CAPE BRETON UNIVERSITY

Chem 1104 - Midterm **Instructor: Calvin Howley**
Date: May 28, 2018 **Time Period: 3 hour**

Student: _____

Student #: _____

Instructions:

Please turn off all cell phones. Only scientific calculators are allowed in the exam room. Students found to be using any electronic organizer or other electronic device during the exam will be given a grade of zero and asked to leave the testing area.

All answers are to be done on test paper. If more room is needed use the back side of the paper and indicate.

Read all questions carefully.

Answer all questions for full point value. Partial marks may be awarded for incomplete questions.

Make sure you have all data sheets and test pages.

Complete as many questions as soon as possible and then go back to incomplete questions.

Test papers not turned in to the instructor at the end of the test period will not be accepted.

Part I: Short Answer
Instructions: Circle the correct answer or fill your answer in the space provided.

1. How many significant figures are there to the answer for the following problem:

$$(8.881 \times 2.100) + 0.590 = ?$$

a) one b) two c) three d) four

2. Round off **507506** to four significant figures:

a) 5.075×10^4 b) 5076 c) 5100 d) 5.075×10^5

3. Which of the following is part of Dalton's atomic theory?

a) Atoms are rearranged but not changed during a chemical reaction..

b) Atoms break down during radioactive decay.

c) Atoms contain protons, neutrons, and electrons.

d) Isotopes of the same element have different masses.

4. Most of the alpha particles directed at a thin gold foil in Rutherford's experiment:

a) bounced directly back from the foil.

b) passed directly through the foil un-deflected.

c) passed through the foil but were deflected at an angle.

d) were absorbed by the foil.

5. How many protons(p), neutrons(n), and electrons(e) are in one atom of $^{26}_{12}Mg$

a) 12 p, 12n, 12e b) 12 p, 14n, 12e c) 12 p, 26n, 10e d) 26 p, 14n, 26e

6. How many electrons are in the ion, P^{3-}?

a) 12 b) 18 c) 28 d) 34

7. What is the sum of the coefficients when the following equation is balanced using the lowest whole number coefficients?

_____ $PH_3(g)$ + _____ $O_2(g)$ → _____ $P_4O_{10}(s)$ + _____ $H_2O(g)$

a) 10 b) 12 c) 19 d) 22

8. How many milliliters of a 9.0 M H_2SO_4 solution are needed to make 0.25 L of a 3.5 M H_2SO_4 solution?

a) 0.097 mL b) 0.64 mL c) 97 mL d) 640 mL

9. Which of the following equations represents "Boyle's Law"?

a) $\frac{P}{V} = k$ b) $\frac{V}{T} = k$ c) $PV = k$ d) $V = nk$

10. Which of the following gases has the **highest** average speed at 400 K?

a) CO_2 b) N_2O_4 c) SF_6 d) UF_6

Part II: Long Answer
Instructions: Fill your answer in the space provided. Show all work for full point value.
A. Measurement, Atoms and Elements
1. Describe briefly the distinction between the following pairs of terms.
a) element and compound

b) homogeneous and heterogeneous mixture

c) electrolyte vs. nonelectrolyte

d) Bronsted acid vs. Bronsted base

2.a) Naturally occurring strontium consists of the following four isotopes:

Isotope	% Abundance	Mass(amu)
Sr-84	0.56	83.913
Sr-86	9.86	85.909
Sr-87	7.00	86.909
Sr-88	82.58	87.906

Calculate the average atomic mass of Sr from the data.

b) The two naturally occurring isotopes of gallium are Ga-69 with an atomic mass of 68.925581 amu; and Ga-71 with an atomic mass of 70.924705 amu. If gallium has an average atomic mass of 69.723072 amu, calculate the percent natural abundance of these isotopes.

3.a) Determine the Percent(%) composition of the compound potassium nitrite(KNO_2).

b) Sodium tetrathionate, an ionic compound formed when sodium thiosulfate reacts with iodine has a percent composition of 17.01% Na, 47.46% S, and 35.52% O by mass, and has a molar mass of 270. g/mole. What is its empirical and chemical formula?

B. Compounds, Nomenclature and Stoichiometry

4. Name or give the formula for each of the following ionic compounds:

a) potassium iodide

b) KCl

c) sodium carbonate

d) copper(II) oxide

e) $Fe(NO_3)_3$

5. Calculate the theoretical yield of ZnS, in grams, from the reaction of 0.488 g Zn and 0.503 g S_8.

$$8Zn + S_8 \rightarrow 8ZnS$$

C. Aquesous Solutions

6. Write the **balanced** molecular equation and **net ionic equation** for the following reaction.

$HCl(aq) + Al(OH)_3(aq) \rightarrow AlCl_3(aq) + H_2O(l)$ (unbalanced)

7.a) Balance the following redox reaction:

$PbO_2 + V^{3+} \rightarrow PbO + VO^{2+}$ (acidic)

b) Given the reaction below. Assign the oxidation numbers for each of the elements in the table below and identify the requested substances.

$$2HCl(aq) + O_2(g) \rightarrow Cl_2(aq) + H_2O(l)$$

Substance	Oxidation State of Element:
HCl	H: _____ Cl: _____
O_2	O: _____
Cl_2	Cl: _____
H_2O	H: _____ O: _____

Agent	Chemical Formula of substance
Substance oxidized:	
Substance reduced:	
Oxidizing agent:	
Reducing agent:	

D. Gases

8.a) What is meant by an “ideal gas”?

b) State two factors that make “real gases” to not behave like an “ideal gas”.

