

Name (Print) \_\_\_\_\_

NAU ID # \_\_\_\_\_

**INSTRUCTIONS:**

- PRINT your name and NAU ID# above.
- Code the answers to the True-False and Multiple-Choice questions on the scantron form. Mark **A** for true and **B** for false. There is only *one* correct answer for each multiple choice question. There is no partial credit given for this section.
- Show all work on the problems section because partial credit is awarded for this section.
- On the scantron form, write the color of your exam above your name.
- Below your NAU ID# above, answer the following question. What is your favourite colour? You will receive 1 bonus pt.
- There are **87** points on this exam.

GOOD LUCK! ENJOY!!

**PART I: True-false statements** (3 points each)

1. The number  $3.0430 \times 10^3$  contains **5** significant figures.
2.  $\text{KCl (aq)}$  is a weak electrolyte.
3. A student uses a 10 mL pipet to measure out three 10 mL volumes. The volumes were determined to be 9.53 mL, 9.48 mL, and 9.51 mL. The student's data is accurate, but not precise.

**PART II: Multiple Choice** (3 points each)

4. Three problems are worked below. Choose the answer that properly describes the correct use of significant figures.

I.  $17.6 \times 2.1 = 37.0$       II.  $0.44 + 86.2 = 86.6$       III.  $24.21 \times 729 = 1.76 \times 10^4$

- [a] I and II are correct, III is incorrect      [b] I and III are correct, II is incorrect  
[c] II and III are correct, I is incorrect      [d] all three are correct      [e] none is correct

5. The diameter of a human hair is approximately 0.00254 centimeters. How many **micrometers** ( $\mu\text{m}$ ) is this?

[a] 25.4  $\mu\text{m}$       [b]  $2.54 \times 10^4 \mu\text{m}$       [c]  $2.54 \times 10^3 \mu\text{m}$       [d]  $2.54 \times 10^{-7} \mu\text{m}$       [e] 0.0254  $\mu\text{m}$



15. Which of the following does **not** correctly describe 16.04 g of methane, CH<sub>4</sub>?

- [a] One mole of methane.
- [b] The amount of methane that contains 12.01 g of carbon.
- [c] The amount of methane that contains 4.03 g of hydrogen.
- [d] The amount that contains  $16.04 \times (6.022 \times 10^{23})$  molecules of methane.
- [e] The amount that contains  $4 \times (6.022 \times 10^{23})$  atoms of hydrogen.

16. Which of the following contains the **greatest** number of **oxygen atoms**?

- [a] 3.0 mol CO
- [b] 1.0 mol CO<sub>2</sub>
- [c] 0.50 mol P<sub>4</sub>O<sub>10</sub>
- [d] 1.0 mol N<sub>2</sub>O<sub>4</sub>
- [e] 0.80 mol P<sub>2</sub>O<sub>5</sub>

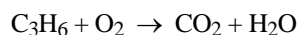
17. Which of the following compounds has the **same percent composition by mass** as styrene, C<sub>8</sub>H<sub>8</sub>?

- [a] acetylene, C<sub>2</sub>H<sub>2</sub>
- [b] benzene, C<sub>6</sub>H<sub>6</sub>
- [c] cyclobutadiene, C<sub>4</sub>H<sub>4</sub>
- [d] none of these
- [e] all have same % composition

18. A compound has a molar mass of 147 g/mol and an empirical formula of C<sub>3</sub>H<sub>2</sub>Cl. What is its **molecular formula**?

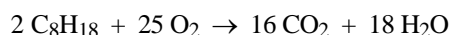
- [a] C<sub>3</sub>H<sub>2</sub>Cl
- [b] C<sub>3</sub>H<sub>5</sub>Cl<sub>3</sub>
- [c] C<sub>6</sub>H<sub>4</sub>Cl<sub>2</sub>
- [d] C<sub>9</sub>H<sub>6</sub>Cl<sub>3</sub>
- [e] C<sub>12</sub>H<sub>8</sub>Cl<sub>4</sub>

19. When the following equation is correctly balanced with the *smallest* set of *whole* number coefficients, the **coefficient for oxygen (O<sub>2</sub>)** is:



- [a] 2
- [b] 3
- [c] 5
- [d] 9
- [e] 18

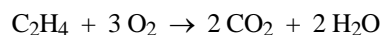
20. Consider the combustion of octane (C<sub>8</sub>H<sub>18</sub>):



If 4.00 moles of octane, C<sub>8</sub>H<sub>18</sub>, are reacted with excess oxygen, how many **moles of CO<sub>2</sub>** are produced assuming complete reaction.

