Name_____ Date_____

AP Chemistry

Key to Reaction Prediction -1

For each of the following eight reactions, in part (i) write a BALANCED equation and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction.

a) Solid Calcium Carbonate is strongly heated.

i. $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

ii. What is the oxidation state of the carbon and does it change?

$C^{4+} \rightarrow C^{4+}$ no change

b) Hydrogen sulfide gas is bubbled into a solution of mercury (II) chloride.

i. $H_2S_{(g)} + Hg^{2+}_{(aq)} \rightarrow HgS_{(s)} + 2\ H^+_{(aq)}$ OR

$H_2S_{(g)} + HgCl_{2(aq)} \rightarrow HgS_{(s)} + 2\ H^+_{(aq)} + 2\ Cl^-_{(aq)}$

ii. What would you expect to observe in the solution during this reaction.

A black precipitate forms.

c) Phosphorus(V) oxide powder is sprinkled over distilled water.

i. $P_4O_{10}(s) + 6\ H_2O_{(l)} \rightarrow 4\ H_3PO_{4(aq)}$ OR

$2\ P_2O_{5(s)} + 6\ H_2O_{(l)} \rightarrow 4\ H_3PO_{4(aq)}$

ii. Estimate the pH of the reacted solution and give your reasoning.

pH would be less than 7 as a weak acid is formed

d) A bar of zinc metal is immersed in a solution of copper(II) sulfate.

i. $Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Cu_{(s)} + Zn^{2+}_{(aq)}$

ii. What is the oxidizing agent? Explain.

$CuSO_4$ is the oxidizing agent. Copper gains electrons.

e) A small piece of sodium metal is added to distilled water.

i. $2\ Na_{(s)} + 2\ HOH_{(l)} \rightarrow 2\ Na^+_{(aq)} + 2\ OH^-_{(aq)} + H_{2(g)}$

ii. A flame is seen above the water. Explain this secondary reaction.

Hydrogen gas is flammable and the reaction is exothermic enough to ignite the gas.

f) Solid barium oxide is added to distilled water.

i. $2\ BaO_{(s)} + HOH_{(l)} \rightarrow Ba^{2+}_{(aq)} + 2\ OH^-_{(aq)}$

ii. Estimate the pH of the reacted solution and give your reasoning.

The pH should be greater than 7 since a base is made.

g) Solid ammonium carbonate is heated.

i. $(NH_4)_2CO_{3(s)} \rightarrow 2\ NH_{3(g)} + CO_{2(g)} + H_2O_{(l)}$

ii. If one mole of reactant is used what is the volume of the product STP.

1 mole of reactant should yield three moles of product.

h) Solutions of manganese(II) sulfate and ammonium sulfide are mixed.

i. $Mn^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow MnS_{(S)}$

ii. Name the spectator ion(s).

Ammonium and sulfate are the spectator ions.

Reaction predictions from:
Hague, G., & Smith, J. (2001). *The Ultimate Chemical Equations Handbook*. Batavia, IL: Flinn Scientific, Inc.
Correlating questions (ii) from:
Rodney Schmitz (2007) Moore County Schools, NC