Name: _____ Date: _____

Problem Solving: Significant Digits

Learning goals

After completing this activity, you will be able to …

- Identify and count the significant digits in a number.
- Record data with the correct number of significant digits.
- Write sums, differences, products, and quotients with proper significant digits.

Introduction

When scientists report data, they try to communicate not only the values of their data but also its accuracy, precision, and resolution. One way to do this is to use the correct number of meaningful digits in each number. Digits that count toward this total are *significant digits*.

Rules for counting significant digits

Rule	Description	Example
1	Any non-zero digit is significant	**3**.**75** has three significant digits
2	Any digit between significant digits is significant	**5**.**004** has four significant digits.
3	Trailing zeros to the right of a decimal point are significant	**7**.**1000** has five significant digits
4	Leading zeros are not significant	0.0000**65** has two significant digits
5	Trailing zeros to the left of a decimal point may or may not be significant	**9**00 has either one, two, or three significant digits
6	When using scientific notation, all digits are significant	**9**.**54** × 10^{16} has three significant digits

1. Underline the significant digits in each number below. Circle any digits that may or may not be significant. Write the number of definite significant digits in the space provided.

Example: 5 , 600 __2__

67.81	_____	85.001	_____	0.0079	_____
0.07001	_____	8.800×10^{-4}	_____	6,000	_____
270,010	_____	3,000	_____	3.00×10^{3}	_____

2. **Apply your knowledge:** How can writing a number with scientific notation convey more information than writing it in standard format?

_____

_____

_____

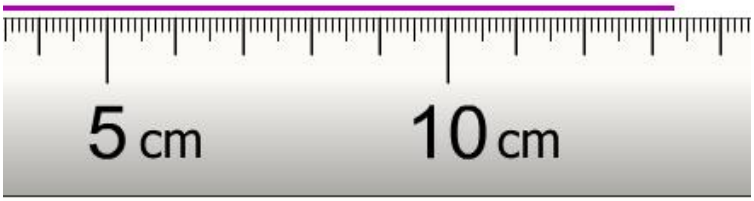
Recording data with significant digits

The number of significant digits should reflect the resolution of the measuring device. The general rule of thumb is that you are allowed one more significant digit than the finest resolution of your device. For example, if a graduated cylinder is marked in milliliters (mL), you are allowed to estimate volume to the nearest 0.1 mL, but it is also acceptable to write the volume to the nearest mL if you cannot make a good estimate.

It is never acceptable to write a measurement with fewer significant digits than allowed by the device. For example, if you are using a ruler marked with millimeters to measure a six-centimeter line, you should record the length as 6.0 cm or 6.00 cm, not 6 cm.

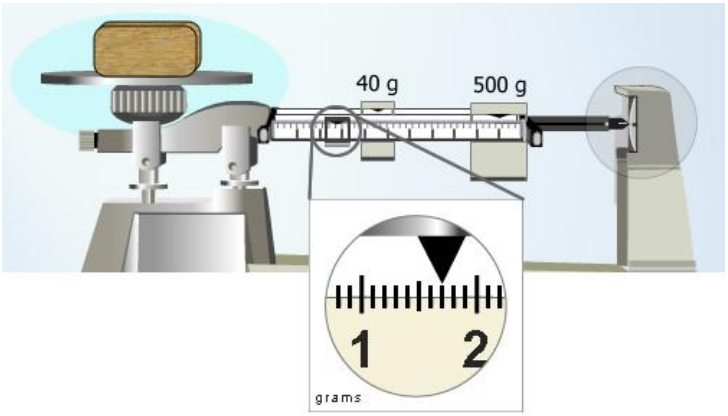
Based on each picture, record the measurement with the correct number of significant digits. Include units. (Note: For the graduated cylinder, measure the bottom of the curve, or *meniscus*.)

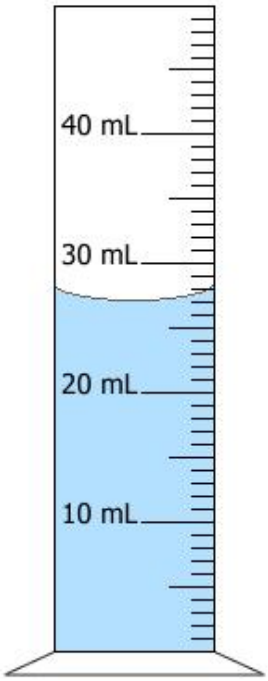
1. The length of the line is: _____



2. The mass of the wooden block is: _____

   (Hint: Add up the values of the three riders on the balance.)





3. The volume of the liquid is:

   _____

Significant digits in calculations

When you are doing a calculation involving a measurement with significant digits, the result of the calculation must also have a limited number of significant digits. Here are some guidelines for calculations and significant digits:

Calculator recommended

Rules for calculations with significant digits

Rule	Description	Example
1	When multiplying or dividing measured values, the answer must have the same number of significant digits as the measurement with the fewest significant digits.	A rectangle measures 11.2 cm (three significant digits) by 5.6 cm (two significant digits. The area of the rectangle is 63 cm^2 (two significant digits).
2	When a measurement is multiplied or divided by a whole number, assume the whole number has infinite significant digits.	A cement block has a mass of 14.5 kg (three significant digits). The mass of five cement blocks is 72.5 kg (three significant digits).
3	When adding two measured values, the answer should have the same number of *decimal places* as the measured value with the fewest decimal places. (In this case, ignore significant digits.)	A rock has a volume of 21.0 cm^3 (one decimal place). A second rock has a volume of 4.52 cm^3 (two decimal places). The sum of their volumes is 25.5 cm^3.

Do each calculation and write the answer with the correct number of significant digits. Include units in your answers. Use the following equations to help you with each calculation:

average speed = distance ÷ time

density = mass ÷ volume

volume of a box = length × width × height

pressure = force ÷ area

1. What is the density of a rock with a mass of 25.6 g and a volume of 11.0 cm^3? _____

2. What is the volume of a box with l = 9.52 cm, w = 11.95 cm, and h = 22.91 cm? _____

3. What is the average speed of a car that goes 1,004.5 meters in 9.45 seconds? _____

4. How much pressure does a person with a weight of 901.0 newtons exert on a scale with an area of 0.90 square meters? _____

5. A stuffed bear has a mass of 1.406 kilograms. What is the mass of 500 identical stuffed bears? _____