Chemistry 12
Review Sheet on Unit 3
Solubility of Ionic Substances

1.   Identify each of the following as **ionic** or **molecular** substances:

a) $NaCl_{(aq)}$ ...._____

b) $CH_3COOH_{(aq)}$ ....._____

c) $CCl_{4(l)}$ ...._____

d) $HNO_{3(aq)}$ ...._____

e) $C_2H_{6(l)}$ ...._____

2.   A good way to test a liquid to see if it contains ___*ions*___ is to   _____

_____

3.   Define a ***saturated solution***   _____

_____

4.   Define an ***unsaturated solution*** _____

_____

5.   What is meant by ***solubility*** ?   _____

_____

6.   On the "Solubility Table", what, precisely, does the word ___*soluble*___ mean?   _____

_____

7.   What is meant by a ***polar molecule*** ?   _____

_____

_____

8.   Draw a diagram of a ***water*** molecule showing the *polarity.*

9.   The process of an ionic solid breaking down into individual ions is called   _____

10.   Given a saturated solution of sodium acetate, outline the procedure you could use to determine the ***solubility*** of sodium acetate at that particular temperature in grams per 100 mL.

11.   Does an *increase in temperature* always increase the ***rate*** of dissolving?_____

12.   Does an *increase in temperature* always increase the solubility of a substance in

      water?_____. Explain.

13. A chemistry stockroom contains a bottle of 12.0 M HCl. A teacher needs to make up 800.0 mL of a 3.0 M solution of HCl. What volume of the stock solution (12.0 M) does the teacher need to use?

Answer_____

14. A chemistry student dilutes a 0.20 M solution by adding 200.0 mL of water to 50.0 mL of the original solution. Calculate the ***molar concentration*** of the final solution.

Answer_____

15. A student has 600.0 mL of a 0.30 M solution of HNO_3. How much water <u>must she add</u> in order to make it a 0.15 M solution? (Be careful that you answer the question!)

Answer_____

16. If 25.0 mL of 0.90 M HCl is added to 125.0 mL of water, what is the final [HCl]?

Answer_____

17. Calculate the $[Fe^{3+}]$ in a 0.25 M solution of $Fe_2(SO_4)_3$?

Answer_____

18. Calculate the $[Na^+]$ in a 0.55 M solution of sodium acetate. (Write the proper formula
     for sodium acetate first.)

Answer_____

19. Calculate the $[Na^+]$ in a 0.55 M solution of sodium carbonate. (Write the proper
     formula for sodium carbonate first.)

Answer_____

20. Calculate the $[Na^+]$ in a 0.55 M solution of sodium phosphate. (Write the proper
     formula for sodium phosphate first)

Answer_____

21. 300 mL of 0.500 M NaCl is mixed with 400 mL of 0.200 M HCl. Calculate the final
     total [Cl⁻].

                                              Answer_____

22. 200 mL of 0.500 M NaCl is mixed with 300 mL of 0.200 M CaCl₂. Calculate the
     final total [Cl⁻].

                                              Answer_____

23. An aqueous solution of $Pb(NO_3)_2$ is mixed with an aqueous solution of KBr and a precipitate
     forms.

     a) Write a ***balanced formula equation*** for this reaction. (*Include all subscripts.*)

         _____

     b) Write a ***balanced total ionic equation*** for this reaction. (*Include all subscripts.*)

         _____

     c) Write a balanced ***net ionic equation*** for this reaction. (*Include all subscripts.*)

         _____

24. An aqueous solution of $Al(NO_3)_3$ is mixed with an aqueous solution of $(NH_4)_2S$ and a precipitate forms.

    a) Write a ***balanced formula equation*** for this reaction. (*Include all subscripts.*)

    _____

    b) Write a ***balanced total ionic equation*** for this reaction. (*Include all subscripts.*)

    _____

    c) Write a balanced ***net ionic equation*** for this reaction. (*Include all subscripts.*)

    _____

25. Devise a procedure to **_separate_** the ions in a mixture which contains the following sets of ions. Be specific about what you add and what happens when you add it. Remember, you cannot add single ions, only compounds or aqueous solutions of the compounds.

    a) Ba^{2+} , Mg^{2+} and Na^+
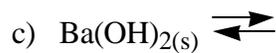
    b) Ag^+ , Cu^{2+} and Mg^{2+}

26. Complete the **balanced dissociation equation** and write the K_{sp} **expression** for the dissolving of the following substances (*Include all subscripts.*):

    a) $CaCO_{3(s)} \rightleftharpoons$

       Ksp =

    b) $Ag_2SO_{4\,(s)} \rightleftharpoons$

       Ksp =

    c) $Ba(OH)_{2(s)} \rightleftharpoons$

       Ksp =

27. Calculate the **molar solubility** of $BaCO_3$ in water.

                                                       Answer_____

28. Calculate the **molar solubility** of $Mg(OH)_2$ in water.

                                                       Answer_____

29. Calculate the number of grams of CaC_2O_4 which will dissolve in 1.5 L of water at $25°C$.

Answer_____

30. Calculate the number of grams of SrF_2 which will dissolve in 0.50 L of water at $25°C$.

Answer_____

31. At a certain temperature the ***molar solubility*** of $Zn(OH)_2$ is 1.65×10^{-5} M.

a) Write the ***solubility equilibrium equation*** for $Zn(OH)_{2(s)}$

_____

b) Write the ***Ksp expression*** for $Zn(OH)_2$.

c) Calculate the ***Ksp*** for $Zn(OH)_2$.

Answer _____

32. The solubility of $CoCO_3$ in water is 1.189 x 10^{-3} *grams per liter.* Calculate the *Ksp* for $CoCO_3$.

Answer_____

33. Will a precipitate form if 100 mL of 1.0 x 10^{-3} M $Pb(NO_3)_2$ solution is added to 100.0 mL of 2.0 x 10^{-3} M $MgSO_4$ solution? Show all calculations and include the Trial Ksp.

Answer_____

34. Will a precipitate form if 2.50 grams of Na_2SO_4 is added to 60.0 mL of a 2.0 x 10^{-4} M solution of $BaCl_2$? Show all calculations and include the Trial Ksp.

Answer_____

35. Calculate the ***maximum concentration*** of fluoride ion possible in a solution in which $[Sr^{2+}] = 5.0 \text{ x } 10^{-3} \text{ M}$.

Answer_____

36. Predict what would happen to the ***solubility*** of $PbSO_{4(s)}$ if some K_2SO_4 solution is added. Explain your answer and include the use of an equilibrium equation.

37. The solubility of $ZnCO_3$ in water is quite low. What could you add to increase the

solubility?   _____

Explain fully how your method would work. Include the use of equilibrium equations.

38. A solution containing silver ions (Ag^+) is titrated with 0.100 M KSCN solution to find the [Ag^+] in the sample. The indicator $Fe(NO_3)_{3\ (aq)}$ is used to signal when the stoichiometric point is reached. It is found that 11.8 mL of 0.100 M KSCN is needed to titrate a 25.0 mL sample of Ag^+ solution. Determine the [Ag^+] in the sample. Show all steps in a clear concise manner.

Answer _____

39. In order to find the concentration of chloride ion in a sample of pool water, a 100.0 mL sample of the pool water was titrated with 0.200 M $AgNO_3$ solution, using sodium chromate solution ($Na_2CrO_{4\ (aq)}$) as an indicator. At the stoichiometric point, it was found that 23.7 mL of $AgNO_3$ solution had been added. Determine the [Cl^-] in the pool water sample. Show all steps.

Answer _____