NAME KEY DATE HOUR

Sec. 2.3 Wksht : Using Scientific Measurements

Part A. ACCURACY AND PRECISION: Read the following passage and answer the questions that follow.

Sheila performed an experiment in order to understand the difference between accuracy and precision. She weighed herself using three different scales. She used a bathroom scale, the scale in the nurse's office at school, and a scale in the gym. She recorded the following measurements:

Bathroom Scale	Nurse's Scale	Gym Scale
144	155	139
134	153	138
139	154	140

She observed that the measurements from the bathroom scale were not very close in value to each other and therefore not very precise. Unlike the bathroom scale, the scale from the nurse's office gave results that were reproducible; but since Sheila knew she did not weigh that much, these measurements were not accurate. The scale from the gym gave results that were both reproducible and close to her true weight, 139 pounds; these measurements were both accurate and precise.

Accuracy is how close a single measurement is to the true value of whatever is being measured. Precision is how close several measurements are to each other. Precise measurements have repeatability.

Apply

The following measurements were made on a piece of copper whose true mass is known to be 1.55 grams: 1.53 g, 1.40 g, 1.65 g, and 1.67 g.

1. Which two measurements are the most precise? Why are they the most precise?

   1.65g and 1.67g they are the two closest to being the same

2. Which measurement is the most accurate? Why is it the most accurate?

   1.53g closest to the actual measurement

3. What are some of the steps you could take during an experiment to make sure that your measurements are both accurate and precise? Read the device correctly, pay attention to significant figures

Part B. PERCENT ERROR : Read the following passage and solve the problems that follow.

Scientists often express their uncertainty and error in measurement by giving a percent error. Percent error represents a measure of accuracy. The percent error is defined as:

$$\% \text{ error} = \frac{|\text{experimental value} - \text{accepted value}|}{\text{accepted value}} \times 100\%$$

1. What is the percent error if you measured the volume of a cube to be 54.3 cm^3 when the cube's actual value is 53.1 cm^3 ?

$\%\ error = \frac{exp - Acc}{Acc} \times 100\%$ $\%\ error = \frac{54.3\,cm^3 - 53.1\,cm^3}{53.1\,cm^3} = .0226 = \boxed{2.26\%}$

2. You measure the mass of a piece of iron as 80.2 grams and its volume as 10.0 mL. The actual density of iron is 7.87 g/mL. Calculate the percent error.

$D = \frac{m}{V}$ $m = 80.2\,g$ $V = 10.0\,mL$ $D = \frac{80.2\,g}{10.0\,mL}$ $D = 8.02\,g/mL$

$\%\ error = \frac{exp - Acc}{Acc} \times 100\%$ $\%\ error = \frac{8.02\,g/mL - 7.87\,g/mL}{7.87\,g/mL} \times 100\% = \boxed{1.91\%}$

Part C. SCIENTIFIC NOTATION: Follow the directions listed for each question.

Scientific notation is used in many fields of science in order to make very large or small numbers easier to use. In scientific notation, a number is written as the product of two numbers: a coefficient and a power of ten to indicate the location of the decimal point.

If the exponent is positive, the decimal places are to the right of the number. If the exponent is negative, the decimal places are to the left of the number.

Example 1) 45,000,000,000,000,000 can be written as 4.5×10^{16}

Example 2) 0.00000000000000378 can be written as 3.78×10^{-15}.

1. Express the following numbers in scientific notation. Place only one nonzero digit to the left of the decimal point in the coefficient.

a. 0.01036 1.036×10^{-2}

b. 1 000 396 1.000396×10^{6}

c. 1534.13 1.53413×10^{3}

d. 0.3235 3.235×10^{-1}

e. 0.000550 5.50×10^{-4}

f. 10 030.010 $1.00300\,10 \times 10^{4}$

g. 0.56 5.6×10^{-1}

h. 13 1.3×10^{1}

i. 15 000 1.5×10^{4}

2. Change the following numbers from scientific notation into conventional numbers.

a. 1.22×10^{-2} .0122

b. 154.6×10^{4} 1546000

c. 0.003×10^{3} 3

d. 3.0×10^{3} 3000

e. 25.0×10^{-6} 0.000025

f. 1.00×10^{-3} 0.00100

g. 17.50×10^{-4} 0.001750

h. 274.0×10^{5} 27400000

i. 1.7×10^{4} 17000

3. Solve the following problems and express the answers in scientific notation.

a. $(7.0 \times 10^{-3}) \times (3.0 \times 10^{7}) = 2.1 \times 10^{5}$ (21000)

b. $(1.23 \times 10^{7}) + (1.54 \times 10^{5}) = 1.25 \times 10^{7}$ (12454000)

c. $(3.21 \times 10^{-1}) - (5.84 \times 10^{-3}) = 3.15 \times 10^{-1}$ 0.3516

d. $(.033) \times (2.20 \times 10^{-3}) = 7.26 \times 10^{-5}$ (.000072600) 7.3×10^{-5}

e. $\frac{(4.50 \times 10^{3}) \times (2.10 \times 10^{2})}{(2.10 \times 10^{6}) \times (1.50 \times 10^{2})} = 3.00 \times 10^{-3}$ 0.003