it is a $30^\circ - 60^\circ - 90^\circ$ triangle. Use these sides to find the height of the tower. Don't forget that 5 feet of the tower is NOT part of the triangle! Don't forget to label your answer.

11a. State all three answers using the 3 vertices (corners). For example, $\triangle ABC$. To decide if they are similar, find out if the sides are in proportion (they have a scale factor) and if the corresponding angles are equal.

11b. What do you know about the ratio of the hypotenuse to its adjacent side in a $30^\circ - 60^\circ - 90^\circ$ triangle? If you aren't sure, see problem 10 for help.

11c. Look at the following patterns to help you see this ratio.



Side AB	6	10	12	8
Side AC	3	5	6	4
Side BC	$\sqrt{27} =$ $\sqrt{9 \cdot 3} =$ $3\sqrt{3}$	$\sqrt{75} =$ $\sqrt{25 \cdot 3} =$ $5\sqrt{3}$	$\sqrt{108} =$ $\sqrt{3 \cdot 36} =$ $6\sqrt{3}$	$\sqrt{48} =$ $\sqrt{3 \cdot 16} =$ $4\sqrt{3}$

What do you notice about the relationship between side AC and side BC? How many times bigger is side BC than side AC?

11d. Look at the ratio in fraction form $\frac{BC}{AC} = \frac{?}{?}$. Can you simplify this ratio?

11e. Use what you learned about the ratio of the hypotenuse to the short side to find the hypotenuse. Then use the Pythagorean Theorem to find the third side. Don't forget to label your answers.

12. What kind of triangles are these? What do you know about the ratio of the sides of these triangles? Start with $\triangle KLN$ and find \overline{KN} . Then you can find \overline{LN} . You can find all of the sides using the relationship between the sides that you found in problem 11d. Now use the length of \overline{LN} to help you find \overline{KM} . Once you have all of the side lengths, you can add the sides to find the perimeter. You may need to change any square roots to decimals to add these amounts. Don't forget to label your answer.

13. What amount times itself equals 121? An irrational number doesn't end and doesn't repeat. Pi is an example of an irrational number.

14. What times itself equals 49? Once you know this, then decide where the decimal needs to be placed. An irrational number doesn't end and doesn't repeat. Pi is an example of an irrational number.

15. What times itself equals 15? If you can't find a number, decide which two whole numbers $\sqrt{15}$ will fit in between (see problems 14-15 in Investigation 2 for help). Once you know what whole number to start with, try to get closer to 15 by trying one decimal place with the whole number. Keep trying different tenths until you can get as close as possible to 15.

16. What times itself equals 1000? If you can't find a number, decide which two whole numbers $\sqrt{1000}$ will fit in between (see problems 14-15 in Investigation 2 for help). Once you know what whole number to start with, try to get closer to 1000 by trying one decimal place with the whole number. Keep trying different tenths until you can get as close as possible to 1000.

17. Use the table below to help you.

Hours	1	2	3	4	5	6
North Car	60	120	180			
East Car	50	100				
Distance between the cars						

Use the Pythagorean Theorem to help you find the distances between the cars. It is started below to find the first distance.

$$a^2 + b^2 = c^2$$

$$60^2 + 50^2 = c^2$$

How do these distances between the cars change each hour? Don't forget to label your answer.

18. Try drawing a right triangle to help you visualize what is happening. How far has the northbound car gone after 2 hours? The cars are 100 miles apart after 2 hours. Where does this information go in picture? Use the Pythagorean Theorem to find the distance the eastbound car has traveled. Remember, this distance is over 2 hours, so how fast does the car go in one hour? Don't forget to label this speed.

19. To change a decimal to a fraction you can divide the numerator by the denominator. Is there an end to the division? If so, then the decimal terminates

(ends). If you keep getting digits in the answer in a pattern, then the decimal is a repeating decimal. For example:

$\frac{1}{8} = 0.125$ The division stops at this point so it is a terminating decimal

$\frac{1}{9} = 0.11111$ The division continues to give you ones in the answer. Since this continues forever, it is a repeating decimal and the one repeats over and over.

