Math 2100 - Spring 2018

Lab 4

Names:_____

_____

_____

Measurement

1. Recall from class that the measurement process involves three steps:

   1) First, choose an object and an attribute of the object to measure.

   2) Second, select an appropriate unit for measuring the object.

   3) Third, measure the object.

   a. Measure the width of this page in thumbs, and record your measurement:_____

   b. Measure the width of this page in hands and record your measurement:_____

   c. Which of the previous two units of measurement do you think is more appropriate unit for measuring the width of this page?_____ Explain.

2. For each of the following objects, choose an appropriate non-standard unit of measurement (thumbs, hands, shoe length, for example) for measuring. Guess each distance and then measure using your chosen non-standard unit.

	Unit	Guess	Measurement
Length of the table			
Height of the door			
Length of a pen			
Width of the hallway			

3. Because you are familiar with standard English units such as inches and yards, you likely have a mental image of the approximate length of each of these. For most Americans, this is not the case when it comes to metric units, because the metric system is not widely used in the United States. In the next problem, you will compare the common metric units to body parts in order to develop mental images of the units of linear measure.

   a. The width of your pinky is approximately one centimeter. Check your pinky

   b. The width of your hand (fingers together including thumb), may be close to one decimeter. Check your hand.

   c. About how many centimeters does it appear are equal to one decimeter?_____

   d. A meter is approximately the distance from your nose to the end of the hand when your head is turned to the opposite direction from your hand. Check this for yourself.

   e. Using your personal metric references, estimate the following measurements. When you have completed your estimates measure the actual distance with a tape measure.

	Estimate (using body-part approx.)	**Measurement (using tape measure)**
Height of the door in decimeters.		
Length of pen in centimeters.		
Width of the room in meters.		
Length of the table in decimeters.		

Dimensional Analysis

Dimensional analysis is the term used to describe the process of changing from one unit of measure to another. The next activity develops the comprehension of this topic.

1. If you buy 4 yards of fabric for $7.00 per yard, what is your total cost?_____

2. Consider the problem of converting 13 feet to yards. Since 1 yard equals 3 feet, you can think of $\frac{1 \text{ yard}}{3 \text{ feet}}$ as a fraction equivalent to 1. Thus in the multiplication problem $13 \text{ feet} \times \frac{1 \text{ yard}}{3 \text{ feet}}$, you leave the value of 13 feet unchanged. Why is it useful to use yards/feet rather than feet/yards?

3. Some dimensional analysis problems are multi-step problems because there are several intermediate conversions that need to be made.

   For example, suppose you have a large collection of nickels. You put the nickels into rolls of 25 coins each. Then you put the rolls into three shoeboxes each containing 30 rolls. In dollars, how much money do you have?

   One way to solve this problem is to first convert the 3 shoeboxes to rolls, then rolls to nickels, and lastly nickels to dollars. The first step is shown below.

$$3 \text{ boxes} \times \frac{30 \text{ rolls}}{1 \text{ box}} = 90 \text{ rolls}$$

   a. Why can you multiply by $\frac{30 \text{ rolls}}{1 \text{ box}}$?

   b. Show the remaining two steps for this problem to arrive at a solution.

   c. Once you thoroughly understand dimensional analysis, you can do the problems such as this one without the need to write out each step individually. Solve this problem with one long process below.

4. Solve the following dimensional analysis problems.

   a. A farmer planted 75 acres of wheat. He expects to harvest 35 bushels per acre and, for each three bushels, he hope to be paid $20. What are his total anticipated earnings?

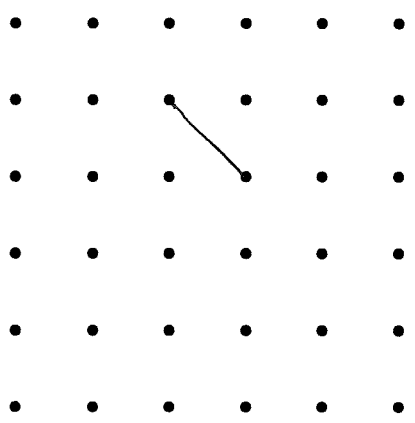
   b. A runner averages 1 mile every 8 minutes. How fast is the runner traveling in feet per second?

   c. If you spend an average of 8 hours per day sleeping, how many weeks sleeping is this per year?

