

Do Now: Solve the following problems using the unit conversions (dimensional analysis) technique. SHOW WORK!

1. You have \$300.00 in gas money to spend on a vacation. If your car gets 32km/liter and current gas prices average \$1.15 per liter, how far can you drive?

2. Your parents have offered to buy pizzas for you and your friends. You are having 8 friends over and each will eat 2.0 pieces of pizza. Each pizza has eight slices and costs \$10.99. How much money will your parents have to spend on pizza?

3. You get paid \$7.00 per hour working at a restaurant. You want to buy a car that costs \$9500. If you work an average of 15 hours a week, how long will it take you to earn the money to buy the car?

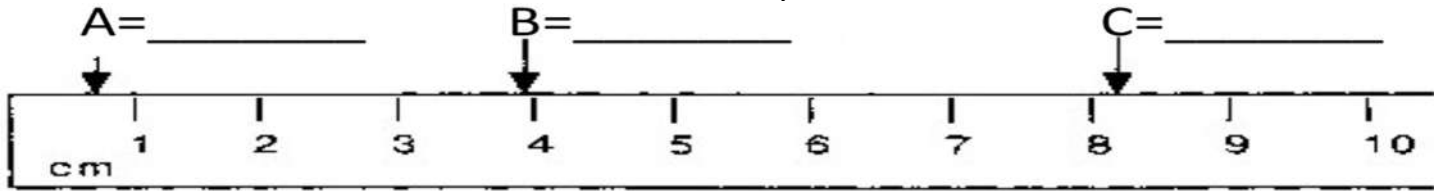
4. Precious metals and gems are measured in troy weights in the English system:
24 grains = 1 pennyweight 20 pennyweights = 1 troy ounce
12 troy ounces = 1 troy pound 1 grain = 0.0648 gram
The most common English unit of mass is the troy pound. What is 2.0 troy pounds in kilograms?

5. How much would it cost to buy nails used to build a fence 125m long if it requires 30 nails per meter? Assume that 50 nails are sold per box at a cost of \$0.75 per box.

Making Measurement & Estimating the Last Digit: When using tools with graduated “tick marks”, you should _____

