Measurement PPt

- Using a sheet of paper, take notes on this PowerPoint, and complete the indicated assignments.
- Note pages are indicated by Notes
- Calculations or answer pages by 1
- Once finished, hand in your calculaitons and answers pages.
- You may work with a partner, but each of you must hand in an assignment.

Chapter 1 "*Scientific Measurement*"

Courtesy of:

Charles Page High School

Chemistry

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*www.cottonchemistry.bizland.com/.../Chapter%203%20**Scientific**%20**Measurement**.ppt -*

Measurements and Their Uncertainty

- OBJECTIVES:
  - Convert measurements to scientific notation.

Measurements and Their Uncertainty

- OBJECTIVES:
  - Distinguish among accuracy, precision, and error of a measurement.

Measurements

Notes

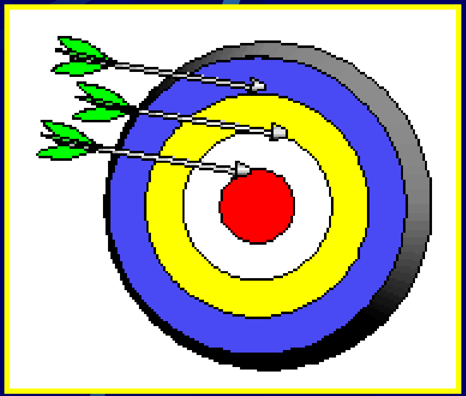
- We make measurements every day: buying products, sports activities, and cooking
- **Qualitative** measurements are *words*, such as heavy or hot
- **Quantitative** measurements involve *numbers* (quantities), 10cm, 1.5sec, $3.4x10^4$ *kg*.
- **Scientific Notation**
  - Coefficient raised to power of 10 (ex. 3.4×10^4)
  - $3.4 \times 10^4 = 34000.0$ (Decimal place moves 4 to the right)
  - $3.4 \times 10^{-4} = 0.00034$ (Decimal place moves 4 to the left)
  - Review: Textbook pages 14 & 15

Accuracy, Precision, and Error

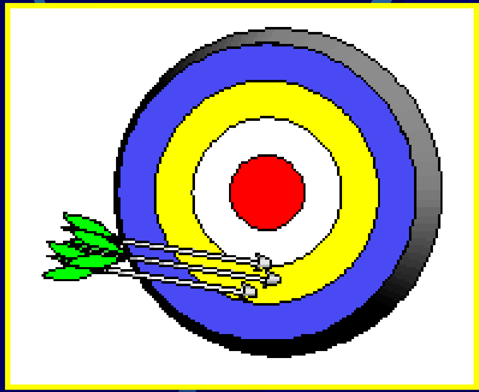
Notes

- It is necessary to make good, reliable measurements in the lab
- Accuracy – how close a measurement is to the true value
- - low level of uncertainty in measurement.
- Precision – how close the measurements are to each other (reproducible)

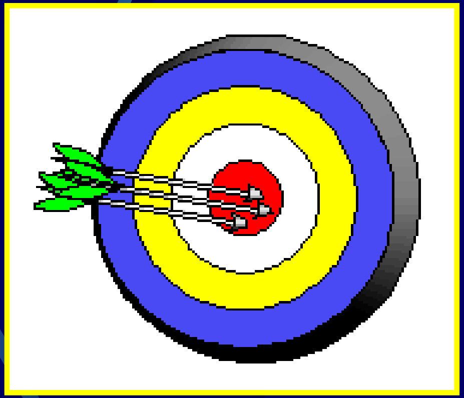
Precision and Accuracy



Neither accurate nor precise



Precise, but not accurate



Precise AND accurate

How often is this clock accurate?

1

Accuracy, Precision, and Error

Notes

- Accepted value = the correct value based on reliable references
- Experimental value = the value measured in the lab

Accuracy, Precision, and Error

Notes

- - Error describes how accurate your measurement can possibly be.
- - For any measuring device, error is ± 1/2 of the smallest division on the device.
  - A thermometer has an error of:

$\pm \frac{1}{2}\,^{o}C$

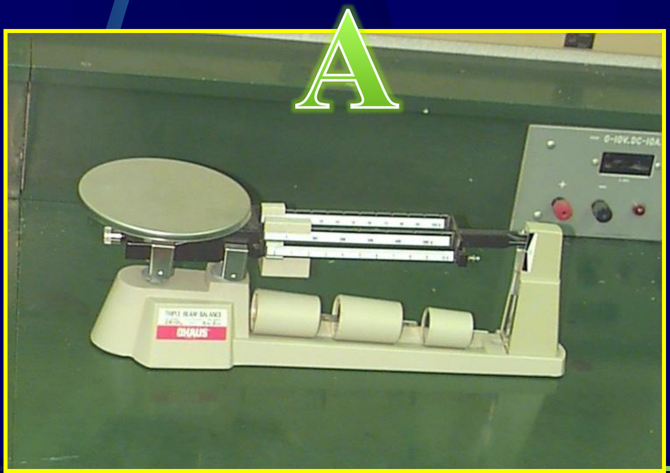
What is the accepted error on this flask?

