As you enter

1. **Under "entry", choose a physical, intensive property of matter and explain why it's physical and intensive rather than chemical and extensive.**
2. **When you're finished with your entry work, add the following pages to your notebook:**
   - P.9: Notes: Significant Figures and Scientific Notation
   - P. 10 & 11: Using Measurements Worksheet
   - P. 12 More Significant Figures & Scientific Notation
   - P. 13 Quiz 1.2
   - P. 14: Unit Conversion Lab
3. **Your homework for next class will be to finish your unit vocabulary definitions and study for Quiz 1.2**

The plan for today

1. Accuracy and Precision.
2. “Using Measurements” worksheet
3. Significant Figures
4. Scientific Notation

The plan for today

1. **Accuracy and Precision.**
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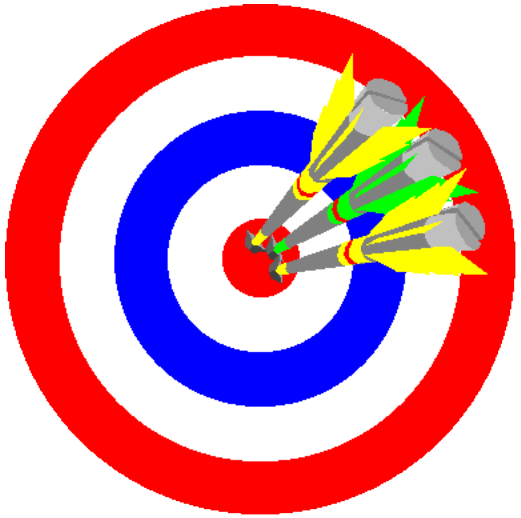
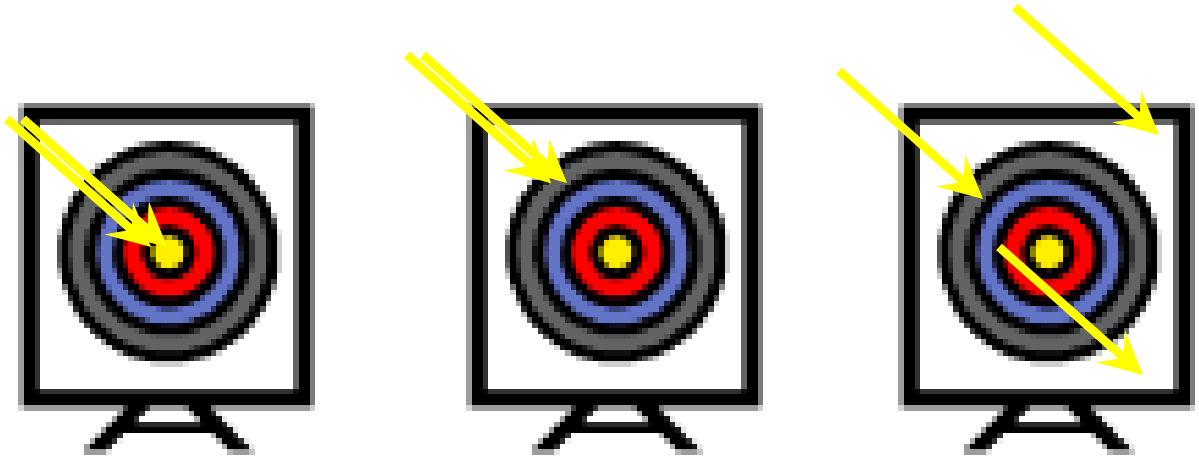
Accuracy & Precision

p. 8



Can you hit the bull's-eye?

Three targets with three arrows each to shoot.



How do they compare?

