

**CHEMISTRY 30S WORKSHEET**  
**UNIT #4 - SOLUTIONS**  
**DISSOCIATION EQUATIONS**

- 1) Consider the situation where one mole of the following substances is dissolved in water. Write an equation to show the number of moles of ions formed by each.
- |                           |                               |
|---------------------------|-------------------------------|
| a) aluminum chloride      | b) copper (II) bromide        |
| c) calcium hydroxide      | d) potassium phosphate        |
| e) magnesium perchlorate  | f) tin (IV) sulfate           |
| g) chromium (III) oxalate | h) barium carbonate           |
| i) lead iodide            | j) ferric fluoride            |
| k) ammonium dichromate    | l) lithium bisulfite          |
| m) hydrogen chloride      | n) calcium hydrogen phosphate |
- 2) Write dissociation equations for the following electrolytes dissolving and dissociating in water. Show the physical state of all species involved.
- |                           |                          |
|---------------------------|--------------------------|
| a) potassium hydroxide    | b) sodium carbonate      |
| c) potassium permanganate | d) hydrogen chloride gas |
| e) ammonium sulfate       | f) gallium carbonate     |
| g) aluminum sulfate       | h) sodium bicarbonate    |
| i) potassium nitrate      | j) magnesium hydroxide   |
| k) silver nitrate         | l) copper (II) nitrate   |
| m) lead (II) nitrate      | n) potassium iodide      |
| o) aluminum chlorate      | p) lithium bromide       |
| q) calcium nitrate        | r) ammonium carbonate    |
| s) sodium bicarbonate     | t) magnesium acetate     |
| u) potassium sulfite      |                          |

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#### MOLARITY

- 1) How many moles of  $\text{H}_2\text{SO}_4$  are there in 500 mL of a 2M  $\text{H}_2\text{SO}_4$  solution?
- 2) How many moles of sugar molecules are there in 100 mL of a 0.5 M sugar solution?
- 3) How many moles of NaOH are there in 1.1 L of a 0.010 M solution?
- 4) How many moles of NaCl are there in 250 mL of a 0.10 M solution?
- 5) How many moles of  $\text{C}_2\text{H}_5\text{OH}$  are there in 50.0 mL of a 3.0 M solution?
- 6) If 5 mL of a 0.10 M  $\text{CaCl}_2$  solution were evaporated to dryness, how many moles of solid  $\text{CaCl}_2$  would there be?
- 7) How many moles of  $\text{Na}_2\text{CO}_3$  would be needed to make 10 mL of a 2.0 M solution?
- 8) What mass of  $\text{H}_2\text{SO}_4$  is there in 100 mL of a 5 M  $\text{H}_2\text{SO}_4$  solution?
- 9) What mass of NaCl is there in 25 mL of a 1.0 M NaCl solution?
- 10) What mass of  $\text{AgNO}_3$  is needed to make 1.5 L of a 0.2 M solution?
- 11) What mass of NaOH is needed to make 250 mL of a 1.0 M solution?
- 12) What mass of HCl is there in 100 mL of a 12 M HCl solution?
- 13) What mass of NaCl would be left if 150 mL of a 0.1 M solution were evaporated to dryness?
- 14) What mass of  $\text{H}_2\text{SO}_4$  is there in 750 mL of a 2 M solution?
- 15) What is the molarity of a solution made by adding 24.5 g of  $\text{H}_2\text{SO}_4$  to water to make 200.0 mL of solution?
- 16) If 37 g of  $\text{Ca}(\text{OH})_2$  are dissolved in 900.0 mL of solution, what is the molarity?
- 17) What is the molarity of a solution containing 7.0 g of KOH per 100 mL of solution?
- 18) If 490 g of  $\text{H}_2\text{SO}_4$  are dissolved in 2.0 L of solution, what is the molarity?
- 19) What is the molarity of 5.3 g of  $\text{Na}_2\text{CO}_3$  dissolved in 400 mL of solution?
- 20) What is the molarity of 5.0 g of NaOH in 750 mL of solution?
- 21) How many grams of  $\text{Ca}(\text{OH})_2$  are needed to make 100 mL of 0.25 M solution?
- 22) How many moles are there in 1.00 mL of 0.005 M HCl?
- 23) What is the molarity of a solution made by dissolving 20.0 g of  $\text{H}_3\text{PO}_4$  in 50.0 mL of solution?
- 24) What mass of KCl is there in 2.5 L of 0.50 M KCl solution?
- 25) What volume of 12 M HCl is needed to contain 3 moles of HCl?
- 26) What volume of 18 M  $\text{H}_2\text{SO}_4$  would contain 2.45 g of  $\text{H}_2\text{SO}_4$ ?