2

Why Is there Uncertainty?

- Measurements are performed with <u>instruments</u>, and no instrument can read to an infinite number of decimal places
- *Which of the balances below* has the greatest uncertainty in measurement?

3



Rounding Calculated Answers

- **<u>Rounding</u>**

  For Mr. Rita's class, you will round all measurements and calculations to no more than 2 decimal places.

Rounding Practice

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Calculation	Rounded Numeric Answer:
a. 3.24 m x 7.2 m	
b. 1.52 g ÷ 23.7 cm^3	
c. 0.02 cm x 2.37 cm	
d. 710 m ÷ 3.0 s	
e. 1818.2 lb x 3.23 ft	
f. 1.030 g ÷ 2.87 mL	

The International System of Units

- OBJECTIVES:
  - List SI units of measurement and common SI prefixes.

The International System of Units

- OBJECTIVES:
  - Distinguish between the ***mass*** and ***weight*** of an object.

The International System of Units

- OBJECTIVES:
  - Convert between the Celsius and Kelvin temperature scales.

International System of Units (SI)

- Measurements depend upon units that serve as reference standards
- The standards of measurement used in science are those of the Metric System (SI)

International System of Units

- Metric system is now revised and named as the International System of Units (SI), as of 1960
- It has simplicity, and is based on 10 or multiples of 10
- **7 base units**, but only five commonly used in chemistry: meter, kilogram, kelvin, second, and mole.

The Fundamental SI Units (Le Système International, SI)

Physical Quantity	Name	Abbreviation
Length	Meter	m
Mass	Kilogram	kg
Temperature	Kelvin	K
Time	Second	s
Amount of substance	Mole	mol
Not commonly used in chemistry:		
Luminous intensity	Candela	cd
Electric current	Ampere	A

Notes

SI Prefixes – Page 17 Common to Chemistry

Prefix	Abbrev.	Meaning	Exponent
Mega	M	1,000,000	10^6
			10^5
			10^4
Kilo	K	1000	10^3
Hecto	H	100	10^2
Deka	Dk	10	10^1
Base Unit		1	10^0
Deci	d	1/10	10^{-1}
Centi	c	1/100	10^{-2}
Milli	m	1/1000	10^{-3}
			10^{-4}
			10^{-5}
Micro	µ	1/1,000,000	10^{-6}

Notes

Nature of Measurements

Measurement - quantitative observation consisting of <u>2 parts</u>:

Notes

- Part 1 – **number**
- Part 2 – unit
  - All measurements must have a unit! (no “naked” numbers)
- Examples:
  - **20** grams
  - **6.63×10^{-34}** Joule seconds

Length

Notes

- In SI, the basic unit of length is the **meter** **(m)**
  - Length is the distance between two objects – measured with ruler
- We make use of prefixes for units larger or smaller

Volume

- The space occupied by any sample of matter.

Notes

- Calculated for a solid by multiplying the length x width x height; thus derived from units of length.
- SI unit = **cubic meter** **(m^3)**
- Everyday unit = Liter (L),

(Note: 1mL = 1cm^3)

Devices for Measuring Liquid Volume

- Graduated cylinders
- Pipets
- Burets
- Erlenmeyer Flasks
- Syringes

Units of Mass

Notes

- **Mass** is a measure of the quantity of matter present
  - *Weight* is a force that measures the pull by gravity- it changes with location
- Mass is constant, regardless of location

True or False?

If false, re-write so it's true.

a. The speed limit on Evergreen Rd. is 35.

b. A beaker measures mass.

c. 1 cm^3 is equal to 1 ml.

d. The base unit for mass is the gram

e. Our mass changes when we go to the moon.

f. The metric system is based on 10.

Working with Mass

Notes

- The SI unit of mass is the **kilogram (kg),** even though a more convenient everyday unit is the gram (Gram is to small to express)
- Measuring instrument is the balance scale

Kg to g comparison

- A small paperclip has a mass of about 1 gram

- A 6 week old puppy has a mass of about 1 kilogram

Units of Temperature

- Temperature is a measure of how hot or cold an object is. **(Measured with a <u>thermometer</u>.)**
- Heat moves from the object at the higher temperature to the object at the lower temperature.
- We use two units of temperature:
  - Celsius – named after Anders Celsius
  - Kelvin – named after Lord Kelvin

Units of Temperature

- Celsius scale defined by two readily determined temperatures:
  - Freezing point of water = 0 ºC
  - Boiling point of water = 100 ºC
- Kelvin scale does not use the degree sign, but is just represented by K
  - absolute zero = 0 K (thus no negative values)
  - formula to convert: K = ºC + 273

Notes

SAMPLE PROBLEM 3.4 - Page 78

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Converting Between Temperature Scales

Normal human body temperature is 37°C. What is that temperature in kelvins?

