Chemistry 11 Solutions Review Sheet Name Key -

Date _____ Block _____

1. Devise a scheme to precipitate separately each ion in a mixture of each of the following sets of ions, and write a net ionic equation for each reaction that occurs.

a. SO_4^{2-} and PO_4^{3-}

① First precipitate PO_4^{3-} by adding any cation except Alkali, H^+, NH_4^+, Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}

eg. $Al^{3+}_{(aq)} + PO_4^{3-}_{(aq)} \rightarrow AlPO_{4(s)}$

② Then precipitate SO_4^{2-} using Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+} or Pb^{2+}

eg. $Ca^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow CaSO_{4(s)}$

b. Fe^{2+}, Pb^{2+}, and Mg^{2+}

① First precipitate Pb^{2+} using Cl^-, Br^-, I^- or SO_4^{2-} eg. $Pb^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow PbSO_{4(s)}$

② Next precipitate Fe^{2+} using S^{2-} eg. $Fe^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow FeS_{(s)}$

③ Then precipitate Mg^{2+} using OH^-, PO_4^{3-}, CO_3^{2-} or SO_3^{2-} eg. $Mg^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Mg(OH)_{2(s)}$

c. Br^-, CO_3^{2-}, and SO_4^{2-} 2 ways to proceed:

① First precipitate CO_3^{2-} using any cation except Alkali, H^+, NH_4^+, Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+} or Cu^+

eg. $Mg^{2+}_{(aq)} + CO_3^{2-}_{(aq)} \rightarrow MgCO_{3(s)}$

② Then ppt Br^- using Cu^+

$Cu^+_{(aq)} + Br^-_{(aq)} \rightarrow CuBr_{(s)}$

③ ppt SO_4^{2-} using Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, or Pb^{2+}

or

② Then ppt SO_4^{2-} using Ca^{2+}, Sr^{2+} or Ba^{2+}

$Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow BaSO_{4(s)}$

③ ppt Br^- using Ag^+, Pb^{2+} or Cu^+

2. For each given solution, calculate the volume of stock solution required to prepare each of the following diluted solutions:

a. given 15 M NH_3; need 2.0 L of 0.40 M NH_3

$$V_c = \frac{M_D V_D}{M_c} = \frac{0.40M \times 2.0L}{15M} = 0.053\,L \text{ or } 53\,mL$$

b. given 6.0 M HCl; need 5.0 L of 0.10 M HCl

$$V_c = \frac{0.10M \times 5.0L}{6.0M} = 0.083L \text{ or } 83\,mL$$

c. given 0.50 M KSCN; need 4.0 L of 0.0020 M KSCN

$$V_c = \frac{0.0020M \times 4.0L}{0.50M} = 0.016L \text{ or } 16\,mL$$

Key.

3. Write the dissociation equation for each of the following solutions, then calculate the concentration of each ion in the solution.

a. 0.18 M $Ca(NO_3)_2$

$Ca(NO_3)_{2(s)} \longrightarrow Ca^{2+}_{(aq)} + 2\,NO_3^-{}_{(aq)}$

$[Ca^{2+}] = 0.18\,M$

$[NO_3^-] = 2(0.18\,M) = 0.36\,M$

b. 0.35 M $(NH_4)_2SO_4$

$(NH_4)_2SO_{4(s)} \longrightarrow 2NH_4^+{}_{(aq)} + SO_4^{2-}{}_{(aq)}$

$[NH_4^+] = 2(.35\,M) = 0.70\,M$

$[SO_4^{2-}] = 0.35\,M$

c. 0.070 M $Fe(ClO_4)_3$

$Fe(ClO_4)_{3(s)} \longrightarrow Fe^{3+}_{(aq)} + 3\,ClO_4^-{}_{(aq)}$

$[Fe^{3+}] = 0.070\,M$

$[ClO_4^-] = 3(0.070\,M) = 0.21\,M$

4. Calculate the concentration of each ion in each of the following solutions in which no reaction occurs.

a. 125 mL of 0.20 M $MgCl_2$ mixed with 375 mL of 0.40 M KCl

$[Mg^{2+}] = \frac{125\,mL \times 0.20\,M}{(125\,mL + 375\,mL)} = 0.050\,M$

$[K^+] = \frac{375\,mL \times 0.40\,M}{(125\,mL + 375\,mL)} = 0.30\,M$

$[Cl^-] = \frac{(125\,mL \times 0.20\,M \times 2) + (375\,mL \times 0.40\,M)}{125\,mL + 375\,mL} = 0.40\,M$