Both accurate and precise

Precise but not accurate

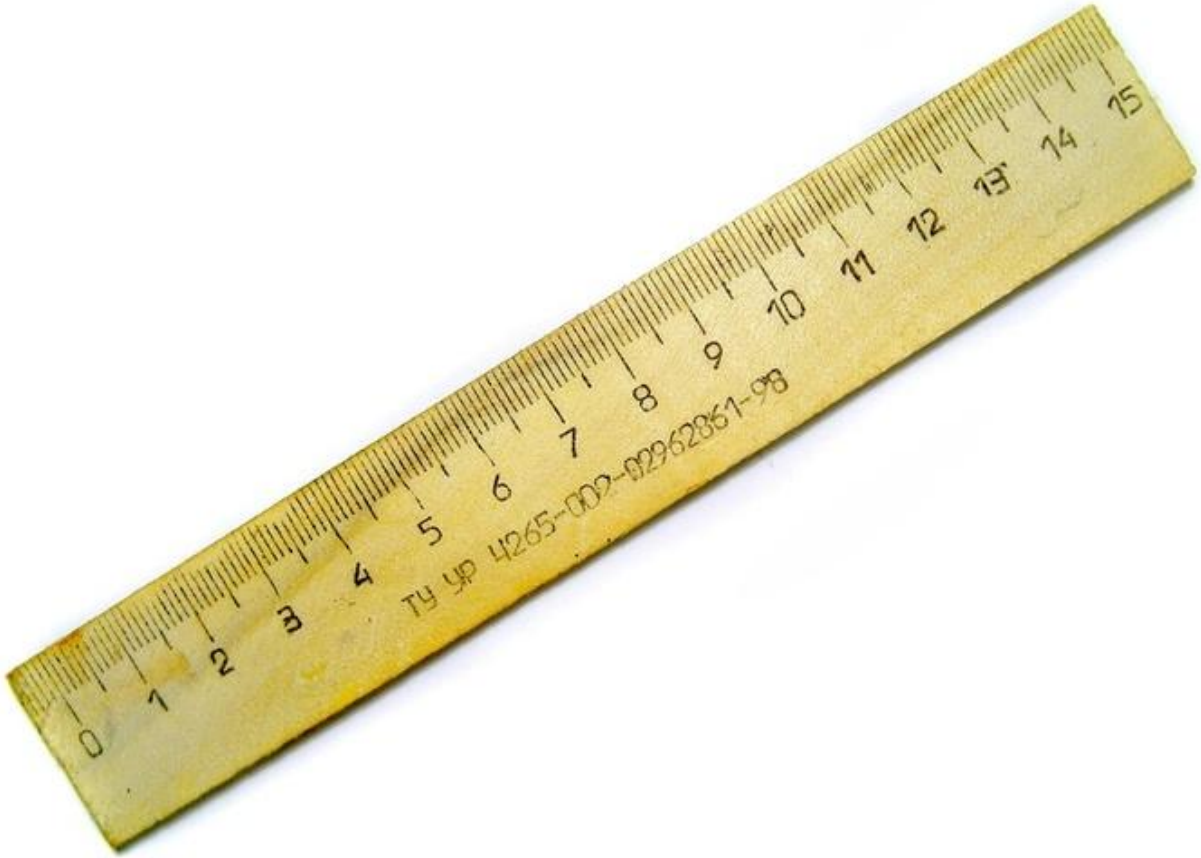
Neither accurate nor precise

Can you define accuracy and precision?

- Accuracy: how close you are to getting the CORRECT answer

- Precision: how often repeated measurements show the same answer.

