Solubility Rules and Precipitation Reactions

1. Define the following terms

Aqueous – dissolved in H_2O

Solute – substance being dissolved

Solvent – substance doing the dissolving

Soluble – able to be dissolved

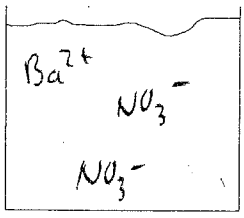
Insoluble – cannot be dissolved

Dissociate – break apart into ions

2. On the basis of the solubility rules, predict if the following compounds are soluble in water. Explain why or why not each for each one. Finally draw how the compound actually appears when placed into a beaker of water.

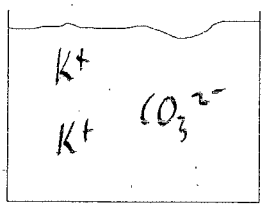
Barium nitrate

Y- contains NO_3^-



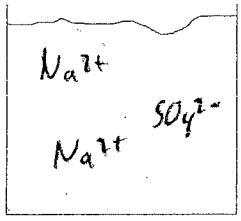
potassium carbonate

Y - Gp 1



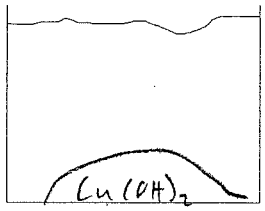
sodium sulfate

Y - Gp 1



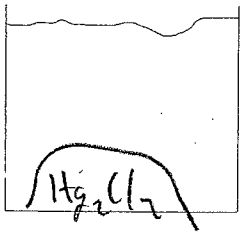
copper(II) hydroxide

N - not Gp 1 or NH_4^+



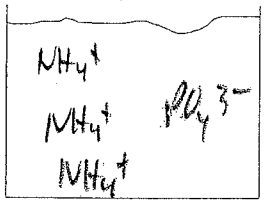
Mercury (I) chloride

N - except to Halogens



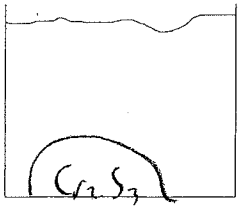
ammonium phosphate

Y - most NH_4^+



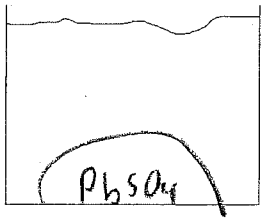
chromium(III) sulfide

N - not Gp 1



lead (II) sulfate

N - except



3. Using the solubility rules, predict the identity of the precipitate that forms, if any. Then state why each product is either solid or aqueous. If both products are aqueous, then right no reaction.

Sodium sulfate + calcium chloride → calcium sulfate (s) + sodium chloride (aq)

Ca except for SO_4^{2-}

Ammonium iodide + silver nitrate → silver iodide (s) + Ammonium nitrate (aq)

except

Potassium phosphate + lead (II) nitrate → potassium nitrate (aq) + lead (II) phosphate (s)

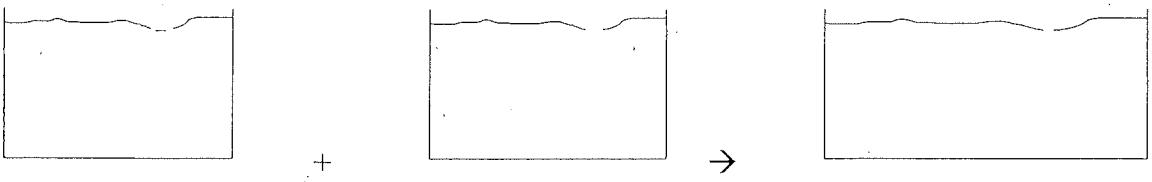
Sodium hydroxide + iron (III) chloride → iron (III) hydroxide (s) + sodium chloride (aq)

Potassium sulfate + sodium nitrate → NR

Sodium carbonate + barium nitrate → Barium carbonate (s) + sodium nitrate (aq)

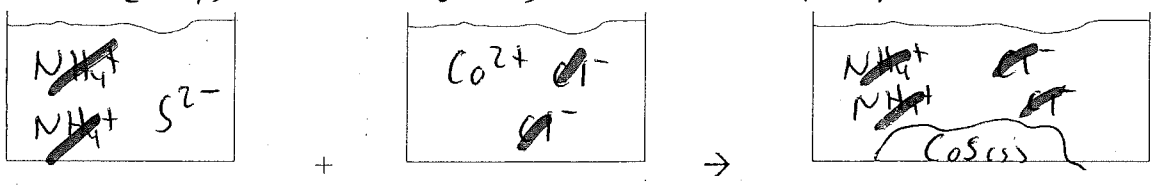
4. Complete the following word equations. Then using the solubility rules, write the balanced formula equations with physical states. Write out what each reactant looks like in the appropriate beaker and then write what the products look like in the product beaker.

