

Chem 205: GENERAL CHEMISTRY I MIDTERM EXAMINATION

PLEASE READ THIS PAGE WHILE WAITING TO START

INSTRUCTIONS: This test paper includes 7 pages, including a periodic table; please check that your paper is complete. You may detach the periodic table if you wish. For Part A, you do not need to show calculations; for Parts B and C, you must show your calculations to receive full marks. Please write clearly and organize your work logically. Non-programmable calculators are permitted; paper 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: _____

Mark breakdown:

Page 2. / 14

Page 3. / 12

Page 4. / 8

Page 5. / 8

Page 6. / 9

TOTAL: / 50 (MAXIMUM MARK = 51)

PERCENT: %

EARNED towards FINAL GRADE: / 20

PART A: ONLY YOUR FINAL ANSWER WILL BE MARKED

1. (___ / 3 marks) Identify the following statements as true or false. (*Circle T or F.*)

T / F Water expands when it freezes; the density of ice is greater than the density of water.

T / F Precision is an indicator of the numerical spread in a set of measurements.

T / F J.J. Thomson determined the charge-to-mass ratio of the electron by bombarding gold foil with alpha particles.

2. (___ / 3 marks) Fill in the blanks:

a) Number of neutrons in ^{207}Pb (*i.e.*, 207-Pb) _____

b) Charge on cadmium in cadmium sulfide _____

c) Products of the decomposition of H_2CO_3 _____

3. (___ / 4 marks) Write each compound's formula or name, **and** circle *ionic* or *molecular* to describe each:

a) potassium sulfate _____ ionic / molecular ?

b) vanadium(V) bromide _____ ionic / molecular ?

c) NH_4NO_3 _____ ionic / molecular ?

d) P_2O_5 _____ ionic / molecular ?

4. (___ / 2 marks) Which three elements are likely to have similar chemical and physical properties?

- a) sodium, lithium, and potassium
- b) sodium, magnesium, and aluminum
- c) nitrogen, oxygen, and neon
- d) nickel, copper, and zinc
- e) uranium, plutonium, and americium

5. (___ / 2 marks) Silver has two isotopes, with an average atomic mass of 107.87 amu. If 48.18% of Ag exists as Ag-109 (108.9047 amu), what is the identity and the atomic mass of the other isotope?

- a) Ag-106; 106.9 amu
- b) Ag-107; 106.9 amu
- c) Ag-107; 107.9 amu
- d) Ag-108; 107.9 amu
- e) Ag-108; 108.9 amu

6. (/ 2 marks) Which of the following will be highly soluble in water: KNO_3 , $\text{Ca}_3(\text{PO}_4)_2$, CuCl_2 , Fe_2S_3 ?

- a) KNO_3 and $\text{Ca}_3(\text{PO}_4)_2$
- b) KNO_3 and CuCl_2
- c) $\text{Ca}_3(\text{PO}_4)_2$ and Fe_2S_3
- d) CuCl_2 and Fe_2S_3
- e) KNO_3 , $\text{Ca}_3(\text{PO}_4)_2$, and Fe_2S_3

7. (/ 2 marks) What are the spectator ions in the reaction between aqueous perchloric acid and aqueous potassium hydroxide?

- a) H^+ , ClO_4^- , K^+ , and OH^-
- b) H^+ and OH^-
- c) K^+ and ClO_4^-
- d) H^+ and ClO_4^-
- e) K^+ and OH^-

8. (/ 2 marks) Choose the correctly balanced half-reaction for the reduction of $\text{ClO}_3^-(\text{aq})$ to $\text{Cl}_2(\text{g})$ in an acidic solution.

- a) $2 \text{ClO}_3^-(\text{aq}) + 6 \text{H}^+(\text{aq}) + 10 \text{e}^- \rightarrow \text{Cl}_2(\text{g}) + 6 \text{OH}^-(\text{aq})$
- b) $2 \text{ClO}_3^-(\text{aq}) + 12 \text{H}^+(\text{aq}) + 5 \text{e}^- \rightarrow \text{Cl}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{l})$
- c) $2 \text{ClO}_3^-(\text{aq}) + 10 \text{e}^- \rightarrow \text{Cl}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{l}) + 3 \text{O}_2(\text{g})$
- d) $2 \text{ClO}_3^-(\text{aq}) + 12 \text{H}^+(\text{aq}) + 10 \text{e}^- \rightarrow \text{Cl}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{l})$
- e) $2 \text{ClO}_3^-(\text{aq}) + 18 \text{H}^+(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 6 \text{H}_3\text{O}^+(\text{aq})$

9. (/ 2 marks) When a handful of copper pennies is submerged in water, they displace 8.26 cm^3 of water. If the combined mass of the pennies is 73.86 g , what is the density of copper?

- a) 0.112 g/cm^3
- b) 1.34 g/cm^3
- c) 8.94 g/cm^3
- d) 32.8 g/cm^3
- e) 107 g/cm^3

10. (/ 4 marks) A compound is found to contain 47.35% C, 10.60% H, and 42.05% O by mass. What is the empirical formula for this compound?

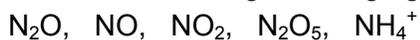
- a) $\text{C}_2\text{H}_6\text{O}$
- b) $\text{C}_3\text{H}_4\text{O}_2$
- c) $\text{C}_3\text{H}_8\text{O}_2$
- d) $\text{C}_4\text{H}_6\text{O}_2$
- e) $\text{C}_4\text{H}_8\text{O}_3$

PART B: Short written answers

- # 11. (/ 5 marks)** The cheapest way to obtain magnesium metal is to “mine” it from seawater, where Mg^{2+} is quite abundant. Your task is to identify the type of reaction involved in each step of the process; choose as many labels as apply: **acid-base, gas-forming, precipitation, OR oxidation-reduction.**

Step in “seawater Mg mining” process	Type of reaction	How can you tell?
STEP 1: Produce quicklime $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$		
STEP 2: Treat quicklime with seawater $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{s})$ <i>trace is dissolved...</i>		
STEP 3: Trap Mg^{2+} from seawater using dissolved OH^- $\text{Mg}^{2+}(\text{aq}) + 2 \text{OH}^-(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s})$		
STEP 4: Redissolve trapped Mg^{2+} $\text{Mg}(\text{OH})_2(\text{s}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + 2 \text{H}_2\text{O}(\text{l})$		
STEP 5: After isolating salt, electrolyze molten salt $\text{MgCl}_2(\text{l}) \rightarrow \text{Mg}(\text{l}) + \text{Cl}_2(\text{g})$		

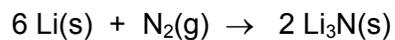
- # 12. (/ 3 marks)** Nitric acid (HNO_3) is a strong oxidizing agent. Which species listed below is least likely to be formed when nitric acid reacts with a strong reducing agent such as zinc? Explain your choice.



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

- # 13.** (/ 8 marks) A mixture of MgCO_3 and $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$ has a mass of 3.057 g. After heating to drive off all the water, the mass of the sample is 2.790 g. What was the mass percent of $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$ in the original mixture?

14. (/ 9 marks) When heated, lithium metal reacts with nitrogen gas to form lithium nitride, which is a substance used in hydrogen-storage units:



Under certain conditions, the reaction will produce a 38% yield of Li_3N . Under the same conditions, how many grams of Li_3N would be produced from the reaction of 12.3 g of Li with 33.6 g of N_2 ?

CHEM 205 Winter 2006 MIDTERM EXAM
Dr. C. Rogers, Section 03

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