

Name (print) _____
Last first

Chem ID# _____

Student Signature _____

TA _____

Chem 151
MIDTERM EXAMINATION
October 15, 2008

Please read the instructions before proceeding.

- Only the following models of calculators are permitted in this exam:
TI-36X, TI-30Xa, TI-30XIIB, and TI-30XIIs.
- The time allowed for this examination is 100 minutes. You may not proceed until you are told to do so. If you finish the exam early, you may turn in the exam and leave. However, after the 10-minute-to-go warning is announced, you must keep your exam and remain seated till the end of the exam period.
- The exam has 16 questions on 8 numbered pages. Verify that your exam is not missing any of the pages.
- The last page of the exam contains a periodic chart. Detach this page and use it as scratch paper. It is not necessary to submit the last page with the exam.
- **The answers to the questions must be written in the space provided. Materials written on the back pages will not be graded.** If you need more space to present your answer, you should indicate as such in the original space and use the space provided on page 7 for this purpose.

For grading only

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Page 3 (Questions 8 → 9) _____ /32

Page 4 (Questions 10 → 13) _____ /30

Page 5 (Questions 14 → 15) _____ /28

Page 6 (Questions 16a → 16c) _____ /20

Page 7 (Question 16d → 16e) _____ /08

Total _____ /154

All re-grade requests must be submitted to the blue locker on the 3rd floor of Lab Sciences Building before 5 pm on Monday (10/20/08).

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1. (4 pts.) In your lab, if you have spilled chemicals in your eye, where is the eye-wash?
2. (4 pts.) In your lab, where can you find the binder with the Material Safety Data Sheets (MSDS)?
3. (6 points) On the right are four interhalogen diatomic molecules. ClF BrF BrCl IBr
 - a) Circle the molecule with highest ionic character and enter its systematic name in the box below.
 - b) The bonds between the halogen atoms in the above molecules are classified as (*ionic bond / covalent bond / polar covalent bond*). Circle the correct answer.
4. (4 pts.) Circle all the element(s) below that has electronegativity lower than 2.2 on Pauling scale.

H, Ag, Ca, Si, Se, N, Cl

5. (4 pts.) Based on the periodic trends of atomic sizes, arrange the following molecules in the order of increasing sizes. NO₂ H₂O O₃ SO₂

< < < largest in size
6. (4 pts.) A diode in an LED was constructed using a semiconductor of germanium doped with gallium connected to a semiconductor of germanium doped with phosphorus. Which semiconductor should be connected to the negative terminal of a battery? Enter your answer in the box.

Semiconductor of germanium doped with

7. (10 pts.) Jerry dissolves 5.00 g of sodium hydrogen phosphate (Na₂HPO₄, molar mass = 142.0 g/mol) in water to make 234 mL of solution.
 - a) List the formula(s) of the major species (cations, anions, and/or molecules) besides water in the box below.
 - b) What is the molarity of sodium ions in solution? Enter your answer in the box and show your work in the space below.

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8. Write a balanced net ionic equation in the appropriate box to illustrate the reaction taken place in each of the following procedures. Also list the spectator ion(s) of each reaction.

- a. (6 pts.) Hydrochloric acid is added to calcium carbonate powder. While calcium carbonate dissolves gradually, gas bubbles out from solution.

Spectator ion(s) =

- b. (8 pts.) Sodium hydroxide solution is added to aluminum sulfate solution and the solution turns cloudy

Spectator ion(s) =

- c. (8 pts.) Hydrochloric acid is added to a 5% sodium hypochlorite solution to produce chlorine gas.

Spectator ion(s) =

9. (10 pts.) Joe finds two bottles of solutions with no clear labels in a lab. These can be 0.1 M solutions from the list of ten possibilities below:

- | | |
|--|---|
| i. CuSO_4 solution | vi. A solution of KOH and K_2CO_3 |
| ii. LiOH solution | vii. A solution of HCl and CuCl_2 |
| iii. $\text{Ca}(\text{CH}_3\text{COO})_2$ solution | viii. A solution of CuCl_2 and H_2SO_4 |
| iv. Li_2CO_3 solution | ix. A solution of CaCl_2 and HCl |
| v. H_2SO_4 solution | x. A solution of CuCl_2 and BaCl_2 |

Solution A is colorless. The pH is approximately 11-12. The flame is red in the flame test.

