

## Chem 205: GENERAL CHEMISTRY I MIDTERM EXAMINATION

### PLEASE READ THIS PAGE WHILE WAITING TO START

**INSTRUCTIONS:** This test paper includes 8 pages, including a periodic table; please ensure your paper is complete. You may detach the periodic table if you wish. For Part A, you do not need to show calculations; for Part C, you must show your calculations to receive full marks. Please write clearly and organize your work logically. Non-programmable calculators are permitted; book-style translation dictionaries are allowed, but electronic dictionaries and cell phones are not allowed.

**Duration: 70 minutes** - spend at least half that time on Parts B & C. **GOOD LUCK!**

LAST NAME: \_\_\_\_\_ FIRST NAME: \_\_\_\_\_

STUDENT NUMBER: \_\_\_\_\_

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#### Mark breakdown:

Page 2. / 12

Page 3. / 15

Page 4. / 8

Page 5. / 7

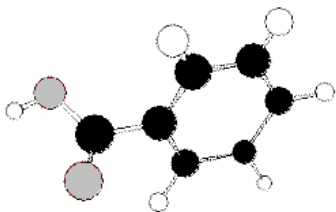
Page 6. / 10

TOTAL: / 50 (MAXIMUM MARK = 52)

PERCENT: %

EARNED towards FINAL GRADE: / 20

**PART A: ONLY YOUR FINAL ANSWER WILL BE MARKED**

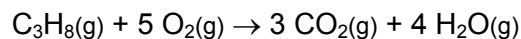
- # 1. (2 marks)** Which three elements are likely to have very similar chemical and physical properties?
- sodium, magnesium, and aluminum
  - carbon, phosphorus and selenium
  - fluorine, chlorine, and bromine
  - zinc, copper, and nickel
  - uranium, plutonium, and americium
- # 2. (2 marks)** Bromine has two naturally occurring isotopes. If 50.54% of bromine is found as  $^{79}\text{Br}$  (78.9183 amu), what is the mass of the other isotope? The average mass of bromine is 79.904 amu.
- 79.82 amu
  - 79.97 amu
  - 80.91 amu
  - 81.93 amu
  - 82.91 amu
- # 3. (2 marks)** You are given a white solid that is either  $\text{Pb}(\text{NO}_3)_2$  or  $\text{Zn}(\text{NO}_3)_2$ . Which one of the following reagents (available as aqueous solutions) would allow you to distinguish between these two compounds?
- KBr
  - $\text{HNO}_3$
  - $\text{CH}_3\text{CO}_2\text{H}$
  - $\text{NH}_4\text{ClO}_4$
  - $\text{LiNO}_3$
- # 4. (2 marks)** The molecular model below depicts a molecule composed of carbon (black), oxygen (gray), and hydrogen (white) atoms. What is the correct empirical formula?
- CHO
  - $\text{C}_6\text{H}_6\text{O}_2$
  - $\text{C}_6\text{H}_7\text{O}$
  - $\text{C}_7\text{H}_6\text{O}$
  - $\text{C}_7\text{H}_6\text{O}_2$
- 
- # 5. (2 marks)** All of the following are examples of *intensive* (also called *intrinsic*) properties EXCEPT
- melting point.
  - mass.
  - colour.
  - density.
  - boiling point.
- # 6. (2 marks)** Pennies made after 1983 have a mass of 2.46 g and are composed of 97% zinc and 3.0% copper. How many atoms of copper are in a penny?
- 0.0012 mol
  - 0.014 mol
  - 0.038 mol
  - 0.040 mol
  - 25 mol

# 7. (3 marks) Identify the following statements as true or false. (Circle T or F.)

T / F When sugar melts, the arrangement and composition of the sugar molecules change.

T / F A solution's pH value always has more digits than the solution's  $H^+$  concentration.

T / F For the reaction below, 1 gram of  $C_3H_8$  would yield 4 grams of water vapour:



# 8. (3 marks) Fill in the blanks:

a) An example of an element that exists as free atoms: \_\_\_\_\_

b) Liquid nitrogen's boiling point (77 K) in Celsius: \_\_\_\_\_

c) Number of electrons in a  $^{48}Ti$  (titanium-48) atom: \_\_\_\_\_

# 9. (3 marks) Write the missing name or formula, and classify each substance by type:

Substance name	Substance formula	Ionic or molecular substance?
potassium acetate		
sulfur trioxide		
	$Cu_3PO_4$	

# 10. (3 marks) Draw particulate-level pictures (*i.e.*, 1 atom = ●) of the molecules involved in a small sample of  $Br_2$  in each of the three states of matter. Use a sample size of approximately 6 molecules.

Solid state	Liquid state	Gaseous state

# 11. (3 marks) Classify the two reactions below, and briefly justify your choices. Use as many of the following "type" labels as apply to each reaction: **precipitation, acid-base, gas-forming or redox.**

Reaction	Reaction type(s)	How did you decide?
$2 NaBr(aq) + F_2(g) \rightarrow 2 NaF( ) + Br_2( )$		
$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2( )$		

**PART B: Short written answers**

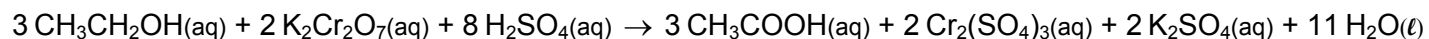
**# 12. (4 marks)** Sulfuric acid and nitric acid are strong acids but also strong oxidizing agents, while hydrochloric acid is not an oxidizing agent. Explain why the chloride ion is not a strong oxidizing agent like  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$ . Include any relevant calculations.

**# 13. (4 marks)** Imagine you mix known but unequal quantities of aqueous KCl and aqueous  $\text{AgNO}_3$  to precipitate out solid AgCl. Explain in detail how you would determine the concentration of excess reactant remaining in the supernatant after the reaction occurs (assume 100% yield).

**PART C: Problems – SHOW YOUR WORK TO GET FULL CREDIT**

- # 14. (7 marks)** Phosphorus, P, is combined with chlorine, Cl<sub>2</sub>, to give a gaseous compound with the formula PCl<sub>x</sub>. If you start with 2.097 g of P and isolate 9.298 g of PCl<sub>x</sub>, what is the value of x? **Show your calculations, and briefly explain your answer.**

**# 15. (10 marks total)** The alcohol ( $\text{CH}_3\text{CH}_2\text{OH}$ ) content in a 10.3 g sample of blood from a driver required 2.79 mL of 0.07923 M  $\text{K}_2\text{Cr}_2\text{O}_7$  solution to reach the equivalence point in a titration involving the reaction shown below. If the legally allowed limit is 0.10 % alcohol by mass in the blood, should the police charge the driver with drunk driving? **Show your calculations, and briefly explain your answer.**



**(1 mark)** What type of reaction is this? Explain your choice.

CHEM 205 Winter 2007 MIDTERM EXAM  
Dr. C. Rogers, Section 04 W/F

Student ID #: \_\_\_\_\_

**POTENTIALLY USEFUL INFORMATION**

Atomic mass unit:  $1 \text{ amu} = 1.66054 \times 10^{-27} \text{ kg}$

Avogadro's number:  $N = 6.022 \times 10^{23} \text{ mol}^{-1}$

**EXTRA SPACE FOR ROUGH WORK ONLY – WILL NOT BE MARKED**