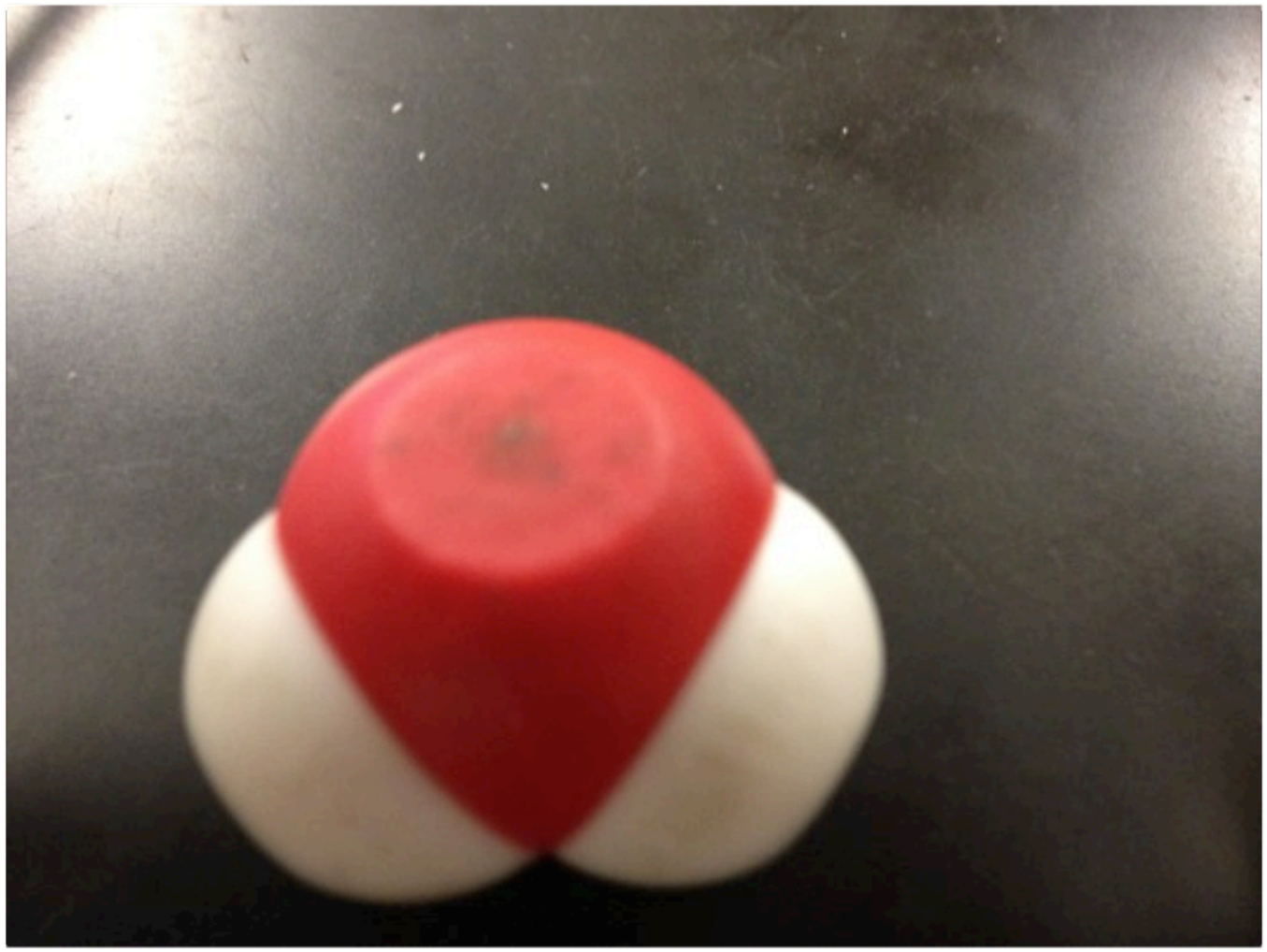
INTERACTIVE CHEMISTRY

NAMING, NET IONIC EQUATIONS AND REACTION PREDICTION



KAVITA GUPTA

To predict the products of a reaction and write the net ionic equations (reaction prediction), you will need to know the following:

1. Nomenclature- naming compounds (Chapter 1)
2. How to write net ionic equations and Solubility Rules (Chapter 2)
3. Types of Reactions (Chapter 3)
4. Practice Problems (Chapter 4)

We will go over each of the above, in the next few chapters.

Types of Inorganic Compounds

It is important to identify the type of a compound before naming it since naming varies with the type. For naming purposes, most inorganic compounds can be classified as ionic, molecular and acids.

- ***Ionic Compounds*** *(generally solids) can be identified by the presence of a metal cation in it. Ex. NaCl, Ca3(PO4)2*
- ***Molecular compounds*** *(generally liquids and gases) are made up of all non metals. Ex. PH3, N2O5*
- ***Acids*** *begin with H (generally present as aqueous solutions or gases) Ex. HCl, HNO3, HClO4, HC2H3O2*

