***Balancing chemical equations and deciphering word problems***

Part I: Review Problems

1. Create a word key based on the following problems. This key should be made by reading through each problem and identifying the indicator words (i.e. context clues) that help figure out you what part of the reaction we’re talking about!

Leads to…

Products

Reactants

Example: A mixed with B yields C. D is also formed.

1. When 0.684 g of an organic compound containing only C, H, and O was burned in oxygen 1.312g CO2 and 0.805g H2O were obtained.
2. Aluminum bromide and chlorine gas react to form aluminum chloride and bromine gas.
3. When fluorine gas is put into contact with calcium metal at high temperatures, calcium fluoride powder is created in an exothermic reaction.
4. In a precipitation reaction, sodium hydroxide solution is mixed with iron(II) chloride solution. Sodium Chloride solution and insoluble iron(II) hydroxide are produced.
5. Elemental boron is produced in one industrial process by heating diboron trioxide (B2O3) with magnesium metal. Magnesium oxide is also produced as a by-product of this reaction.
6. Nitrous oxide (N2O), also known as "laughing gas" is used by some dentists as an anesthetic. Nitrous oxide (and water vapor as a by-product) can be produced in small quantities in the laboratory by careful heating of ammonium nitrate.
7. When sulfuric acid is added to solid sodium chloride and the mixture is heated, hydrogen chloride gas is generated, leaving a solid residue of sodium sulfate.
8. When bright red mercury (II) oxide is heated in a test tube, oxygen gas is evolved, and droplets of liquid mercury condense at the cooler top of the test tube.
9. When hydrogen sulfide, H2S, gas is bubbled through a solution of lead (II) nitrate, Pb(NO3)2, a black precipitate of lead (II) sulfide, PbS, forms, and nitric acid, HNO3 is produced.
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11. Lead (III) nitrate and sodium sulfate will produce lead (III) sulfate and sodium nitrate when they react.
12. Barium chloride solution reacts with sodium sulfate solution to make solid barium sulfate and aqueous sodium chloride.
13. Write a balanced chemical equation for:

The complete combustion of 2,2-dimethylpropane (C4H10) in oxygen.

The reaction of nitric acid with potassium hydroxide. (double displacement)

The reaction of iron metal with oxygen to form iron (III) oxide. (synth)

\_\_\_ Pb(NO3)2 + \_\_\_ HCl 🡪 (double displacement)

\_\_\_ KClO3   🡪 \_\_ KCl   + \_\_ O2

\_\_\_Al2(SO3)3   +  \_\_\_ NaOH  🡪 \_\_\_Na2SO3    +   \_\_\_Al(OH)3

Part II: Strategies

1. What are key terms or indicators in a problem that help you to know that this is a problem involving this concept?
2. What is a generalized procedure/equation that can be used to attack this kind of problem?
3. What are some problem solving strategies for the times when you can’t remember the general rules?

***Nomenclature and Activity Series***

Part I: Review Problems

Using the rules for naming, write the name or chemical formula for each of the following:

The reaction of AlBr3 with Mg(OH)2

FeCl3

Carbon tetrafluoride

Copper (II) phosphate

Ni(NO3)2

H2S

H2SO4

**Typical charges**: What charge(s) will the following atoms have when ionized?

 Charge? Cation or anion?

Ba \_\_\_\_\_\_

Cl \_\_\_\_\_\_

Zn \_\_\_\_\_\_

Ag \_\_\_\_\_\_

Al \_\_\_\_\_\_

O \_\_\_\_\_\_

F \_\_\_\_\_\_

**Symbols in Chemical Reactions**

*Describe what each of these symbols communicate when written in an equation for a chemical reaction.*

|  |  |
| --- | --- |
| **Symbol** | **Description** |
| Subscripts | The numbers behind a letter in a chemical formula. These indicate the number of atoms of each element present in that compound |
| Coefficients |  |
| (g) |  |
| (l) |  |
| (aq) |  |
| (s) |  |
| Symbols above the arrow, such as ∆ or Pt |  |

**Activity Series**

* 1. Order the following in terms of their “activity” (i.e. their degree of reactivity)

Zinc Potassium Mercury Magnesium

* 1. Describe the consequences of these “activities” in single-displacement and double-displacement reactions?
	2. Which of the following reactions occur?
1. Steel wool (iron) is placed in sulfuric acid
2. Mercury is poured into an aqueous solution of zinc nitrate
3. Bromine reacts with aqueous barium iodide.



