Name: _____   Date: _____

Chemistry 30 Unit Exam   **60 marks total**
SOLUTIONS

I. Multiple Choice   *20*

1. A solution that contains only a small amount of solute is best described as:

    A. dilute   C. saturated

    B. supersaturated   D. miscible

2. A solution in which dissolved and undissolved solute are in equilibrium is *****.

    A. saturated   C. dilute

    B. concentrated   D. unsaturated

3. Acids and ionic compounds (salts) generally dissolve in water and produce ions. These solutions can conduct electricity and are thus called:

    A. polar   C. electrolytes

    B. solutes   D. diluted

4. A small crystal of ammonium chloride is added to a solution of ammonium chloride and shaken vigorously. If the crystal dissolves, the original solution was:

    A. dilute   C. unsaturated

    B. concentrated   D. saturated

5. A measure of solution concentration calculated as the number of moles of solute dissolved in one litre of solution is known as:

    A. ppm   C. normality

    B. molarity   D. molality

6. If the pressure of a gas above a liquid is increased, while the temperature remains constant, the solubility of the gas in the liquid:

    A. remains unchanged

    B. increases

    C. decreases

    D. would be impossible to calculate

7. An ionic compound has a solubility of 30 grams per 100 mL of water at room temperature. A solution of the same substance that contains 80 grams of the compound in 250 mL of water at room temperature is:

    A. saturated

    B. supersaturated

    C. unsaturated

    D. immiscible

8. The symbol M, for molarity, is best described by which unit(s):

    A. molecules $\bullet$ L^{-1} C. L $\bullet$ mol^{-1}

    B. mol $\bullet$ L^{-1} D. moles

9. Which material will have the largest concentration of Ag^+ ions present in a saturated aqueous solution?

    A. $AgCH_3COO$ $K_{sp} = 2.0 \times 10^{-3}$

    B. $AgIO_3$ $K_{sp} = 3.0 \times 10^{-8}$

    C. AgCl $K_{sp} = 1.7 \times 10^{-10}$

    D. AgBr $K_{sp} = 5.0 \times 10^{-13}$

10. When Ca^{2+} (aq) ions are added to an unknown solution, large amounts of a white precipitate form immediately.

The unknown solution could be which of the following:

A. NaCl   C. $NaNO_3$

B. $NaC_2H_3O_2$ D. Na_2SO_4

11. Which positive ion will form a compound with low solubility in water when combined with OH^-?

A. Cu^{2+} C. H^+

B. K^+ D. NH_4^+

12. What is the molarity of 200 mL of solution in which 2.0 moles of sodium bromide is dissolved?

A. 2.0 M   C. 10 M

B. 0.40 M   D. 4.0 M

13. If 0.20 moles of $Ca_3(PO_4)_2$ were dissolved to make 500 mL of solution, the concentration of the calcium ion, Ca^{2+} would be:

A. 0.20 M   C. 0.40 M

B. 0.60 M   D. 1.2 M

14. What volume of 18.0 M aqueous sulfuric acid is needed to make 5.00 L of a 0.500 M aqueous solution?

A. 0.155 L   C. 0.278 L

B. 0.139 L   D. 0.070 L

15. Which of the following equations represents the solubility product constant, K_{sp}, for the following reaction:

$$(NH_4)_3PO_4 \text{ (s)} \rightleftharpoons 3\ NH_4^+\text{(aq)} + PO_4^{3-}\text{(aq)}$$
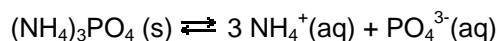
A. $K_{sp} = \dfrac{[NH_4^+]^3[PO_4^{3-}]}{[(NH_4)_3PO_4]}$

B. $K_{sp} = [NH_4^+]^3[PO_4^{3-}]$

C. $K_{sp} = \dfrac{[(NH_4)_3PO_4]}{[NH_4^+]^3[PO_4^{3-}]}$

D. $K_{sp} = \dfrac{1}{[NH_4^+]^3[PO_4^{3-}]}$

16. How many moles of KIO_3 would be needed to make 8 mL of solution having a concentration of 0.20 M?

A. 1.6   C. 0.25

B. 0.001 6   D. 40

17. If you mix equal volumes of NaOH solution and $Al(NO_3)_3$ solution, the formula for the most likely precipitate would be:

A. $Al(OH)_3$ C. AlOH

B. $Na(NO_3)_3$ D. $NaNO_3$

18. An aqueous solution contains a mixture of Mg^{2+}, Ba^{2+}, Pb^{2+}, and Fe^{2+}. One positive ion and one only would be precipitated out when a solution of which one of the following negative ions is added:

A. SO_4^{2-} C. I^-

B. NO_3^- D. PO_4^{3-}
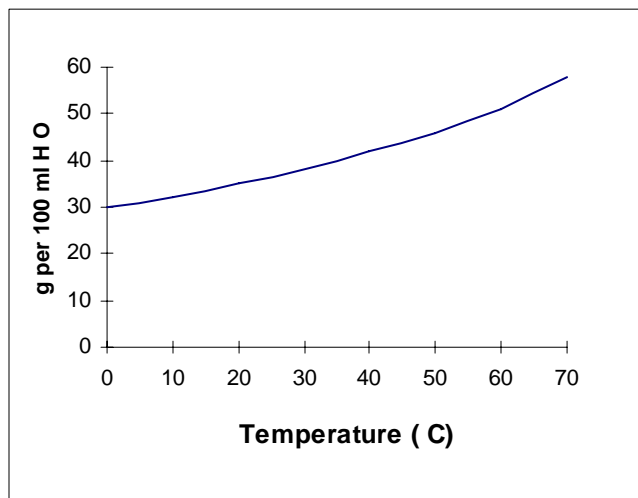
19. If a solution of NH_4Cl is found to contain 50 g of solute per 100 g of water at 20°C, the solution must be:

   A. dilute   C. saturated

   B. unsaturated   D. supersaturated

20. Approximately what mass of NH_4Cl can be dissolved in 100 mL of water at 50°C:

   A. 25 g   C.   35 g

   B. 50 g   D.   60 g

II. SHORT ANSWER   40

1. Calculate the concentration (molarity) of a solution prepared by dissolving 12.00 grams of potassium chloride, KCl, in water, for a total solution volume of 250.0 mL.   **3**

2. Calculate the mass of $AgNO_3$ required to make 200 mL of 0.40 M silver nitrate solution.   *3*

3. What volume of a 1.44 M solution of potassium sulfide (K_2S) contains 113.0 g of K_2S?   **3**

4. A solution is prepared by adding enough water to 5.88 g of calcium hydroxide, $Ca(OH)_2$ to make a solution volume of 0.750 L.

    a) Write a balanced equation for the dissociation reaction.   **1**

    b)   Calculate the concentration of the calcium hydroxide solution.   **3**

    c)   Determine the concentration of the calcium ions, Ca^{2+}, and hydroxide ions, OH^-.   **2**

5. What volume of a 2.00 M NaOH stock solution would you require in order to prepare 250 mL of a 0.600 M NaOH solution?   ***3***

6. A contaminated sample of water contains 325 ppm of lead ions, Pb^{2+}.
   Calculate the concentration of lead ions in mol $\cdot$ L^{-1}. Show all work. ***2***

7. A calcium nitrate solution, $Ca(NO_3)_2$, is mixed with an ammonium sulfate solution, $(NH_4)_2SO_4$.

   a. Write a **balanced** equation for this reaction. You must indicate the physical state of all participants. This will include predicting any precipitates that might form. **3**

   b. Write the ***net ionic equation*** for this reaction. ***2***

8. Write the equations for the reactions that occur when each of the following electrolytes is dissolved in water AND the solubility product expressions ***4***

Compound	Balanced Dissociation Equation	K_{sp} Expression
$Ba(OH)_2$	$Ba(OH)_2(s) \rightleftharpoons$	$K_{sp} =$
Na_2CO_3	$Na_2CO_3(s) \rightleftharpoons$	$K_{sp} =$

9. At a certain temperature a saturated solution of calcium carbonate, $CaCO_3$, has a concentration of 7.1×10^{-5} mol • L^{-1}. Calculate the value of K_{sp} of calcium carbonate. **3**

10. Calculate the concentrations of barium ions, Ba^{2+}, and sulfate ions, SO_4^{2-}, in a saturated aqueous solution of barium sulfate, $BaSO_4$, in which the value of K_{sp} is 1.1×10^{-10}.

11. You are given a solution that contains the following anions

$$I^- \qquad CO_3^{2-} \qquad SO_4^{2-}$$
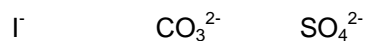
You wish to separate these ions by causing one, and only one, ion to precipitate out of solution at a time. In order to do so you are provided with the following cations in solution (all are nitrate compounds):

$$Ba^{2+} \qquad Fe^{3+} \qquad Pb^{2+}.$$
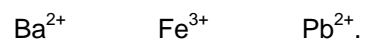
In what order should you add these solutions in order to remove one anion at a time from the original solution, by precipitation? Give the formulas of the three precipitates that you will be forming. **4**