Review 1.1 Identifying types of compounds

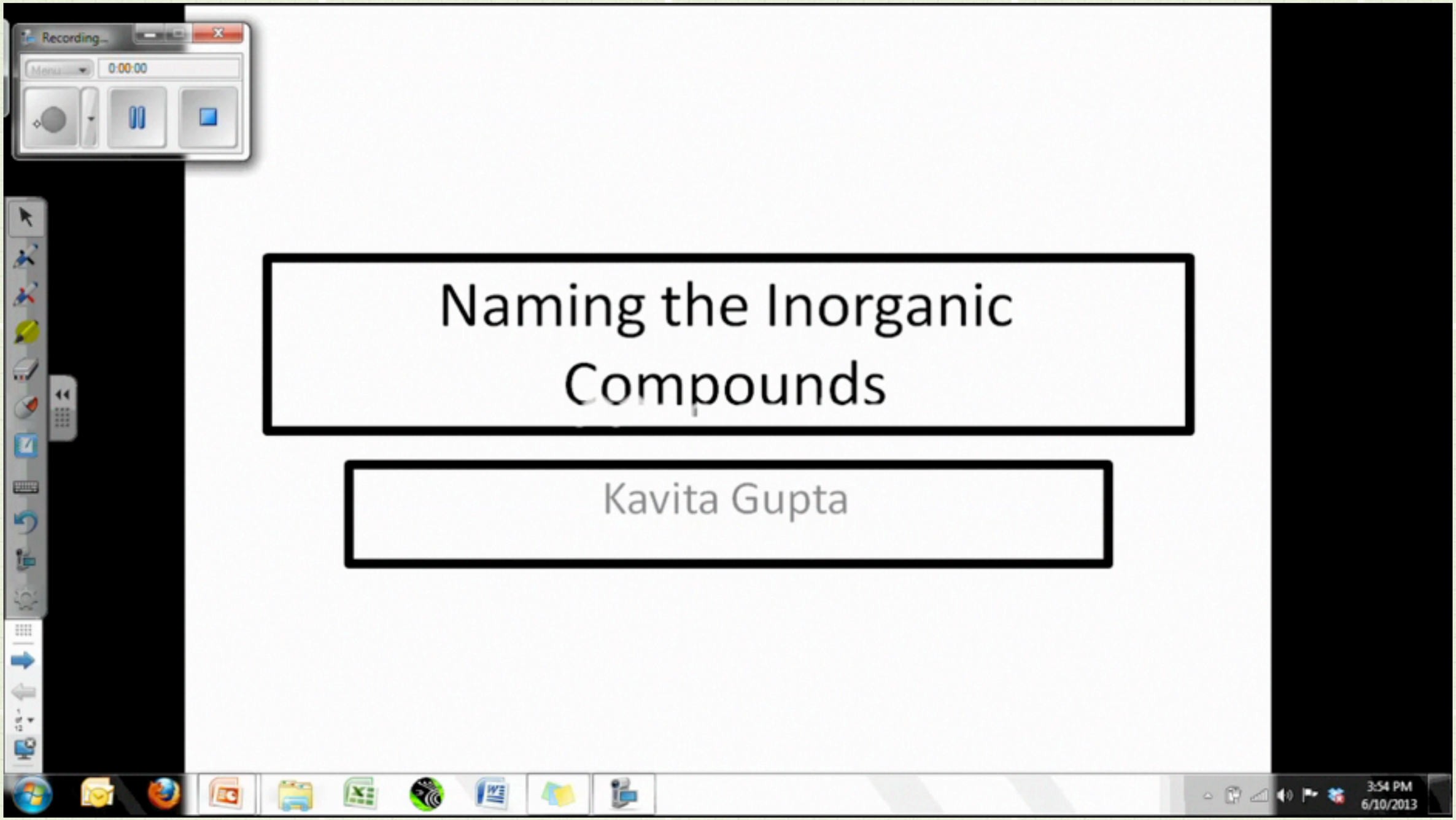
Question 1 of 3

Which of the following is an example of an ionic compound?

- **A.** H_2O_2
- **B.** NaClO
- **C.** P_2O_5

Check Answer

Click on the button below before moving to the next page.


Recording...
Menu
0:00:00
Naming the Inorganic Compounds
Kavita Gupta
3:54 PM
6/10/2013

Naming Ionic Compounds

While naming the ionic compounds, name the cation first, followed by the anion.

-To name the cation, use the element name if the cation does not show variable valency.
-For the variable valency cations, in addition to the element name, add a roman numeral to indicate the charge, in the stock way of naming. Ex. Fe (II) or Fe (III). In the old way of naming, the lower to the two valencies has the ending -ous and the higher one has the ending -ic. Ex. Ferrous (Fe2+), Ferric (Fe3+). Table #1 on the right, shows some of the variable valency cations.

-To name the anion identify the type of anion first.
-Monoatomic anions are named as their element with the ending –ide, and polyatomic anions are named as such. look at the table #2 on the right for the names of common polyatomic ions.
Ex. Fe2O3 (Iron (III) Oxide) or Ferric Oxide, MgO(Magnesium Oxide), (NH4)2SO4 (Ammonium Sulfate) Note: Prefixes are not used in naming the ionic Compounds.

Ionic compounds consist of a cation and an anion. The cation may show one valency (charge) such as Al3+ and Na+ (generally group 1, 2 or 13 metal cations) or show variable valency (generally transition metal cations). The anion can be monoatomic such as Cl-, S2-, P3- or Polyatomic such as NO3- or SO42-. The rules for naming ionic compounds with single valency cation, variable valency cation and mono- and polyatomic anions are given on the left.

Table #1:Cations with Variable Valency

Copper	Cu	Cuprous, Cupric	Cu^{+}	Cu^{2+}
Cobalt	Co	Cobaltous, Cobatic	Co^{2+}	Co^{3+}
Iron	Fe	Ferrous, Ferric	Fe^{2+}	Fe^{3+}
Lead	Pb	Plumbous, Plumbic	Pb^{2+}	Pb^{4+}
Mercury	Hg	Mercurous, Mercuric	Hg_2^{2+}	Hg^{2+}
Tin	Sn	Stannous, Stannic	Sn^{2+}	Sn^{4+}

Table #2: Polyatomic Ions

Ammonium	NH_4^+	Chlorate	ClO_3^-	Thiosulfate	$S_2O_3^{2-}$
Nitrate	NO_3^-	Perchlorate	ClO_4^-	Thiocynate	SCN^-
Phosphate	PO_4^{3-}	Chlorite	ClO_2^-	Peroxide	O_2^{2-}
Hydroxide	OH^-	Hypochlorite	ClO^-	Sulfite	SO_3^{2-}
Sulfate	SO_4^{2-}	Permanganate	MnO_4^-	Nitrite	NO_2^-
Carbonate	CO_3^{2-}	Acetate	$C_2H_3O_2^-$ CH_3COO^-	Phosphite	PO_3^{3-}
Chromate	CrO_4^{2-}	Bicarbonate (hydrogen carbonate)	HCO_3^-	Bisulfate (hydrogen sulfate)	HSO_4^-
Dichromate	$Cr_2O_7^{2-}$	Cyanide	CN^-	Oxide	$O2^-$

Review 1.2 Naming Ionic Compounds

Question 1 of 3

What is the name of CaO?

