

**Exam 2 Chm 203 (Dr Mattson) 27 September 2017**

Name: \_\_\_\_\_

**Academic Integrity Pledge:** *In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.*

Chemistry Student Number (1 pt): \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Instructions:** Show all work whenever a calculation box is provided! Write legibly. Include units whenever appropriate. You will receive credit for how you worked each problem as well as for the correct answer. If you need more space, you may use the back of the periodic table provided — Write: "See periodic table" in the answer box — then write your name on the periodic table and turn it in with your exam. On your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks, bags, and purse-like items must be stored in the rear section of the room. Cell phones must be silent and placed in your backpack/bag/purse — not in your pocket.

**Important:** Throughout the exam, if you cannot recall a chemical formula, give it your best guess and you can still get credit for your calculations if they are correct.

$$N_A = 6.02 \times 10^{23}$$

1. (4 pts) What is the molar mass of potassium dichromate? Report answer to the hundredths place.

You must show work for credit.

Answer with units: \_\_\_\_\_

2. (4 pts) How many moles of titanium(IV) chloride are in a 145 g sample?

You must show work for credit.

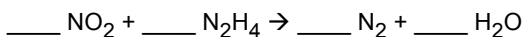
Answer with units: \_\_\_\_\_

3. (4 pts) How many hydrogen atoms are in 0.134 mol ammonium sulfate? (Use Avogadro's number)

You must show work for credit.

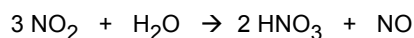
Answer: \_\_\_\_\_ H atoms

4. (4 pts) Balance the following equation and report your answer with the smallest whole number coefficients.



5. (4 pts) How many moles of NO can be produced from 0.147 mol nitrogen dioxide and excess water?

You must show work for credit.



Answer with units: \_\_\_\_\_

6. (5 pts) Titanium metal is produced from the mineral rutile,  $\text{TiO}_2$ . What mass of rutile is needed to produce 1.80 kg titanium metal? (Hint: 1 mol  $\text{TiO}_2$  corresponds to (?) mol Ti)

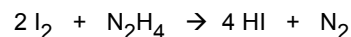
You must show work for credit.

Answer with units: \_\_\_\_\_

**Question 7a-b-c.** Molar masses:  $\text{I}_2 = 253.8 \text{ g/mol}$ ,  $\text{N}_2\text{H}_4 = 32.05 \text{ g/mol}$ ,  $\text{HI} = 127.9 \text{ g/mol}$ , and  $\text{N}_2 = 28.02 \text{ g/mol}$ .

- 7a. (5 pts) What mass of  $\text{I}_2$  is needed to react with 55.5 g  $\text{N}_2\text{H}_4$ ?

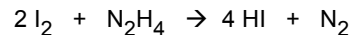
You must show work for credit.



Answer with units: \_\_\_\_\_

- 7b. (5 pts) In another experiment involving the same reaction, suppose 0.814 mol  $\text{I}_2$  and 0.425 mol  $\text{N}_2\text{H}_4$  were reacted. What is the theoretical yield of HI in moles?

You must show work for credit.



Answer with units: \_\_\_\_\_

- 7c. (4 pts) In yet another experiment involving this same reaction, suppose the theoretical yield of HI is 0.928 mol HI, but the actual yield is 93.4 g. What is the percent yield?

You must show work for credit.

Answer: \_\_\_\_\_ %

8. (4 pts) What is the percent zirconium in zircon,  $ZrSiO_4$ ?

You must show work for credit.

Answer to four significant figures with units: \_\_\_\_\_

9. (5 pts) What is the formula of an important fertilizer known to contain C, H, N and O and analyzes for 20.00% C, 6.713% H and 46.65% N?

You must show work for credit.

Answer with units: \_\_\_\_\_

10. (3 pts) A chlorinated hydrocarbon used as a de-greaser has an empirical formula of  $C_2H_1Cl_1$  and a molar mass of 181.4 g/mol. What is its molecular formula?

You must show work for credit.

Answer with units: \_\_\_\_\_

11. (4 pts) Suppose 15.9 g of copper(II) sulfate pentahydrate were added to a 100.00 mL volumetric flask, dissolved in water and diluted to the line on the neck. What is the molarity of the copper ion?

You must show work for credit.

