

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: _____

Mark breakdown:

Page 2. / 15

Page 3. / 10

Page 4. / 7

Page 5. / 8

Page 6. / 11

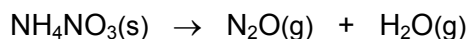
TOTAL: / 50 (MAXIMUM MARK = 51)

PERCENT: %

EARNED towards FINAL GRADE: / 20

PART A: ONLY YOUR FINAL ANSWER WILL BE MARKED**# 1. (___ / 4 marks)** Identify the following statements as true or false. (*Circle T or F.*)

- T / F When water boils, the arrangement and composition of the water molecules change.
- T / F A sample containing 3×10^{15} atoms can be described as containing 5 micromoles of atoms.
- T / F If a mass of 2.3720 g is measured with a digital balance, the "0" is uncertain but significant.
- T / F The coefficients needed to balance the reaction equation shown below are: 1, 1, 2.

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

- a) Number of neutrons in a ^{119}Sn (tin-119) atom _____
- b) Body temperature (37°C) on the Kelvin scale _____
- c) Substance that has more than one allotrope _____

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

- a) phosphorus trichloride _____ ionic / molecular ?
- b) manganese(II) carbonate _____ ionic / molecular ?
- c) $(\text{NH}_4)_2\text{SO}_4$ _____ ionic / molecular ?
- d) IF_6 _____ ionic / molecular ?

4. (___ / 2 marks) Which one of the following substances yields acid rain when it enters into rain clouds?

- a) ammonia
- b) calcium oxide
- c) nitrogen dioxide
- d) hydrogen sulfide
- e) sulfur

5. (___ / 2 marks) You have 4.15 g of each of the following elements: Ca, Cu, Ce, Cs, Cf. Which sample contains the largest number of atoms?

- a) Ca
- b) Cu
- c) Ce
- d) Cs
- e) Cf

6. (___/ 2 marks) Which two of the following atoms are isotopes? ${}_{21}^{45}\text{Sc}$, ${}_{22}^{48}\text{Ti}$, ${}_{22}^{50}\text{Ti}$, ${}_{23}^{50}\text{V}$

- a) ${}_{21}^{45}\text{Sc}$ and ${}_{23}^{50}\text{V}$
- b) ${}_{22}^{48}\text{Ti}$ and ${}_{22}^{50}\text{Ti}$
- c) ${}_{22}^{50}\text{Ti}$ and ${}_{23}^{50}\text{V}$
- d) ${}_{21}^{45}\text{Sc}$ and ${}_{22}^{50}\text{Ti}$
- e) ${}_{22}^{48}\text{Ti}$ and ${}_{23}^{50}\text{V}$

7. (___/ 2 marks) You are given an unknown white solid that is either NaI or NaNO₃. If you prepare an aqueous solution of the unknown and test it by adding the various reagents listed below, which reagent will allow you to distinguish between the two compounds?

- a) NaOH
- b) HCl
- c) K₃PO₄
- d) NH₄Br
- e) Pb(NO₃)₂

8. (___/ 2 marks) Write a net ionic equation for the reaction of aqueous acetic acid and aqueous potassium hydroxide.

- a) $\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{K}^+(\text{aq}) + \text{CH}_3\text{CO}_2^-(\text{aq}) + \text{H}_2\text{O}(\ell)$
- b) $\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{KCH}_3\text{CO}_2(\text{aq}) + \text{H}_2\text{O}(\ell)$
- c) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\ell)$
- d) $\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{CH}_3\text{CO}_3\text{H}_2^-(\text{aq})$
- e) $\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{CH}_3\text{CO}_2^-(\text{aq}) + \text{H}_2\text{O}(\ell)$

9. (___/ 2 marks) Which statement concerning solid MgSO₄ is true?

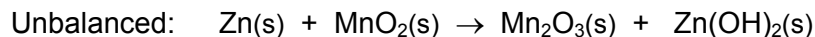
- a) It is a homogeneous mixture.
- b) It is a heterogeneous mixture.
- c) It is a chemical compound.
- d) The percentage of S in the solid is dependent on where the sample is obtained.
- e) It has properties similar to its component elements: magnesium, sulfur and oxygen.

10. (___/ 2 marks) The density of iron is 7.87 g/cm³. Calculate the number of iron atoms present in a cube that has an edge of length 3.00 cm.

- a) 1.75×10^{21} atoms
- b) 3.69×10^{22} atoms
- c) 1.75×10^{23} atoms
- d) 2.29×10^{24} atoms
- e) 1.28×10^{26} atoms

PART B: Short written answers

11. (___/ 5 marks) Alkaline batteries exploit the following oxidation-reduction reaction, which occurs in the presence of a basic aqueous electrolyte solution inside the battery:



a) **(2 marks)** Identify the oxidizing agent and reducing agent. Provide supporting calculations and explanation.

b) **(1 mark)** Can you balance this chemical equation by inspection? Why or why not?

c) **(2 marks)** How many electrons are involved in this overall redox process? Explain.

12. (___/ 2 marks) The liquid substances water ($d = 1.00 \text{ g/mL}$), mercury ($d = 13.5 \text{ g/mL}$) and cyclohexane ($d = 0.778 \text{ g/mL}$) do not form a solution when mixed, but separate into distinct layers. Sketch how the liquids would position themselves in a test tube; clearly label your diagram.

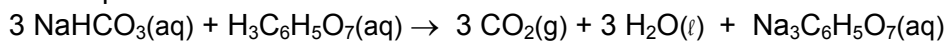
PART C: Problems – SHOW YOUR WORK TO GET FULL CREDIT

13. (8 marks) The koala eats exclusively eucalyptus leaves, which are poisonous to other animals. The chief constituent of eucalyptus oil is a substance called eucalyptol, which contains 77.87% C, 11.76% H, and remainder O by mass.

a) **(7 marks)** What is the empirical formula for this substance?

b) **(1 mark)** A mass spectrometry experiment determined a molecular mass of 154 g/mol for this substance. What is its molecular formula?

14. (___ / 11 marks) The fizz produced when an Alka-Seltzer[®] tablet is dissolved in water is due to:



- a) **(2 marks)** What type(s) of reaction is this? How you can tell (be specific)?
- c) **(7 marks)** If you start with 1.00 g of sodium bicarbonate and 1.00 g of $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ dissolved in a glass of water, what is the maximum number of grams of carbon dioxide that can form via this reaction?
- d) **(2 marks)** What mass of excess reagent remains in the reaction solution after the reaction is complete?

POTENTIALLY USEFUL INFORMATIONAtomic 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**