- **A.** Calcium Monoxide
- **B.** Calcium Dioxide
- **C.** Calcium Oxide
- **D.** Mono calcium monoxide

Check Answer

Criss-Cross Method for Writing Formula of an Ionic Compound

-Criss cross method enables you to write the formula of an ionic compound given its name. writing the formula of an ionic compound is based upon the fact that ionic compounds are neutral. The positive and negative charges in an ionic compound must be equal.

-To Use criss-cross method: bring the numerical value of the charge of cation down as a subscript next to the anion and vice versa.

-Ex. Sodium Sulfide:
Na^+ ↘ ↙ S^{2-}
Na_2S

Naming Hydrates: Hydrates are ionic compounds that have .H2O in their formula, indicating physically attached water molecules to these compounds.

Click on the image for further information on naming the hydrates.

Naming Complexes: Complex: species in which a central metal ion (usually a transition metal) is bonded to a group of surrounding molecules or ions. Ex. $[Cu(NH_3)_4]^{2+}$, Coordination compound: compound that contains a complex ion or ions. Ex. $[Cu(NH_3)_4]Cl_2$ (click on the icon below to see further details)

Click on the image for further details on naming the complexes.

CHAPTER 1, SECTIONS 1-3 REVIEW

Practice: Write the formula for the following ionic compounds on a separate sheet of paper and check your answers by scrolling down.

1. *Magnesium Phosphide*
2. *Sodium Fluoride*
3. *Strontium Permanganate*
4. *Chromium (II) Phosphate*

Online website for the review on naming ionic compounds
http://www.quia.com/quiz/1240133.html

Naming Molecular Compounds

1.*Stock Way of naming molecular compounds: Write name of the first element followed by its oxidation state in parenthesis. Example: CO2 can be named as Carbon (IV) Oxide or Carbon dioxide*

Oxidation Numbers (ONs)

- ON is equal to the charge on a monoatomic ion. Ex. Mn2+= +2, Cl- = -1 etc.

- Sum of ONs of all elements is zero in a neutral compound. Ex. HNO3 =0

- Exceptions:H has ON of +1 (except in hydrides like NaH, where it is -1), O has ON of -2 except in peroxides (H2O2 or Na2O2), where it is -1

2.Prefix Way: Use Prefix (mono-, di-, tri- etc.) to indicate the number of atoms of each element. Mono not used before first element. Ex. CO is CO is Carbon monoxide and not Monocarbon monoxide

Molecular compounds can be named in two ways- Stock way or Prefix way. Guidelines for naming the molecular compounds are given on the left.

Review: Section 2 Naming Molecular Compounds

Question 1 of 3

What is the correct name of P2O5?

- **A.** Phosphorus (II) Oxide
- **B.** Phosphorus Oxide
- **C.** Phosphous pentoxide
- ✓ **D.** Diphosphorus pentoxide

◀ Check Answer ▶

Acids are of two types:

-Acids that do not contain Oxygen. Ex. HCl, HBr, HF

-Acids that contain oxygen are called as oxyacids. Ex. H_3PO_4, HNO_3 etc.

-The guidelines for naming both types of acids are given on the left.

Naming Acids

To name an acid without oxygen (Ex. HCl, HF etc.):

-Start with Hydro- followed by the name of anion ending in –ic Acid. Ex. HCl- Hydrochloric acid

To name an acid with Oxygen (Oxyacids, such as $HClO$, HNO_3 etc.):

-Anion ending decides the name of the acid. If anion ends in –ate, then acid is –ic acid, if anion ends in –its, then acid is –ous acid.

Ex. $HClO_4$- Perchloric Acid (anion perchlorate)

$HClO_3$- Chloric Acid (anion Chlorate)

HNO_3- Nitric Acid

Review Section 3: Naming Acids

Question 1 of 4

What is the correct name of HNO_2?

- ✓ **A.** Nitrous Acid
- **B.** Hydro Nitrous Acid
- **C.** Nitric Acid
- **D.** None of the above

Check Answer

Click on the button below before moving to the next page.

Cumulative Review for Naming Compounds

Directions: Write the formula or the name for the following compounds on a separate sheet of paper and check your answers by scrolling down.

1. *Mg3P2*
2. *NaF*
3. *Sr(MnO4)2*
4. *Cr3(PO4)2*
5. *Al2Se3*
6. *FeCl3*
7. *HNO3*
8. *Ferrous Sulfate*
9. *Ammonium Carbonate*
10. *Copper(II) Chloride*
11. *Dinitrogen Monoxide*
12. *Sulfuric Acid*

CHAPTER 2: WRITING NET IONIC EQUATIONS

Net Ionic Equations

What are they?

