Name:_____Date:_____Grade:_____/42

Laboratory – Significant Figures and Measurement

In this activity you will learn the concept behind significant figures and how to make measurements and calculations using that concept.

Correlates to: *Addison-Wesley Chemistry, Section 3.2*

Background: Any measuring device is limited in its precision. To a large degree, the precision of a measurement is determined by the nature of the measuring instrument itself. Specifically, to what degree the instrument is subdivided will determine to what decimal place the measurement will be reported. In science, we typically limit ourselves to measuring scales that have been divided based on powers of ten. A meter stick, for instance, might be divided into tenths, hundredths, and thousands of a meter if the smallest scale division marked on the ruler is the millimeter. Each of the digits you report in your measurement is considered a *significant figure*. In general, we report measurements by including all of the digits of which we are certain plus one estimated digit. In making measurements with a metric scale, it is conventional to report measurements to the smallest scale division marked on the scale, plus one estimate beyond the smallest scale division. There are exceptions to these rules that differ based on what you are measuring or the measurement technique, but these rules are generally followed.

Materials: Modified ruler, pen, calculator, this worksheet

Procedure:
For this activity, you will be measuring the geometric shapes page two using the ruler that has been provided to you on the last page. Cut out one of each ruler, and follow the protocol for making measurements. All Trial 1 measurements are to be made with the ruler which has been subdivided into centimeter units only. Trial 2 measurements will be made with the ruler that has centimeter and millimeters divisions.

<u>Part A</u>
1. Measure the following quantities using the ruler in units of centimeters only.
    a. The length and width of the rectangle
    b. The base, height (altitude), and all three sides of the triangle
    c. The radius and diameter of the circle.

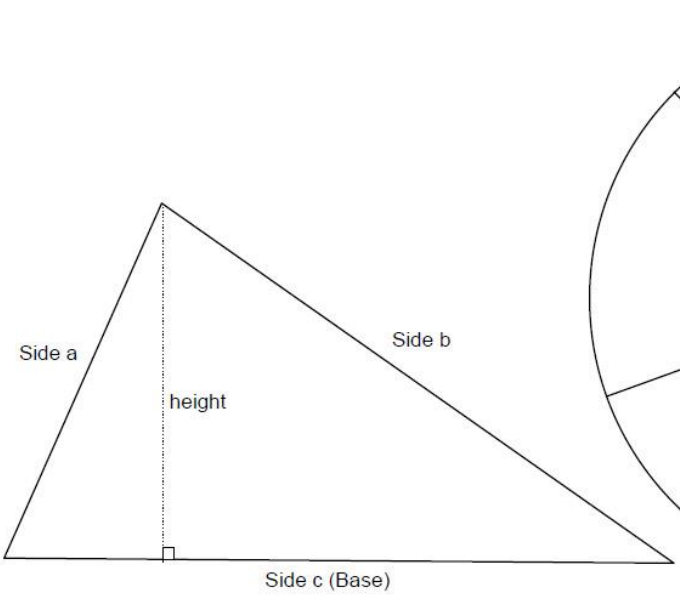
Record your measurements in the trial 1 section of the data table, to the correct number of significant figures based on the concepts described above.

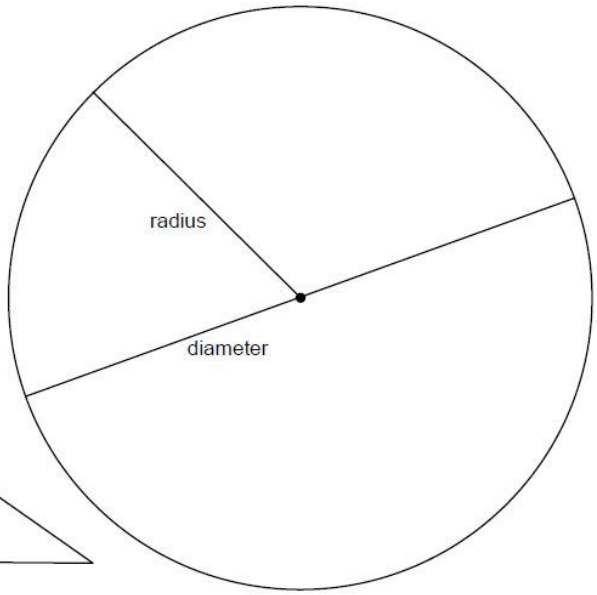
2. Make the following calculations based on the measurements.
    a. Perimeter and area of the rectangle
    b. Perimeter and area of the triangle
    c. Circumference and area of the circle

