CHEM 103 Atoms

Lecture Notes January 31, 2006 Prof. Sevian





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Agenda

- A few announcements
 - Discussion and lab both start this week
 - Links to online skill drills are in the Miscellaneous section in the course website
- More calculations skills you need
 - Scientific notation
- What are atoms? How do we know? Why should you care?
- How do atoms make compounds? What kinds of compounds exist? How do we name them?

Concerning lab exemptions

- Today is the deadline for requesting lab exemptions
- To request a lab exemption, you must EMAIL me a request so that your request is documented in writing (for your own protection)
- I will email you an answer to whether you have a lab exemption
- Until you receive an answer, you must attend lab, in case you do not receive a lab exemption

Some Measurements and Conversions You Need to Know



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Two types of conversions

- Proportional
 - Time
 - Length or distance
 - Volume
 - Mass
- Equations
 - Temperature





Metric Prefix Meanings for Conversions



Prefix	Meaning	Example	
Centi (c)	1/100 th of	1 cm = 0.01 m 100 cm = 1 m	
Milli (m)	1/1000 th of	1 mL = 0.001 L 1000 mL = 1 L	
Kilo (k)	1000 of	1 kg = 1000 g	
Micro (μ)	10 ⁻⁶ of	1 μmol = 10 ⁻⁶ mol 1,000,000 μmol = 1 mol	
Nano (n)	10 ⁻⁹ of	1 nm = 10 ⁻⁹ m	





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Volume Conversions

Important volume conversion to remember: $1 \text{ mL} = 1 \text{ cm}^3$

A can of soda is marked as having 258 cc of soda in it. How many liters is this? ^{3 sig figs}





Temperature Conversions Require Equations





Example: A gas has a temperature of 25.8 °C. What is the temperature in Kelvin?



Really Big Numbers



In a 22.4 liter sample of air at standard conditions, there are approximately this many particles present:



Really Small Numbers



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A single snowflake has a mass of approximately

0.000 0030 kg

 $=3.0 \times 10^{-6} \text{kg}$

Calculations Using Scientific Notation



- A typical snowflake has 100=10² ice crystals
- A single ice crystal has 10¹⁸ water molecules
- A water molecule has a mass of 3.0 x 10⁻²⁶ kg
- Therefore, a typical snowflake has a mass of approximately

 $10^{2} crystals \times \frac{10^{18} water molecules}{1 crystal} \times \frac{3.0 \times 10^{-26} kg}{1 water molecule} = 3.0 \times 10^{-6} kg$

Data taken from http://hypertextbook.com/facts/2001/JudyMoy.shtml



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Scientific Notation

- A nice way to represent big and small numbers
- Makes it easy to indicate significant figures
 9000 written with two sig figs is 9.0 x 10³
- Makes it easy to estimate answers
 (3.0 x 10⁸) x (2.0 x 10⁻⁶) = 6.0 x 10²
- Scientific notation and your calculator → try the practice problems in the Assignments section on the course website to make sure you are proficient at using scientific notation in your own calculator



What is an Atom?



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- B.C.E. Democritus: an atom is the smallest particle of matter
- 1800's Electrons exist and they have some properties (negative charge, very small mass)
- Late 1800's-Mid 1900's Protons and neutrons exist and they have some properties (protons are +, neutrons are neutral, have nearly same mass which is > electron mass)

How is the atom organized? What is the nucleus?















What's in an Atom?

	Location	Charge	Mass
Proton	Nucleus	+	~1 a.m.u.
Neutron	Nucleus	0	~1 a.m.u.
Electron	Most of atom's space	-	$\frac{1}{1836^{th}}$ of an a.m.u.

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The Actual Numbers

	Charge	Mass	
Proton	+1.602 × 10 ⁻¹⁹ C	1.007276 a.m.u.	
Neutron	0	1.008665 a.m.u.	
Electron	-1.602 × 10 ⁻¹⁹ C	0.00054858 a.m.u.	

Atomic mass units

1 a.m.u. = 1.661×10^{-24} grams

Important Implications



- 1. For an atom to be neutral, it must have equal quantities of protons (+) and electrons (-).
- Different quantities of neutrons do not affect the total charge of an atom. It (apparently) doesn't matter how many neutrons are in an atom.
- Most of the mass of an atom is in the nucleus (protons and neutrons). Can estimate an atom's mass by counting protons + neutrons.





Same	All have 6 electrons	All have 6 protons	All neutral	
Different	6 neutrons	7 neutrons	8 neutrons	
Symbol	$^{12}_{6}C$	¹³ ₆ C	$^{14}_{6}C$	

What Information does the Symbol Contain?



Where is each piece of information contained?

- How many protons?
- Why is the quantity of protons called the atomic number?
- How many neutrons?
- How many total particles in the nucleus? Why is this called the mass number?





Catching up on some vocabulary

How would you define these words now?

- Isotope
- Nucleus
- Neutral
- Mass number
- Atomic number



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Think-Pair-Share

Fill in the missing information				
Symbol	Protons	Neutrons	Mass Number	Electrons (in neutral atom)
¹¹ ₅ B				
		20	37	



What does % mean in chemistry?

$$\% = \frac{\text{part}}{\text{whole}} \times 100$$

Example: How would you figure out what % of students in the room are between the ages of 20-29?



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Isotopes and Natural Abundances

The mass of a typical sample of an element¹ is a weighted average of the masses of the isotopes



1A

H

Li

Na

K

Rb

Cs

Fr





Lanthanides and actinides Copyright © 2006 Pearson Prentice Hall, In





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Terminology we will use all year

- Period = row across
- Group = column down
 - Several common groups
 - Group 1A: Alkali metals
 - Group 2A: Alkaline earth metals
 - Group 7A: Halogens
 - Group 8A: Noble gases
 - Groups B: Transition metals
- Early chemists (Mendeleev, Moseley) organized the Periodic Table according to properties of elements
- There are reasons why the Periodic Table is organized the way it is (stay tuned until chapters 6 and 7)



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