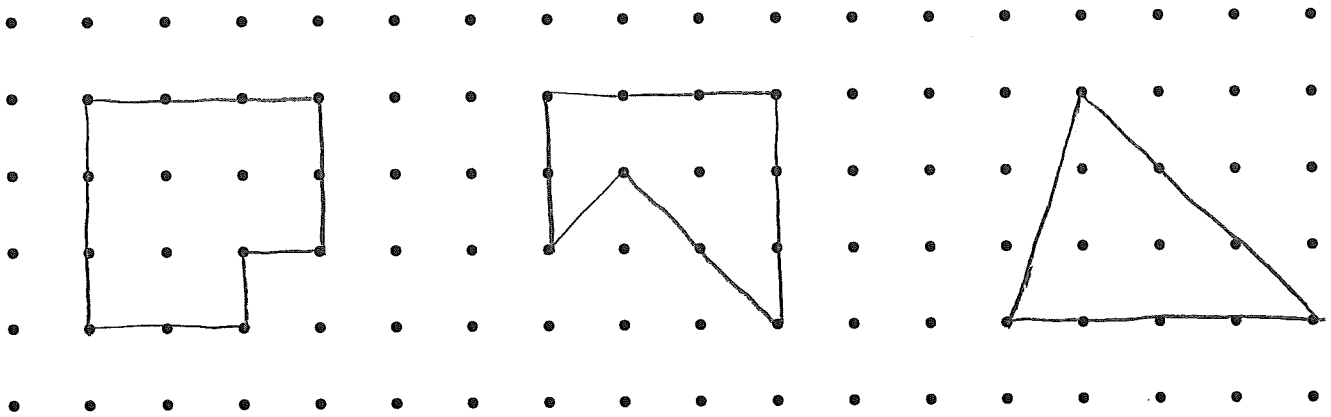
Perimeter and Area

In the next activity, we will use a geoboard to investigate the meanings of perimeter and area. The unit used to measure length on a geoboard is the horizontal (or vertical) distance between two adjacent pegs.

1. What is the diagonal distance between two adjacent pegs on a geoboard as marked below? Show your work. _____ units



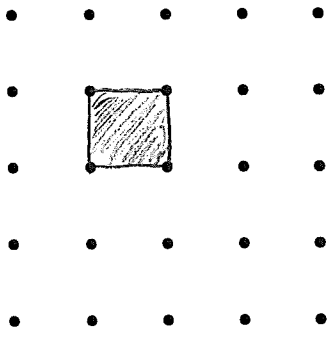
2. The **perimeter** of a polygon is found by adding the lengths of all its sides. Find the perimeter of each of the following geoboard figures and record your answer. Show your work.



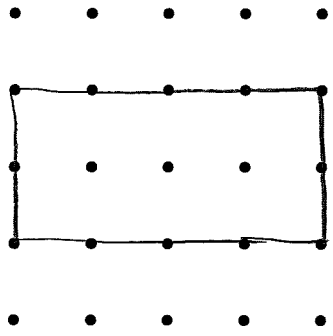
_____ units _____units _____units

3. Linear units are useful for measuring one-dimensional attributes such as width, height, or perimeter (yes, perimeter is a one-dimensional attribute!). Now we will use square units to measure a two-dimensional attribute such as area.

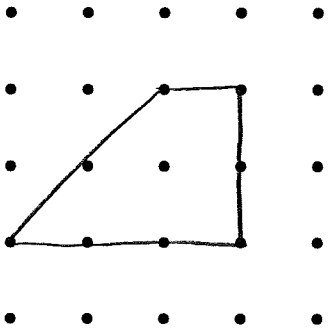
   The unit used to measure area is called a square unit, demonstrated below.



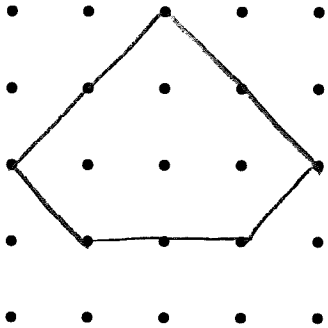
Use this measurement to find the area of the rectangle below. Draw in the amount of square units required to find the area.



4. Find the area of the figures below.

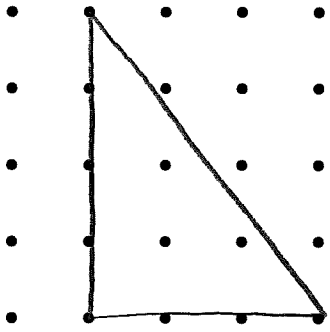


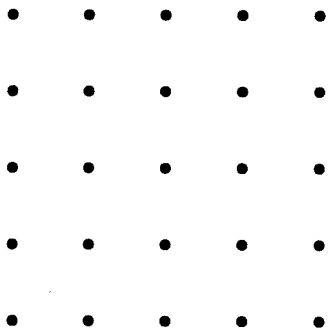
_____square units



_____square units

5. Explain how you could find the area of the right triangle below by using a rectangle. Draw your method on the open area to the right.