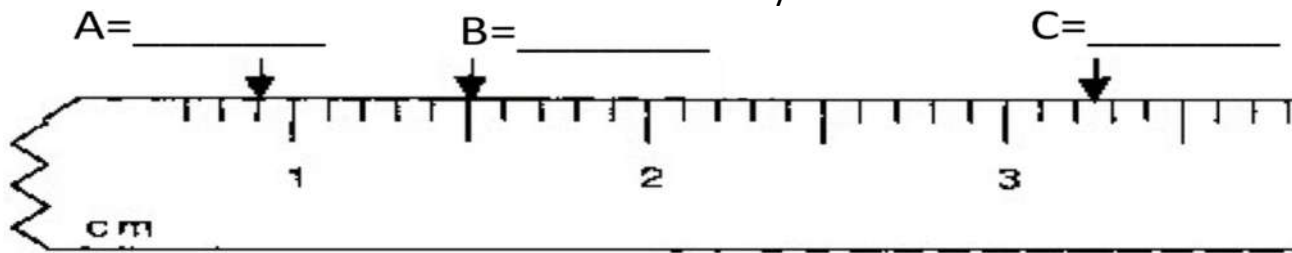
Practice: Reading a Ruler

1. Estimate the number of centimeters indicated by each of the arrows below.



***Each “tick mark” is worth _____, therefore estimate to the nearest _____

2. Estimate the number of centimeters indicated by each of the arrows below.

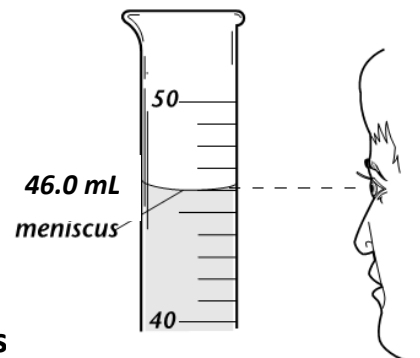


***Each “tick mark” is worth _____, therefore estimate to the nearest _____

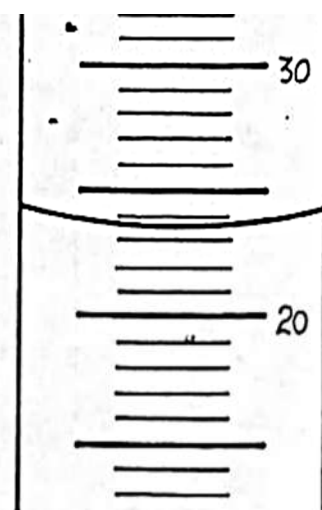
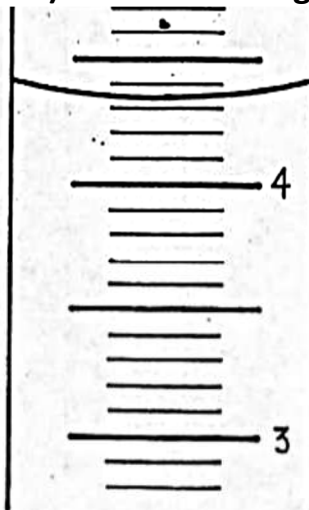
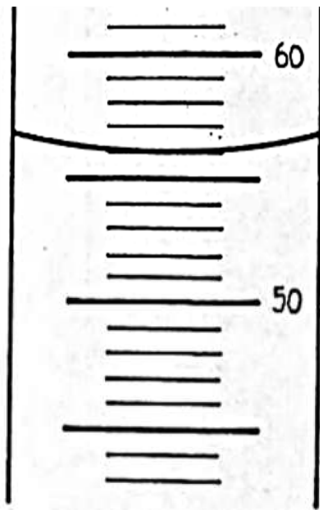
Reading Graduated Cylinders:

*Liquids form a curved surface when in graduated cylinders.

As a standard, you should read the liquid level from the _____



Practice: Estimate the volume (in mL) in the following cylinders



Significant Figures:

- When we make measurements, we are limited by the measuring tool. We can only state values in a measurement that we are sure are correct.
- With each measurement, there is a degree of uncertainty/estimation beyond the markings
- The last digit in a measurement is called the **uncertain digit**
- **Significant figures include** _____
- The _____ significant figures, the _____ precise the instrument

Rules for Counting Number of Significant Figures



<p>1. _____ (1,2,3,4,5,6,7,8,9) are ALWAYS significant 15=2 sig figs 145=3 sig figs</p> <p>2. 0's between nonzero digits (_____) are ALWAYS significant 105=3 sig figs 5005=4 sig figs</p> <p>3. 0's to the left of the first nonzero are NOT significant 0.0005=1 sig fig 0.0505=3 sig figs</p> <p>4. If there is a _____, the _____ of the number are ALWAYS SIGNIFICANT 9010.0 = 5 sig figs</p> <p>5. If there _____, the 0's at the end of the number DO NOT count! 91010 = 4 sig figs</p> <p>6. For scientific notation, only count the sig figs for the decimal part (not the $\times 10^n$ part) $3.6 \times 10^5 = 2$ sig figs</p>	<p>"Pacific-Atlantic Method"</p> <p>P = Pacific = Present If the decimal point is _____, start counting digits from the _____ _____ starting with the first non-zero digit. → 1 2 3 0.00310 (3 sig. figs.)</p> <p>A = Atlantic = Absent If the decimal point is _____, start counting digits from the _____ _____ starting with the first non-zero digit. 3 2 1 ← 31,400 (3 sig. figs.)</p>
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Practice: Underline the significant digits and indicate how many significant figures are in each number

- | | | |
|----------------|--------------------|----------------------------|
| 1) 1234 _____ | 4) 91010 _____ | 7) 0.00120 _____ |
| 2) 0.023 _____ | 5) 9010.0 _____ | 8) 3.4×10^4 _____ |
| 3) 890 _____ | 6) 1090.0010 _____ | 9) 9.0×10^3 _____ |

Calculations and Rounding with Significant Figures

- Adding and Subtracting:** Count the number of _____.
Round the final answer to the _____.

$$\begin{array}{r} 89.332 \leftarrow 3 \text{ digits after decimal point} \\ +1.1 \leftarrow 1 \text{ digit after decimal point} \\ \hline 90.432 \leftarrow \text{Raw answer} \end{array}$$

90.4 ← Rounded answer, 1 digit after decimal point

$$\begin{array}{r} 3.70 \leftarrow 2 \text{ digits after decimal point} \\ -2.9133 \leftarrow 4 \text{ digits after decimal point} \\ \hline 0.7867 \leftarrow \text{Raw answer} \end{array}$$

