Name: _____ Class: _____ Date: _____

Measuring With Significant Digits

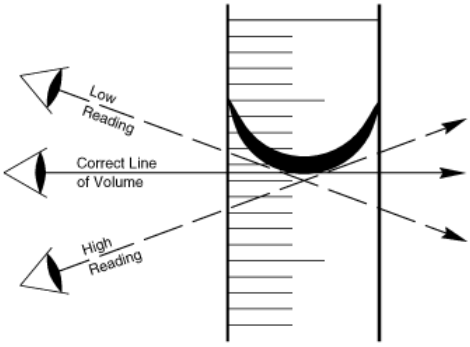
Introduction

All scientific conclusions are based in measurements and observations. In the case of quantitative measurements, scientists try to be as accurate as possible. **Accuracy** is the closeness of a measurement to its true or actual value.

Volume

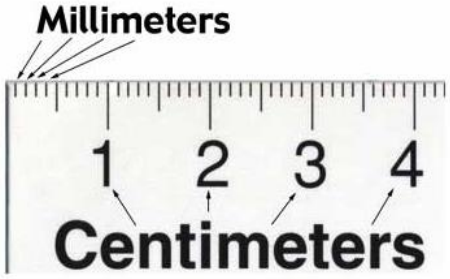
Volume is measured with graduated cylinders. When a liquid is poured inside, it forms a meniscus, or a curve at the top of the liquid. There are two important rules in reading a meniscus accurately:

- Measurements must be taken from the bottom of the meniscus.
- You must look at the meniscus from eye level.



Length

Length is measured with a ruler or meter stick. In this class, the numbered lines will represent centimeters, while the smaller un-numbered lines are millimeters.



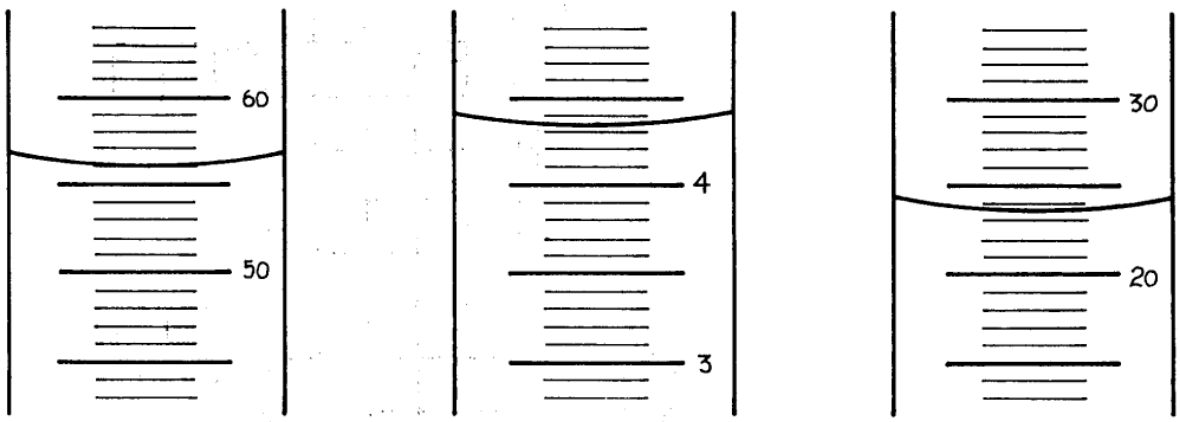
Significant Figures

In a measurement, **significant figures** consist of the *digits definitely known + one estimated digit*.

In the example above, measurement A is definitely beyond the 7cm mark and the 0.8cm mark. By looking carefully, we can estimate that the measurement is halfway between 7.8cm and 7.9cm, so the final measurement is 7.85cm. This measurement has *three significant digits*.

How would you record measurement B with three significant digits? _____

Practice recording accurate measurements with the three graduated cylinders shown below. Remember to follow the rules of recording volume. Assume all units are milliliters (mL).



a) _____ b) _____ c) _____

How many significant digits does each of these measurements have? _____

Rules for Zeroes

In any measurement, any non-zero numbers are always considered significant. However, this is not always the case with zeroes.