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24. Try squaring all of the numbers and then check to see if two of them total the third.

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26a. Use the Pythagorean Theorem to find b. Don't forget to label your answer.

26b. They want you to draw what the pyramid will look like when the net is put together. If you aren't sure, trace the net and fold it into the pyramid and then draw what it looks like.

26c. Surface area means to total all of the areas of the surfaces together. Therefore, you need to find the area of each triangle. The formula for the area of

a triangle is $A = \frac{bh}{2}$. You need to multiply the base times the height and then divide that amount by 2. The base and height are given for the three triangles that are equal in size. You will need to find the base and height of the equilateral triangle. The base can be found using the Pythagorean Theorem. Use what you know about the ratios in a $30^\circ - 60^\circ - 90^\circ$ triangle to help you find the height. Once you know all of the areas, find the total surface area, by adding the areas together. Remember to square your label because you are finding an area answer.

27. Think about which two whole numbers each amount is in between. You could also use a calculator to change the amounts to decimals.

28a. Remember that similar figures have sides that are proportional (there is a scale factor) and corresponding angles are equal.

28b. You already found the side lengths for the larger triangle in problem 4.3C. Since you know the triangles are similar, you can find the scale factor and use it to find the missing sides. Don't forget to label your answers.

28c. One way to find how the triangles are related is to use what you know about scale factor and how it affects the area. Another way is to find the area of each triangle. The larger triangle is how many times bigger than the smaller triangle?

29. Write the decimal as a fraction and then reduce the fraction. For example:

$$0.25 = \frac{25}{100} = \frac{1}{4}$$

$$3.525 = 3\frac{525}{1000} = 3\frac{105}{200} = 3\frac{21}{40}$$

$$26.006 = 26\frac{6}{1000} = 26\frac{3}{500}$$

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32. Will 0.06 times itself ($0.06 \cdot 0.06$) be equal to 0.36 ?

33. Does $1.5 \cdot 1.5 = 2.25$?

34. Does $11 \cdot 11 = 101$?

35a. You already found the side lengths of $\triangle ACD$ in problem 4.4. To find the perimeter, add the sides. Since some of the sides are in square root form, use a calculator to find the decimal equivalent. Don't forget to label your answer.

35b. You already found the perimeter of $\triangle ACD$ in problem 4.4 and the perimeter in problem 35a. The perimeter of $\triangle ABC$ is how many times bigger than the perimeter of $\triangle ACD$?

35c. You already found the area of both triangles in problem 4.4. The area of $\triangle ABC$ is how many times bigger than the area of $\triangle ACD$?

36. We know that $\sqrt{27}$ can't be between 2 and 3 because both of these numbers squared are smaller than 27. 2^2 is 4 and 3^2 is 9. One of the amounts must be smaller than 27 and the other amount must be larger than 27 when you square the amounts. For example, $\sqrt{45}$ is between 6 and 7 because $6^2 = 36$ (smaller than 45) and 7^2 is 49 (larger than 45). Use this information to help you find the whole numbers that $\sqrt{39}$ will be between.

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38a. To change a fraction to a decimal, divide the numerator by the denominator. For example, to change $\frac{1}{9}$ to a decimal, divide $1 \div 9$.

38b. Look at the fractions you started with and the decimals you found. What do you notice about these numbers? How are they alike?

38c. If the pattern continues could you write decimals for these fractions without dividing? If not, go ahead and divide the numerator by the denominator to change the fractions to decimals.

38d. Look at the table to find the fraction for $0.\overline{2}$. If $0.\overline{2}$ equals this fraction, how would you show $1.\overline{2}$? Repeat this process to change $2.\overline{7}$ to a fraction.

39. Create a table like the one you made in problem 38. To change a fraction to a decimal, divide the numerator by the denominator. Do you see a pattern in these decimals? Describe the pattern.

