Unit 5 – Chemical Reactions Notes

Introduction: Chemical substances have physical and chemical properties

Physical Properties – **<u>Examples</u>:**	**2 Types of Physical Properties**	
	Extensive Physical Properties	**Intensive Physical Properties**
Chemical Properties – **<u>Examples</u>:**		

1. What is a **<u>chemical change</u>**?

   List some examples of a **<u>chemical change</u>**.

   List several indicators that a chemical change has occurred.

2. What is a **<u>physical change</u>**?

   List some examples of **<u>physical changes</u>**.

   Describe each state of matter:

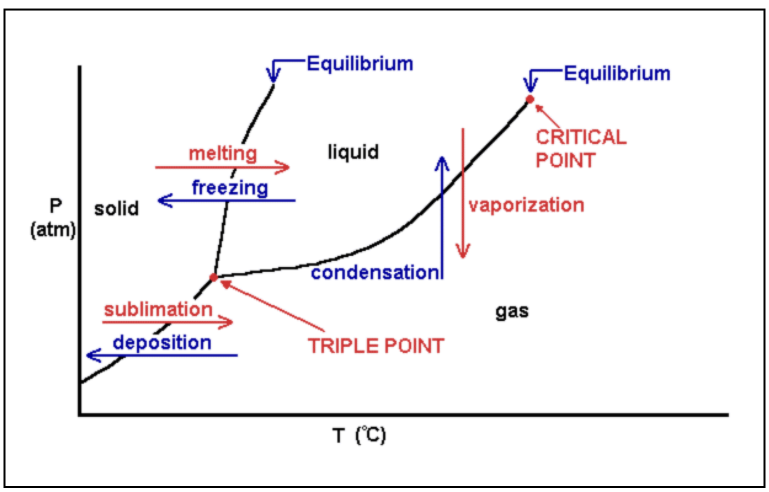
   <u>Solid</u>

   <u>Liquid</u>

   <u>Gas</u>

   Define the following **<u>phase changes</u>**:

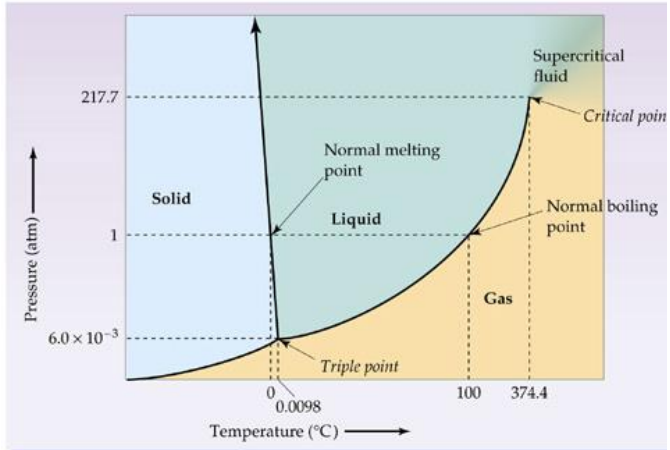
   Melting
   Freezing
   Vaporization
   Condensation
   Sublimation
   Deposition



3. What is a **phase diagram**?

Define and label these points on a phase diagram.

a) **Triple point**



b) **Critical point**

c) **Critical temperature**

d) **Critical pressure**

e) **Normal freezing/melting point**

f) **Normal boiling point**

g) **Areas representing solid, liquid, and vapor phase**

h) **Equilibrium lines for melting, vaporization, and sublimation**

Chemical Reactions

1. What is a **chemical reaction**?
2. What is a **chemical equation**?
3. Fill in the following table of chemical equations symbols and terms.

Symbol or Term	Explanation
Reactants	
Products	
→	
↔	
(s)	
(l)	
(g)	

(aq)	
Coefficient	
Subscript	
Δ →	
Catalyst →	
Exothermic	
Endothermic	
Activation energy	

Balancing Equations:

1. State the **<u>Law of Conservation of Mass</u>** in terms of a chemical equation.

2. Remember, when balancing chemical equations only the ___________________________ can be changed, **NEVER** the __________________________. Explain.

3. Balance the following equations:

____ $Na(s)$ + ____ $Cl_2(g)$ → ____ $NaCl(s)$

____ $H_2(g)$ + ____ $O_2(g)$ → ____ $H_2O(g)$

____ $Al(s)$ + ____ $CuSO_4(aq)$ → ____ $Cu(s)$ + ____ $Al_2(SO_4)_3(aq)$

Word Equations:

Sodium chloride and lead (II) nitrate are combined to make lead (II) chloride and sodium nitrate.

Iron and chlorine react to produce iron (III) chloride

When chlorine gas reacts with methane, carbon tetrachloride and hydrogen chloride are produced.