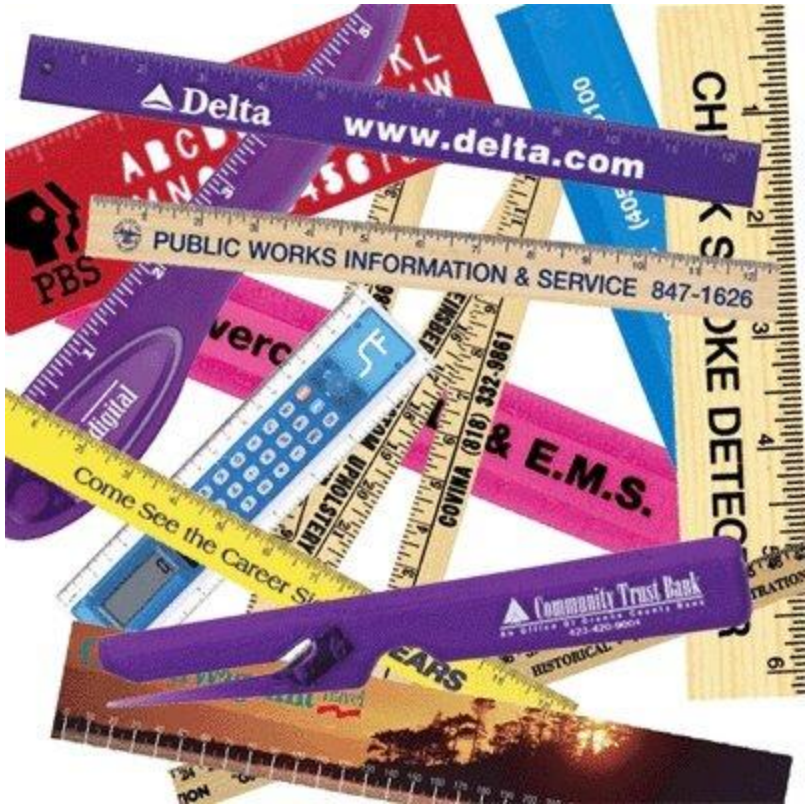
Measuring Precisely



Which measurement tool is the most precise?

- Using a ruler, measure the width of your table in centimeters.

- When you are done, come write your answer up on the board!!!!



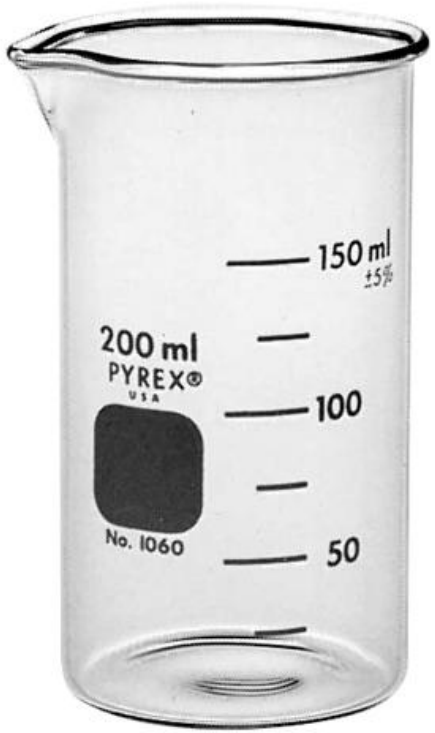
Which measurement tool is the most precise?

- Measuring tools with the most tick marks are the most precise, because they allow us to estimate the more digits past the decimal place.

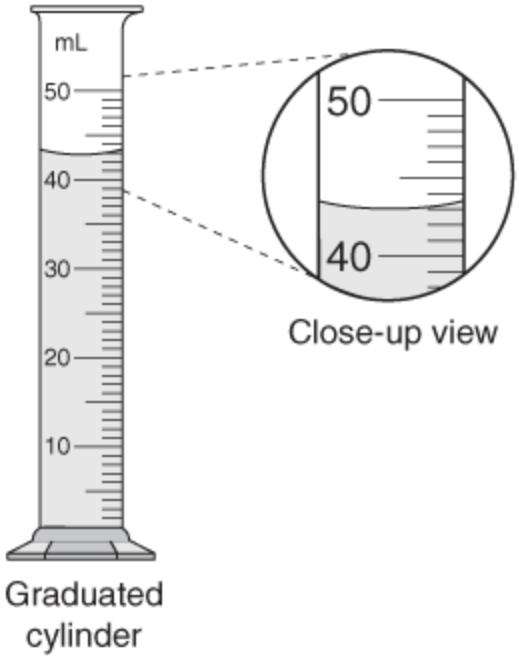
- MORE TICK MARKS = MORE PRECISE

Which piece of equipment would you rather use to measure out 30mL of water precisely?

A)



B)



Measuring Precisely

- The numbers reported in a measurement are limited by the measuring tool
- Significant figures in a measurement include the known digits plus one estimated digit
- Always estimate ONLY ONE number place past the smallest tick mark

Reading a Meterstick

. I^2. . . . I . . . . I^3 . . . .I . . . . I^4. . cm

First digit (known)	= 2	2.?? cm
Second digit (known)	= 0.6	2.6? cm
Third digit (estimated) between 0.05- 0.07		
Length reported	=	2.65 cm
	or	2.64 cm
	or	2.66 cm

“Known” & “Estimated” Digits

In 2.76 cm…

- Known digits 2 and 7 are 100% certain (there are TICK MARKS to represent them!)

- The third digit 6 is estimated (no tick mark)

- In the reported length, all three digits (2.76 cm) are significant including the estimated one

Learning Check!

