

Questions for Review - Answers

Chem 1C Exam #2, Spring 09, Lingwood

1. For each transition metal complex, give the charge on the transition metal center and either the name or the formula of the compound.

- a. $K_4[Cu(CN)_6]$ Cu^{2+} potassium hexacyanocuprate(II)
b. $[Cu(NH_3)_5(OH)]NO_3$ Cu^{2+} pentaamminehydroxocopper(II) nitrate
c. sodium tetrahydrozincate(II) $Na_2[Zn(OH)_4]$ Zn^{2+}
d. dichlorobis(ethylenediamine)cobalt(III) chloride $[CoCl_2(en)_2]Cl$ Co^{3+}

2. Which types of isomerism could the following compounds display?

- a. $[FeBrCl(en)_2]Cl$ coordination, geometrical and optical
b. $Ca[Fe(NO_2)_4(en)]$ linkage

3. How many unpaired electrons are in the following? Assume all complex ions have an octahedral or tetrahedral geometry.

- a. $Ca_2[Fe(NO_2)_6]$ Fe^{2+} 6 d electrons Octahedral, large Δ no unpaired electrons
b. $Ca[Mn(NO_2)_4]$ Mn^{2+} 5 d electrons Tetrahedral, always small Δ 5 unpaired e^-
c. $Mg_2[FeBr_6]$ Fe^{2+} 6 d electrons Octahedral, small Δ 4 unpaired electrons

4. Which of the complex ions below absorbs the shortest wavelength of light? Shortest λ = largest Δ
 $Mg_2[FeBr_6]$ $Ca_2[Fe(NO_2)_6]$ $[Fe(NH_3)_5(OH)]NO_3$

5. An aqueous solution of glycerol (MW=92.02g/mol) was made by dissolving 45.3g of glycerol in 110.0 mL of water. The resulting volume was 118.3 mL. Assume the density of water is 1.000 g/mL. Calculate the molarity, molality and mole fraction of glucose in this solution.

Molarity: 4.16M
molality: 4.47m
mole fraction: 0.0746

6. What is the solubility of O_2 in water at 25°C when the partial pressure of oxygen above the water is 2.00 atm? The Henry's law constant of O_2 is 4.34×10^4 atm at 25°C, and give your answer in terms of the mole fraction of oxygen.

$$\chi_{\text{oxygen}} = 4.61 \times 10^{-5}$$

7. What is the vapor pressure of the solution in problem 5 at 25°C? The vapor pressure of pure water at 25°C is 23.76 torr.

$$P_{\text{solution}} = 21.99 \text{ torr}$$

8. What is the boiling point, and freezing of the solution in problem 5? Also calculate the osmotic pressure at 25°C. Glycerol is a non-electrolyte. Water: $K_f = 1.86$ °C kg/mol, $K_b = 0.51$ °C kg/mol

Boiling point = 102.28 °C
Freezing point = - 8.31°C
Osmotic pressure = 101.8 atm

9. You mix ethanol and pentane together, and the resulting solution feels cold to the touch.
- Is this an ideal solution? **no**
 - If this is a non-ideal solution, does it display a positive or negative deviation from Raoult's law?
Positive deviation
 - What is the sign of $\Delta H_{\text{solution}}$ for this mixture? **positive**
10. You have a 0.25 molal, 0.20 molar aqueous solution of sodium sulfate, Na_2SO_4 . What is the boiling point, freezing point and osmotic pressure (at 20°C) of the solution? Assume complete dissociation of the soluble salts. Water: $K_f = 1.86^\circ\text{C kg/mol}$, $K_b = 0.51^\circ\text{C kg/mol}$
- Boiling point = 100.38°C**
Freezing point = -1.4°C
Osmotic pressure = 14.43 atm