

Chem 3C Midterm 2

Version A

Credit will only be given for answers on this sheet. Units must be included in your answers and points will be taken off for incorrect or missing units. No partial credit will be awarded. Calculators are allowed. Cell phones may not be used as calculators.

Name:	Perm Number

Make sure your writing is dark and large enough to be picked up by a scanner. Failure to do this results in the loss of 5 points on the exam.

If you are sitting next to someone with the same version of the test, you both will lose 5 points on the exam.

If you are still writing after time is called, you will lose 5 points on the exam.

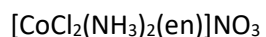
Fundamentals			
Question (Points)	Answer		
1 (7 pts)			
2 (7 pts)	1.63 g		
3 (6 pts)	$5690 \frac{g}{mol}$		
4 (6 pts) 2 each	potassium diaquabis(oxalato)chromate(II) $K_2[Cr(C_2O_4)_2(H_2O)_2]$ or $K_2[Cr(ox)_2(H_2O)_2]$		
	$[CoCl_2(NH_3)_2(en)]NO_3$ diamminedichloroethylenediaminecobalt(III) nitrate		
	chlorobis(ethylenediamine)thiocyanatocobalt(III) tetrachlorocadmiumate(II) $[CoCl(SCN)(en)_2]_2[CdCl_4]$		
5 (6 pts) 2 each	$M = 1.8 M$	$\chi = 0.033$	$m = 1.9 m$
6 (6 pts) 2 each	Oxidation Number $3+$ or Co^{3+}	Electron Configuration $[Ar]3d^6$	Coordination Number 6

Multiple Choice	
Question (Points)	Answer
7 (6 pts)	<input checked="" type="radio"/> A <input type="radio"/> B <input checked="" type="radio"/> C <input type="radio"/> D <input checked="" type="radio"/> E <input type="radio"/> F
8 (6 pts)	<input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input checked="" type="radio"/> E
9 (6 pts) 3 each	<input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D
	<input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E
10 (6 pts)	<input type="radio"/> A <input type="radio"/> B <input checked="" type="radio"/> C <input type="radio"/> D <input type="radio"/> E
11 (6 pts) 2 each	<input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input checked="" type="radio"/> E <input type="radio"/> F
	<input checked="" type="radio"/> A <input type="radio"/> B
	<input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D
12 (8 pts) 2 each	<input type="radio"/> A <input checked="" type="radio"/> B <input type="radio"/> C
	<input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C
	<input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C
	<input type="radio"/> A <input type="radio"/> B <input checked="" type="radio"/> C

Challenge Problems	
Question (Points)	Answer
13 (14 pts) (8,6)	0.657
	0.345 atm
14 (10 pts)	$[\text{Cr}(\text{NH}_3)_5]\text{I}_2$

4) 6 pts What is the name or formula of the following?

potassium diaquabis(oxalato)chromate(II)



chlorobis(ethylenediamine)thiocyanatocobalt(III) tetrachlorocadmiumate(II)

5) 6 pts If you have an aqueous solution that is 10.% NaCl by mass, calculate the following:

- Molarity of NaCl
- Mole fraction of NaCl
- Molality of NaCl

The density of the NaCl solution is $1.07 \frac{\text{g}}{\text{cm}^3}$ and the density of water is $1.00 \frac{\text{g}}{\text{cm}^3}$.

6a) 2 pts What is the oxidation number (on the metal) of $[\text{Co}(\text{ox})_3]^{3-}$?

6b) 2 pts What is the electron configuration for Co^x (x is the oxidation number found in 6a)?

6c) 2 pts What is the coordination number for $[\text{Co}(\text{ox})_3]^{3-}$?

Multiple Choice

- 7) 6 pts Which of the following are capable of linkage isomers
- SCN⁻
 - N₃⁻
 - NO₂⁻
 - NH₂CH₂CH₂NH₂
 - OCN⁻
 - I⁻
- 8) 6 pts A solution with 0.640 g of azulene in 100.0 g of benzene boils at 80.230°C. The boiling point of benzene is 80.100°C; the K_b is 2.53 $\frac{^{\circ}\text{C}\cdot\text{kg}}{\text{mol}}$. What is the molecular weight of azulene? Helpful Information: The van't Hoff factor is 1 for azulene.
- 108 $\frac{\text{g}}{\text{mol}}$
 - 117 $\frac{\text{g}}{\text{mol}}$
 - 134 $\frac{\text{g}}{\text{mol}}$
 - 99 $\frac{\text{g}}{\text{mol}}$
 - None of the Above

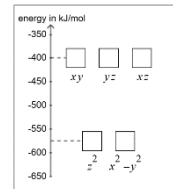
- 9) 6 pts Predict what will be observed in each experiment below.

