1.1 - 1.6 Measurements, Diensional Analysis

Keep Your Booklets Closed for Now!

What's this?

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Atoms vs. Molecules

- Atom: smallest part of an element that is still that element.
- Molecule: Two or more atoms joined which act as a unit.
- Matter is composed of atoms.

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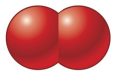
Oxygen and Hydrogen Molecules

Write the formula for sodium oxide!

Ions List Resources Page 5.

Use subscripts when more than one atom is in the molecule.

oxygen molecule  written O_2

hydrogen molecule  written H_2

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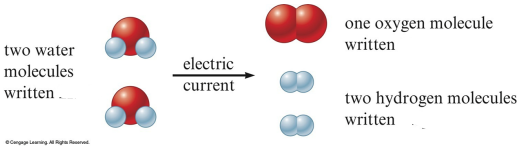
Chemical Reactions

- One substance changes to another by reorganizing the way the atoms are attached to each other.
- Write the reaction for the following situation:



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Science

- Science is a framework for gaining and organizing knowledge.
- Science is a plan of action — a procedure for processing and understanding certain types of information.
- Scientists are always challenging our current beliefs about science, asking questions, and experimenting to gain new knowledge.
- Scientific method is needed.

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General Process

1. Observation is made, leading to
2. Question: Why's that happening?
3. Hypothesis – Tentative explanation of an observation.
4. Experiment – Controlled conditions that test hypothesis, making data.
5. Conclusion – Judgment based on information obtained from an experiment.

Note: Hypotheses can't be proven, only supported.

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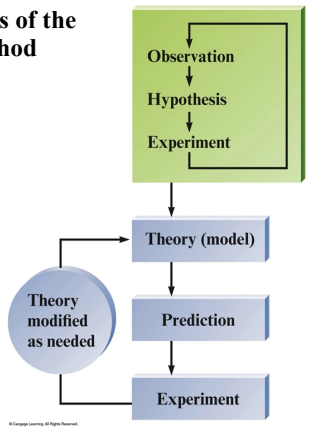
Fundamental Steps of the Scientific Method



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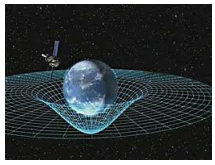
Theory vs. Law

Scientific Law – Relationship in nature supported by a wide variety of experiments. Generally, a single mathematical statement governs these.
Ex. Newton's Law of Universal Gravitation, Universal Gas Law.

Scientific Theory – Model of complex phenomena based upon many observations over time.
Ex. Theory of Relativity, Theory of Evolution, Heliocentrism, Quantum Theory.



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Base Units

Base Units: Fundamental (simplest) units of measurement.

2. Match the base units to what is measured!

meter (m) second (s) ampere (A)

kilogram (kg) Kelvin (K) mole (mol)

candela (cd)

length, time, mass, electric current, luminous intensity, temperature, amount of matter

Answers:
m = length, kg = mass, s = time, A = electric current, K = temperature, mol = amount of matter, cd = luminous intensity

These describe EVERYTHING measureable in the universe!

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Metric Prefixes

Modify unit values to suit size of measurement.

Resources - Page 1

Multiple	Prefix	Symbol
1.0 E 9	giga	G
1.0 E 6	mega	M
1.0 E 3	kilo	k

Multiple	Prefix	Symbol
1.0 E-1	deci	d
1.0 E-2	centi	c
1.0 E-3	milli	m
1.0 E-6	micro	μ
1.0 E-9	nano	n

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Characteristics of Matter

Mass – a measurement of amount of matter

Weight – Measurement of matter that accounts for gravitational pull.

Matter - Any physical object; NOT energy.

2. Would you weigh more or less on the moon, which is smaller than the earth?

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Uncertainty in Measurement

- A digit that must be estimated in a measurement is called uncertain.
- A measurement always has some degree of uncertainty. It is dependent on the precision of the measuring device.
- Record the certain digits and the first uncertain digit (the estimated number).

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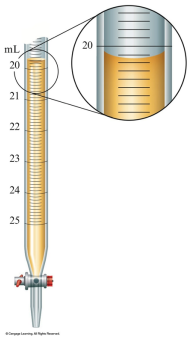
Measurement of Volume Using a buret.

