Section 3.2– Qualitative Analysis– Identifying Unknown Ions (Part I) WORKSHEET key

1. Classify each of the substances as being soluble or insoluble in water.

a. potassium bromide – **sol**
b. lead (II) carbonate – **insol**
c. barium sulfate – **insol**
d. zinc hydroxide – **insol**
e. sodium acetate – **sol**
f. silver iodide – **insol**
g. cadmium (II) sulfide – **insol**
h. zinc carbonate – **insol**
i. silver acetate – **sol**
j. copper (II) sulfide – **insol**
k. $Mg_3(PO_4)_2$ – **insol**
l. KOH – **sol**
m. $NiCl_2$ - **sol**
n. NH_4OH – **sol**
o. Hg_2SO_4 – **insol**
p. PbI_2 – **insol**

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2. Identify the two new compounds which form if the solutions, as suggested by the following table, were mixed. CIRCLE the names of the compounds which would precipitate from the solutions.

	KBr	Na_2CO_3	CaS	NH_4OH
$AgNO_3$	**$\underline{AgBr}$** + KNO_3	$NaNO_3$ + **$\underline{Ag_2CO_3}$**	$Ca(NO_3)_2$ + **$\underline{Ag_2S}$**	**$\underline{AgOH}$** + NH_4NO_3
$BaCl_2$	KCl + $BaBr_2$	NaCl + **$\underline{BaCO_3}$**	$CaCl_2$ + BaS	$Ba(OH)_2$ + NH_4Cl
$Al(NO_3)_3$	$AlBr_3$ + KNO_3	$NaNO_3$ + **$\underline{Al_2(CO_3)_3}$**	$Ca(NO_3)_2$ + **$\underline{Al_2S_3}$**	NH_4NO_3 + **$\underline{Al(OH)_3}$**
$CuSO_4$	$CuBr_2$ + K_2SO_4	Na_2SO_4 + **$\underline{CuCO_3}$**	**$\underline{CuS}$** + **$\underline{CaSO_4}$**	$(NH_4)_2SO_4$ + **$\underline{Cu(OH)_2}$**

Net Ionic Equations

Write chemical equations, total ionic equations and net ionic equations for each reaction. The first one is done for you. (assume that all reactions occur):

1. Magnesium metal is placed in hydrochloric acid

$$Mg_{(s)} + 2\,HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2\,(g)}$$
$$Mg_{(s)} + 2\,H^{+}_{(aq)} + 2\,Cl^{-}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + 2Cl^{-}_{(aq)} + H_{2\,(g)}$$
$$Mg_{(s)} + 2\,H^{+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + H_{2\,(g)}$$

2. Zinc metal is placed in silver nitrate solution

$$Zn_{(s)} + 2Ag\,NO_{3\,(aq)} \rightarrow Ag_{(s)} + 2\,Zn(NO_3)_{2\,(aq)}$$
$$Zn_{(s)} + 2Ag^{+}_{(aq)} + 2\,NO_3^{-}{}_{(aq)} \rightarrow 2Ag_{(s)} + Zn^{+2}_{(aq)} + 2NO_3^{-}{}_{(aq)}$$
$$Zn_{(s)} + 2Ag^{+}_{(aq)} \rightarrow Zn^{+2}_{(aq)} + 2Ag_{(s)}$$

3. Barium chloride solution is added to lead (II) nitrate solution.

$$BaCl_{2\,(aq)} + Pb(NO_3)_{2\,(aq)} \rightarrow PbCl_{2\,(s)} + Ba(NO_3)_{2\,(aq)}$$

$$Ba^{2+}_{(aq)} + 2Cl^{-}_{(aq)} + Pb^{2+}_{(aq)} + 2NO_3^{-}{}_{(aq)} \rightarrow PbCl_{2\,(s)} + Ba^{2+}_{(aq)} + 2NO_3^{-}{}_{(aq)}$$

$$Pb^{2+}_{(aq)} + 2Cl^{-}_{(aq)} \rightarrow PbCl_{2\,(s)}$$

4. Sulphuric acid is added to Strontium hydroxide solution.

$$H_2SO_{4\,(aq)} + Sr(OH)_{2\,(aq)} \rightarrow 2H_2O_{(l)} + SrSO_{4\,(s)}$$

$$2H^{+}_{(aq)} + SO_4^{2-}{}_{(aq)} + Sr^{2+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow 2H_2O_{(l)} + SrSO_{4\,(s)}$$

$$2H^{+}_{(aq)} + SO_4^{2-}{}_{(aq)} + Sr^{2+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow 2H_2O_{(l)} + SrSO_{4\,(s)}$$

5. Sodium carbonate solution is added to nickel (III) nitrate solution.

$$3Na_2CO_{3(aq)} + 2Ni(NO_3)_{3\,(aq)} \rightarrow Ni_2(CO_3)_{3\,(s)} + 6NaNO_{3\,(aq)}$$
$$6Na^{+}_{(aq)} + 3CO_3^{2-}{}_{(aq)} + 2Ni^{3+}_{(aq)} + 6NO_3^{-}{}_{(aq)} \rightarrow Ni_2(CO_3)_{3\,(s)} + 6Na^{+}_{(aq)} + 6NO_3^{-}{}_{(aq)}$$

$$3CO_3^{2-}{}_{(aq)} + 2Ni^{3+}_{(aq)} \rightarrow Ni_2(CO_3)_{3\,(s)}$$

6. Aqueous chlorine is added to sodium bromide solution.

$$Cl_{2\,(aq)} + 2NaBr_{(aq)} \rightarrow 2NaCl_{(aq)} + Br_{2\,(aq)}$$
$$Cl_{2\,(aq)} + 2Na^{+}_{(aq)} + 2Br^{-}_{(aq)} \rightarrow 2Na^{+}_{(aq)} + 2Cl^{-}_{(aq)} + Br_{2\,(aq)}$$

$$Cl_{2\,(aq)} + 2Br^{-}_{(aq)} \rightarrow 2Cl^{-}_{(aq)} + Br_{2\,(aq)}$$

7. Nitric acid is added to aluminum hydroxide solution.

$$2HNO_{3\,(aq)} + Sr(OH)2_{(aq)} \rightarrow 2H_2O_{(l)} + Sr(NO_3)_{2\,(aq)}$$
$$2H^{+}_{(aq)} + 2NO_3^{-}{}_{(aq)} + Sr^{2+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow 3H_2O_{(l)} + Sr^{2+}_{(aq)} + 2NO_3^{-}{}_{(aq)}$$
$$H^{+}_{(aq)} + OH^{-}_{(aq)} \rightarrow H_2O_{(l)}$$