Chem 12: Chapters 13, 10, 11, 12, 14
Unit 3 Worksheet

1. What is miscible? Immiscible?
2. What is saturated? Unsaturated? Supersaturated?
3. How does Temperature affect a) the solubility of a gas in an aqueous solution? b) Solubility of a solid in aqueous solution.
4. How does Pressure affect the solubility of a gas in an aqueous solution?
5. a) Will I₂ or CH₂Cl₂ be more soluble in water? Explain. b) Which (CO₂ gas in water or KCl solid) is expected to be more soluble at higher temperatures c) Will CO₂ gas be more soluble in water when the container is pressurized with air or carbon dioxide?
6. For a solution is made adding together 12.0 g of KNO₃ and 70.0 grams of water. The density of the resulting solution is 1.08 g/ml. Solve for the mass %, Molarity, and molality.
   Mass percent: \[ \text{mass} \% = \frac{\text{mass of the part}}{\text{total mass}} \times 100\% \]
   Molarity: \[ M = \frac{\text{moles of solute}}{\text{Liter of solution}} \]
   Molality: \[ m = \frac{\text{moles of solute}}{\text{kg of only solvent}} \]
7. Describe both quantitatively and qualitatively how you can prepare 300 ml of 2.00 M HCl solution from concentrated 12.0 M HCl solution.
8. Solve for the grams of potassium nitrate in 40.5 grams of 14.8 % KNO₃ solution.
9. Calculate the molarity of a solution prepared by dissolving 5.72 grams of NaOH in 43.8 ml of solution.
10. How many moles of NH₄NO₃ must be dissolved in 250 ml of solution to prepare a 0.452 M NH₄NO₃ solution?
11. If you evaporate to dryness all the water from a 450 g solution of 8.00% NaCl, how many grams of NaCl will remain?
12. A solution is produced by dissolving 6.75 grams of Ca(NO₃)₂ in water to produce 375 ml of solution that has a density of 1.03 g/ml. Calculate the mass percent of the Ca(NO₃)₂ in the solution.
13. What is osmosis?
14. What is the boiling point of an aqueous solution that is 5.00 m? The normal boiling point of water is 100°C, \( K_b \) for water = 0.512 °C·kg/mol.
15. Complete the following table for the indicated substances.

<table>
<thead>
<tr>
<th>substance</th>
<th>SiF₄</th>
<th>CO₃²⁻</th>
<th>C₂H₄O</th>
<th>K₂SO₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draw the best Lewis structure(s), resonances, and structural isomers if any with octet</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>name electronic geometry around central atom</td>
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<tr>
<td>name molecular geometry around central atom</td>
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<tr>
<td>a) show 3-D sketch with atoms &amp; bonds in it</td>
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<tr>
<td>b) Indicate polar bonds with dipole arrows toward the more electronegative</td>
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<tr>
<td>give all bond angles</td>
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<tr>
<td>is it an ionic compound, polar or nonpolar molecule or an ion?</td>
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</tbody>
</table>
16. What is stronger (single, double, triple) bond? What is longer?

17. Using the Valence Shell Electron Repulsion (VSEPR) theory, fill in the angles for the number of Electron Regions (2) ________ (3) ________ (4) ________

18. Fill in the following tables: VSEPR drawings

<table>
<thead>
<tr>
<th>#of electron regions</th>
<th>number of bonded atoms</th>
<th>electronic geometry name</th>
<th>molecular geometry name</th>
<th>bond angles</th>
<th>rough 3-D sketch</th>
<th>an example molecule or ion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>109.5°</td>
<td></td>
<td>CO₂</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>trigonal planar</td>
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</tbody>
</table>

19. What is the volume of 32.7 grams of F₂ gas at STP?

20. What is the number of moles of gas in a 550 ml container at 30.0°C and 751 torr pressure?

21. 534 mL of CH₄ gas was collected at 23°C and 754 torr. What new volume would the CH₄ gas occupy at 732 torr and 46°C?

22. 127 ml of N₂ gas was collected by displacement of water at 25°C and 742 torr. What is the number of moles of N₂ gas? (The vapor pressure of water at 25°C is 24 torr.)

23. What pressure will 4.15 g of CO₂ gas have when placed in a 320 mL container at 45.0°C?

24. Nitrogen gas is placed into a steel tank until its pressure is 21.4 atm at 20°C. The maximum pressure the tank can safely contain is 50.0 atm. What is the highest temperature in °C that this tank be safely heated?

25. a) Balance the following unbalanced equation:
   \[ \text{C}_5\text{H}_{12} (g) + \text{O}_2 (g) \rightarrow \text{CO}_2 (g) + \text{H}_2\text{O} (g) \]
b) What volume of CO₂ gas at STP will be produced from 144 g of C₅H₁₂?

26. Balance \( \text{H}_2 (g) + \text{N}_2 (g) \rightarrow \text{NH}_3 (g) \) all gases at same temperature and pressure. How many cubic centimeters of H₂ gas are required to produce 200 cm³ of ammonia gas?
27. A vessel with an internal volume of 10.0 L contains 7.00 g of nitrogen gas (N\textsubscript{2}), 1.00 g of helium gas (He), and 3.20 g of oxygen gas (O\textsubscript{2}). At 25 °C, what is the partial pressure from each substance and what is the total pressure inside the vessel?