1. The volume is read at the bottom of the liquid curve (meniscus).
What is the volume?



Meniscus of the liquid is at about 20.15 mL.

Which are certain, and uncertain digits?

20.1 mL is certain, 0.05 is uncertain.

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Data Terms

What's accuracy?
– How close a measurement is to an accepted value.

What's precision?
– How close measurements are to each other.
ALSO: a measuring device is said to be more precise than another if it reads more decimal places (even if inacurrate).

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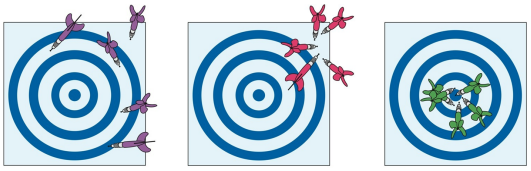
Precision vs. Accuracy



2. How are these shots?

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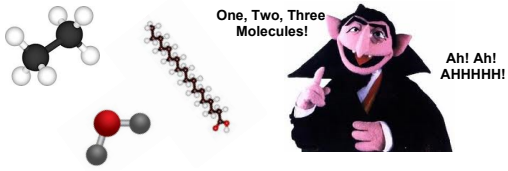
Significant Figure Rules

A. Non-zero digits are significant. 4.32 = 3 sig figs
B. Zeros between non-zeros are also. 409 = 3 sig figs
C. Trailing zeros only **if a decimal is present**. 310.0 = 4
D. Placeholders and leading zeros are insignificant.
0.0034 and 4200 = 2
E. Exponent numbers don't count. 2.3 E 14 = 2
F. Exact numbers & defined constants have infinite number.
Ex: 6 molecules, 60 s = 1 minute



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Significant Figure Examples

How many significant figures in the following?

0.389 = 3 All non-zero digits are significant. Leading zeros are insignificant.
0.9023 = 4 All zeros in between non-zeros are significant.
0.3890 = 4 A decimal makes all ending zeros significant.
480 = 2 If no decimal - all end zeros are placeholders.
480.0 = 4 A decimal makes all ending zeros significant.
5.20 E 4 = 3 Numbers in the exponent don't matter.

Converting numbers into scientific notation eliminates ambiguity in significant figuring.

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Scientific Notation

Way of managing **BIG** or small numbers, using factors of ten.

Process:

Step 1. Reposition the decimal after the first digit.
Step 2. Count how many places the decimal moved: that is your exponent.
If decimal moves left, exponent is positive; if it moved right, it is negative.
Report the exponent as "X 10" or "E" (stands for exponent - many calculators use this format).

Ex: 0.00087 = 8.7 E -4
Coefficient
Exponent

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Scientific Notation Examples

Put the following in scientific notation:

1. 460,000,000 → 4.6 E 8

2. 0.0000128 → 1.28 E -5

3. 456.23 → 4.5623 E 2

- Two Advantages
  - > Number of significant figures can be easily indicated.
  - > Fewer zeros are needed to write a very large or very small number.

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Rounding Process

Find number to right of last sig. fig.

If 4 or less, drop it completely. 23.6783 = 23.678

If 5 or more, increase last sig. fig by 1 before dropping.

23.678 = 23.68

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Rounding Example

Round the following to three sig. figs:

14.2865	14.3
0.0086220	0.00862
1.267 E 14	1.27 E 14
771,490	771,000

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Significant figures in Operations

1. For multiplication or division, the number of significant figures in the result is the same as the number in the least precise measurement used in the calculation.
2. For addition or subtraction, the result has the same number of decimal places as the least precise measurement used in the calculation.

Solve: 1.24 X 14.314

$1.24 \cdot 14.314 = 17.74936 \rightarrow 17.7$

Solve 14.314 + 1.24

$$\begin{array}{r} 14.314 \\ +\ 1.24 \\ \hline 15.554 \end{array} \rightarrow 15.55$$

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Homework

Read 1.7 - 1.10 in your books

1.1 -1.6 Problems in your Booklets
Due: Next Class

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