Experiment	predicted observation (choose 1)
A student sees tiny bubbles clinging to the inside of an unopened plastic bottle full of carbonated soft drink. The student squeezes the bottle.	<ol style="list-style-type: none"> The bubbles will shrink, and some may vanish. The bubbles will grow, and more may appear. The bubbles won't change. I need more information to predict what will happen to the bubbles.
A pair of 100 ml samples of water are taken from a well bored into a large underground salt (NaCl) deposit. Sample #1 is from the top of the well, and is initially at 32°C. Sample #2 is from a depth of 50.m, and is initially at 42°C. Both samples are allowed to come to room temperature (20°C) and 1 atm pressure. An NaCl precipitate is seen to form in Sample #1.	<ol style="list-style-type: none"> A bigger mass of NaCl precipitate will form in Sample #2. A smaller mass of NaCl precipitate will form in Sample #2. The same mass of NaCl precipitate will form in Sample #2. No precipitate will form in Sample #2. I need more information to predict whether and how much precipitate will form in Sample #2.

- 10) 6 pts Which of the following complexes is chiral?
- trans-[CoCl₂(en)₂]
 - trans-[CoCl(NH₃)(en)₂]
 - [Co(en)₃]³⁺
 - [Fe(CN)₆]³⁻
 - All of the above are achiral

11) 6 pts

When a certain weak-field ligand forms a tetrahedral complex with Fe^{2+} cation, the energies of the valence d orbitals on the iron atom are split according to this electron box diagram: Using this diagram, answer the following questions.
How many unpaired d electron spins does the iron atom have?



- A. 0
- B. 1
- C. 2
- D. 3
- E. 4
- F. None of the above

Is the complex paramagnetic or diamagnetic?

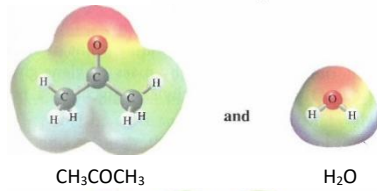
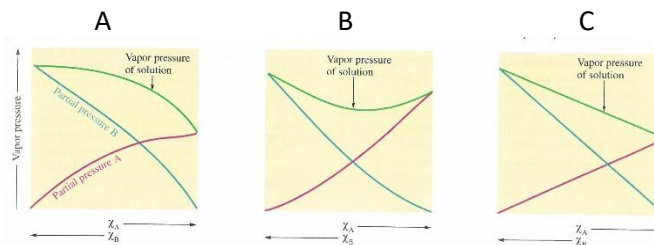
- A. paramagnetic
- B. diamagnetic

Predict the color of the complex.

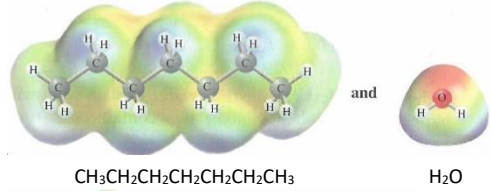
- A. blue or green
- B. red or violet
- C. orange or yellow
- D. white or transparent

12) 8 pts

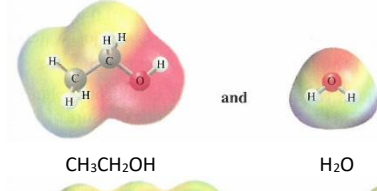
Match the vapor pressure diagrams with the solute-solvent combination.



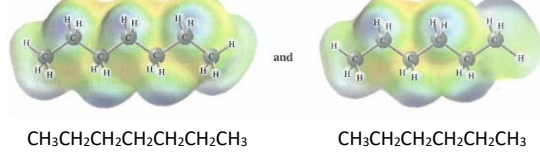
A. B. C. (see drawing above)



A. B. C. (see drawing above)



A. B. C. (see drawing above)



A. B. C. (see drawing above)

Challenge Problems

13a) *8 pts* The vapor pressure of carbon tetrachloride CCl_4 , is 0.354 atm and the vapor pressure of chloroform, CHCl_3 , is 0.526 atm at 316 K. A solution is prepared from equal masses of these two compounds at this temperature. Calculate the mole fraction of the chloroform in the vapor above the solution

13b) *6 pts* If the vapor above the original solution is condensed and isolated into a separate flask, what would the vapor pressure of chloroform be above this new solution?

- 14) 10 pts Ammonia and potassium iodide solutions were added to an aqueous solution of $\text{Cr}(\text{NO}_3)_3$. A solid was isolated (compound A) and the following data was collected:
1. When 0.105 g of compound A was strongly heated in excess O_2 , 0.0203 g of CrO_3 was formed.
 2. In a second experiment it took 32.93 mL of 0.100M HCl to titrate completely the NH_3 present in 0.341 g of compound A.
 3. Compound A was found to contain 73.53% iodine by mass.
 4. The freezing point of water was lowered by 0.64°C when 0.601 g of compound A was dissolved in 10.00 g of H_2O ($K_f = 1.86 \frac{^\circ\text{C}\cdot\text{kg}}{\text{mol}}$)

What is the formula of the compound? What is the structure of the complex ion present? [Hints: Cr^{3+} is expected to be six-coordinate with NH_3 and (possibly) I^- acting as ligands. The I^- ions will be the counter ions if needed.

A will have the formula $[\text{CrI}_x(\text{NH}_3)_y]\text{I}_z$