CHAPTER 2 VIDEO NOTES SIGNIFICANT FIGURES IN MEASUREMENTS
CHEMISTRY 1 DR. CASAGRANDE

III. ACCURACY & PRECISION IN MEASUREMENTS

Follow along and complete these notes as you view video "#3: Accuracy & Precision in Measurements" at https://edpuzzle.com.

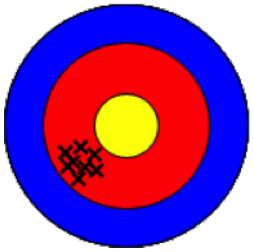
Measurements

- Accuracy – how close a measurement is to _____
  - Closer is _____
- Precision – how close a set of measurements are to _____
  - Smaller spread is _____

Examples using targets:

(Note: it is "accepted" that the bull's eye is the place everyone aims for.)

- Accurate and precise
  - Small spread in data can be reduced _____
    _____
    - Random error—_____
  - remove its effects by _____
    - Should always use _____, with the most calibration markings
  - e.g. use 10-mL graduated cylinder, not 50-mL graduated cylinder or 600 mL-beaker for measuring 10.00 mL of liquid



- Precise but not Accurate
  - Consistency in technique
  - Systematic error: due to _____: affects accuracy
    - Example: _____
    - Eliminate by _____
      _____

- Accurate but not precise
  - Taking average gives accepted answer
  - Spread in data too large
  - _____

- Neither precise nor accurate
  - The average is off and the spread is large
  - Need to _____
  - Need to _____

Measuring Accuracy

- Want error to be 0
  - Measure difference between _____ as a percentage of accepted result:

$$\text{Percent Error} = \frac{\text{Error}}{\text{accepted result}}$$

$$\text{where Error} = \text{accepted result} - \text{experimental result}$$

    - We take absolute value of the error because _____.
  - Example: The accepted density for Cu is 8.92 g/cm^3. What is the % error if a student obtains a value of 8.42 g/cm^3 for the density of Cu?

Practice

- The accepted density of gold (Au) is 19.3 g/cm^3. A student measures the following densities for 3 samples of Au: A: 19.0 g/cm^3, B: 19.7 g/cm^3 and C: 19.1 g/cm^3. Which measurement is most accurate?

- C is the most accurate measurement since _____.

IV. SIGNIFICANT FIGURES IN MEASUREMENTS

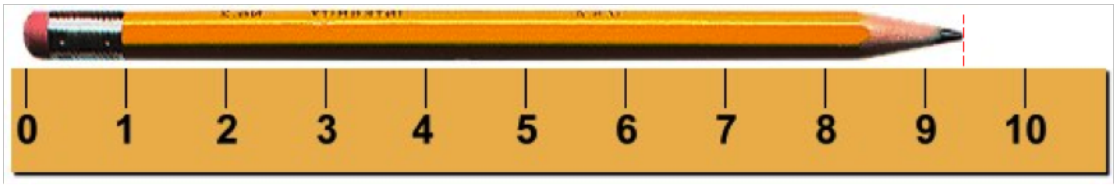
Follow along and complete these notes as you view video "#4: Significant Figures in Measurements" at https://edpuzzle.com.

Precision in Measurements

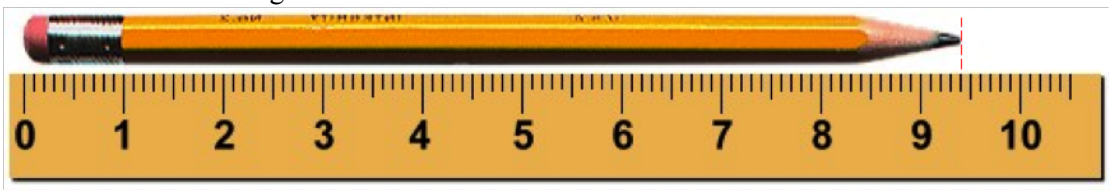
- Measurements (3.25 cm) are different from other numbers (3.14159265, 25 students).
  - Measurements represent _____.
  - Measurements have _____
  - _____ is exact.
  - This uncertainty is the result of _____ in reading the measuring device
  - The *amount of the uncertainty* (precision) depends on how fine the markings (calibrations) are on the measuring device
- Measurements have _____.