When A is added to 0.1 M KOH solution, no obvious changes are observed.

When A is added to a 0.1 M BaCl_2 solution, the solution turns cloudy.

When A is added to 2 M sulfuric acid, gas bubbles are formed.

Choose from the above list to enter the most likely identity of A in the box.

Solution B is light blue. The pH is approximately 1-2 and the flame color is green in the flame test.

When B is added to 0.1 M KOH solution no obvious changes are observed.

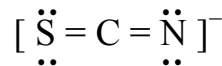
When B is added to a 0.1 M BaCl_2 solution, the solution turns cloudy

When B is added to 2 M sulfuric acid, no obvious changes are observed.

Choose from the above list to enter the most likely identity of B in the box.

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10. (8 pts.) Shown on the right is the Lewis dot structure of the polyatomic anion, thiocyanate, SCN^- .



- a) Enter the systemic name of $\text{Ca}(\text{SCN})_2$ in the box.
- b) Enter the oxidation numbers of S, C, and N in the boxes below.
O.N. of S = O.N. of C = O.N. of N =
- c) When thiocyanate reacts with other substances in a redox reaction, will it most likely act as a reducing agent or an oxidizing agent? Circle your answer.
11. (8 pts.) Selenium and tellurium are in the same group of sulfur in the periodic chart.
- a) What is the highest possible oxidation number of Te? Enter your answer in the box.
- b) Which of the three elements, Se, Te, or S, would have the greatest metallic character?
- c) Enter the systematic name of the acid, H_2SeO_3 , in the box below

- d) When H_2SeO_3 reacts with other substances in a redox reaction, it will
- i. always be an oxidizing agent
 - ii. always be a reducing agent
 - iii. either be an oxidizing agent or a reducing agent
- } **Circle one correct response**

12. (10 pts.) For the reactions listed below, circle the letter for each of the redox reactions, and list all the disproportionation reactions in the box below.

- a) $2 \text{NH}_4\text{VO}_3 (\text{s}) \rightarrow \text{V}_2\text{O}_5 (\text{s}) + 2 \text{NH}_3 (\text{g}) + \text{H}_2\text{O} (\text{g})$
- b) $5 \text{IF} (\text{g}) \rightarrow \text{IF}_5 (\text{g}) + 2 \text{I}_2 (\text{g})$
- c) $2 \text{ICl}_3 (\text{g}) \rightarrow \text{I}_2 + 3 \text{Cl}_2$
- d) $\text{I}_2 (\text{s}) + 2 \text{S}_2\text{O}_3 (\text{aq}) \rightarrow 2 \text{I}^- (\text{aq}) + \text{S}_4\text{O}_6^{2-} (\text{aq})$
- e) $2 \text{HNO}_3 (\text{aq}) \rightarrow \text{N}_2\text{O}_5 (\text{g}) + \text{H}_2\text{O} (\text{l})$
- f) $\text{N}_2\text{O}_3 (\text{g}) \rightarrow \text{NO} (\text{g}) + \text{NO}_2 (\text{g})$

The disproportionation reaction(s) is/are:

13. (4 pts.) In Exp 3, when a drop of glucose solution is added to the Tollens reagent, $\text{Ag}(\text{NH}_3)_2\text{OH}$, a silver mirror is coated onto the inner wall of the test tube. Which of the following is the strongest reducing agent? Which is the strongest oxidizing agent? Draw a circle around the strongest reducing agent and draw a square around the strongest oxidizing agent.