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***Reaction Types***

Part I: Review Problems

1. What are the general chemical equations for the five reaction types of that we’ve been studying?
2. What are key words/context clues for each type of reaction? For example, when reading a word problem, which describes a decomposition reaction, what words are *typically* used to describe this reaction? What should we watch for?
3. Which reaction types to we need to consider the “activity of metals” for?

|  |  |  |
| --- | --- | --- |
| **Type** | **General Form of Chemical Equation** | **Context Clues** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. What type of reaction does each of the following represent?
2. When sulfuric acid is added to solid sodium chloride and the mixture is heated, hydrogen chloride gas is generated, leaving a solid residue of sodium sulfate.
3. When bright red mercury (II) oxide is heated in a test tube, oxygen gas is evolved, and droplets of liquid mercury condense at the cooler top of the test tube.
4. When hydrogen sulfide, H2S, gas is bubbled through a solution of lead (II) nitrate, Pb(NO3)2, a black precipitate of lead (II) sulfide, PbS, forms, and nitric acid, HNO3 is produced.
5. Lead (III) nitrate and sodium sulfate will produce lead (III) sulfate and sodium nitrate when they react.
6. Barium chloride solution reacts with sodium sulfate solution to make solid barium sulfate and aqueous sodium chloride.
7. \_\_\_ KClO3    \_\_ KCl   + \_\_ O2

Part II: Strategies

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***Predicting Products***

Part I: Review Problems

1. Once we have made a list of possible products, what are the different tests we have to determine if we have the following substances present?

|  |  |
| --- | --- |
| **Substance** | **Test** |
| Hydrogen gas |  |
| Oxygen gas |  |
| Ammonia gas |  |
| Carbon dioxide gas |  |
| Water vapor (g) |  |
| Water (*l*) |  |
| Precipitate (s) |  |

1. What products are likely to be formed given the following information?
2. The reaction of copper with aqueous silver nitrate (single displacement)
3. Propane (C3H8) reacting with oxygen (combustion)
4. The reaction of lead (II) nitrate with potassium iodide (double displacement)
5. Aluminum reacting with bromine (synthesis)
6. Ammonia decomposes into its constituent elements (decomposition)

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***Solubility***

Part I: Review Problems

1. Complete the Sweet 16 Ion Chart.
2. Break the following reactions down into ions EXCEPT for those that have undergone a chemical change (i.e. are no longer soluble in water). Examples of substances that should *not* be written as ions, include:

H­2 (g), BaSO4 (s), Al (s), CO2 (g)

1. Aqueous solutions of sodium sulfide and cadmium nitrate are mixed in a beaker to form solid cadmium sulfate and aqueous sodium nitrate.
2. Barium nitrate (aq) and sodium hydroxide (aq) react to form sodium nitrate and barium hydroxide.
3. AgNO3 (aq) + AlCl3 (aq) 🡪 (silver chloride is a precipitate).
4. For the reactions in Problem 2, what will be their net ionic equations?

Remember net ionic equations are defined to be: *an equation for a reaction in solution that shows only those particles that are directly involved in the chemical change.* *Spectator ions, which do not participate, are thus not included*.

Example: Pb (s) + 2AgNO3 (aq) 🡪 Ag (s) + Pb(NO3)2 (aq)

 Complete ionic equation:

 Pb (s) + 2Ag+ (aq) + 2NO3- (aq) 🡪 Ag (s) + Pb2+(aq) + 2NO3- (aq)

 Net ionic:

Pb (s) + 2Ag+ (aq) 🡪 Ag (s) + Pb2+(aq)

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