Problem Set 2

Reading

Chapter 13.4 - 13.6

Exercises

1. 5 g of Table Salt (NaCl) is added to 95 g of Water. What is the concentration of this solution in wt%, molality and mole fraction?

2. Acetonitrile has a density of 0.786 g/mL and Methanol a density of 0.791 g/mL. What is the mole fraction of Acetonitrile in a solution that is prepared from 25 mL Acetonitrile and 25 mL Methanol?

3. Describe you might prepare 2.0 kg of a 0.35 mole fraction solution of a Domoic Acid (C_{15}H_{21}NO_6) in Water.

4. Concentrated Phosphoric Acid (H_3PO_4) is 85 wt% in Water. What is the molarity of this solution? The density is 1.7 g/mL.

5. What is the wt% of a 2.5m solution of Chloroform (CHCl_3) in Benzene (C_6H_6)?

6. What is the mole fraction of NaCl (x_{NaCl}) for a 2.6m aqueous NaCl solution?

7. What is the wt% Glucose of a x_{Glu} = 0.45 aqueous Glucose (C_6H_12O_6) solution?

8. 100.0 g of KNO_3 is added to 200g of Water at Room Temperature. Will the salt dissolve completely? If the system is brought to a boil, what will happen? The system is allowed to cool to Room Temperature, where it is observed solvation of the KNO_3 is complete. Is this solution saturated, unsaturated or supersaturated? Use Figure 13.15 of the text.

9. The Henry's Law Constant for O_2 in Water is 1.38 x 10^{-3} M/atm at 70°F. Determine the solubility in grams/liter of O_2 in a sea level lake. Recall that the atmosphere is roughly 21% O_2. Use figure 13.16 of the text to estimate the Henry's Law Constant for O_2 at 46°F. Use this to determine the solubility in grams/liter of O_2 in a high mountain lake at this temperature where the atmospheric pressure has dropped to 620 Torr.
10. The Henry's Law Constant for CO₂ in Water varies with temperature as:

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>K (Pa) x 10⁻⁸</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.73</td>
</tr>
<tr>
<td>10</td>
<td>1.05</td>
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<tr>
<td>20</td>
<td>1.44</td>
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<tr>
<td>25</td>
<td>1.65</td>
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<tr>
<td>30</td>
<td>1.88</td>
</tr>
<tr>
<td>40</td>
<td>2.36</td>
</tr>
<tr>
<td>50</td>
<td>2.87</td>
</tr>
</tbody>
</table>

Suppose a Soda Pop manufacturer bottles his carbonated beverages at 10°C under a CO₂ pressure of 2 atm. When sitting in the hot Sun, the temperature of the soda may rise to 130°F. What is the minimum pressure the bottle must be able to withstand in order that it will not burst in this situation?

11. Calculate the vapor pressure when 25 g Lactose (C₁₂H₂₂O₁₁) is added to 300 g Water at 25°C and 80°C. P₀ for Water at various temperatures can be found in Appendix B of the text.

12. Dissolving 76.2 g of Glycerol (C₃H₈O₃) in 1000g Water results in a solution that freezes at -1.54°C. Use this data to determine K_f for Water.

13. a) If 8.67 g of Mannose is dissolved in 100 g of Water, the Freezing Point Depression is 0.895°C. What is the molecular weight of Mannose?

   b) An elemental analysis of Mannose reveals it is:

   - 40.00% Carbon
   - 6.71% Hydrogen
   - 53.29% Oxygen

   What is the empirical formula of Mannose? What is the chemical formula of Mannose? (Part b of this problem is in the form of review from CHEM 121.)

14. Lysozyme is a moderately sized enzyme. 0.15g of Lysozyme in 210 mL of solution has and osmotic pressure of 0.953 Torr at 25°C. What is the molecular weight of Lysozyme?