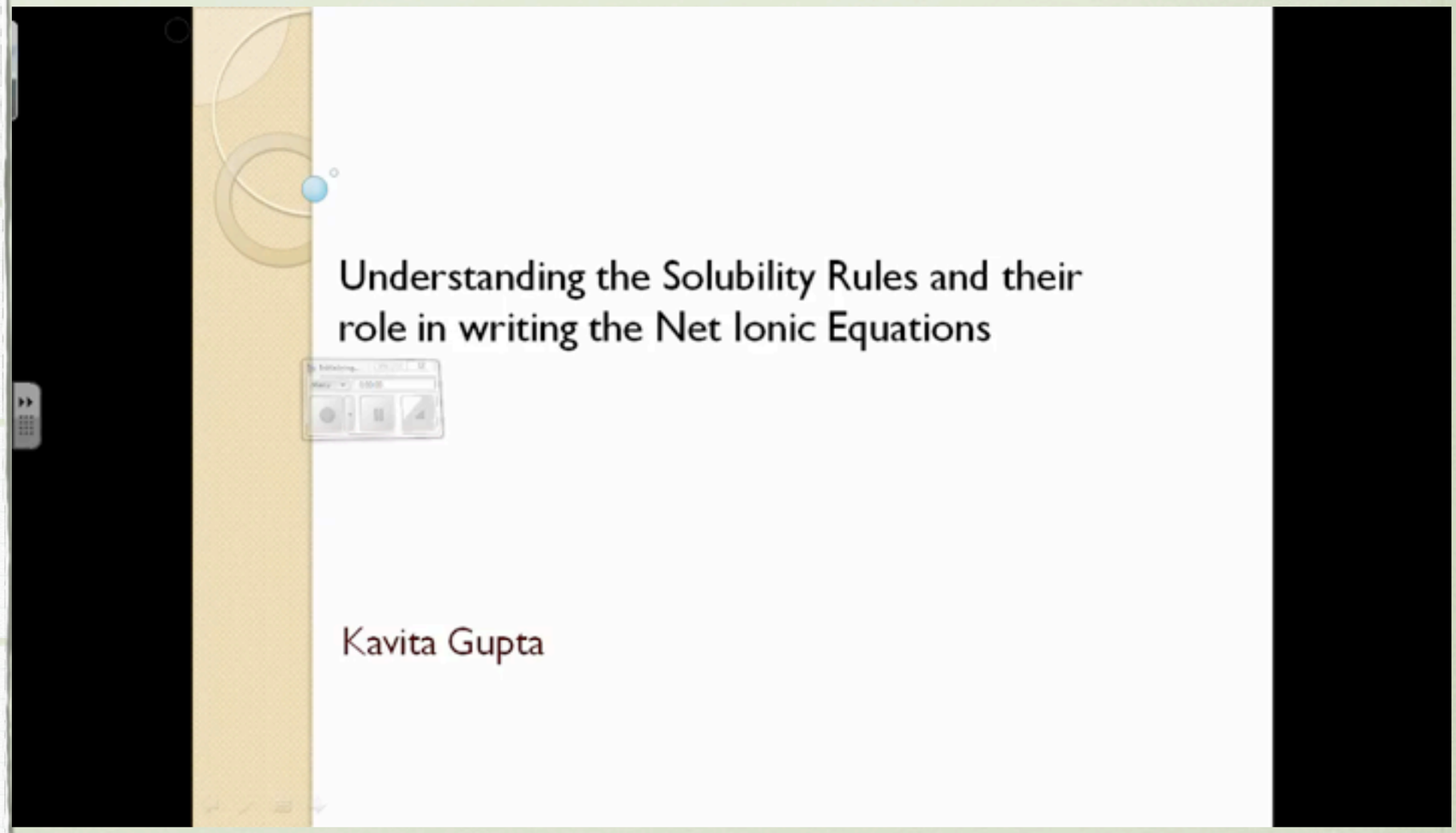
Net ionic equations indicate the "net reaction" since the spectator ions are present in the solution unchanged before and after the reaction. Net ionic equations are written when all the spectator ions are crossed off from the complete ionic equations.

Click on the icon below for the list of Strong Acids and Strong Bases.

Click on the icon below for the list of common solubility rules for Ionic Compounds.

- CHAPTER 2 •UNDERSTANDING THE SOLUBILITY RULES

So what do these solubility rules mean and how do we apply them in the context of the net ionic equations? Let us explore these questions in detail with the podcast below.



Review for understanding of the solubility rules

On a separate sheet of paper, write the formula of the compounds that are insoluble *(precipitates) in the aqueous solutions.*

1.MgF2

2. CuSO4

3. NH4Cl

4. Fe(OH)3

5. CsF

6. AgCl

7. CdS

8. CuF2

9.PbSO4

10. Ba(OH)2

11. NH4OH

12. Hg2I2

13. Na2CrO4

Answers:

Click on the button below before moving to the next page.

Steps in writing net ionic equations

Step 1: *First you need to write the formula for each compound*

Step 2: *Figure out the products. (For this, you will need to know types of reactions which are discussed in next chapter.)*

Step 3: *Write balanced complete molecular equation.*

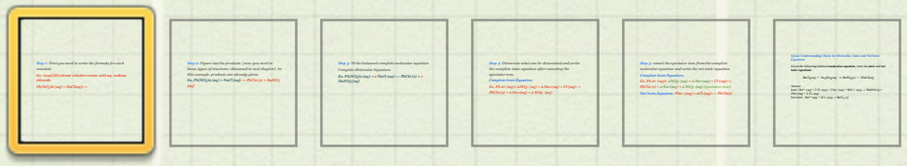
Step 4: *Dissociate what can be dissociated and write the complete ionic equation.*

Step 5: *Cancel the spectator ions and write the net ionic equation.*

Step 1: *First you need to write the formula for each reactant.*

Ex: Lead (II) nitrate solution reacts with aq. sodium chloride.

Pb(NO3)2 (aq) + NaCl(aq)-->



Gallery 2.1 Important things to remember regarding Reaction Prediction

1. Metal are insoluble and are atomic, written as (s) in these equations. Ex. Mg(s)

Ex. Magnesium reacts with Chlorine.

Molecular Equation: Mg (s) + Cl2 (g)--> MgCl2

Complete Ionic: Mg (s) + Cl2 (g)--> Mg2+ + 2 Cl-

Net ionic: Mg (s) + Cl2 (g)--> Mg2+ + 2 Cl-

(same as complete ionic since no spectator ion is present)

On a separate sheet of paper, write the net ionic equations for the following reactions. (Scroll down to see the answers.)

