Significant Digits
Integrated Science Physics/Design

Name: _____

Significant digits are the meaningful digits in a measured quantity. Scientists have agreed upon a number of rules to determine which numbers in a measurement are significant. The rules are:

1. Non-zero digits in a measurement are always significant. This means that the distance measured by the car odometer, 7.2 miles, has two significant digits.

2. Zeros between two significant digits in a measurement are significant. This means that the measurement of kilometers per mile, 1.609 kilometers, has four significant digits.

3. All final zeros to the right of a decimal point in a measurement are significant. This means that the measurement 1.000 miles has four significant digits.

1
1.000

4. If there is no decimal point, final zeros in a measurement are NOT significant. This means that the number 20 in the phrase "20-liter water cooler" has one significant digit. The water cooler isn't marked off in 1-liter increments, so no measurement decision was made regarding the ones place.

100

5. A decimal point is used after a whole number ending in zero to indicate that a final zero IS significant. If you measure 100 grams of lemonade powder to the nearest whole gram, write the number as 100. grams. This shows that your measurement has three significant digits.

1.0008
0.0008
0.00080

6. In a measurement, zeros that exist only to put the decimal point in the right place are NOT significant. This means that the number 0.0008 in the phrase "0.0008 kilometer" has one significant digit.

7. A number that is found by counting rather than measuring is said to have an infinite number of significant digits. For example, the race officials count 386 runners at the starting line. The number 386, in this case, has an infinite number of significant digit

Find the number of significant digits for each value below.

Example	Number of Significant Digits
a. 36.33 minutes	4
b. 100 miles	1
c. 120.2 mL	4
d. 0.0074 km	2
e. 0.010 kg	2
f. 300. g	3
g. 39 students	infinite

In the table below, write two of your own examples of significant digits for each of the 7 rules. The first one has been done for you. (The 7 rules are listed at the top of this worksheet.)

Rule	Example	# of Significant Digits	Example	# of Significant Digits
1	45 minutes	2	143.98 dL	5
2	150 miles	2	1.063 mm	4
3	1.432 mi.	4	82.01 cm	4
4	9.000 km	4	3.1 g	2
5	35 Ss	infite	0.00007 Dm	1
6	0.023 m	2	1000 people	infite
7	0.01 cm	1		

Using Significant Digits in Calculations Name: _____
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Taking measurements and recording data are often a part of science classes. When you use the data in calculations, keep in mind this important principle: When using data in a calculation, your answer can't be more precise than the least precise measurement.

You are using a ruler to measure the length of each side of a rectangle. The ruler is marked in tenths of a centimeter. This means that you can estimate the distance between two 0.1 cm marks and make measurements that are to two places after the decimal.

You measure the two short sides of the triangle and find that they each have a length of 12.25 cm. The long sides each have a length of 20.75 cm.

The rectangle's perimeter (distance around) is 12.25 cm + 20.75 cm + 12.25 cm + 20.75 cm, or 66.00 cm. The two zeros to the right of the decimal point show that you measured with a precision of 0.01 cm.

The area of the rectangle is found by multiplying the length of the short side by the length of the long side.

$$12.25 \text{ cm} \times 20.75 \text{ cm} = 254.1875 \text{ cm}^2$$

The answer you get from you calculator has seven significant digits. This incorrectly implies that your ruler can measure to one ten-thousandth of a centimeter. Your ruler can't measure distances that small!

Follow these steps for determining the right answer for your calculation:

- When multiplying or dividing measurements, find the measurement in the calculation with the least number of significant digits. After doing your calculation, round the answer to that number of significant digits.
  In the rectangle example on the previous page, each measurement has 4 significant digits. When you multiply the measurements to find the area, your answer should be rounded to four significant digits. The area should be reported as 254.2 cm^2.

- When adding or subtracting measurements, the answer must not contain more decimal places than your least accurate measurement.

  In the rectangle example, the perimeter is reported to two decimal places to show that your ruler measures length to the nearest 0.01 centimeter. It is important to note that when adding or subtracting, you are not concerned with the number of significant digits to the left of the decimal point. When adding 1.25 cm + 1,000.50 cm + 2,000,000.75 cm, the answer is 2,001,002.50 cm. It is okay to have an answer with nine significant digits, because only TWO of them are to the right of the decimal point.

Report your answers with significant digits

Have you ever participated in a road race? The following problems are all related to a road race event. Can you come up with some other problems that you might have to solve if you were running in or volunteering for a road race?

1. The banner over the finish line of a running race is 400. centimeters long and 86 centimeters high. What is the area of the banner? (area = length x width)

$a = w \times l = 86\,cm \times 400.\,cm = 34{,}000\,cm^2$

2. Heidi stops at three water stations during the running race. She drinks 0.25 liters of water at the first stop, 0.3 liters at the second stop, and 0.37 liters at the third stop. How much water does she consume throughout the race?

0.25 L
0.3 L
0.37 L
0.92 L

0.9 L

3. The race officials want to set up portable bleachers near the finish line. Each set of bleachers is 4.50 meters long and 2.85 meters wide. What is the area of the bleachers?

$a = l \times w = 4.50\,m \times 2.85\,m = 12.8\,m^2$

4. Come up with one more problem that uses information that is related to a road race. Write your problem in the space below and come up with the answer. Be sure to write your answer with the correct number of significant digits.