Types of Chemical Reactions: (See Reference Packet)

1. Describe and write the general form for each of the following reaction types:

   a) **Synthesis** reaction

   b) **Decomposition** reaction

   c) **Single replacement** reaction

   d) **Double replacement** reaction

   e) **Combustion** reaction

Predicting Products

1. **Combustion** (look for the hydrocarbon and oxygen):

   CH_4 + O_2 →
   C_2H_6 + O_2 →
   C_2H_8 + O_2 →

2. **Synthesis**

   Remember to _______________ _________ ________________ for ionic compounds!
   Most are _________________
   *You may need to use your reference table

   $Mg_{(s)}$ + $O_{2(g)}$ →
   $Na_{(s)}$ + $Cl_{2(g)}$ →
   $Al_{(s)}$ + $O_{2(g)}$ →
   * Na_2O + H_2O →

3. **Decomposition**

   Remember the diatomic molecules (__________________)
   Most are ______________
   *You may need to use your reference table

   Fe_2O_3 →
   KBr →
   H_2O →
   * $Ca(OH)_2$ →
   * $Al(ClO_3)_3$ →

4. **Single Replacement**

Use the ____ to predict whether or not a **single replacement** reaction will occur.

If the free element is _____________________________________ than the element in the compound, then the reaction will ____.

If the free element is ____ than the element in the compound, then the reaction will ____.

Practice Problems:

Ag + $ZnCl_2$ →

Zn + $AgNO_3$ →

Zn + $CuSO_4$ →

NaCl + Li →

K + H_2O →

NaCl + I_2 →

LiOH + Na →

NaI + Br_2 →

* Check Reference table*

Na(s) + H_2O(l) →

Ag(s) + HCl(aq) →

5. **Double Replacement**

Switch ___________ ions

In order for a **double replacement** reaction to occur, one product must be a __________________, _________________, or a ___________________________.

Use ____ in the reference packet to predict precipitates. Remember: **soluble** means *aqueous* (dissolves in water) and **Insoluble** means *solid precipitate* (does not dissolve in water)

You must include states of matter for these reactions!

Which substances are **always soluble**?

Which substances tend to be **red flags**?

Practice Problems:

____ $Ba(OH)_2$(aq) + ____ H_3PO_4(aq) →

____ KOH(aq) + ____ H_2SO_4(aq) →

____ K_2SO_4(aq) + ____ $CaCl_2$(aq) →

____ $FeBr_2$(aq) + ____AlI_3(aq) →

____ $(NH_4)_2CO_3$(aq) + $CaCl_2$(aq) →

Writing Ionic and Net Ionic Equations

1. **Rules:**

   Aqueous ionic compounds can be separated into ions. (Don't forget charges!)

   Strong acids can be separated into ions.

   Substances that are solids, liquids, or gases **cannot** be separated.

   Spectator ions are removed from the ionic equation leaving the **net ionic equation**.

2. Example: $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow 2NaCl(aq) + BaSO_4(aq)$

Ionic Equation: ____

Net Ionic Equation: ____

Spectator Ions: ____

Remember your Check List for the Ionic and Net Ionic Equations:

1. Is it aqueous or solid/liquid/gas?
   Aqueous →Bust it into ions!
   Solid/Liquid/Gas → Keep it together!
2. Do your **ions** have **charges**?
3. Does everything have a **phase**?
4. Does everything have a **coefficient** if needed?

Redox Reactions

1. Redox reactions involve the transfer of ________________________.
   _________________________________ = ________________________________
2. Redox reactions always involve simultaneous ______________________ and ____________________ reactions.
3. Oxidation involves the ______________ ________ _________________, oxidation number ___________________
4. Reduction involves the _______________ ________ __________________, oxidation number __________________
5. What is an oxidation number?

6. Rules for assigning oxidation numbers:
   a. Free elements and HOFBrINCl have oxidation numbers of 0
   b. Hydrogen has an oxidation number of +1 (except when it is combined with a metal it is -1)
   c. Oxygen has an oxidation number of -2 (except in peroxides it's -1 and when with F it's +2)
   d. In a binary molecule the more electronegative element is its charge if it were an ion
   e. The sum of oxidation numbers in a neutral compound is 0
   f. The sum of oxidation numbers in a PAI is its charge
7. Assign oxidation numbers:
   a. O_2
   b. H_2O
   c. Fe
   d. CaO
   e. Al_2S_3
   f. HNO_2
   g. H_2SO_4
   h. $Fe(NO_3)_2$
8. Redox reactions always involve a change in oxidation numbers!
9. Identify the following as redox or nonredox:
   a. $C + O_2 \rightarrow CO_2$
   b. $NH_3 + HCl \rightarrow NH_4^+ + Cl^-$
   c. $2H_2O \rightarrow 2H_2 + O_2$
   d. $2KClO_3 \rightarrow 2KCl + 3O_2$
   e. $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$
   f. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
10. Half reactions
    a. A half-reaction represents either the reduction half or the oxidation half in a redox reaction.
    b. The sum of the two must equal the overall reaction
    c. You must balance the electrons (make sure they are the same on both.

11. Let's try it!
    a. Oxidation of K to K^+

    b. The reduction of Fe^{3+} to Fe^{2+}

    c. The reduction of S to S^{2-}

    d. The oxidation of F^- to F_2

    e. $Mg + Br_2 \rightarrow MgBr_2$

    f. $Fe + Zn^{2+} \rightarrow Fe^{3+} + Zn$