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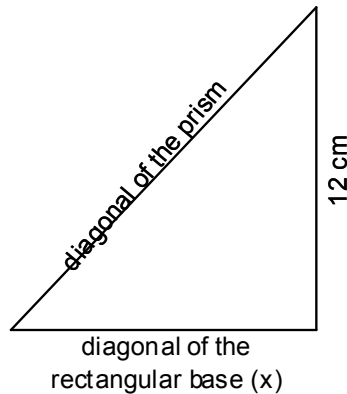
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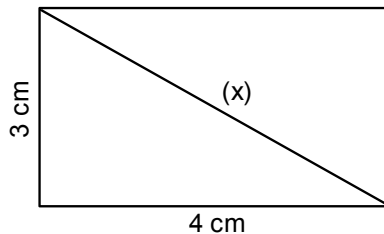
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47. Imagine the triangle drawn as a two-dimensional figure. It would look like this:

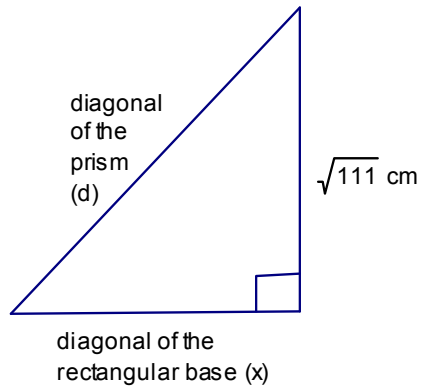


The base of the prism looks like this:

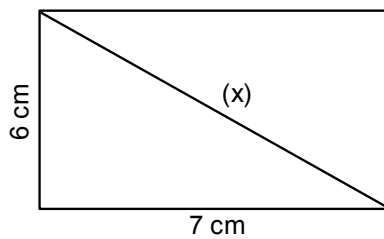


Find this diagonal (x) first using the Pythagorean Theorem. Then use this amount to find d using the Pythagorean Theorem.

48. Imagine the triangle drawn as a two-dimensional figure. It would look like this:

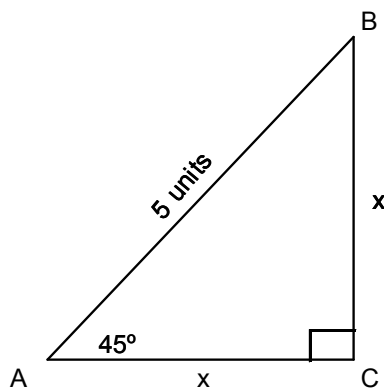


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49a. The triangle would look as follows:



The sides \overline{AC} and \overline{BC} must be the same length since the triangle must be a $45^\circ - 45^\circ - 90^\circ$ triangle. Therefore, you can set up the equation using x for sides \overline{AC} and \overline{BC} in the Pythagorean Theorem. This is started below:

$$\begin{aligned}
 a^2 + b^2 &= c^2 \\
 x^2 + x^2 &= 5^2 \\
 2x^2 &= 5^2
 \end{aligned}$$

Finish solving the equation to find x . Once you know the distance for x to 2 decimal places, you can write the coordinates of point B.

49b. Remember, slope is rise over run.

50a. You are given the diameter of each circle instead of the radius. The radius is how much of the diameter? Once you know what the radius of each circle is, find the area of each circle. Multiply π times the radius ($A = \pi r^2$) to find the area of a circle. Since we only need the area of each HALF circle, we need to take half of each amount. Don't forget to square your labels since you are finding area.

50b. Will two of the half circles equal the other half circle?

51a. We know the triangles drawn on the sides of the right triangle are all equilateral triangles. If we draw in the height of each triangle, we end up with $30^\circ - 60^\circ - 90^\circ$ triangles. Use what you learned about the ratio of the sides in $30^\circ - 60^\circ - 90^\circ$ triangles to help you find the height in each triangle. Once you know the height, use it and the given base to find the area of each triangle. Don't forget to square your labels since you are finding area.

51b. Will two of the triangle areas equal the third triangle area?

