

Chemistry 1C
Exam #2
May 20, 2009
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Form B
Blue Exam

6 Pages, 18 Questions

DO NOT TURN THE PAGE UNTIL TOLD TO BEGIN

You will have 50 minutes for this exam. No notes are allowed. No sharing of calculators, no hats/hoods, no phones / iPods / etc.

BEFORE YOU BEGIN

On your Scantron answer sheet:

- Fill in the “test form”. This blue exam is **Form B**.
 - Fill in your perm number. Seven digits only.
 - Write your name on the Scantron answer sheet.

Completely fill bubbles ●

Completely fill answers ■

This is a multiple choice exam. You will only receive credit for answers you mark on the separate, scantron answer sheet.

Each question is worth 2 points unless noted otherwise.

The last page of the exam is an info sheet that you can **carefully** tear off if you wish.

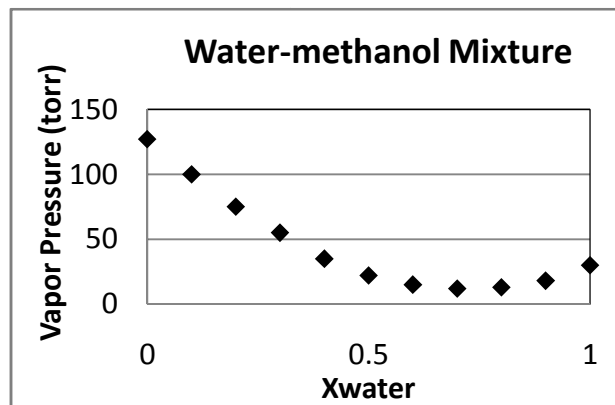
You can use this booklet for your work. Turn in the scantron answer sheet when you are done, and take this booklet with you to check your answers online.

- 1) How many unpaired electrons does the compound $\text{Na}_2[\text{Cr}(\text{NO}_2)_4(\text{en})]$ have? (5 pts)
- a) 0
 - b) 1
 - c) 2**
 - d) 3
 - e) 4
- 2) Choose the complex ion with no unpaired electrons. All complex ions have an octahedral or tetrahedral geometry. (10 pts)
- a) $\text{Cr}(\text{CO})_4^{2+}$ Cr^{2+} 4 d electrons, tetrahedral, always small Δ , 4 unpaired electrons
 - b) $\text{Fe}(\text{CO})_4^{2+}$ Fe^{2+} 6 d electrons, tetrahedral, always small Δ , 4 unpaired electrons
 - c) $\text{Co}(\text{CO})_6^{3+}$ Co^{3+} 6 d electrons, octahedral, large Δ , 0 unpaired electrons**
 - d) $\text{Co}(\text{Cl})_6^{3-}$ Co^{3+} 6 d electrons, octahedral, small Δ , 4 unpaired electrons
 - e) None of the above
- 3) Which transition metal center has a +1 charge? (6 pts)
- a) $\text{Na}[\text{Cr}(\text{en})(\text{NCS})_4]$
 - b) $\text{Ni}(\text{CN})_2(\text{NH}_3)_2$
 - c) $[\text{Cu}(\text{CN})(\text{H}_2\text{O})_5]^{1+}$
 - d) $\text{Mg}[\text{Cu}(\text{H}_2\text{O})(\text{NCS})_3]$**
 - e) None of the above

- 4) The vapor pressures of several solutions of water-methanol (CH_3OH) were determined at various compositions at 25°C . A plot of vapor pressure vs. mole fraction of water is shown below. (5 pts)

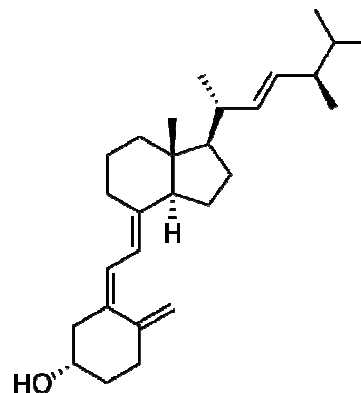
Which best describes this system?