28. A 450 ml sample of nitrogen gas at 21 °C and 0.987 atm is heated and expands to 9.00 L at a new pressure of 75.0 torr. What is the final temperature in °C?

29. What are characteristics of an ideal gas according to the kinetic molecular theory?

30. It is recommended to check the air pressure in your car tires when they are cold, not after driving a great distance when they are warm. Explain what kind of pressure reading difference one can expect.

31. A gas is collected over water at a certain temperature. The total pressure is 747 torr. The vapor pressure of water at this temperature is 22 torr. What is the partial pressure of the dry gas collected?

32. Balance the following unbalanced equation:

\[ \text{C}_6\text{H}_{12}\text{O}_6 (s) + \text{O}_2 (g) \rightarrow \text{CO}_2 (g) + \text{H}_2\text{O} (g) \]

From the 75.0 g of O\textsubscript{2} and 35.0 g of C\textsubscript{6}H\textsubscript{12}O\textsubscript{6}, determine how much carbon dioxide can theoretically be produced in units of moles, liters at STP, and grams of CO\textsubscript{2}? Which is the limiting reactant?

33. Fill in the term for each definition or description:

______________A special kind of strong dipole-dipole attraction which occurs among molecules when a H atom is bonded to a highly electronegative atom such as N, O, or F.

______________Forces between molecules

______________A unit of concentration that measures mole solute per liter solution

______________The temperature point at which the vapor pressure of a liquid is equal to the normal atmospheric pressure of 760 torr or 1 atm.

______________A scale used to quantitatively measure the acidity or basicity of an aqueous solution.

34. What type of intermolecular bonds will the following have? (draw Lewis structures to help visualize)

(a)-dipole-dipole attraction, (b)-hydrogen bonding, (c)-London dispersion forces

_____ H\textsubscript{2}O _____ HF _____ CH\textsubscript{4} _____ Br\textsubscript{2} _____ NH\textsubscript{3} _____ HI
35. The vapor pressure at 20°C is given for the following substances:
   H₂O  17.5 torr  and  Br₂  173 torr
   a) Which liquid is more volatile? __________
   b) What type of intermolecular forces does each of these have?
   c) Explain why the difference in vapor pressure at 20°C makes sense.

36. a) Finish and balance the following acid / base reaction:
    
    HC₂H₃O₂ (aq) + NaOH (aq) →

    b) For the above balanced equation, label and draw lines connecting the acid and its
       conjugate base, and the base and its conjugate acid.

c) A titration starts with 25 ml of 0.42 M HC₂H₃O₂, acetic acid, solution. 42.5 ml of
   NaOH solution are then added to neutralize the solution. Calculate the moles of HC₂H₃O₂
   initially, the moles of NaOH used, and the molarity of the NaOH solution.

37. A KOH solution is standardized using KHP. Using the following titration data, calculate
   the molarity of the KOH solution. (the molecular weight of KHP is 204.2g/mol)

   KOH buret readings:
   final  32.65 ml       mass of flask + KHP  144.301 g
   initial 12.73 ml      mass of empty flask  143.422 g

38. Given the following pH values label each as acidic, basic or neutral.
    
    pH = 7 _______  pH = 3 _______  pH = 9 _______  pH = 0.5 _______

39. Fill in the missing pieces of this table

<table>
<thead>
<tr>
<th>acid, base, or neutral?</th>
<th>[H⁺]</th>
<th>[OH⁻]</th>
<th>pH</th>
<th>pOH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.2 x 10⁻¹²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.0 x 10⁻⁷</td>
<td></td>
<td></td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>3.7</td>
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</tbody>
</table>
40. Circle the letters of the following which are not a conjugate acid-base pair. Circle the acid and underline the base for each conjugate acid-base pair.

a) HCl, Cl⁻  
b) Cl⁻, ClO₄⁻  
c) H₃PO₄, PO₄³⁻  
d) H₂SO₄, HSO₄⁻  
e) NH₃, NH₄⁺  
f) H₂O, H₃O⁺

41. Answer the following as true or false. For the false statements what must be changed to make them true?:

_____ A solution is a homogeneous mixture which can only be found in the liquid state.

_____ A buffered solution resists change in its pH even when a strong acid or base is added.

_____ A buffered solution always contains a strong acid and its conjugate base.

_____ A weak acid will completely dissociate in water.

_____ A combination of HCl and NaCl would make a good buffer solution.

_____ A combination of HCN and KCN would make a good buffer solution.

_____ An amphoteric substance can act as either an acid or a base.

_____ An acid-base reaction is often called a neutralization reaction because the acid and base are neutralized by creating water.

_____ If more solute is added to a solution that is saturated, that solute will dissolve and make the solution more concentrated.

_____ When an ionic solution such as NaCl dissolves in water, the NaCl molecules stay attached to each other.

_____ It is possible to have an aqueous solution with 0.0007 M [H⁺] and 0.0000003 M [OH⁻].

_____ Cl⁻ is the conjugate acid of HCl.

_____ A pipet will deliver a specified amount of liquid with great accuracy.

42. 30.0 ml of 0.240 M NaOH is required to stoichiometrically react with 20.0 ml of HCl solution. Write the balanced acid-base equation and calculate and Molarity of the HCl solution?