Lesson 3: Significant Digits, Scientific Notation

Measurement:
Measurements are always expressed by a number and a ___________. Whenever a measurement is made, an ________________ is required.

The ________________ in measurements (underlined) is an ________________ because the liquid level falls in between the lines. Numbers from a measurement are ________________. They always have some ________________ due to the ____________________________ and the ________________ of the person taking the measurement.

Different tools have different degrees of _________________. Measurements should always have all the digits that are known plus _____________________________.

How long is each line? Circle the estimated digit in your measurement.

Significant figures (aka significant digits): the number of digits that are known plus one estimated digit are considered significant in a measured quantity
**Significant Digits Rules:**

1. **Non zero digits.** All non-zero digits are significant.

2. **Exact numbers.** Exact numbers have an infinite number of significant digits. Includes: counting numbers (counting a number of definite things) and defined numbers (example: 100 cm = 1 m). No uncertainty with these numbers.

3. **Zeros.**
   a. Significant zeros
      - between nonzero digits
        - 205 mL = ____ significant digits
        - 2.08 g = ____ significant digits
        - 84.05 L = ____ significant digits
      - at the end of a number that has a decimal point
        - 0.500 s = ____ significant digits
        - 28.120 mg = ____ significant digits
        - 4.00 mL = ____ significant digits
        - 30. g = ____ significant digits
   b. Non-significant zeros
      - before the first nonzero digit
        - 0.00082 mg = ____ significant digits
        - 0.0117 dL = ____ significant digits
      - at the end of a number without a decimal point
        - 2000 L = ____ significant digit
        - 840 K = ____ significant digits

**PRACTICE.** Count the number of significant digits.

1. 5,000 mL
2. 0.000208 g
3. 102 m
4. 107.0 mL
5. 0.0084000 s
6. 1,000. g
Rounding with Significant Digits:
When using calculators, we often obtain numbers that have too many digits than are ________________.

We must ________________ and drop the excess digits to properly and fairly express measurements.

1. 7.458110 g/mL round to 3 significant digits: ________________
2. 0.021150 mL round to 2 significant digits: ________________
3. 51.2098 round to 4 significant digits: ________________
4. 800.5 round to 3 significant digits: ________________

Significant Digits in Calculations:

Multiplication & Division × ÷
The answer must contain the same number of significant digits as the measurement that has the ________
_______________________________.

1. 4.2 g ÷ 5.01 mL = __________
2. 6.01 cm × 1.2 cm × 5.022 cm = __________
3. 81.05 g ÷ 2.000 L = __________
4. 3.44 m × 6 m = __________

Addition & Subtraction + −
The answer must be expressed to the same number of significant digits as the least precise measurement.
Round the result to the ________________________________ as the value with the ________________ decimal places.

1. 125.17 g + 129 g + 52.2 g = ________________
2. 800 m + 71.2 m + 902.5 m = ________________
3. 1587 K − 120 K = ________________
4. 132.56 mL − 14.1 mL = ________________
Scientific Notation.

Scientific notation: a mathematical expression used to represent a decimal number between 1 and 10 _______________, so you can write large numbers using less digits.

\[ 5.90 \times 10^2 \]

- Exponent is positive = number is greater than one.
- Exponent is negative = number is less than one.
- Coefficient is always between 1 and 10.
- The base is always 10.

Write each value in either scientific or standard notation.

1. \( 1.215 \times 10^4 \)
2. \( 7.05 \times 10^{-3} \)
3. \( 2.001 \times 10^5 \)
4. \( 6.10 \times 10^{-4} \)
5. \( 1,005,000,000 \)
6. \( 0.0000058 \)
7. \( 0.000710 \)
8. \( 2,500 \)

One way of indicating that zeros are significant? **Write in scientific notation.**

1,000. mL = 3 significant digits = \( 1.000 \times 10^3 \) mL

590 g = 2 significant digits = \( 5.90 \times 10^2 \) g

0.00005210 mg = 4 significant digits = \( 5.210 \times 10^{-5} \) mg

All digits written in the coefficient are significant.