1 **Analyze** *List the known and the unknown.*

Known

- Temperature in °C = 37°C

Unknown

- Temperature in K = ? K

Use the known value and the equation K = °C + 273 to calculate the temperature in kelvins.

Units of Energy

- Energy is the capacity to do work, or to produce heat.
- Energy can also be measured, and two common units are:

1) Joule (J) = the SI unit of energy, named after James Prescott Joule
2) calorie (cal) = the heat needed to raise 1 gram of water by 1 ºC

Conversion Problems

- OBJECTIVE:
  - Construct conversion factors from equivalent measurements.

Conversion Problems

- OBJECTIVE:
  - Apply the techniques of dimensional analysis to a variety of conversion problems.

Conversion Problems

- OBJECTIVE:
  - Solve problems by breaking the solution into steps.

Conversion Problems

- OBJECTIVE:
  - Convert complex units, using dimensional analysis.

Conversion factors

Notes

- A “ratio” of equivalent measurements
- Start with two things that are the same:

  one meter is one hundred centimeters
- write it as an equation

  1 m = 100 cm
- We can divide on each side of the equation to come up with two ways of writing the number “1”

Conversion factors

$$\frac{1\ \text{m}}{100\ \text{cm}} = \frac{\cancel{100\ \text{cm}}}{\cancel{100\ \text{cm}}}$$

Conversion factors

$$\frac{1\text{ m}}{100\text{ cm}} = 1$$

Conversion factors

$$\frac{1\ \text{m}}{100\ \text{cm}} = 1$$

$$\frac{\cancel{1\ \text{m}}}{\cancel{1\ \text{m}}} = \frac{100\ \text{cm}}{1\ \text{m}}$$

Conversion factors

$$\frac{1\ \text{m}}{100\ \text{cm}} = 1$$

$$1 = \frac{100\ \text{cm}}{1\ \text{m}}$$

Conversion factors

- A unique way of writing the number 1
- Equivalence statements always have this relationship:

big # small unit = small # big unit

1000 mm = 1 m

Which below are good conversion factors?

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a. $\frac{1 \text{ inch}}{2.54 \text{ cm}}$

b. $\frac{1 \text{ kilometer}}{1 \text{ mile}}$

c. $\frac{1000 \text{ ml}}{1 \text{ liter}}$

d. $\frac{30 \text{ days}}{1 \text{ month}}$

Complete the conversion factor

e. $\frac{100 \text{ cm}}{\square}$

f. $\frac{1 \text{ class period}}{\square}$

Practice by writing the <u>two</u> possible conversion factors for the following:

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a. Between kilograms and grams

b. between feet and inches

c. using 1.0 gal. = 3.8 L

Conversion factors; what are they good for?

Notes

- We can multiply by the number "one" creatively to change the units.
- Question: 13 inches is how many yards?
- We know that 36 inches = 1 yard.
- $\dfrac{1 \text{ yard}}{36 \text{ inches}} = 1$
- $\dfrac{1 \text{ yard}}{36 \text{ inches}} \times 13 \text{ inches} = ?$

To be continued

Here's how!

Notes

- Q: 13 inches equals how many yards?
- We know that 1 yard = 36 inches.
- Since we need an answer in yards, that goes on the top.
- Now multiply by 13 inches.

$$\frac{1\ \text{yard}}{36\ \text{inches}} \times 13\ \text{inches} = 0.36\ \text{yards}$$

Units cancel out just like numbers do!

Remaining unit goes with the answer.

Let's practice!

You must show all work like shown below.

a. How many meters are in 100 yards?

$$\frac{\square \text{ meters}}{\square \text{ cm}} \times \frac{\square \text{ cm}}{\square \text{ inches}} \times \frac{\square \text{ inches}}{\square \text{ yard}} \times \square \text{ yard} =$$

b. How many centimeters are in a foot?

c. How many minutes are in a day?

d. One lap around the track is 400 meters. How many miles is this equal to?

- It's not ¼ of a mile……

More on units

Notes

- Remember that units can be canceled just like numbers.
- They can also be multiplied like numbers.
- $12 \times 12 = 12^2 = 144$
- $12\text{m} \times 12\text{m} = 144\ \text{m}^2$
- $\frac{5\ \text{cm}}{10\ \text{sec}} = \frac{2\ \text{m}}{\text{sec}}$

Go back to question 4 10

- Give the proper unit for each of the numeric answers calculated there.

That's the end!

- This assignment is due by Monday (9/20/10) If you did not complete it in class, it is homework.
- Hand in your completed paper to the completed assignment basket.