

## 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. / 10

Page 3. / 15

Page 4. / 8

Page 5. / 10

Page 6. / 8

TOTAL: / 50 (MAXIMUM MARK = 51)

PERCENT: %

EARNED towards FINAL GRADE: / 20

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

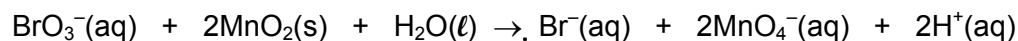
**# 1. (2 marks)** Based on their position in the periodic table, which of these pairs of elements would you expect both to be malleable and good electrical conductors?

- a) phosphorus and rubidium
- b) copper and lead
- c) iodine and selenium
- d) calcium and boron
- e) sulphur and germanium

**# 2. (2 marks)** The density of silver is  $10.5 \text{ g/cm}^3$ . What is the volume of a piece of Ag that contains  $2.8 \times 10^{22}$  atoms?

- a)  $0.48 \text{ cm}^3$
- b)  $53 \text{ cm}^3$
- c)  $4.8 \times 10^{-2} \text{ cm}^3$
- d)  $2.1 \text{ cm}^3$
- e) cannot calculate without knowing the sample's shape (e.g., block, wire, foil, etc.)

**# 3. (2 marks)** Consider the reaction shown below and pick the correct statement:



- a) Bromine is oxidized and hydrogen is reduced.
- b) Bromine is reduced and hydrogen is oxidized.
- c) Bromine is reduced and manganese is oxidized
- d) The reaction is an acid – base reaction, NOT an oxidation – reduction reaction!
- e) Manganese is oxidized and hydrogen is reduced.

**# 4. (2 marks)** An example of a weak acid in water is:

- a)  $\text{HNO}_3$
- b)  $\text{HBr}$
- c)  $\text{NH}_3$
- d)  $\text{H}_2\text{SO}_4$
- e)  $\text{CH}_3\text{COOH}$

**# 5. (2 marks)** Consider the following description about the element, sulphur:

1. Sulphur is a yellow non-metallic element.
2. It burns in oxygen to form a choking gas,  $\text{SO}_2$ .
3.  $\text{SO}_2$  reacts with water to produce acid rain.
4. Sulphur is produced commercially by injecting steam into deposits of it underground to melt it.
5. It is then carried by the steam to the surface, where it separates from the water after cooling.

Which of the statements refer to chemical reactions and which refer to physical properties or changes?

- |    | <b>Chemical</b>           | <b>Physical</b>       |
|----|---------------------------|-----------------------|
| a) | Statements 2, 3, 4, and 5 | Statements 1 only     |
| b) | Statements 2 and 3        | Statements 1, 4 and 5 |
| c) | Statements 2, 3 and 4     | Statements 1 and 5    |
| d) | Statements 2, 3 and 5     | Statements 1 and 4    |
| e) | Statements 1, 4 and 5     | Statements 2 and 3    |

# 6. (5 marks) Identify the following statements as true or false. (Circle T or F.)

- T / F The reaction of an acid with a base typically yields a salt and water as products.  
 T / F Electrons and protons have identical masses but opposite charges.  
 T / F A homogeneous mixture is a pure substance that is composed of only one type of atom.  
 T / F Particles in a liquid are packed closely together but are not confined to specific positions.  
 T / F In their elemental forms, metals generally act as reducing agents.

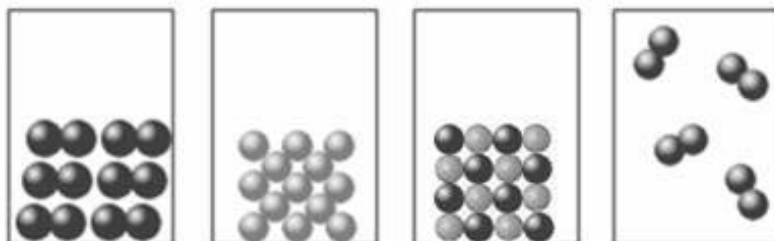
# 7. (5 marks) Fill in the blanks:

- a) Carbon dioxide's sublimation point ( $-78^{\circ}\text{C}$ ) in Kelvin: \_\_\_\_\_  
 b) Number of neutrons in a  $^{25}\text{Mg}$  (magnesium-25) atom: \_\_\_\_\_  
 c) The species not included in a net ionic equation are called: \_\_\_\_\_  
 d) Sulfuric acid is formed by the reaction of water with: \_\_\_\_\_  
 e) The solid that will form if  $\text{FeBr}_2(\text{aq})$  is added to  $\text{Ba}(\text{OH})_2(\text{aq})$ : \_\_\_\_\_

# 8. (3 marks) Write the missing name or formula, and classify each substance by type:

Substance name	Substance formula	Ionic or molecular substance?
calcium phosphate		
xenon hexafluoride		
	$\text{NH}_4\text{NO}_3$	

# 9. (2 marks) Each picture shown below represents a sample (at  $25^{\circ}\text{C}$ ) of one of the four substances listed below. Label each picture with the formula and state of the substance it most correctly represents.



**SUBSTANCES SHOWN:**

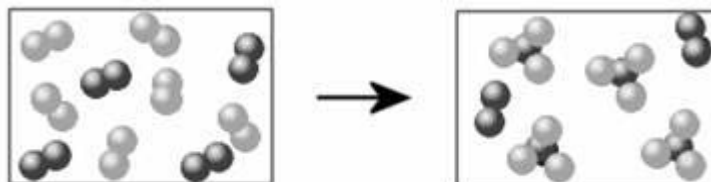
- lithium fluoride  
 potassium  
 nitrogen  
 iodine

**PART B: Short written answers**

**# 10. (4 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, redox.**

Reaction	Reaction type(s)	How did you decide?
$\text{CH}_3\text{CO}_2\text{H}(\text{s}) + \text{NH}_3(\text{aq}) \rightarrow \text{NH}_4\text{CH}_3\text{CO}_2(\text{aq})$		
$\text{Na}(\text{s}) + \text{H}_2\text{O}(\ell) \rightarrow \text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$		

**# 11. (4 marks)** The diagram to the right represents the gas-phase reaction of  $\text{A}_2$  (darker spheres) with  $\text{B}_2$  (lighter spheres). Write a balanced equation for the reaction, and identify the limiting reactant. **Explain each answer briefly.**



a) Balanced equation:

b) Limiting reagent:

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

**# 12. (10 marks)** Dissolved lead ions are toxic, and precipitation reactions are often done to remove lead from waste solutions. Imagine a solution containing 1.50 g of  $\text{Pb}(\text{NO}_3)_2$  is mixed with 125 mL of 0.100 M  $\text{Na}_2\text{SO}_4$  solution to produce a precipitate of  $\text{PbSO}_4$  and 175 mL of supernatant\* solution (\*the liquid phase left after the precipitate has been filtered off).

**Calculate the concentrations of all ions that remain in the solution after the reaction is complete. Has all of the dissolved lead been precipitated?**

**# 13. (8 marks)** Toluene is a volatile organic solvent that gives its characteristic smell to some paint thinners and glues. It is a compound composed of 91.25% C and 8.75% H.

***Determine the empirical formula for toluene. Show and briefly explain all calculations.***

CHEM 205 Fall 2007 MIDTERM EXAM  
Dr. C. Rogers, Section 02 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**