	Deviation from Raoult's Law	Sign of ΔH_{soln}
a)	negative	negative
b)	positive	positive
c)	none	zero
d)	negative	positive
e)	positive	negative



- 5) The structure of vitamin D₂ is shown at right. Which solvent would best dissolve vitamin D₂? (5 pts)

- a) water (H_2O)
 b) ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)
 c) **hexane ($\text{CH}_3(\text{CH}_2)_4\text{CH}_3$)**
 d) acetic acid (CH_3COOH)



- 6) What is the freezing point of a 1.30 molal aqueous solution of magnesium chloride, MgCl_2 ? The molal freezing-point depression constant for water is $1.86^\circ\text{C kg/mol}$. Assume complete dissociation of the soluble salts. (6 pts)

- a) -2.42°C
 b) 4.84°C
 c) 7.25°C
 d) **-7.25°C**
 e) -4.84°C

$$\Delta T = i K_f m$$

$$\text{MgCl}_2 \quad i = 3$$

$$\Delta T = 3 (1.86^\circ\text{C kg/mol}) (1.30 \text{ mol/kg}) = 2.418^\circ\text{C}$$

$$\text{Freezing point} = \text{normal f.p.} - \Delta T = 0 - 2.418 = -2.418^\circ\text{C}$$

7) What is the formula of ammonium tetrachloro(ethylenediamine)chromate(III)? (4 pts)

- a) $\text{NH}_4[\text{Cr}(\text{Cl})_4(\text{NH}_3)_2]$
 b) $[\text{Cr}(\text{NH}_3)_4(\text{en})]\text{Cl}_4$
 c) $[\text{Cr}(\text{NH}_3)(\text{en})]\text{Cl}_2$
d) $\text{NH}_4[\text{Cr}(\text{Cl})_4(\text{en})]$
 e) $[\text{Cr}(\text{Cl})_4(\text{en})]$

8) Give the name for the compound $[\text{Fe}(\text{CO})_4(\text{H}_2\text{O})_2]\text{Cl}_2$ (4 pts)

- a) diaquatetracarbonyliron(II) chloride**
 b) diaquatetracarbonyliron(IV) chloride
 c) diaquatetracarbonylferrate(II) chloride
 d) tetracarbonyldiaquairon(II) chloride
 e) tetracarbonyldiaquairon(IV) chloride

9) Which of the following will have the highest boiling point at 1.0 atm? (5 pts)

- a) pure water
 b) a solution of glucose in water with $\chi_{\text{C}_6\text{H}_{12}\text{O}_6} = 0.01$
 c) a solution of ammonium chloride in water with $\chi_{\text{NH}_4\text{Cl}} = 0.01$
d) a solution of sodium phosphate in water with $\chi_{\text{Na}_3\text{PO}_4} = 0.01$
 e) a solution of ammonium chloride in water with $\chi_{\text{NH}_4\text{Cl}} = 0.015$

10) A mixture of benzene and toluene has a vapor pressure of 125 torr at 45°C. What is the mole fraction of **benzene** in this mixture? At 45°C, the vapor pressure of pure benzene is 227.6 torr, and the vapor pressure of pure toluene is 74.1 torr. Assume the solution is ideal. (7 pts)

- a) 0.668 3 pts
b) 0.332
 c) 0.451
 d) 1.69
 e) 0.549

$P_{\text{total}} = X_1 P_1^\circ + X_2 P_2^\circ$ $125 \text{ torr} = X_1 (227.6 \text{ torr}) + (1 - X_1) 74.1 \text{ torr}$ $125 \text{ torr} = X_1 (227.6 \text{ torr}) + 74.1 \text{ torr} - (74.1 \text{ torr}) X_1$ $125 \text{ torr} = X_1 (227.6 \text{ torr}) + 74.1 \text{ torr} - (74.1 \text{ torr}) X_1$ $125 \text{ torr} = X_1 (153.5 \text{ torr}) + 74.1 \text{ torr}$ $X_1 = 0.332$	I chose "1" to be benzene	$1 = X_1 + X_2$
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- 11) A solution of glucose (MW=180.2g/mol) was made by dissolving 23.4g of glucose in 130.0 mL of water. The resulting volume was 144.8 mL. What is the molarity of glucose?
Assume the density of water is 1.000 g/mL. (6 pts)