Example #1: 0.085m
This measurement only has <u>two</u> significant figures; the 8 and 5. The two zeroes are not considered significant because they are *place holders*. If the measurement was written in centimeters, it would be 8.5cm.

Example #2: 4000mL
This measurement only has <u>one</u> significant figure; the 4. The three zeroes at the end are also place holders. The measurement could be re-written as 4L.

Example #3: 5.09s
<u>All three</u> digits in this measurement are significant. The zero is not a place holder, it is actually part of the accuracy of the measurement. Even if the time was measured in a different unit(such as 509ms), the zero would still be there.

Rules for Determining Significant Figures
1. **All non-zero digits** are significant.
2. **Zeros to the <u>left</u> of non-zero digits** are NEVER significant.
3. **Zeros <u>between</u> non-zero digits** are ALWAYS significant.
4. **Zeros to the <u>right</u> of non-zero digits** are significant ONLY if a decimal point is shown.
5. **Defined values** have an infinite number of significant digits.

Practice Problems

1. Indicate the number of significant figures in each of the following measurements:

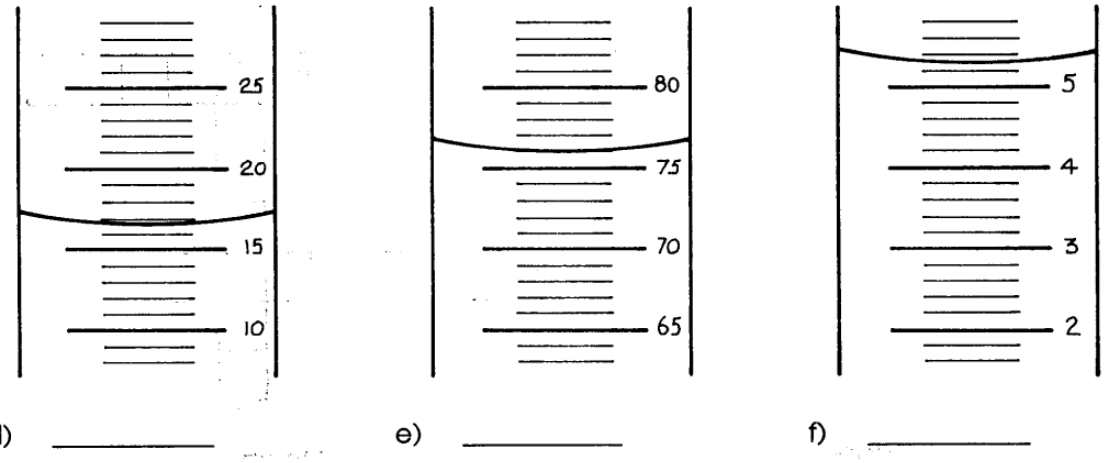
a. 0.0410cm	d. 0.020 mL	g. 200.0g
b. 12 inches in a foot	e. 2,403 feet	h. 2,000 miles
c. 10 pounds	f. 80.5300m	i. $2.4x10^3$ kg