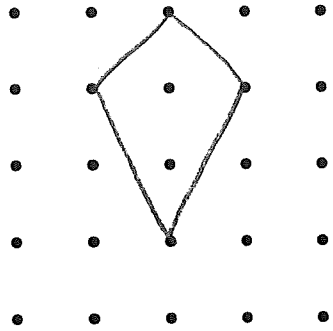


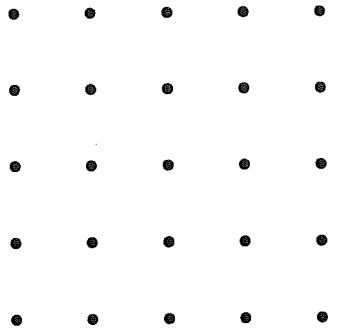


This demonstrates the area of a triangle with base b and height h is $A =$ _____

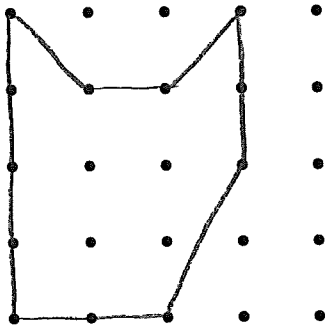
6. Find the area of the following figures by subdividing the figures into well-known shapes. Produce your subdivisions on the blank canvas to the right of each figure. Show your work.

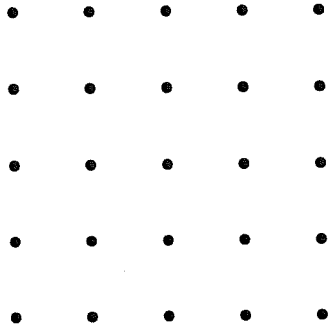
a.



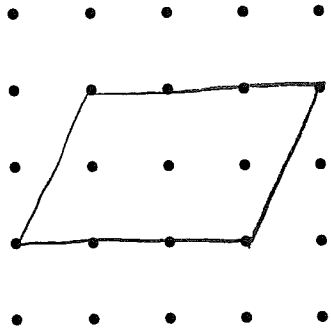


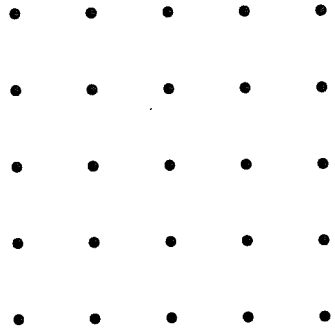
b.





7. Consider the parallelogram formed on the geoboard shown below.





a. What are the lengths of the sides of the parallelogram?_____

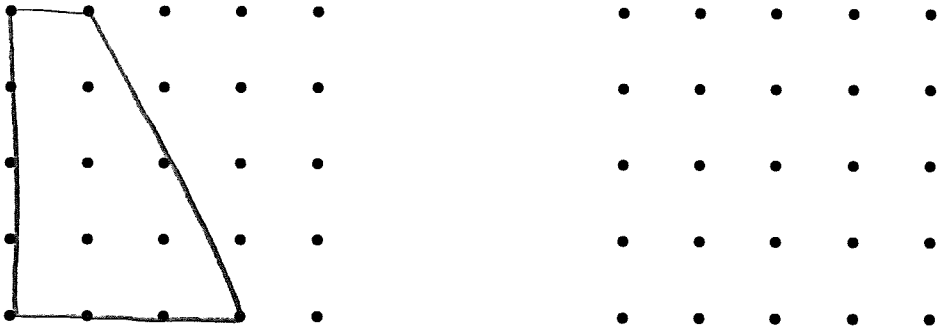
b. What is the height of the parallelogram?_____

c. Show how to cut and rearrange the parallelogram to form a rectangle and draw this above.

d. What are the dimensions of this rectangle?_____area?_____

e. This shows the area of a parallelogram with base b and height h is A = _____

8. In class, we derived the formula for the area of a trapezoid by cutting it into triangles and rectangles. Another method would be to make a different cut and make a parallelogram. Provide a drawing of how this could be done below.



a. Do the resulting parallelogram and the original trapezoid have the same area?_____

b. What is the relationship between the length of the base of the parallelogram and the lengths of the two bases of the trapezoid?_____

c. How does the height of the resulting parallelogram compare to the height of the original trapezoid?_____

d. What is the area of the parallelogram?_____trapezoid?_____

e. Based on these observations, write the formula for the area of a trapezoid with bases a and b and height h.