- The uncertainty in a measurement needs to be communicated.
  - Significant figures explicitly show _____
  - Read to the _____,
    then _____
  - For electronic equipment, such as our balances, the last digit is _____, which is why it often fluctuates (varies)
  - In the following measurement, the ruler is marked to 10 cm divisions. It is read to the _____, which is estimated.

    The most precisely you can read the length of the pencil is _____.
  - This ruler is marked to 1 cm divisions. By adding calibrations at 1 cm intervals, you add a level of precision to the ruler and can read the length of the pencil to _____:



    Now the scientist is *certain* about the 9 and can estimate one more place, so she can report the length as 9.4 cm. Notice that some people might disagree and read it as 9.3 cm or 9.5. This is the random error in the measurement. The 9 is certain and the 0.3, 0.4, or 0.5 is *estimated*, giving us _____.
  - This ruler is marked to 0.1 cm divisions. It is estimated to the _____. This is the precision in the measurement of length that we will use in class:

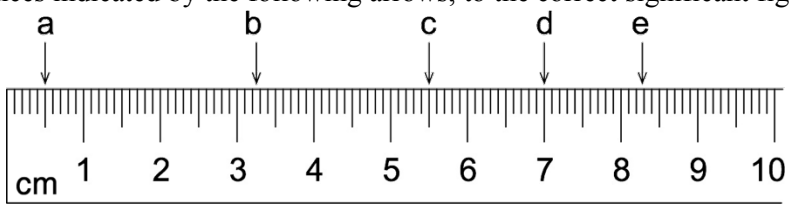


    Now you can be *certain* of the 9.4 and we must estimate to the 0.01 cm. Thus you may say 9.42 cm, 9.43 cm, or 9.44 cm. Thus the 9 and 0.4 are certain, and the 0.02, 0.03, or 0.04 are estimated, giving us _____.
- As the size of the divisions _____, the precision of the measurement and the number of sig figs _____

WARNING!! If you do not use the correct number of significant figures in your answer on labs, quizzes & tests, you will be ZAPPED with a small, but significant deduction! So, be sure you use the rules...they really are significant!

Practice:

- Determine the distances indicated by the following arrows, to the correct significant figures:



Determining The Number Of Significant Figures

- All _____ ARE significant (assume these #s represent _____)

  504 83401 200.002 6001

- If a decimal point is _____, the _____ is the most significant figure. Digits _____ (precision of measurement)
  - Any zeroes to the left are _____, used to maintain the correct size of the number
  - Important to value but not significant (not precision)

    0.0023 0.0000901 0.00000003 0.0517

  - Any zeroes after the last non-zero digit _____
    - Adding another zero would not change the size of the number, so it would be for precision

      25.0 340.20 0.0006200 100.

- With _____, zeroes after the last non-zero digit are only _____
  - Adding another zero would change the size of the number

    70 12,000 801,000 240,090

  - For numbers in scientific notation, _____ (not the exponent) are significant (there is a dec. pt.)

    3.0×10^{3} 8.090×10^{-12} 4.0000×10^{24} 1.70×10^{125}

  - _____ and _____ (e.g. conversion factors or standard values) are exact numbers with _____ significant figures
    - 12 eggs, 100 pencils, $1,200
    - 12 in/ft, 1000 mg/g, 16 oz/lb

You Practice

Determine the number of sig figs in each of the following numbers.

VALUE	SF	VALUE	SF
250 cm		0.00009 s	
3.99 kg		9.8801 L	
0.0045 g		100 forks	
4000 km		4.0×10^{-3} g	
100 cg/g		4.00×10^{-3} cm^3	