- a) 0.999 M 2 pts partial credit
b) 162 M
c) 180 M
d) 0.897 M
e) 1.11 M

$$M = \text{mol} / L \quad (L = \text{total volume of solution})$$

$$23.4 \text{ g glucose} / 180.2 \text{ g/mol} = 0.130 \text{ mol}$$

$$M = 0.130 \text{ mol} / 0.1448 \text{ L} = 0.897 \text{ M}$$

- 12) What is the mole fraction of ethanol in a solution consisting of 50.0g of ethanol (MW=46.07g/mol) and 50.0g of water? The densities of ethanol and water are 0.789 g/mL and 1.000 g/mL, respectively. (7 pts)

- a) 0.391
b) 0.308
c) 0.500
d) 0.236 2 pts partial credit
e) 0.281

$$\text{Moles of ethanol: } 50.0\text{g} / 46.07\text{g/mol} = 1.085 \text{ mol}$$

$$\text{Moles of water: } 50.0\text{g} / 18.016\text{g/mol} = 2.775 \text{ mol}$$

$$X_{\text{ethanol}} = 1.085 / (1.085 + 2.775) = 0.281$$

The density information is not needed.

- 13) An aqueous solution of 200.0g of ascorbic acid, also known as Vitamin C, has a volume of 1.00L at 25°C. The solution's osmotic pressure at 25°C is found to be 27.8 atm. What is the molar mass of ascorbic acid? Ascorbic acid is a non-electrolyte. (7 pts)

- a) 1495 g/mol
b) 14.8 g/mol
c) 176 g/mol
d) 1.78×10^{-4} g/mol
e) 265 g/mol

$$\Pi = i M R T \quad i = 1$$

$$27.8 \text{ atm} = 1 (M) (0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}) (273.15 + 25)$$

$$M = 1.136 \text{ mol/L} \times 1.00 \text{ L} = 1.136 \text{ mol}$$

$$\text{Molar Mass} = 200.0 \text{ g} / 1.136 \text{ mol} = 176 \text{ g/mol}$$

- 14) Select the complex ion that absorbs the longest wavelength of light. (4 pts)
- a) Co(OH)_6^{3-}
 - b) $\text{Co(H}_2\text{O)}_5\text{Cl}^{2+}$
 - c) $\text{Co(en)}_2\text{(CN)}_2^{1+}$
 - d) Co(Br)_6^{3-}**
 - e) Co(CN)_6^{3-}
- 15) If the compound $\text{Co(H}_2\text{O)}_6^{2+}$ appears red, what color could Co(NCS)_6^{4-} appear? (5 pts)
- a) violet
 - b) orange**
 - c) blue
- 16) Which types of isomerism could the compound $\text{Ca}_2[\text{Fe(OH)}_5\text{(NCS)}]$ display? (5 pts)
- a) linkage**
 - b) geometrical and linkage
 - c) coordination and geometrical
 - d) coordination and linkage
 - e) geometrical, linkage and coordination
- 17) Which types of isomerism could the compound $\text{Cu(H}_2\text{O)}_4\text{Cl}_2$ display? (5 pts)
- a) linkage
 - b) optical
 - c) geometrical**
 - d) geometrical and optical
 - e) coordination and geometrical
- 18) Is there any geometrical isomer of the complex ion $\text{Fe(en)(H}_2\text{O)}_2\text{Cl}_2$ that is optically active? (i.e. it has an optical isomer)? (4 pts)
- a) yes**
 - b) no