Chem MT 1-6 Cheat Sheet

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The Scientific Method

Chemistry is the science that deals with the materials of the universe and the changes that these materials undergo.

Steps:

1. *State the problem and collect data* (make observations)

2. *Formulate hypotheses*. A hypothesis is a *possible* explination for the observation.

3. *Preform Experiments*. Gather new information that allows us to decide whether the hypothesis is supported by the new information we have learned

Measurements and Calculations

Scientific notation expresses a number as a product of a number between 1 and 10 and the appropriate power of 10.

Ex. (100= 1.0×10^{2} , 0.010=1.0×10^{-2})

If the decimal is moved to the left, the power of 10 is *positive* ; if the decimal is moved to the right, the power of 10 is *negative*.

Unit Prefixes

Common Prefixes used with SI Units			
Prefix	Symbol	Meaning	Order of Magnitude
giga-	G	1 000 000 000	10^{9}
mega-	M	1 000 000	10^{6}
kilo-	k	1 000	10^{3}
hecto-	h	100	10^{2}
deka-	da	10	10^{1}
	base unit	1	10^{0}
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}

Significant Figures

The numbers recorded in a measurement are called **significant figures**.

1. *Nonzero integers* always count as significant figures. Ex. (4567 has four nonzero integers that count as significant figures.)

2. *Zeros*.

Significant Figures (cont)

a. *leading zeros* never count as significant figures. Leading zeros are all zeros that *precede* nonzero integers.

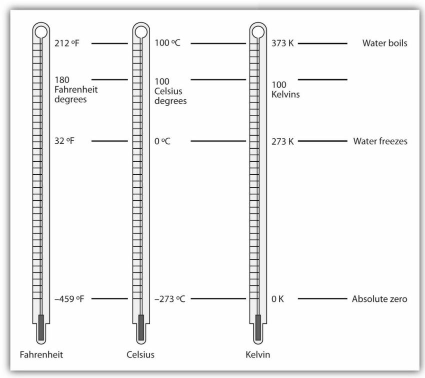
b. *captive zeros* always count as significant figures. Captive zeros are zeros that fall in between two nonzero digits.

c. *trailing zeros* are sometimes significant figures. Trailing zeros are zeros right at the end of a number. They are **only** significant if the number is written with a decimal. (Ex. The number 100 only has one SF 1 ; but the number 100. has three SF.

3. *Exact Numbers* never limit the number of significant figures in a calculation.

Significant figures also apply to scientific notation.

Temperature Conversion



TC Equations

Temperature in Kelvins = Temperature in Celsius + 273

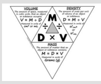
Temperature in Celsius = Temperature in Kelvin - 273

Temperature in Fahrenheit = 1.80(Temperature in Celsius) +32

TC Equations (cont)

Temperature in Celsius = Temperature in Fahrenheit - 32 / 1.80

Density, Mass, and Volume



Elements and Compounds

An **element** is a substance that cannot be broken down into other substances by chemical means.

When elements combine, they form **compounds**, which are substances that can be broken down into elements by chemical means.

Pure Substances and Mixtures

A *pure substance* is either an element or compound.

A *mixture* can be defines as something that has variable composition.

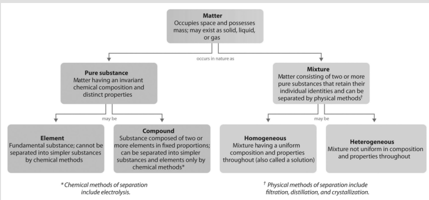
Mixtures can be classified as either homogeneous or heterogeneous.

A *homogeneous* mixture is the same throughout. This type of mixture is also called a solution.

A *heterogeneous* mixture contains regions that have different properties from those of other regions.

These mixtures can be separated through **distillation** and **filtration**.

Mixtures



Dalton's Atomic Theory

1. Elements are made of tiny particles called **atoms**.

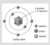
2. All atoms of a given element are identical.

3. The atoms of a given element are different from those of any other element.

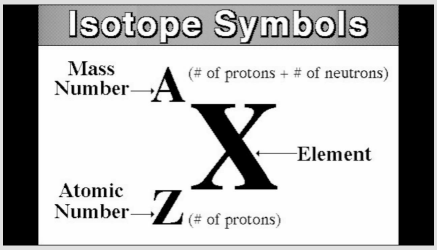
3. Atoms of one element can combine with atoms of other elements to form compounds. A given compound always has the same relative numbers and types of atoms.

4. Atoms are indivisible in the chemical process. Atoms are not created nor destroyed in chemical reactions. A chemical reaction simply changes the way the atoms are grouped together.

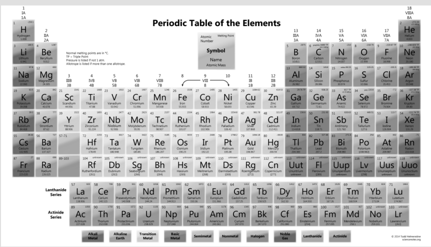
Atom Structure



Isotopes



Periodic Table



Ions

An *ion* is an atom or molecule with a net electric charge due to the loss or gain of one or more electrons.

A *cation* is a positively charged ion; an ion that has lost electrons.

An *anion* is a negatively charged; an atom that has gained electrons.

