



Chemistry SM-1131

Lesson 1

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Scientific Notation



- Helps write numbers compactly.
- $0.01 = 1 \times 10^{-2}$
- $0.1 = 1 \times 10^{-1}$
- $1 = 1 \times 10^0$
- $10 = 1 \times 10^1$
- $100 = 1 \times 10^2$
- Number must be “one through ten times 10^x ”
- Ex: 3.5×10^{-3} or 9.875×10^5

Scientific Notation



- A positive exponent tells you how many zeros would go after the first number
- A negative exponent tells you when the number starts after the decimal point. A -1 means it starts right after it. A -2 means put a zero in and then your number. A -3 means you have to put in 2 zeros and then the number.

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Rounding



- Numbers 5-9 round up
- Numbers 0-4 round down
- Look to see where you have to round to.
Normally you round to the second number.
- 2,549,337 to the millions = 3.0×10^6
- 2,549,337 to the 100ks = 2.50×10^6
- 2,549,337 to the 10k = 2.550×10^6
- 17 will round up to 20, 14 rounds to 10

Sig. Figs.



- Significant Figures help us keep accuracy in mind.
- If you add 0.0045 lbs to a ~1 ton pile of dirt can you really measure a change?
- If you add 0.00456g to a 0.003g sample?
- Sig Figs help chemists keep scale in mind.

Rules for Sig Figs



- There are 8 rules just to define them. Hang in there.
- Any of the following numbers counts as a sig. fig.: 1,2,3,4,5,6,7,8,9. How many Sig Figs in this #?

54,637

- Zeros sometimes count and sometimes don't count as Sig. Figs. If a zero is placed between two numbers (1-9) then it counts as a Sig. Fig. So how many Sig. Figs. are in the following number?

2,112,302

Rules for Sig Figs



- A series of zeros between two numbers (1-9) all count as Sig. Figs. so how many Sig. Figs. are in the following number?

2,000,000,000,2

- Zeros that come before a number (1-9) don't count as Sig. Figs. So, how many Sig. Figs. are in the following number?

00000004

Rules for Sig Figs



- More than one rule can be in effect at the same time. How many Sig. Figs. are in the following number?

000,2,000,242,234,202

Rules for Sig Figs



- Zeros that come at the end of a number if they are after the decimal point count as Sig. Figs. How many Sig. Figs. are in the following number?

22.34000

Rules for Sig Figs



- There is a rare case where you don't need to have two numbers (1-9) to make all the digits significant. If a number has been measured very specifically down to at least one decimal place and all the numbers after the first number are zero then all the numbers (0-9) after the first number (1-9) are significant.

2,000.000

Sig Figs



- Zeros at the end of a number but before the decimal are significant if they have been measured. If they have not been measured then the zeros at the end of a number but before the decimal are not significant. (Hint: you know they have been measured if the number ends with a decimal point).

2,000

2,000.

Sig Figs: Addition



- You can only have Sig Figs up to the largest known number!

$2,043 + 25 + 135 = \mathbf{2,190}$ we know all numbers, so no big deal.

$2,000 + 25 + 135 = 2,190$, but the biggest value that we know is in the thousands, so we round to that.

$2,190 = 2,000$

After you round you put it in scientific notation

= $\mathbf{2.2 \times 10^3}$

Let's Try Subtraction



- $15,000. - 300 - 12,000 = 2,700$

BUT you can only have SIG FIG to the thousands!

So we have to round

$2,700 \rightarrow$ **$3,000$**

Now we convert to scientific notation

3×10^3

What happens with decimals and addition?



- $1,000.242 + 5.2 + 0.44 = 1,005.882$, but the biggest number that we know is in the tenths place. So we round to that

$$1,005.882 = 1,005.9$$

And then we put it into scientific notation

$$1.0059 \times 10^3$$

Multiplication



- The answer can only have as many Sig Figs as the number in the problem with the fewest Sig Figs.

$$2,000.45 \times 3,200 = 641,440$$

So we have to round, 640,000

Then we use scientific notation 6.4×10^5

Division is just like X



- $555 / 1.111 = 499.5499549954999549954995\dots$
- Round to 500.0
- Put into scientific notation with 3 sig figs
- 5.00×10^2

Prefix Multipliers



- These are handy references

Prefix	Symbol	Multiplier	
exa	E	10^{18}	1,000,000,000,000,000,000
peta	P	10^{15}	1,000,000,000,000,000
tera	T	10^{12}	1,000,000,000,000
giga	G	10^9	1,000,000,000
mega	M	10^6	1,000,000
kilo	k	10^3	1,000
hecto	h	10^2	100
deka	da	10^1	10
deci	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
milli	m	10^{-3}	0.001
micro	μ	10^{-6}	0.000,001
nano	n	10^{-9}	0.000,000,001
pico	p	10^{-12}	0.000,000,000,001
micro micro	$\mu\mu$		
femto	f	10^{-15}	0.000,000,000,000,001
atto	a	10^{-18}	0.000,000,000,000,000,001

Measurements



- Time
- Distance
- Mass
- Volume
- Rate

UNITS!!!



- Time = Seconds, hours, days, years
- Distance = Meters, Yards, Feet, Inches
- Mass = Pounds, kilograms, tons
- Volume = cm^3 , Liters, gallons, ounces
- Rate = something / something
- Ex = speed is a rate of distance / time
- Weight loss = lbs / month

SI Units



- “International System of Units”
- Kg, g, L, sec, meters, kilometers
- Typically, we’ll use these units
- English Units like pounds and yards are harder to use.

Answer Questions with Units that Make Sense



- How many hours will it take to go 50 miles?
7 miles? 4 kg? 3 hours
- What's the mass of 3L of water?
4L? 6 miles? 3kg?
- What is the speed of a car that goes 60 miles in 1 hr?
60 miles? 1 hr? 60 miles/hour?
- Some units have more than one component

Converting Units



- You guys do this all the time.

How much money do you have if you have 7 nickels?

You know it's \$0.35, but how?

1 nickel = \$0.05, which can be written

1 nickel: \$0.05, which can be written

\$0.05

1 Nickel

7 ~~Nickels~~ * \$0.05 = \$0.35

1 ~~Nickel~~

Couple of things are happening



- You have to understand $X/X = 1$

$$\begin{array}{cccccc} \underline{5} = 1 & \underline{25} = 1 & \underline{XZ} = 1 & \underline{\text{Cat}} = 1 & \underline{\text{kg}} = 1 & \\ 5 & 25 & XZ & \text{Cat} & \text{kg} & \end{array}$$

Anything divided by itself is 1!!!

What about a week. It's also 7 days.

So, we can talk about this amount of time in terms of 1 week or 7 days and we're still talking about the same amount of time.

Working with Weeks



- 1 week = 7 days

How many days is 3 weeks?

How many is “the question”

Days let’s you know the units of the final answer

3 weeks is “THE GIVEN” The given has 2 components a number (3) and a unit (weeks)

How to solve in a chemistry class



How many days is 3 weeks?

First set up a ratio.

7 Days : 1 week

Second, set up an equation. To start copy “the given” word for word

3 weeks

Then multiply by the division form of a ratio

3 ~~weeks~~ X 7 Days = ?

1 ~~week~~

Copy These NOTES



- OK, that was probably the densest class I'll ever teach in here.
- You can't learn that just by having listened
- COPY THESE NOTES INTO A BOOK IN YOUR OWN HAND WRITING
- Solve the problems in the syllabus handout.