CHEM 110

General Chemistry

King Abdul Aziz University

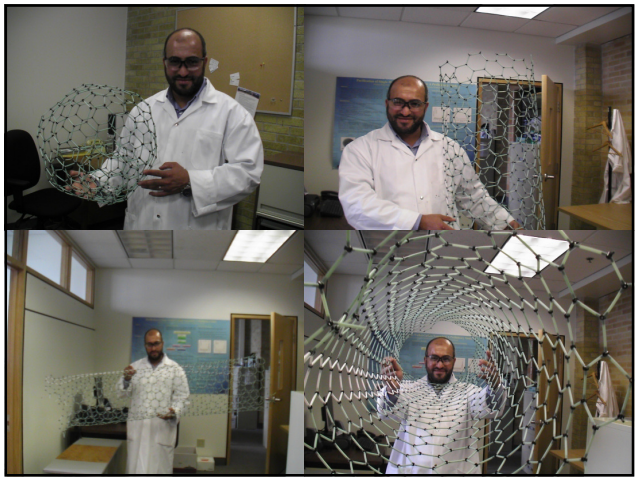
Jeddah KSA

Who am I?

Dr. Mohamed Abdel Salam

Assistant Professor of Physical Chemistry

- PhD in Nano Chemistry, Canada (2006)
- M Sc in Electrochemistry, Canada (2003)
- PhD in Physical Chemistry, Egypt (2001)
- M Sc in Physical Chemistry, Egypt (1994)



How to reach me?

- Faculty of Science, Chemistry Department
- Room 359.
- Email me at:
- masalam16@hotmail.com
- mabdelsalam@kau.edu.sa
- Website:
- www.kau.edu.sa/mabdelsalam

Text Book

- Any General Chemistry Book
- Selected textbooks:
- Chemistry, Chang
- University Chemistry at Khawarizm Library
- General Chemistry, McMurray
- Chemistry, Whitten
- Chemistry, By C. Mortimer, 6th edition

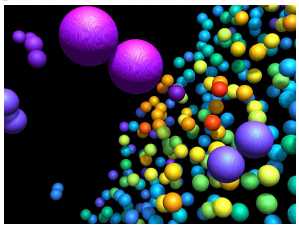
Grading System

30% First midterm
30% Second midterm
40% Final exam

Grading System

95 – 100 % A+
90 – 95 % A
85 – 89 % B+
80 – 84 % B
75 – 79 % C+
70 – 74 % C
65 – 69 % D+
60 – 64 % D
< 60 % F (Fail)

Chapter 1 Atoms, Molecules, Ions & Formulas



Measurements

The International System of Measurements (SI)

There are seven SI base units.

PROPERTY	UNIT	SYMBOL
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Amount	Mole	mol
Temperature	Kelvin	K
Electrical Current	Ampere	A
Luminosity	Candela	Cd

Derived Units: Units that are made up of some combination of SI base units are called **Derived Units**.

PROPERTY	UNIT	SYMBOL	DEFINITION
Force		N	$kg\ m/s^2$
Pressure	Pascal	Pa	N/m^2 or $kg/m\ s^2$
Energy	Joule	J	$kg\ m^2/s^2$ or N m
Electrical Charge	Coulomb	C	A s
Electrical Potential	Volt	V	J/C
Frequency	Hertz	s^{-1} or Hz	1/s

SI Prefixes: used with the base units in order to increase or decrease the value that they represent.

To remove a prefix from a value, insert the numerical value of the prefix in place of the symbol.

Example:
Convert 5.83 pm to meters

Replace "p" with x 10^{-12}
= 5.83 x 10^{-12} m

To insert a prefix into a value, insert both the prefix and the inverse of its numerical value.

PREFIX	SYMBOL	NUMERICAL EQUIVALENT
exa-	E	1 000 000 000 000 000 000 (10^{18})
peta-	P	1 000 000 000 000 000 (10^{15})
tera-	T	1 000 000 000 000 (10^{12})
Giga	G	1 000 000 000 (10^{9})
Mega	M	1 000 000 (10^{6})
Kilo	k	1000 (10^{3})
hecto-	h	100 (10^{2})
deca-	da	10 (10^{1})
deci-	d	0.1 (10^{-1})
Centi	c	0.01 (10^{-2})
milli-	m	0.001 (10^{-3})
micro-	μ	0.000 001 (10^{-6})
nano-	n	0.000 000 001 (10^{-9})
pico-	p	0.000 000 000 001 (10^{-12})
femto-	f	0.000 000 000 000 001 (10^{-15})
atto-	a	0.000 000 000 000 000 001 (10^{-18})