1. *Barium Chloride + Potassium Sulfate -->Barium Sulfate + Potassium Chloride*

2. *Zinc + Hydrochloric acid --> Zinc Chloride + Hydrogen*

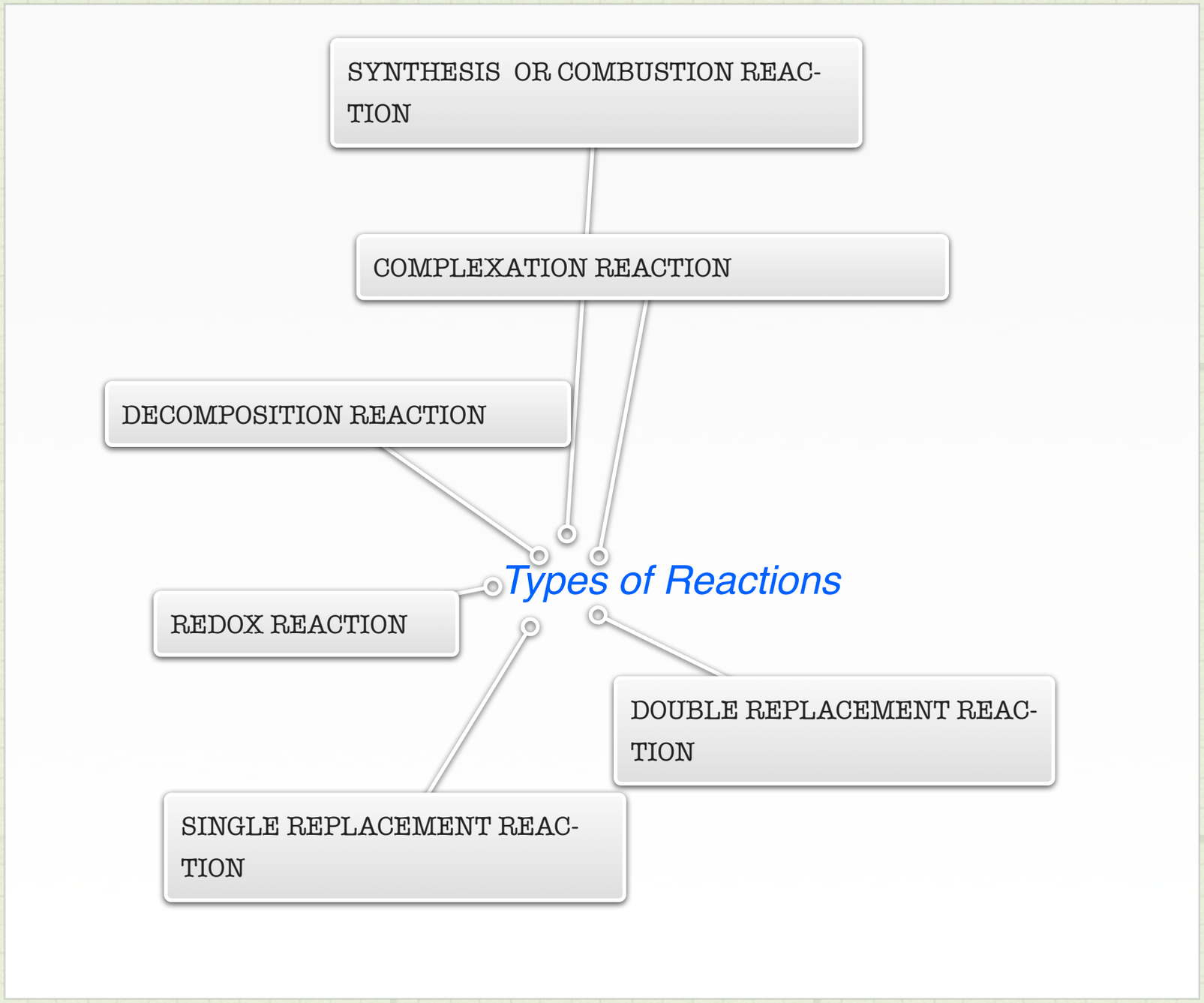
3. *Silver Nitrate + Hydrogen Sulfide --> Silver Sulfide + Nitric Acid*

CHAPTER 3: TYPES OF REACTIONS

Types of Reactions

1. *Synthesis or Combination*
2. *Decomposition*
3. *Single Replacement*
4. *Double Replacement*
5. *Combustion (sometimes under synthesis)*
6. *Redox*
7. *Complexation*

Interactive 3.1 Types of Reactions.Click on each box for the details.



Synthesis or Combination Reactions

Combination Rxn (also called Synthesis): Single compound is formed
A + B --> C

- *Metal combines with nonmetal to form salt.*
  Ex, Na(s) + Cl2 (g) --> 2Na+ + 2Cl -(aq)

- *Metallic oxides (called basic anhydrides) and water form bases.*
  Li2O(s) + H2O(l)--> 2 Li+(aq) + 2OH- (aq)

- *Nonmetallic oxides (acid anhydrides) and water form acids.*
  SO2 + H2O -->H2SO3
  SO3 + H2O -->2H+ (aq) + SO42- (aq)

- *Metallic oxides and nonmetallic oxides form an ionic compound (salt).*
  MgO(s) + CO2 (g)--> MgCO3(s)

Credit: Wikispaces

Gallery 3.1 Practice on Synthesis Reactions

Predict the products and write the net ionic equations for the following Synthesis Reactions.

1. Calcium is heated in Nitrogen.
2. Sodium oxide is added to water.
3. Phosphorus (V) oxide is added to water.

Decomposition Reactions

Decomposition Rxn: Single compound breaks down into 2 or more products; A -->B + C

- *Metal Carbonates —> CO2 + Oxide*
  CaCO3(s)--> CaO (s) + CO2 (g)

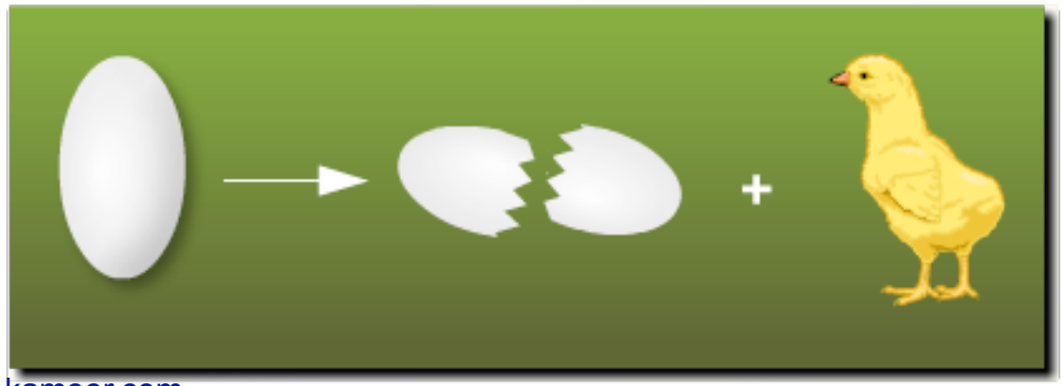
- *Metal Chlorates —> chloride compound + O2*
  KClO3(s)--> 2KCl + 3O2

- *Ammonium carbonates —> NH3+ H2O + CO2*
  (NH4)2CO3(s)--> 2NH3 (g) + H2O (g) + CO2(g)

- *Binary compound —> Two elements*
  2ALCl3(s)--> 2Al(s) + 3 Cl2 (g)

- *Hydrogen peroxide —> H2O + O2*
  2H2O2 (l)--> 2H2(g) + O2(g)

- *Bicarbonates--> CO2 + H2O + metal carbonate*
  2NaHCO3(s)--> Na2CO3(s) + CO2(g) + H2O (g)



kamoor.com

Gallery 3.2 Practice on Writing Decomposition Reactions

Predict the products and write the net ionic equations for the following decomposition reactions:

1. Ammonium carbonate is strongly heated.
2. Potassium Chlorate is strongly heated.
3. Sodium bicarbonate is strongly heated.