. I^{8}. . . . I . . . . I^{9}. . . .I . . . . I^{10}. . cm

What is the length of the line?

A) 9.9 cm

B) 9.92 cm

C) 9.93 cm

How does your answer compare with your neighbor's answer? Why or why not? Can I guess 9.9245676 cm? Why or why not?

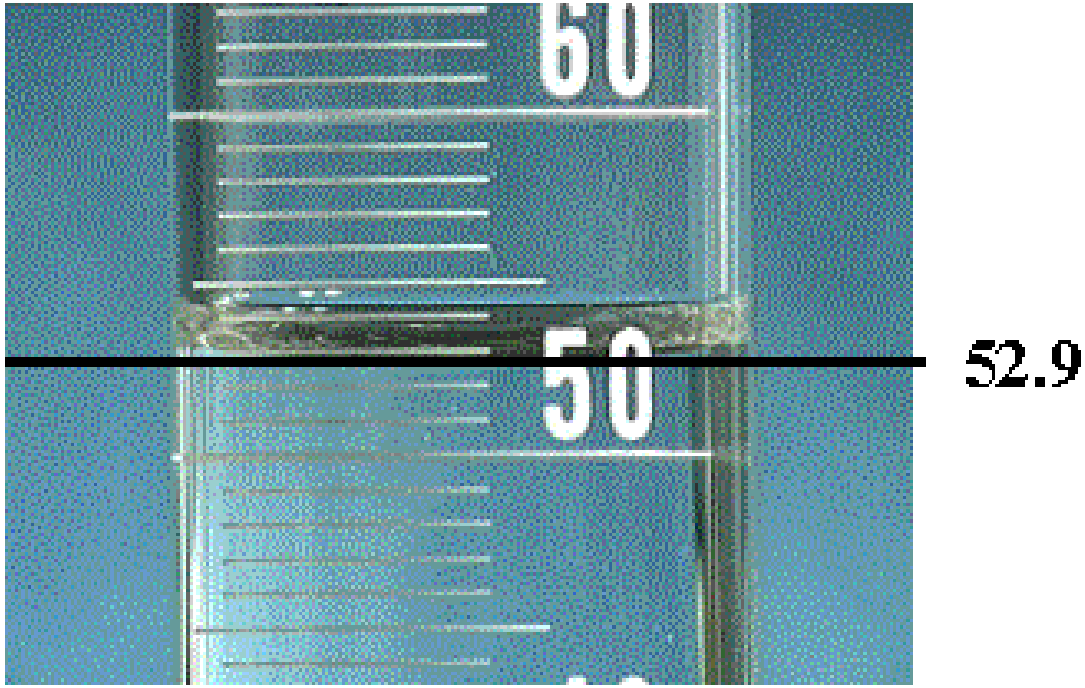
It's OK to use a Zero as your estimated digit!

. I^3. . . . I . . . . I^4 . . . . I . . . . I^5. . cm

What is the length of the line?

First digit	5.?? cm
Second digit	5.0? cm
Last (estimated) digit is	5.00 cm

Always estimate ONE place past the smallest mark!



The plan for today

1. Accuracy and Precision.
2. **“Using Measurements” worksheet**
3. Significant Figures
4. Scientific Notation

The plan for today

1. Accuracy and Precision.
2. “Using Measurements” worksheet
3. **Significant Figures**
4. Scientific Notation

Significant Figures

Counting Significant Figures

RULE 1. All non-zero digits in a measured number are significant. Only a zero could indicate that rounding occurred.

	Number of Significant Figures
38.15 cm	4
5.6 ft	2
65.6 lb	___
122.55 m	___

Leading Zeros

RULE 2. Leading zeros in decimal numbers are NOT significant.

	Number of Significant Figures
0.008 mm	1
0.0156 oz	3
0.0042 lb	____
0.000262 mL	____

Sandwiched Zeros

RULE 3. Zeros between nonzero numbers are significant. (They can not be rounded unless they are on an end of a number.)

	Number of Significant Figures
50.8 mm	3
2001 min	4
0.702 lb	____
0.00405 m	____

Trailing Zeros

RULE 4. Trailing zeros in numbers without decimals are NOT significant. They are only serving as place holders.