2. Round the following to **three** significant figures.

a. 3.478m _____ b. 4.8055cm _____

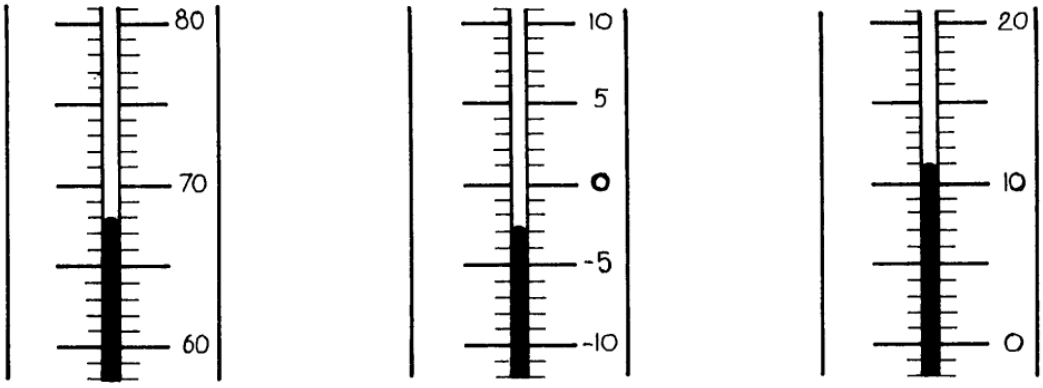
c. 5.333g _____ d. 7.999L _____

3. Record each of the following measurements of volume with the correct number of significant digits.



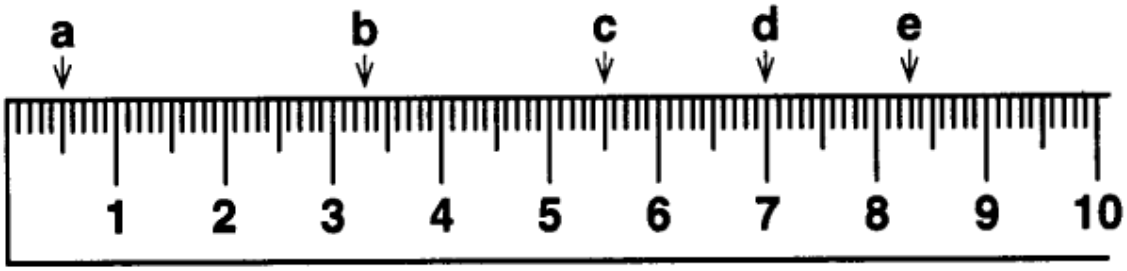
d) _____ e) _____ f) _____

4. Record each of the following measurements of temperature with the correct number of significant digits.



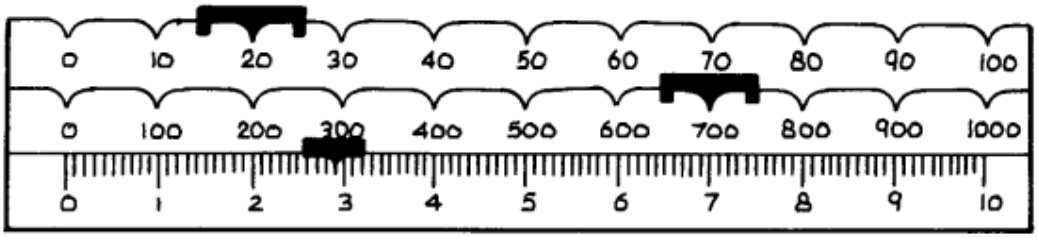
a) _____ b) _____ c) _____

5. Record each of the following measurements of length in both centimeters and millimeters. Use the correct number of significant digits.

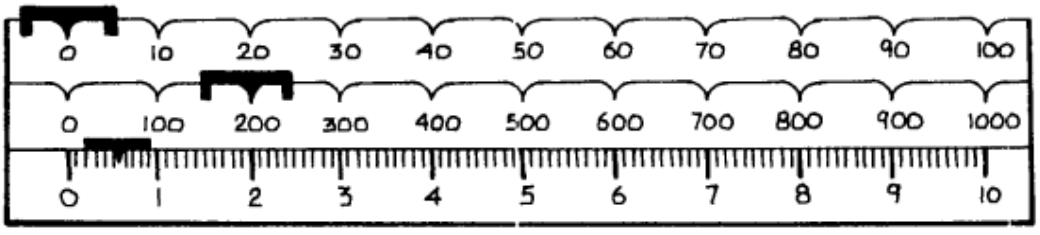


Marker	Length in cm	Length in mm
a		
b		
c		
d		
e		

6. Record the mass taken by each of these triple beam balances shown below. Use the correct number of significant digits. The unit is grams.



a. _____



b. _____