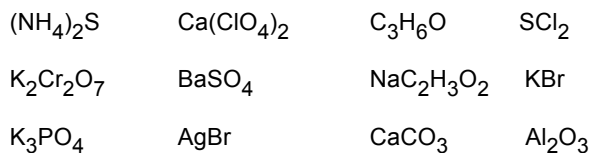
Answer with units: \_\_\_\_\_

12. (4 pts) What volume of a 0.225 M solution should be used to produce 250.0 mL of a  $5.10 \times 10^{-3}$  M solution?

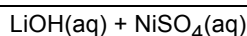
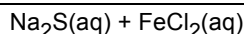
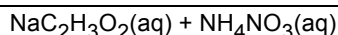
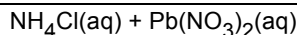
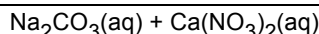
You must show work for credit. Report answer in mL

Answer: \_\_\_\_\_ mL

13. (12 pts) Electrolytes. Circle all of the substances below that form electrolytes in water. Remember that insoluble salts do not form electrolytes.



14. (10 pts) Will a precipitate form when the following solutions are mixed? If so, write the formula for the precipitate.



15. (3 pts) A precipitate forms when aqueous barium nitrate and aqueous sodium sulfate are mixed. Write the net ionic equation for this precipitation.

\_\_\_\_\_

16. (5 pts) Write the overall equation and the net ionic equation for the acid-base reaction of  $HCl(aq)$  and  $KOH(aq)$ . In the net ionic equation, use  $H_3O^+$ .

\_\_\_\_\_

17. (10 pts) Naming. Complete the formula or name for each pair of the following. If you were notified by e-mail that you are nomenclature certified, skip this question.

A. ammonium nitrite

B. potassium oxalate

C. dinitrogen trioxide

D. titanium(II) chlorite

E. chromium(III) sulfate

F.  $KC_2H_3O_2$

G.  $HNO_3(aq)$

H.  $Fe(MnO_4)_2$

I.  $OCl_2$

J.  $LiClO$

Total score (out of 100): \_\_\_\_\_

A+  $\geq$  95% A  $\geq$  90% B+  $\geq$  85% B  $\geq$  80% C+  $\geq$  75% C  $\geq$  70% D  $\geq$  60%

## Answers

- 294.20 g/mol
- 0.764 mol
- $6.45 \times 10^{23}$  H atoms
- $2 \text{NO}_2 + 2 \text{N}_2\text{H}_4 \rightarrow 3 \text{N}_2 + 4 \text{H}_2\text{O}$
- 0.0490 mol
- 3.00 kg  $\text{TiO}_2$ .
- 7a. 878 g  $\text{I}_2$
- 7b. 1.63 mol HI
- 7c. 79 %
- 49.76 %
- $\text{CH}_4\text{N}_2\text{O}$
- $\text{C}_6\text{H}_3\text{Cl}_6$
- 0.637 M
- 5.67 mL
- Electrolytes:  $(\text{NH}_4)_2\text{S}$ ,  $\text{Ca}(\text{ClO}_4)_2$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{NaC}_2\text{H}_3\text{O}_2$ , KBr,  $\text{K}_3\text{PO}_4$
- Yes,  $\text{CaCO}_3(\text{s})$ , Yes,  $\text{PbCl}_2(\text{s})$ , No. Yes,  $\text{FeS}(\text{s})$ , Yes,  $\text{Ni}(\text{OH})_2(\text{s})$
- $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
- Overall:  $\text{HCl}(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{KCl}(\text{aq})$ ; Net ionic equation, use  $\text{H}_3\text{O}^+ + \text{OH}^- \rightarrow 2 \text{H}_2\text{O}$
- |                       |                                   |
|-----------------------|-----------------------------------|
| ammonium nitrite      | $\text{NH}_4\text{NO}_3$          |
| potassium oxalate     | $\text{K}_2\text{C}_2\text{O}_4$  |
| dinitrogen trioxide   | $\text{N}_2\text{O}_3$            |
| titanium(II) chlorite | $\text{Ti}(\text{ClO}_2)_2$       |
| chromium(III) sulfate | $\text{Cr}_2(\text{SO}_4)_3$      |
| potassium acetate     | $\text{KC}_2\text{H}_3\text{O}_2$ |
| nitric acid           | $\text{HNO}_3$                    |
| iron(II) permanganate | $\text{Fe}(\text{MnO}_4)_2$       |
| oxygen dichloride     | $\text{OCl}_2$                    |
| lithium hypochlorite  | $\text{LiClO}$                    |