0.79 ← Rounded answer, 2 digits after decimal point

***Don't round your answer until the very end!**

Original Problem	Raw Answer	Final Answer w/ Proper Sig Figs and Units
3.482 cm + 8.51 cm + 16.324 cm		
48.0032 g + 9.17 g + 65.4321 g		
80.4 cm - 16.532 cm		
106.5 mL - 30. mL		

- Multiplying and Dividing:** Count the number of _____.
Round the final answer to the _____.

$$\begin{array}{c} 4.51 \times 3.6666 = 16.536366 = 16.5 \\ \uparrow \quad \uparrow \quad \uparrow \\ 3 \text{ sig figs} \quad 5 \text{ sig figs} \quad \text{round to} \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad 3 \text{ sig figs} \end{array}$$

$$\begin{array}{c} 6.8 \div 112.04 = 0.0606926 = 0.061 \\ \uparrow \quad \uparrow \quad \uparrow \\ 2 \text{ sig figs} \quad 5 \text{ sig figs} \quad \text{round to} \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad 2 \text{ sig figs} \end{array}$$

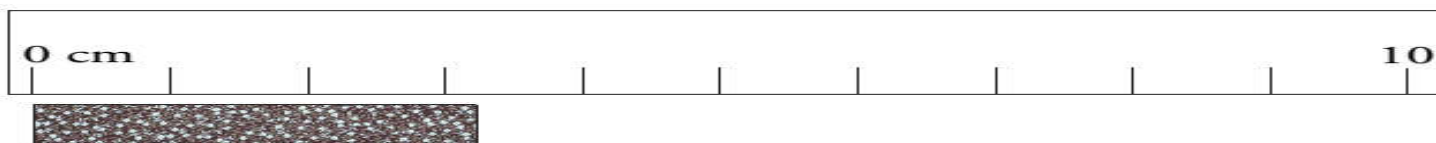
***Don't round your answer until the very end!**

***This rule doesn't apply for calculating averages (i.e. when dividing by 3 to find the avg of 3 measurements)**

Original Problem	Raw Answer	Final Answer w/ Proper Sig Figs and Units
48.2 cm × 1.6 cm × 2.12 cm		
8.3 m × 4.0 m × 0.9823 m		
64.34 cm ³ ÷ 8.149 cm		
4.93 mm ² ÷ 18.71 mm		

Pre-Lab Questions

1.



How does the value of each “tick mark” on a measurement tool determine how many decimal places you need to report your answer? Explain your answer using the ruler and block shown above.

2. What is meant by the “Pacific-Atlantic” Rule for counting significant figures?

3. What is the rule for rounding calculated answers to the proper number of significant figures when adding/subtracting?

4. What is the rule for rounding calculated answers to the proper number of significant figures when multiplying/dividing?

Task 1: Balances

a. Mass of object “A” _____ g b. Mass of object “B” _____ g

- **Calculation:** Add the masses.

Original Problem. Label Sig Figs!	Raw Answer	Final Ans w/ Proper # of Sig figs & units

Task 2: Rulers

- a. Look at ruler A. What is each little tick mark worth? _____
b. What decimal place do you need to estimate your measurement to? _____
c. Read the length and report your measurement using the correct number of significant figures

Length of object "A" _____ cm

- d. Look at ruler B. What is each little tick mark worth? _____
e. What decimal place do you need to estimate your measurement to? _____
f. Read the length and report your measurement using the correct number of significant figures

Length of object "B" _____ cm

- **Calculation:** Multiply "A" and "B".

Original Problem. Label Sig Figs!	Raw Answer	Final Ans w/ Proper # of Sig figs & units

Task 3: Graduated Cylinders:

- a. Look at graduated cylinder A. What is each little tick mark worth? _____
b. What decimal place do you need to estimate your measurement to? _____
c. Read the volume and report your measurement using the correct number of significant figures

Meniscus reading for graduated cylinder "A" _____ mL

- d. Look at graduated cylinder B. What is each little tick mark worth? _____
e. What decimal place do you need to estimate your measurement to? _____
f. Read the volume and report your measurement using the correct number of significant figures

Meniscus reading for graduated cylinder "B" _____ mL

- **Calculation:** Subtract the volumes in the graduated cylinders.

Original Problem. Label Sig Figs!	Raw Answer	Final Ans w/ Proper # of Sig figs & units