9. A 32.3 L sample of gas at 305. °C and 1.20 atm is to be cooled at constant pressure until its volume becomes 28.4 L. What will be the new temperature in °C?

10. A 1.75 L container is initially filled with CO_2 gas at 25.°C and 225 kPa pressure. The container springs a leak. When the container is re-sealed, the pressure is 185 kPa and the temperature is 10.°C. How many grams of gas were initially in the container? How many grams of gas were lost?

Grade Sheet

The points awarded for this exam are outlined below. Please review. If there are any questions or possible corrections please consult the instructor.

Question	Points Awarded
Part I	
1-10	
Part II	
A	
1-3	
B	
4-5	
C	
6-7	
D	
8-10	
Total	

Comments:

Some Useful Data or Not!

Constants:

1 mole = 6.022×10^{23} elementary particles

$N_a = 6.0223\times10^{23}$

1000 g = 1 kg

1 g = 1000 mg = 0.001 kg

1 lb = 453.6 g

1 pg = 1×10^{-12} g

1 μg = 1×10^{-6} g

1 km = 1000 m

1 cm = 0.01 m

1 nm = 1×10^{-9}m

1 pm = 1×10^{-12} m

1 μm = 1×10^{-6} m

1 L = 1000 mL

R = 0.0821 L·atm/K·mole

R = 8.314 J/K·mole

R = 8.314 kg·m^2/s^2·K·mole

STP: T = 0°C, P = 1.00 atm

1 atm = 760 mm Hg = 760 torr

1 atm = 101.325 kPa

Equations:

T°C = (5°C/9°F)×(T°F - 32°F) **T(K) = T(°C) + 273.15°C**

Avg Atomic Mass = Σ(natural abundance)×(atomic mass)

$$\text{density} = \frac{\text{mass}}{\text{volume}} \qquad \mathbf{M_1V_1 = M_2V_2} \qquad \mathbf{PV = nRT}$$

$$\mathbf{P_a = X_a \cdot P_{total}} \qquad \mathbf{P_1V_1 = P_2V_2} \qquad \mathbf{X_a} = \frac{\mathbf{n_a}}{\mathbf{n_{total}}}$$

$$\frac{\mathbf{P_1}}{\mathbf{T_1}} = \frac{\mathbf{P_2}}{\mathbf{T_2}} \qquad \frac{\mathbf{V_1}}{\mathbf{T_1}} = \frac{\mathbf{V_2}}{\mathbf{T_2}} \qquad \mathbf{d} = \frac{\mathbf{PM}}{\mathbf{RT}}$$

$$\frac{\mathbf{P_1V_1}}{\mathbf{T_1}} = \frac{\mathbf{P_2V_2}}{\mathbf{T_2}} \qquad \mu_{rms} = \sqrt{\frac{3RT}{M}}$$

SCRAP PAPER(Do not pass in!!)

Answer Set For Chem 1104-Midterm:

Part I

1.d)

2.d)

3.a)

4.b)

5.b)

6.b)

7.c)

8.c)

9.c)

10.a)

Part II

1.a) An element is a substance that can not be broken down into a simpler substance by chemical reactions. A compound is a substance made up of atoms of two or more elements.

b) A homogeneous has the same composition of components throughout while a heterogeneous mixture has a composition that varies throughout the mixture.

c) An electrolyte is a substance that when added to water enhances its conductivity while a non-electrolyte does not enhance the conductivity.

d) Bronsted acid is a proton(H^+) donor while a Bronsted base is a proton acceptor.

2.a) 87.62 amu; b) Ga-69: 60.108%, Ga-71: 39.892%

3.a) %K = 45.94, %N = 16.46%, %O = 37.60%
b) empirical formula: NaS_2O_3
chemical formula:$Na_2S_4O_6$

4.a) KI; b) potassium chloride; c) Na_2CO_3; d) CuO; e) iron(III) nitrate

5. 0.00746 mol Zn, 0.00196 mol S_8; LR: Zn; 0.727 g ZnS

6. $3HCl(aq) + Al(OH)_3(aq) \rightarrow AlCl_3(aq) + 3H_2O(l)$ molecular equation
$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ net ionic equation

7. a) $PbO_2 + 2V^{3+} + H_2O \rightarrow PbO + 2VO^{2+} + 2H^+$
b)

Substance	Oxidation State of Element:
HCl	H: +1 Cl: -1
O_2	O: 0
Cl_2	Cl: 0
H_2O	H: +1 O: -2

Agent	Chemical Formula of substance
Substance oxidized:	HCl
Substance reduced:	O_2

Oxidizing agent:	O_2
Reducing agent:	HCl

8.a) An ideal gas is a gas the obeys the ideal gas law.

b) Two factors that cause non-ideal gas behavior is the molecular volume of the individual gas molecules and intermolecular attraction between the gas molecules.

9. 235°C

10. 7.00 g CO_2 initially; 0.93 g CO_2 lost