	Number of Significant Figures
25,000 in.	2
200. yr	3
48,600 gal	____
25,005,000 g	____

Learning Check

A. Which answers contain 3 significant figures?

1) 0.4760 2) 0.00476 3) 4760

B. All the zeros are significant in

1) 0.00307 2) 25.300 3) 2.050×10^3

C. 534,675 rounded to 3 significant figures is

1) 535 2) 535,000 3) 5.35×10^5

Learning Check

In which set(s) do both numbers contain the *same* number of significant figures?

1) 22.0 and 22.00
2) 400.0 and 40
3) 0.000015 and 150,000

Learning Check

State the number of significant figures in each of the following:

A. 0.030 m	1	2	3
B. 4.050 L	2	3	4
C. 0.0008 g	1	2	4
D. 3.00 m	1	2	3
E. 2,080,000 bees	3	5	7

Significant Numbers in Calculations

- A calculated answer cannot be more precise than the measuring tool.
- A calculated answer must match the least precise measurement.
- Significant figures are needed for final answers from
    1) adding or subtracting
    2) multiplying or dividing

Adding and Subtracting

The answer has the same number of decimal places as the measurement with the fewest decimal places.

	25.2	*one decimal place*
+	1.34	*two decimal places*
	26.54	

answer 26.5 *one decimal place*

Learning Check

In each calculation, round the answer to the correct number of significant figures.

A. 235.05 + 19.6 + 2.1 =

1) 256.75 2) 256.8 3) 257

B. 58.925 - 18.2 =

1) 40.725 2) 40.73 3) 40.7

Multiplying and Dividing

Round (or add zeros) to the calculated answer until you have the same number of significant figures as the measurement with the fewest significant figures.

Learning Check

A. 2.19 X 4.2 =

1) 9 2) 9.2 3) 9.198

B. 4.311 ÷ 0.07 =

1) 61.58 2) 62 3) 60

C. $\frac{2.54 \text{ X } 0.0028}{0.0105 \text{ X } 0.060}$ =

1) 11.3 2) 11 3) 0.041

Rounding off

- When the answer to a calculation contains too many significant figures, it must be rounded off.
- If the digit is smaller than 5, drop this digit and leave the remaining number unchanged. Thus, 1.684 becomes 1.68.
- If the digit is 5 or larger, drop this digit and add 1 to the preceding digit. Thus, 1.247 becomes 1.25.

The plan for today

1. Accuracy and Precision.
2. “Using Measurements” worksheet
3. Significant Figures
4. **Scientific Notation**

SCIENTIFIC NOTATION

Types of Observations and Measurements

- We make QUALITATIVE observations of reactions — changes in color and physical state.
- We also make QUANTITATIVE MEASUREMENTS, which involve numbers.
  - Use SI units — based on the metric system

What is Scientific Notation?

- Scientific notation is a way of expressing really big numbers or really small numbers.
- For very large and very small numbers, scientific notation is more concise.

Scientific notation consists of two parts:

- A number between 1 and 9
- A power of 10

$$N \times 10^{x}$$

To change standard form to scientific notation…

- Place the decimal point so that there is one non-zero digit to the left of the decimal point.
- Count the number of decimal places the decimal point has “moved” from the original number. This will be the exponent on the 10.
- If the original number was less than 1, then the exponent is negative. If the original number was greater than 1, then the exponent is positive.

Examples

- Given: 289,800,000
- Use: 2.898 (moved 8 places)
- Answer: 2.898×10^{8}

- Given: 0.000567
- Use: 5.67 (moved 4 places)
- Answer: 5.67×10^{-4}

To change scientific notation to standard form…

- Simply move the decimal point to the right for positive exponent 10.
- Move the decimal point to the left for negative exponent 10.

(Use zeros to fill in places.)

Example

- Given: 5.093×10^{6}
- Answer: 5,093,000 (moved 6 places to the right)

- Given: 1.976×10^{-4}
- Answer: 0.0001976 (moved 4 places to the left)

Learning Check

- Express these numbers in Scientific Notation:

1) 405789
2) 0.003872
3) 3000000000
4) 2
5) 0.478260

Before you leave

1. Write down your homework:
   - finish your unit vocabulary definitions
   - study for Quiz 1.2
2. Under “exit” explain why a scientist would want to use significant figures correctly when recording a number.
3. Feed your entry/exit sheet to the basket on your way out.
4. Have a groovy day.