b. 4.0 L of 0.25 M $CuSO_4$ mixed with 6.0 L of 0.75 M Na_2SO_4

$[Cu^{2+}] = \frac{4.0\,L \times 0.25\,M}{4.0\,L + 6.0\,L} = 0.10\,M$

$[Na^+] = \frac{6.0\,L \times 0.75\,M \times 2}{4.0\,L + 6.0\,L} = 0.90\,M$

$[SO_4^{2-}] = \frac{(4.0\,L \times 0.25\,M) + (6.0\,L \times 0.75\,M)}{4.0\,L + 6.0\,L} = 0.55\,M$

c. 300 mL of 0.30 M $CrBr_3$ mixed with 700 mL of 0.10 M $CaBr_2$

$[Cr^{3+}] = \frac{300\,mL \times 0.30\,M}{300\,mL + 700\,mL} = 0.090\,M$

$[Ca^{2+}] = \frac{700\,mL \times 0.10\,M}{300\,mL + 700\,mL} = 0.070\,M$

$[Br^-] = \frac{(300\,mL \times 0.30\,M \times 3) + (700\,mL \times 0.10\,M \times 2)}{300\,mL + 700\,mL} = 0.41\,M$

Key

5. 35 mL of 0.40 M $BaCl_2$ solution are mixed with 15 mL of 0.50 M K_2CrO_4, and a precipitate forms.

a. what is the identity of the precipitate?

$BaCrO_{4(s)}$

b. write a net ionic equation for its formation.

$Ba^{2+}_{(aq)} + CrO_4^{2-}{}_{(aq)} \longrightarrow BaCrO_{4(s)}$

c. calculate the mass of precipitate formed.

mols Ba^{2+} = 35mL × 0.40 M = 0.014 mols Ba^{2+}

mols CrO_4^{2-} = 15mL × 0.50M = 0.0075 mols CrO_4^{2-}

CrO_4^{2-} is the limiting factor

mols $BaCrO_{4(s)}$ = 0.0075mols mass = 0.0075mol × 253.3 g/mol = 1.9 g.

d. calculate the concentration of each ion left in the mixed solution after precipitation has occurred.

$[CrO_4^{2-}] = 0.00\ M$

$[Ba^{2+}] = \frac{0.014mol - 0.0075mol}{35mL + 15mL} = 0.13\ M$

$[K^+] = \frac{15mL \times 0.50M \times 2}{35mL + 15mL} = 0.30\ M$

$[Cl^-] = \frac{35mL \times 0.40M \times 2}{35mL + 15mL} = 0.56\ M$

6. Calculate the concentration of the solute in each of the following diluted solutions:

a. 250 mL of 0.16 M $Co(NO_3)_2$ diluted to 8.0 L.

$M_D = \frac{M_C V_C}{V_D} = \frac{0.16M \times 250mL}{8.0L} = 0.0050\ M$

b. 12 mL of 0.20 M $CuCl_2$ diluted to 150 mL.

$M_D = \frac{0.20M \times 12mL}{150mL} = 0.016\ M$

c. 166 mL of 12 M HCl diluted to 5.0 L.

$M_D = \frac{12M \times 166mL}{5.0L} = 0.40\ M$

7. Calculate the molarity of a solution made by dissolving 31.5 g of $NaNO_3$ in enough water to make 435 mL of solution.

31.5g ÷ 85.0g/mol = 0.37 mols $NaNO_3$

$M = \frac{n}{V} = \frac{0.37mol}{435mL} = 0.852\ M$

Key.

8. Calculate the molarity of a solution made by dissolving 408 g of $(NH_4)_3PO_4$ in enough water to make 9467 mL of solution.

Fw = 149.0 g/mol

n = 408 g ÷ 149.0 g/mol = 2.74 mol

$M = \frac{n}{V} = \frac{2.74\ mol}{9467\ mL} = 0.289\ M$

9. How many grams of NaCl are present in 1.440 L of a 1.21 M solution of NaCl?

n = M • V = 1.21 M × 1.440 L = 1.74 moles NaCl

Fw = 58.5 g/mol.

mass = 1.74 moles × 58.5 g/mol = 102 g

10. What volume of solution would be made if 61.9 g of $Cu(NO_3)_2$ are used to make a 0.250 M solution of $Cu(NO_3)_2$?

Fw = 187.5 g/mol

61.9 g ÷ 187.5 g/mol = 0.330 mols $Cu(NO_3)_2$

$V = \frac{n}{M} = \frac{0.330\ mols}{0.250\ M} = 1.32\ L$