.....

Combustion Reactions

* *Sometimes called as synthesis reactions.*
* *One of the reactants is oxygen.*
* *Ex. X + O2--> XO2*
* *Metal and nonmetals form oxides as the result of combustion reactions.*
  Ex: Mg(s) + O2(g)--> 2 MgO (s)
* *Hydrocarbons form CO2 and H2O gases as the result of combustion.*
  CH4(g) + 2O2(g)--> CO2(g) + 2H2O (g)
* *Incomplete combustion of a hydrocarbon results in the formation of CO and H2O gases*

Type to enter text

www.cssci.org

Gallery 3.3 Practice on Combustion Reactions

Predict the products and write the balanced net ionic equations for the following combustion reactions.

1. Calcium metal burns in the air.
2. Hydrogen gas is burned in air.
3. Glucose (C6H12O6) is burned in air

Single Replacement Reactons

Single replacement reactions are always between an element and a compound. The products are also an element and a compound.
Driving force: Element with higher order of reactivity or activity series.
Ex. A + BC -->AC + B (A and B are metals)

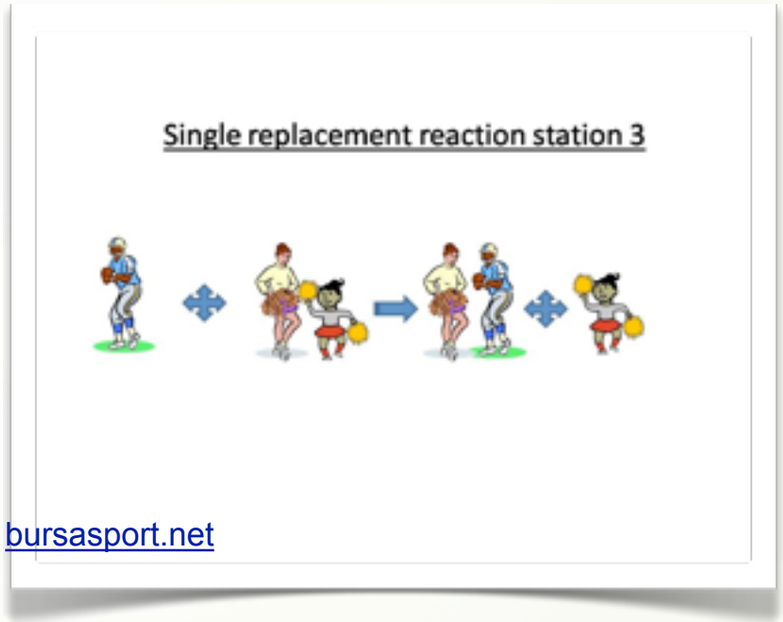
* *Fe + Pb(NO3)2 -->Fe(NO3)2 + Pb*
  Net ionic Fe +Pb2+-->Fe2+ + Pb
  OR 2Fe + 3Pb(NO3)2 --> 2Fe(NO3)3 + 3Pb
  Net Ionic 2Fe + 3Pb2+--> 2Fe2+ + 3Pb

* *D + EF--> ED + F (D and F are halogens)*
  Cl2 + 2KI--> 2KCl + I2
  Net Ionic Cl2 + 2I- --> 2Cl- + I2

* *Metal + Water → Hydroxide + Hydrogen *(if metal is higher than H in activity series)*

2 Ca + 2 H2O--> 2 Ca(OH)2 + H2

Net Ionic 2 Ca + 2 H2O --> 2 Ca + 2 OH- + H2



Gallery 3.4 Practice on Single Replacement Reactions

Predict the products and write balanced, net ionic equations for the following single replacement reactions.

1. Solid calcium is added to hydrobromic acid solution.
2. Calcium metal is added to water.
3. Solid copper is added to a solution of silver nitrate.

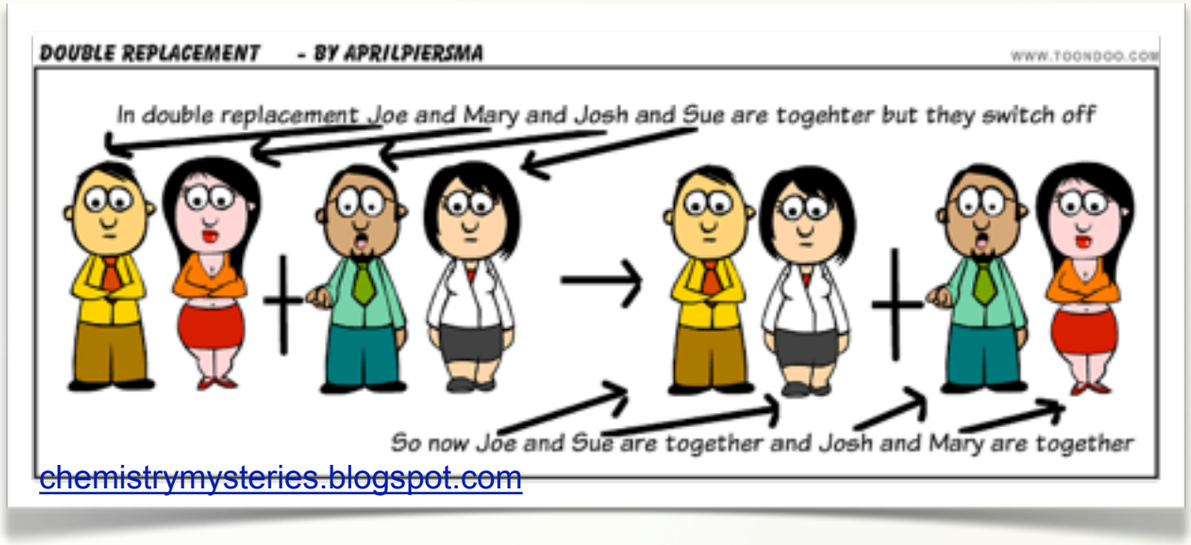
Double Replacement Reactions

* *exchange of positive ions between 2 reacting compounds. Driving force is formation of solid (precipitate), liquid (molecular compound like water), or gas.*
  AB+ CD -->AD + CB