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#### DILUTION PROBLEMS

- 1) To what volume must 300 mL of 4.00 M  $C_2H_5OH$  be diluted to make a 3.00 M solution?
- 2) What would be the final concentration if 600 mL of 6.00 M HCl were diluted to a volume of 800 mL?
- 3) What volume of 2.50 M  $BaCl_2$  solution is necessary to make 8.00 L of a 0.500 M solution of  $BaCl_2$ ?
- 4) If 70.0 mL of 0.800 M  $ZnBr_2$  is used to make a 0.300 M solution, what is the final volume?
- 5) What volume of 2.00 M  $Cu(NO_3)_2$  is necessary to make 50.0 mL of a 1.70 M solution of  $Cu(NO_3)_2$ ?
- 6) If water were added to 500.0 mL of 3.0 M  $FeSO_4$  to give a final volume of 580.0 mL, what would be the final concentration?
- 7) If 80.0 L of 3.00 M NaOH were released from an industrial plant into a holding tank, what final volume of solution is necessary to yield a final concentration of 0.00100 M?
- 8) If 60.0 L of a 2.50 M toxic substance were poured into a pond to give a final volume of  $5.00 \times 10^3$  L, what is the final concentration?
- 9) To what final volume must the 60.0 L of 2.50 M solution in problem 8 be diluted to make the final concentration  $1.00 \times 10^{-6}$  M, a fairly safe concentration for toxic substances?
- 10) To what volume must 600.0 mL of a 2.00 M solution of  $Ca(BrO_3)_2$  be evaporated to make the solution 4.50 M?

#### OTHER UNITS OF CONCENTRATION

- 1) What is the molality of a solution in which 25 g of NaCl is dissolved in 2.0 L of water?
- 2) What is the mass percent of  $NaHCO_3$  in a solution that contains 20 g of  $NaHCO_3$  in 600 mL of water?
- 3) You have 1.50 kg of a bleach solution. The mass percent of the solute (sodium hypochlorite) is 3.62 %. How many grams of solute are in the solution? What is the mole fraction for the solution?
- 4) What is the volume percent of ethanol in a solution that contains 35 mL of ethanol dissolved in 115 mL of water?
- 5) What is the mole fraction of sodium hydroxide in an aqueous solution that contains 22.8% NaOH by mass?

## CHEMISTRY 30S WORKSHEET

### UNIT #4 - SOLUTIONS

#### PROBLEMS INVOLVING IONS

- 1) What is the concentration of  $\text{Br}^-$  ions in 25 mL of a 0.30 M  $\text{MgBr}_2$  solution?
- 2) What is the concentration of  $\text{NO}_3^-$  ions in 375 mL of a 1.5 M  $\text{Fe}(\text{NO}_3)_3$  solution?
- 3) What is the concentration of  $\text{Na}^+$  ions in a 0.25 M  $\text{Na}_3\text{PO}_4$  solution?
- 4) In 10.0 mL of a 0.075 M  $\text{AgNO}_3$  solution, what is the concentration of the  $\text{Ag}^+$  ions?
- 5) What are the concentrations of a)  $\text{Al}^{3+}$  and b)  $\text{SO}_4^{2-}$  in a 0.60 M  $\text{Al}_2(\text{SO}_4)_3$  solution?
- 6) What are a) moles of  $\text{Al}^{3+}$  and b) molarity of  $\text{Cl}^-$  in 250 mL of a 1.2 M  $\text{AlCl}_3$  solution?
- 7) What are a) moles of  $\text{K}^+$  and b) molarity of  $\text{SO}_4^{2-}$  in 375 mL of a 0.800 M  $\text{K}_2\text{SO}_4$  solution?
- 8) What is the concentration of  $\text{Cl}^-$  if 3.65 g of  $\text{HCl}$  are dissolved in 500 mL of solution?
- 9) How many moles of  $\text{Cl}^-$  ions are there in 250 mL of a 2.0 M  $\text{FeCl}_3$  solution?
- 10) How many moles of  $\text{NH}_4^+$  ions are there in 500.0 mL of a 0.36 M ammonium sulfate solution?
- 11) How many moles of  $\text{OH}^-$  ions would there be in 50.0 mL of a 0.001 M  $\text{Ca}(\text{OH})_2$  solution?
- 12) How many moles of  $\text{Cu}^{2+}$  ions are there in 10.0 mL of a 0.5 M solution of cupric sulfate?
- 13) How many moles of a)  $\text{NO}_3^-$  and b)  $\text{Fe}^{3+}$  are there in 0.5 L of a 0.2 M  $\text{Fe}(\text{NO}_3)_3$  solution?