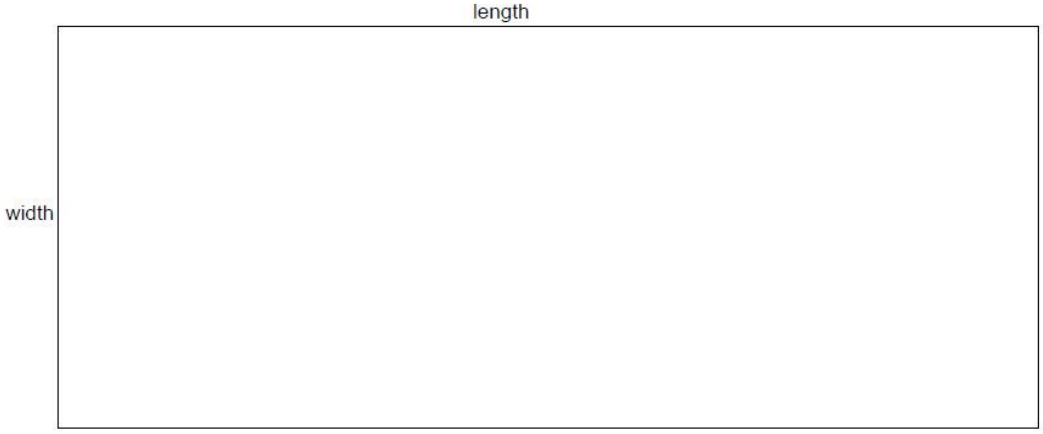
Below the data table, show all work for each calculation. This should include starting with the equation written symbolically. For example, the area of a rectangle is equal to the length of the rectangle times the width of the rectangle. This should be written as $A = L \times W$. The next step in the calculation should show substitution of measurements (including units) into the equation. The final step should be writing the final answer with the correct units. Record the results of these calculations in the appropriate boxes in the trial 1 section of the data table.

Part B

Repeat the procedure above for sections 1 and 2, but use the side of the ruler which has been divided into millimeters. Report all values in units of centimeters, as accurately as your ruler will permit. Remember to estimate the last digit.







Rectangle			Triangle			Circle		
	Trial 1	Trial 2		Trial 1	Trial 2		Trial 1	Trial 2
length			base			radius		
width			height			diameter		
			side a					
			side b					
			side c					
perimeter			perimeter			circumference		
area			area			area		

Areas highlighted above are worth 2 points each, 24 points total.

Questions (3 points each, 18 points total)

1. To what precision (decimal place) did you report each of the measurements made in Trial 1?

Explain why.

2. Was the number of significant figures in each of your measurements in Trial 1 constant?

Explain.

3. Explain how you determined how many significant figures to include in the result of each of the calculations done for Trial 1.

4. To what precision (decimal place) did you report each of the measurements made in Trial 2?

Explain why.

5. Was the number of significant figures in each of your measurements in Trial 2 constant?

Explain.

6. Explain how you determined how many significant figures to include in the result of each of the calculations done for Trial 2.

Appendix

Calculation Rules for Significant Figures

1. When adding or subtracting, the answer must be rounded to the place which has the greatest uncertainty.

2. When multiplying or dividing, the answer must be rounded to the same number of significant figures as the factor having the smallest number of significant figures.

The rules for determining whether a number is significant are as follows:

1. All nonzero digits (1 – 9) are significant.

2. Zeros between nonzero digits are significant, (ex. 304; 26,007; 0.62005).

3. In numbers with a decimal point, beginning with the first nonzero digit (1 – 9), all numbers (including zeros) to the right are significant, (ex. 310.00; 4.330).

   - On the other hand, the zeros in the numbers 0.000324 and 0.579 are not significant; they are important because they hold a place, but they are not considered significant.

4. In numbers without a decimal point, trailing zeros (those to the right of the last nonzero digit) are not significant.

   - Compare the numbers 310 and 4800, to 310.00 and 4800. as used in rule 3 above. The zeros in 310 and 4800 are not significant because there is no decimal point in the numbers.

- -

Cut each of the rulers out below and use as directed in the laboratory protocol.