52a. Regular hexagons can be cut into six equilateral triangles. Since you just learned how to find the area of an equilateral triangle drawn next to the sides of the right triangle in problem 51a, you can use that information to find the area of each hexagon. The hexagon is how many times bigger than the equilateral triangle? Find the area of each hexagon. Don't forget to square your labels because you are finding area.

52b. Will two of the hexagonal areas equal the third hexagonal area?

53. We know many square roots are irrational. Try to find a square root that would be between 6.23 and 6.35.

54a. Let $x = 0.15151515\dots$. Since the repeating pattern is 15, you need to multiply x by 100 to shift the pattern to a whole number position. Then subtract the two equations like below:

$$\begin{array}{r}
 100x = 15.15151515\dots \\
 - \quad x = 0.15151515 \\
 \hline
 \end{array}$$

Finish solving the above equation to find the fraction.

54b. What is the repeating pattern? What power of 10 do you need to multiply the equation by to shift one group of the pattern to a whole number position? Write the equations, subtract them and solve to find the fraction. See problem 54a for help if necessary.

54c. What is the repeating pattern? What power of 10 do you need to multiply the equation by to shift one group of the pattern to a whole number position? Write the equations, subtract them and solve to find the fraction. See problem 54a for help if necessary.

55a. Use the Pythagorean Theorem to find the distance. Don't forget to label your answer.

55b. What did the pole help the farmer decide?

55c. Use the Pythagorean Theorem to find the distance. Don't forget to label your answer.

55d. The triangle must be a right triangle, so any amounts that form Pythagorean triples would work.

56. Triangle CDB is similar to triangle ABC because both triangles have a right angle and angle B. Find side CD using the Pythagorean Theorem. Find the side in $\triangle ABC$ that corresponds to side CD in $\triangle CBD$. Find the scale factor between these corresponding sides. Then use the scale factor to find the remaining sides. Once you know all of the sides, add them to find the perimeter. Don't forget to label your answer.

57a. Use the Pythagorean Theorem to find half of a side of the square base. What would you need to do to this amount to find the side of the square? Once you know the side of the square, multiply the side by the side ($A = s^2$) to find the area. Don't forget to square your label because you are finding area.

57b. Surface area is the total of all of the sides' areas. You found the area of the square in problem 57a. Now find the area of one of the triangles by multiplying the base times the height and then dividing this amount by 2. The height of the triangle is given in the problem and you found the base of the triangle in problem 57a. Once you know the area of one triangle, how big is the area of the other triangles? Add all five areas together to find the surface area. Don't forget to square your label because you are finding area.

57c. Look at the right triangle formed with the height in the right picture. You know the hypotenuse because that information is given in the problem. How big is the base of the right triangle? Think about where that distance is located in the

square base to help you find this length. Then use the Pythagorean Theorem to find the height of the pyramid. Don't forget to label your answer.

57d. Volume of a pyramid is found by multiplying the area of the Base by the height of the pyramid and then dividing by 3 ($V = \frac{Bh}{3}$). You found the area of the Base in problem 57a. You found the height of the pyramid in problem 57c. Use this information to find the volume. Don't forget to cube your label because you are finding volume.

58a. If the diameter is 4.5 inches, how big is the radius? Volume of a cone is found by multiplying the area of the Base by the height of the cone and then dividing this amount by 3 ($V = \frac{Bh}{3}$). The Base of the cone is a circle so use $A = \pi r^2$ to find the area of the Base. To do this, multiply π times the radius times the radius. Once you know the area of the Base, find the volume. Don't forget to cube your label since you are finding volume.

58b. Since a right triangle is formed with the radius, slant height and height of the cone, use the Pythagorean Theorem to find the radius. Once you know the radius, you can find the area of the Base by multiplying π times the radius times the radius ($A = \pi r^2$). Once you know the area of the Base, you can find the volume by multiplying the area of the Base times the cone height and then dividing this by 3 ($V = \frac{Bh}{3}$). Don't forget to cube your label because you are finding volume.