* *Ex. K2CO3(aq) + BaCl2(aq) +K2CO3(aq) --> 2KCl (aq) + BaCO3 (s) Net Ionic Ba2+ (aq) + CO3 2- (aq) -->BaCO3 (s)*

* *Metal Oxide + Acid -->Salt + Water*
  Li2O(s) + 2 HCl(aq) --> 2 LiCl(aq) + H2O(l)
  Net Ionic Li2O + 2H+ + 2Cl- --> 2Li+(aq) + 2Cl- (aq) +H2O (l)

* *Acid + Base--> Salt + Water*
  Ex. HCl + NaOH--> NaCl + H2O Net Ionic H+(aq) + OH-(aq) --> H2O (l)



Gallery 3.5 Practice on Double Replacement Reactions

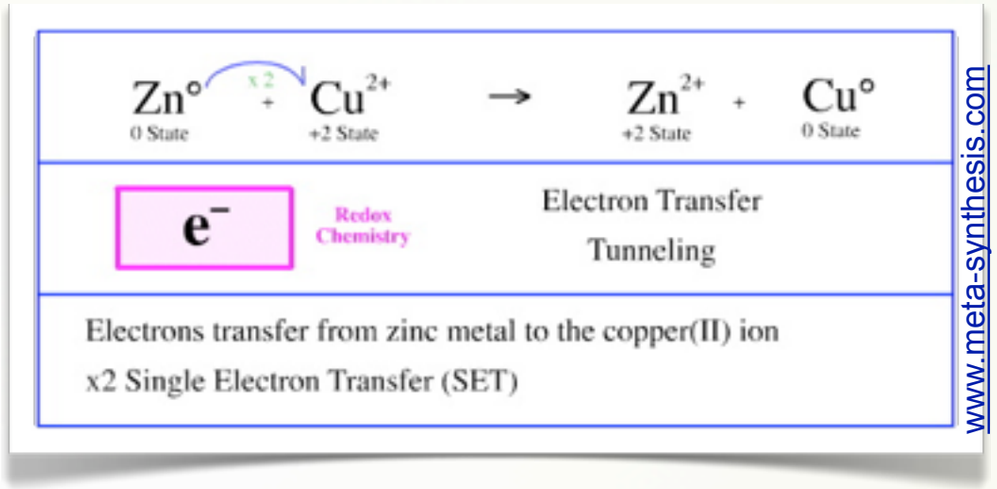
Predict the products and write the balanced, net ionic equations for the following double replacement reactions.

1. A solution of lead nitrate is mixed with potassium sulfate.
2. Equal volumes of 0.1 M sodium phosphate is added to hydrochloric acid.
3. Ammonia reacts with acetic acid solution.
4. Hydrogen sulfide gas is bubbled through a solution of lead(II) nitrate.
5. Solutions of silver nitrate and sodium chromate are mixed.

Redox Reactions

Involve transfer of the electrons (involves change in Oxidation number of the elements)

* *Most reactions involving permanganate, dichromate, or chromate are redox reactions.*
* *"A solution of tin(II) chloride is added to an acidified solution of potassium permanganate."*
  $5Sn2+ + 16H+ + 2MnO4– \rightarrow 5Sn4+ + 2Mn2+ + 8H2O$
* *"Solid sodium dichromate is added to an acidified solution of sodium iodide."*
  $Na2Cr2O7 + 14H+ + 6I– \rightarrow 2Na+ + 2Cr3+ + 7H2O + 3I2$
* *$MnO4–$ in acidic solution $Mn2+$*
  $MnO2$ in acidic solution $Mn2+$
  $MnO4–$ in neutral or basic solution $MnO2$
  $Cr2O7–$ in acidic solution $Cr3+$
  $HNO3$ concentrated $--NO2$
  $H2O2$ -- $O2$, $H2O$



Gallery 3.6 Balancing Redox Reactions

Tap on the frame below for the full screen view.

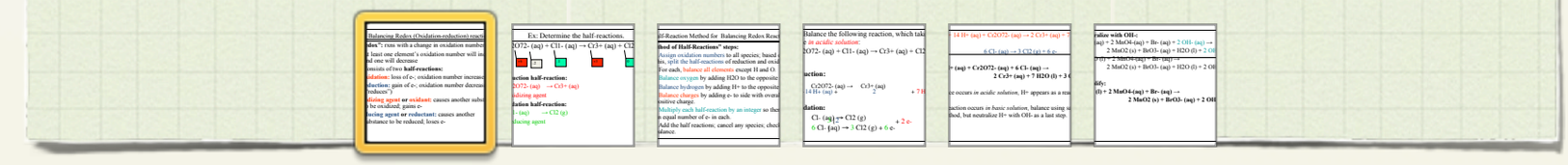
Balancing Redox (Oxidation-reduction) reactions

"Redox": rxns with a change in oxidation number

- At least one element's oxidation number will increase and one will decrease
- Consists of two **half-reactions:**

  oxidation: loss of e-; oxidation number increases

  reduction: gain of e-; oxidation number decreases ("reduces")



Practice Problems on Redox

Scroll down for the answers.