## CHEMISTRY 30S WORKSHEET

### UNIT #4 - SOLUTIONS

#### PRECIPITATION

- 1) Write complete and net ionic equations for the following.
  - a) sodium sulfide solution + silver nitrate solution
  - b) lead (II) nitrate solution + potassium chloride solution
  - c) ferric chloride solution + sodium hydroxide solution
  - d) silver nitrate solution + sodium chloride solution
  - e) calcium hydroxide solution + sodium phosphate solution
  - f) calcium chloride solution + sodium carbonate solution
  - g) aluminum nitrate solution + potassium sulfide solution
  
- 2) 50 mL of a 0.75 M barium chloride solution is added to 50 mL of a 1.0 M silver nitrate solution. Determine the concentration of the ions after precipitation.
  
- 3) 10 mL of a 6.0 M sodium hydroxide solution is added to 10 mL of a 1.0 M aluminum chloride solution. Determine the concentration of the ions after precipitation.
  
- 4) 100 mL of a 0.20 M barium chloride solution is added to 200 mL of a 0.20 M aluminum sulfate solution. Determine the concentration of the ions after precipitation.
  
- 5) 250 mL of a 0.40 M silver nitrate solution is mixed with 750 mL of a 0.40 M potassium chloride solution. Determine the concentration of the ions after precipitation.

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### UNIT #4 - SOLUTIONS

#### MISC. CONCENTRATION PROBLEMS

- Given an aqueous solution which contains 4.41 g of  $\text{H}_2\text{SO}_4$  in 0.200 L of solution calculate:
  - the concentration
  - the concentration when diluted with water to make 0.500 L of solution
- What will be the concentration of the resulting solution if 85 mL of a 0.0260 mol/L NaOH solution is added to 60 mL of a 0.0360 mol/L NaOH solution?
- How much water must be added to 75.0 mL of a 0.640 M  $\text{KNO}_3$  solution to change it to a 0.460 M solution?
- What would be the new concentration of 40.0 mL of a 0.150 M NaOH solution if it is diluted to 65.0 mL?
- A 0.0450 M  $\text{AgNO}_3$  solution with a volume of 160 mL contains how many moles of  $\text{AgNO}_3$ ? how many grams of  $\text{AgNO}_3$ ?
- 200 mL of a 1.60 M NaOH solution is diluted to a volume of 350 mL. What is the new concentration?
- What will be the concentration of the resulting solution if 75.0 mL of a 0.026 M KCl solution is added to a 0.0450 M KCl solution of 40 mL volume?
- 1 L of solution contains 0.100 mol of iron (III) nitrate and 0.200 mol of calcium nitrate. Calculate the concentration of all the ions present.
- Explain how you would make 750 mL of a 0.60 M silver nitrate solution.
- How many grams of solute are necessary to make 100 mL of a 0.050 M cobalt (II) chloride solution? If 200 mL of water is added to this solution what will its concentration become?
- Write the equation for the dissolving of potassium chromate. Calculate the concentration of this solution if 20.0 g of solute has been dissolved in 150 mL of solution. How much water must be added to halve the concentration of this solution?
- Write the overall and net ionic equations for the reaction which occurs when a sodium phosphate solution is mixed with a magnesium sulfate solution.
- Write the equation for the dissolving of sodium sulfate. How many moles of each ion will be present in 250 mL of a 1.2 M solution? Calculate the concentration of all the ions present.
- Calculate the final concentration of chloride ions in a solution made by mixing 200 mL of a 3.0 M calcium chloride solution with 300 mL of a 4.0 M aluminum chloride solution.
- Calculate the concentration of each ion in a 0.60 M aluminum acetate solution.
- Calculate the volume of an ammonium phosphate solution if 30.0 g has been used to make a 1.5 M solution.