Alkali Metals are the most reactive metals that can form cations easily by only needing to lose one valence electron.

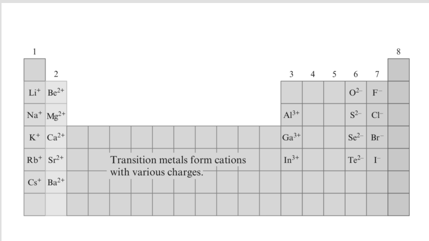
Halogens are the most reactive nonmetals that can form anions easily by only needing to gain one valence electron.

Noble Gasses have 8 valence electrons so they are already stable.

An ionic bond is a chemical bond resulting from the attraction between oppositely charged ions.

A chemical compound must have a net charge of 0 (zero)

Ionic charges



Common Simple Cations and Anions

Cation	Name	Anion	Name
H^+	hydrogen	H^-	hydride
Li^+	lithium	F^-	fluoride
Na^+	sodium	Cl^-	chloride
K^+	potassium	Br^-	bromide
Cs^+	cesium	I^-	iodide

Common Simple Cations and Anions (cont)

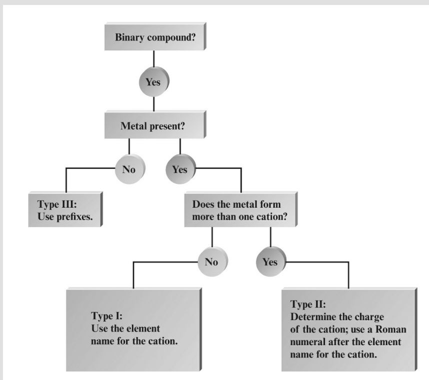
Be^{2+}	beryllium	O^{2-}	oxide
Mg^{2+}	magnesium	S^{2-}	sulfide
Ca^{2+}	calcium		
Ba^{2+}	barium		
Al^{3+}	aluminum		
Ag^+	silver		
Zn^{2+}	zinc		

Common Type II Cations

Ion	Systematic Name	Older Name
Fe^{3+}	iron(III)	ferric
Fe^{2+}	iron(II)	ferrous
Cu^{2+}	copper(II)	cupric
Cu^+	copper(I)	cuprous
Co^{3+}	cobalt(III)	cobaltic
Co^{2+}	cobalt(II)	cobaltous
Sn^{4+}	tin(IV)	stannic
Sn^{2+}	tin(II)	stannous
Pb^{4+}	lead(IV)	plumbic
Pb^{2+}	lead(II)	plumbous
Hg^{2+}	mercury(II)	mercuric
Hg_2^{2+}	mercury(I)	mercurous

Mercury(I) ions always occur bound together in pairs to form Hg_2^{2+}.

Nomenclature



Common Polyatomic Ions.

Ion	Name	Ion	Name
NH_4^+	ammonium	CO_3^{2-}	carbonate
NO_2^-	nitrite	HCO_3^-	hydrogen carbonate (bicarbonate is a widely used common name)
NO_3^-	nitrate	ClO^-	hypochlorite
SO_3^{2-}	sulfite	ClO_2^-	chlorite
SO_4^{2-}	sulfate	ClO_3^-	chlorate
HSO_4^-	hydrogen sulfate (bisulfate is a widely used common name)	ClO_4^-	perchlorate
OH^-	hydroxide	$C_2H_3O_2^-$	acetate
CN^-	cyanide	MnO_4^-	permanganate
PO_4^{3-}	phosphate	$Cr_2O_7^{2-}$	dichromate
HPO_4^{2-}	hydrogen phosphate	CrO_4^{2-}	chromate
$H_2PO_4^-$	dihydrogen phosphate	O_2^{2-}	peroxide

Rules for Naming Acids

If the anion does not contain oxygen, the acid is named with the prefix *hydro-* and the suffix *-ic* attatched to the rootname of the element.

Ex. HCl= *hydro*-chlor-*ic* acid

2. When anions contain oxygen, the acid name is formed from the root name of the central element of the anion or the anion name with the suffix of *-ic* or *-ous*.

When the anion name ends in *-ite*, the suffix *-ic* is used.

(Ex. H2SO4 = SO4^{2-}(sulfate) = Sulfric Acid)

When the anion name ends in *-ite*, the suffix *-ous* is used in the acid name.

(Ex. H2SO3 = SO3^{2-} (sulfite) = Sulfurous acid)

Chemical Equations

We represent a chemical reaction by writing a **chemical equation** in which the chemical reactions (the **reactants**) are shown to the left of an arrow and the chemicals are formed by the reaction (the **products**) are shown to the right of the arrow.

In the process of balancing equations is that atoms are conserved in a chemical reaction.

The identities (formulas) of the compounds must never be changed in balancing a chemical equation.

Balancing Equations

Step 1 Read the description of the chemical reaction.

Step 2 Write the unbalanced equation that summarizes the information from step 1.

Step 3 Balancing the equation by inspection, starting with the most complicated molecule. Proceed element by element to determine what coefficients are necessary so that the same number of each type of atom appears on both the reactant and the product side.

Step 4 Check to that the coefficients used, give the same number of each type of atom on both sides of the arrow. Also check to see that the coefficients used are the smallest integers that give the balanced equations. This can be cone by determining whether all coefficients can be divided by the same integer to give a set of smaller integer coefficients.