Example:
Convert 0.000462 g to milligrams
(note that the inverse of milli is 10^{+3})
= 0.000462 x 10^{+3} mg = 4.62 x 10^{-1} mg OR 0.462 mg

The Modern Atomic Theory

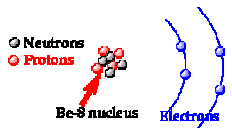
Modern Atomic theory has four assumptions:

1. **Atoms make up all matter.**
2. **The atoms of one element are different from the atoms of another element.**
3. **Atoms combine in definite ratios to make compounds.**
4. **Combinations of atoms in compounds can change only when a chemical reaction happens. This means reactions alter atom combinations, but the identity of the atoms themselves remain the same.**

Structure of Atoms

- Atoms are made up of three main particles, neutron, electron, and proton.

Particle	Symbol	Charge	Mass
electron	e^-	-1	0.0005486 amu
proton	p^+	+1	1.007276 amu
neutron	n^o	0	1.008665 amu



Atomic number, Z:

The identity of an element is controlled by the number of protons in the nucleus.

In the neutral atom: number of protons inside the nucleus is the same number of electrons around the nucleus.

Atomic number = # of Protons = # of Electrons

Every element has its own unique atomic number.

Example What is the atomic number for nitrogen, N?
Nitrogen is in the seventh position in the periodic table.

This means nitrogen atoms have 7 protons in the nucleus, 7 electrons around the nucleus, and they have an atomic number of 7.

- ## Mass number, A:

It is equal to the sum of neutrons and protons inside the nucleus, because the "massive" particles in the atom are protons and neutrons.

Mass number = # of Protons + # of neutrons

# of neutrons = Mass number - # of Protons

# of neutrons = A – Z

How many neutrons, electrons and protons are in an atom of $^{23}_{11}Na$?

Sodium, Na, has atomic number 11.

# of Protons =11 # of Electrons = 11

Number of neutrons = A - Z

Number of neutrons = 23 - 11 = 12

An atom with a mass number of 39 contains 20 neutrons. What is the atomic number and identity of the element?

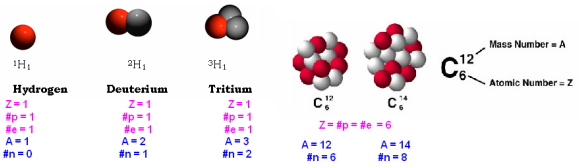
The atomic number is Z = 39- 20 =19.

The identity is potassium because K is element 19

Isotopes

All the atoms of the same element have the same atomic number, but they can have different:

numbers of neutrons and mass numbers



Isotope abundances

The isotopes of an element do not occur with equal frequency.

The relative abundance depends on the relative stability of the isotope.

The isotopes contribute to the average atomic mass based on their abundance.

The atomic weights in the periodic table are weighted averages.

This means the tabulated value doesn't match any actual atom, but is closer to the most common isotope.

Average weight = % First isotope abundance x its mass + % Second isotope abundance x its mass

What is the average atomic mass for thallium, Tl, if there are two isotopes with the following masses and abundances? (Tl-203 (203Tl) has a mass of 203.059 amu with an abundance of 29.52 %, Tl-205 (205Tl) has a mass of 205.059 amu with an abundance of 70.48 %)

Step 1: Convert percents to decimals 29.52 % to 0.2952 and 70.48 % to 0.7048

Step 2: Average weight = 0.2952 x (203.059 amu) + 0.7048 x (205.059 amu)
204.466 amu rounded off to 204.5 amu with 4 significant.

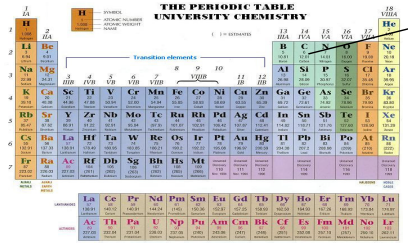
Atomic Mass

The **atomic mass** of an element is the mass average of the atomic masses of the different isotopes of an element.

For example, naturally occurring carbon, for example, is a mixture of two isotopes, ^{12}C (98.89%) and ^{13}C (1.11 %).

Individual carbon atoms therefore have a mass of either 12.000 or 13.03354 amu. But the average mass of the different isotopes of carbon is 12.011 amu.

$$\frac{98.89}{100} \times 12.000\ amu + \frac{1.11}{100} \times 13.003354\ amu = 12.011\ amu$$



C
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12.01
Carbon

لمزيد من التمارين و الشرح
أحصل على نسختك من كتاب
University Chemistry
من مكتبة خوارزم