Glucose Gluconic acid Tollens reagent Silver metal

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14. Jenny dissolves $\text{K}_2\text{Cr}_2\text{O}_7$ crystals, in 2 M H_2SO_4 to make an orange solution. Then, she puts ~2 grams of granular zinc metal in the solution and stirs it on a stirring plate. She observes gas bubbling out from the solution and the color of the solution gradually turns green, the color of aqueous Cr^{3+} ions. The amount of zinc metal in the flask also decreases as the stirring continues.

a) (2 pts.) What ion is responsible for the orange color in Jenny's solution?
Enter the chemical formula of the ion in the box.

b) (2 pts.) What is the identity of the gas bubbling out of the solution?
Enter the chemical formula of the gas in the box.

c) (4 pts.) In the box below, write an unbalanced (skeletal) net ionic equation to show the reactants and products of the reaction between potassium dichromate and zinc.

d) (4 pts.) In the box below, write a balanced net ionic equation to illustrate the oxidation half-reaction.

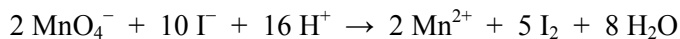
e) (4 pts.) In the box below, write a balanced net ionic equation to illustrate the reduction half-reaction.

f) (2 pts.) In the box below, write a balanced net ionic equation to illustrate the overall redox reaction between potassium dichromate and zinc.

15. (10 pts.) Write a balanced net ionic reaction equation to illustrate the oxidation of sodium chlorite by sodium hypobromite to form sodium chlorate and sodium bromide in a sodium hydroxide solution. Show your work in the space below and enter the balanced equation in the box.

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16. Below is a balanced equation showing the reaction between KMnO_4 and KI in an acidic solution:



Joan and Dean each performed a procedure similar to the procedure in Exp 4. Described below are their procedures and observations.

Joan mixed 1.0 mL of 0.10 M KI solution and 1.0 mL of 2 M sulfuric acid in a small vial. She added one drop (that is 0.050 mL) of 0.060 M KMnO_4 solution to the vial and the solution turned light brown. Then, she added 1.0 mL of cyclohexane to the vial, shook the vial vigorously to mix the solution and set it on the lab bench. When the solution settled, it formed two layers, the top layer was purplish and the bottom layer was yellow.

Dean followed the same procedure as Joan except he used a 0.60 M KMnO_4 solution instead of the 0.060 M. Upon the addition of the one drop of KMnO_4 , a dark color precipitate was form. The precipitate re-dissolved after shaking with 1 mL of cyclohexane. When the solution settled, both the top layer and the bottom layer of the solution were purplish.

- a) (4 pts.) Calculate the number of moles of KI and moles of KMnO_4 that had been added to Joan's vial. Enter your answers in the appropriate boxes.

moles of KI

moles of KMnO_4

- b) (8 pts.) Calculate the number of moles of I_2 produced in Joan's procedure. Show your work in the space below and enter your answer in the box.

moles of I_2

- c) (8 pts.) Calculate the number of moles of I_2 produced in Dean's procedure. Show your work in the space below and enter your answer in the box.

moles of I_2

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Question 16 continues

- d) (6 pts.) In each of the box below, enter the chemical formula of the ion/molecule responsible for the color in the solutions.

The yellow color in the bottom layer of Joan's solution

The purplish color in the top layer of Joan's solution

The purplish color in the bottom layer of Dean's solution

- e) (2 pts.) Enter the formula of the dark color precipitate

If you need more space to present your answer, indicate the question number and write your answer inside the box below.

~ The End ~
Have a Great Fall Break!!

Name (Last, First) _____

Periodic Table of the Elements

1 IA	Periodic Table of the Elements																18 VIIIA
1 H 1.0079												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.01	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 —	9 VIIIB	10 —	11 IB	12 IIB	13 Al 26.982	14 Si 28.09	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.7	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	71 Lu 174.9	72 Hf 178.5	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	103 Lr (260)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Uun (269)	111 Uuu (272)	112 Uub	113 Uut	114 Uuq	116 Uuh			118 Uuo

Lanthanides	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0
Actinides	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)