Nitric acid + barium chloride → NR



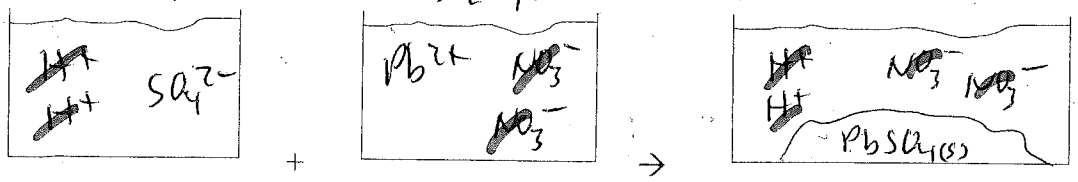
ammonium sulfide + cobalt (II) chloride → Ammonium chloride + cobalt(II) sulfide

$(NH_4)_2S(aq)$ + $CoCl_2(aq)$ → $2\,NH_4Cl(aq)$ + $CoS(s)$



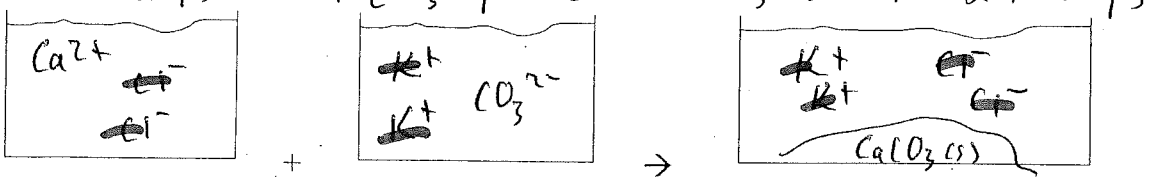
sulfuric acid + lead (II) nitrate → lead(II) sulfate + nitric acid

$H_2SO_4(aq) + Pb(NO_3)_2(aq) \rightarrow PbSO_4(s) + 2\,HNO_3(aq)$



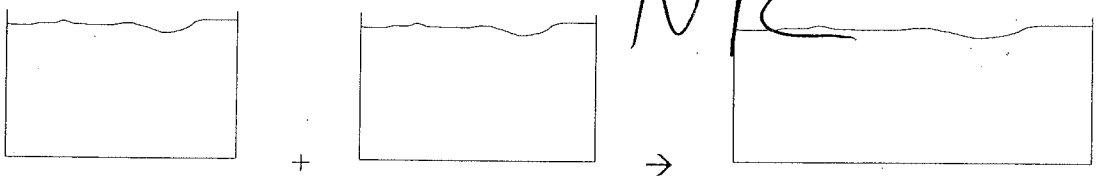
calcium chloride + potassium carbonate → calcium carbonate + potassium chloride

$CaCl_2(aq) + K_2CO_3(aq) \rightarrow CaCO_3(s) + 2\,KCl(aq)$



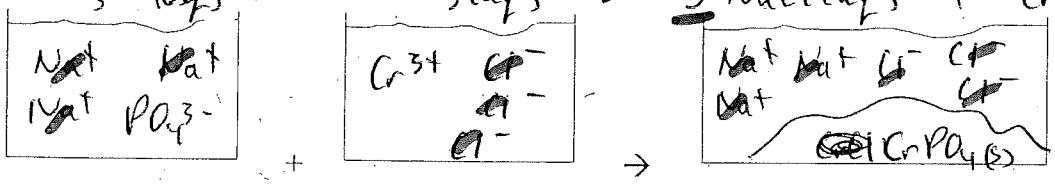
sodium acetate + ammonium chloride →

NR



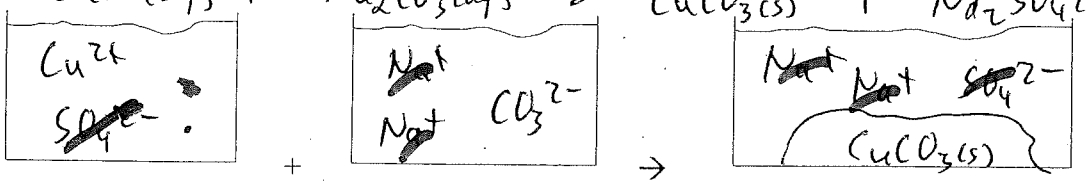
sodium phosphate + chromium (III) chloride → sodium chloride + chromium(III) phosphate

$Na_3PO_4(aq) + CrCl_3(aq) \rightarrow 3\,NaCl(aq) + CrPO_4(s)$



copper (II) sulfate + sodium carbonate → copper(II) carbonate + sodium sulfate

$CuSO_4(aq) + Na_2CO_3(aq) \rightarrow CuCO_3(s) + Na_2SO_4(aq)$



5. Go back to all the beakers in problem number 4 and put a line through all the substances that are exactly the same on both sides.

Using the solubility rules, write net ionic equations for all of the following reactions. Assume that all reactants are solutions (aqueous).

Iron (III) nitrate + sodium carbonate → Iron(III) carbonate (s) + sodium nitrate (aq)

$2\,Fe^{3+}_{(aq)} + 3\,CO_3^{2-}_{(aq)} \rightarrow Fe_2(CO_3)_3(s)$

Ammonium phosphate + cobalt (II) sulfate →

$2\,PO_4^{3-}_{(aq)} + 3\,Co^{2+}_{(aq)} \rightarrow Co_3(PO_4)_2(s)$

Barium bromide + lead (II) nitrate →

$2\,Br^-_{(aq)} + Pb^{2+}_{(aq)} \rightarrow PbBr_2(s)$

Strontium chloride (aq) + mercury (II) nitrate (aq) → strontium nitrate (aq) + mercury (II) chloride (s)

$2\,Cl^-_{(aq)} + Hg^{2+}_{(aq)} \rightarrow HgCl_2(s)$

Lithium sulfate + calcium acetate →

$SO_4^{2-}_{(aq)} + Ca^{2+}_{(aq)} \rightarrow CaSO_4(s)$

Silver nitrate + hydrochloric acid →

$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl(s)$

Zinc nitrate + sodium phosphate →

$3\,Zn^{2+}_{(aq)} + 2\,PO_4^{3-}_{(aq)} \rightarrow Zn_3(PO_4)_2(s)$