1. A solution of tin(II) chloride is added to an acidified solution of potassium permanganate.”

2. Solid sodium dichromate is added to an acidified solution of sodium iodide.

Complexation Reactions

1. *Involve a coordination compound. A coordination compound has complex ion in it.*
2. *Complex ion has a transition metal cation and ligands (small molecules or anions, such as NH3, Cl-, h2O etc.) attached to the metal cation.*
3. *Ex. of complex ions [Cu(NH3)4]2+, Na(OH)4-*
4. *Complexation reactions may involve formation of a complex, dissolving a precipitate or formation of a precipitate.*
5. *When forming complex ions, you will often add double the number of ligands than the oxidation state of the metal.*

Gallery 3.7 Complexation Reactions

Complexation Reactions

Complexation reactions may involve:

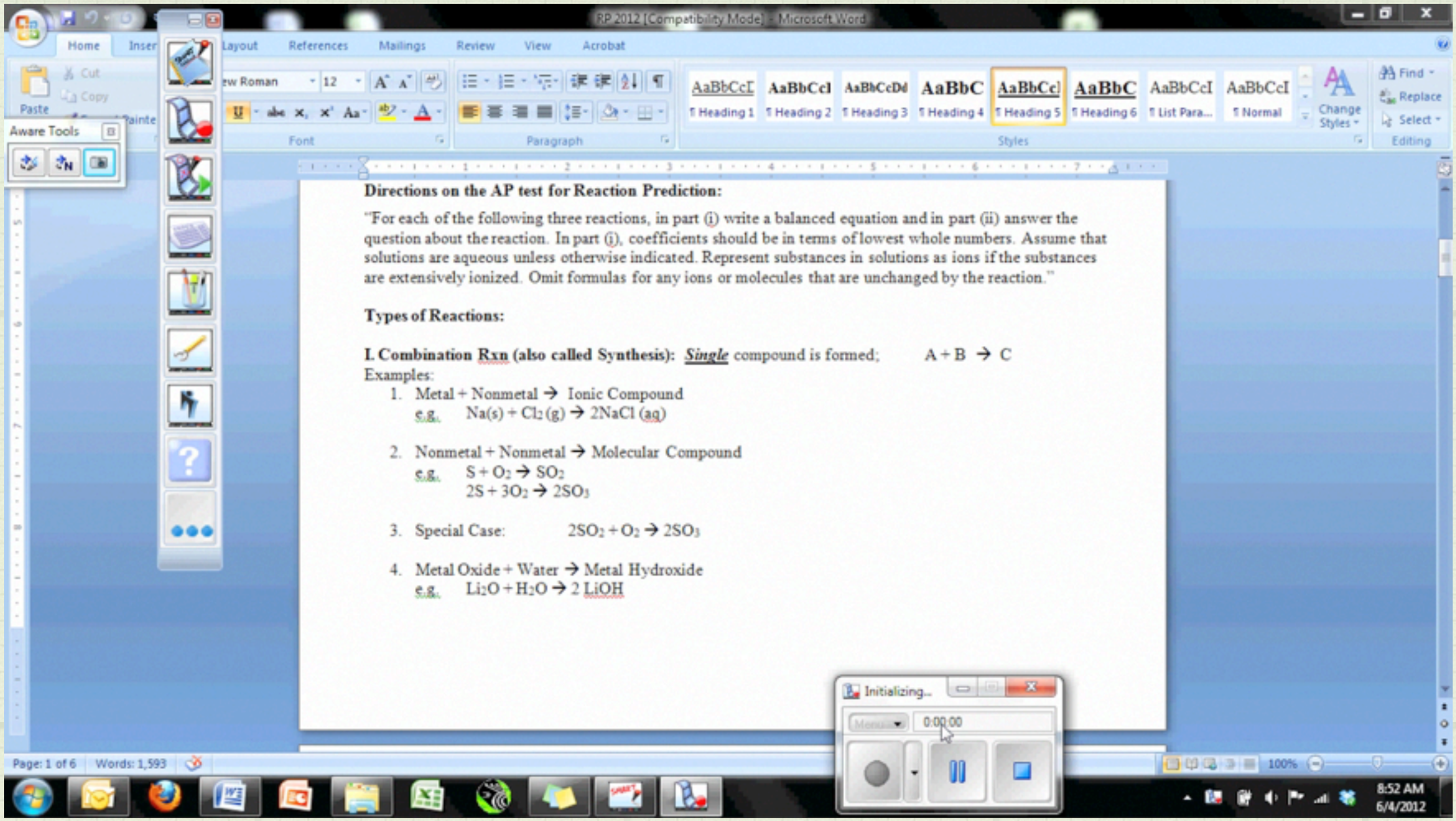
-formation of a complex between a metal cation and a ligand

- dissolving a precipitate

- formation of a precipitate

CHAPTER 4: PRACTICE ON REACTION PREDICTION

Movie 4.1 Podcast on Reaction Prediction Practice



Review 4.1 Review for the Reaction Prediction

Question 1 of 3

What are the products formed upon decomposition of carbonic acid?

- **A.** H_2CO_3
- **B.** $H_2 + CO_2$
- **C.** $H^+ + HCO_3^-$
- ✓ **D.** $H_2O + CO_2$

Check Answer

Click on the button below before moving to the next page.

Practice on Reaction Prediction and net ionic equations

For each of the reactions below, write the following on a separate sheet of paper. Scroll down for the answers.

-type of reaction

-balanced complete molecular equation

-complete ionic equation

-net ionic equation

1. *Solid zinc sulfide reacts with aq hydrochloric acid.*
2. *Phosphorus (V) Oxide is mixed with water.*
3. *Solutions of silver nitrate and sodium chromate are mixed.*
4. *Butane is burned in air.*
5. *Concentrated ammonia is bubbled through the solution of cupric nitrate.*

• COPYRIGHT •

Acids: Compounds that act as proton donors, the formula of acids generally begins with H (3)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Cation: Positively charged atom, formed when an atom loses one or more electrons (2.1)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Complexes: Ions that have a trasition metal cation bonded to ligands (small neutral molecules or anions) (2.1)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Ionic Compounds: Made up of a cation and anion, generally present as solids (2.1)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Molecular Compounds: Made up of all non metals, generally present as gases or liquids(2.2)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Net Ionic Equations: Shows what happens in a reaction after crossing out spectator ions(3)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Nomenclature: Naming of compounds(2)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Solubility Rules: Set of rules predicting what ionic compounds will break up into ions when dissolved in water(2.1)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Strong Acids: Acids that completely dissociate into ions(3)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term

Weak Acids: Only partly dissociate(3)

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

Related Glossary Terms

Drag related terms here

Index Find Term