- [a] 0.250 mol CO<sub>2</sub>
- [b] 8.00 mol CO<sub>2</sub>
- [c] 16.0 mol CO<sub>2</sub>
- [d] 32.0 mol CO<sub>2</sub>
- [e] 36.0 mol CO<sub>2</sub>

21. Consider the following balanced chemical equation. 11.0 grams of C<sub>2</sub>H<sub>4</sub> were reacted with an excess of O<sub>2</sub> and 10.6 grams of CO<sub>2</sub> were obtained. What was the **percent yield** of CO<sub>2</sub>? (Molar masses: C<sub>2</sub>H<sub>4</sub> = 28.05 g/mol, CO<sub>2</sub> = 44.01 g/mol)



- [a] 30.7%
- [b] 61.4%
- [c] 63.7%
- [d] 78.4%
- [e] 96.4%

22. Which of the following compounds are **soluble** in water?

- I) Na<sub>2</sub>CO<sub>3</sub>
- II) CaSO<sub>4</sub>
- III) AgCl
- IV) FeS
- V) Ba(OH)<sub>2</sub>

- [a] I, II, III
- [b] I, V
- [c] II, III, IV
- [d] I only
- [e] all are soluble

### PART III: Problems

23. Naming compounds. [6pts]

[a] Write correct names for the following formulas.

1)  $\text{CrO}_3$  \_\_\_\_\_

2)  $\text{Na}_2\text{SO}_4$  \_\_\_\_\_

3)  $\text{ClF}_3$  \_\_\_\_\_

[b] Write correct chemical formulas for the following compounds.

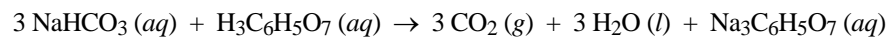
1) dinitrogen monoxide \_\_\_\_\_

2) iron(III) sulfide \_\_\_\_\_

3) calcium carbonate \_\_\_\_\_

24. Cadaverine, a foul smelling substance produced by the action of bacteria on meat, contains 58.75% C, 13.81% H, and 27.42% N by mass. What is the **empirical formula** of cadaverine? [5 pts]

25. The fizz produced when an Alka-Seltzer® tablet is dissolved in water is due to the reaction between sodium bicarbonate ( $\text{NaHCO}_3$ ) and citric acid ( $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ ).



Molar masses:      84.01 g/mol      192.12 g/mol      44.01 g/mol      18.02 g/mol

- [a] In a certain experiment, 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react. Which reactant is the **limiting reagent**? You must SHOW WORK to receive credit. [4 pts]

- [b] How many **grams** of  $\text{CO}_2$  are produced in the above reaction, assuming complete reaction? [3 pts]

- [c] How many **moles** of excess reactant remain after the reaction is complete? [3 pts]

## Potentially Useful Information

Avogadro's number =  $6.022 \times 10^{23}$  particles/mole

1 g =  $6.022 \times 10^{23}$  amu

electron charge =  $-1.6022 \times 10^{-19}$  C

1 in = 2.54 cm (exactly)

% yield =  $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$

1 lb = 454 g

1 L = 1.06 qt

4 qts = 1 gal

1 mi = 1609 m

molar mass =  $\frac{\text{g of substance}}{\text{mol of substance}}$

<b>SOLUBLE COMPOUNDS</b>	<b>EXCEPTIONS</b>
Compounds containing alkali metal ions and the ammonium ion	
Nitrates, bicarbonates ( $\text{HCO}_3^-$ ), and chlorates ( $\text{ClO}_3^-$ )	
Halides ( $\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ )	Halides of $\text{Ag}^+$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
Sulfates	Sulfates of $\text{Ag}^+$ , $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ba}^{2+}$ , and $\text{Pb}^{2+}$
<b>INSOLUBLE COMPOUNDS</b>	<b>EXCEPTIONS</b>
Carbonates, phosphates, chromates ( $\text{CrO}_4^-$ ), and sulfides	Compounds containing alkali metal ions and the ammonium ion
Hydroxides	Compounds containing alkali metal ions and the $\text{Ba}^{2+}$ ion

## Answer Key

- 1) T      2) F      3) F      4) c      5) a      6) d      7) a      8) e      9) a  
10) b      11) a      12) b      13) c      14) b      15) d      16) c      17) e      18) c  
19) d      20) d      21) a      22) b

- 23) a) 1) chromium(VI) oxide  
2) sodium sulfate  
3) chlorine trifluoride  
b) 1)  $\text{N}_2\text{O}$   
2)  $\text{Fe}_2\text{S}_3$   
3)  $\text{CaCO}_3$

24)  $\text{C}_5\text{H}_{14}\text{N}_2$

- 25) a)  $\text{NaHCO}_3$   
b) 0.524 g  $\text{CO}_2$   
c) 0.00124 mol  $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$