

LAST NAME: _____

FIRST NAME: _____

Student Number: _____

CHM 1311 A Midterm #1 Fall 2012

Please keep your work covered at all times and keep your eyes on your own paper! Cheating or any appearance of cheating will result in an F in the course and possible expulsion from the university.

There are 10 pages in this test. A periodic table and data sheets are provided at the end. You may rip these pages off of the exam and use them to cover your work during the test. Any scratch work should be done on the back of these pages.

Please show all work to receive partial credit.

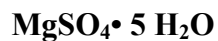
You have 75 minutes to complete the test.

Question	Points Possible	Points Earned	TA Initial
1	10		
2	10		
3	10		
4	10		
5	10		
TOTAL	50		

#1. (10 points) Short Answer Questions

a) Name the following compounds:





b) The number of ions present in 250 mL of 0.00100 M CaCl₂ (aq) is:

4.52 x 10²⁰

2.50 x 10⁻⁴

6.02 x 10²³

1.51 x 10²⁰

c) Determine the oxidation state of the indicated element in the following:



oxidation state: _____



oxidation state: _____

d) Complete the following table:

Chemical Symbol	Mass Number	Number of protons	Number of electrons	Number of neutrons
¹³³ ₅₅ Cs ⁺				

e) The standard heat of formation of solid silver nitrate is -124.4 kJ. Write the chemical equation for the reaction to which this value applies (include phases).

f) If the molar mass of a gas is doubled, the root-mean-squared speed of the molecules will increase by a factor of $\sqrt{2}$. TRUE FALSE

g) A standard laboratory solution contains 1.8% sodium bromide. This concentration expressed in mol/L is: _____

h) Which of the following gaseous processes would produce the *largest positive* change in internal energy for the system?

EXOTHERMIC CONTRACTION

ENDOTHERMIC CONTRACTION

EXOTHERMIC EXPANSION

ENDOTHERMIC EXPANSION

#2. (10 points) A sulfide of iron, containing 36.5% S by mass, is heated in $O_2(g)$, and the products are sulfur dioxide and an oxide of iron containing 30.0% O by mass.

a) What is the empirical formula of the sulfide of iron?

Answer: _____

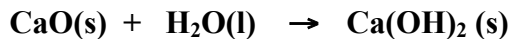
b) What is the empirical formula of the oxide of iron?

Answer: _____

c) Using these formulas, write a possible balanced chemical equation for the reaction described above.

d) Label the oxidation states of each element in your equation above and indicate which species is the oxidizing agent.

#3. (10 points). In the Marion lab, you mix 56.0 g of CaO with exactly 100 mL of water at 25.0°C and you observe the following reaction, as well as the release of some steam:



a) What is the reagent in excess and how many grams of it will be left at the end of the reaction?

Reagent in excess: _____

Mass: _____

b) Using the data in the table below and on page 9, calculate the mass of the steam that escaped during the reaction.

CaO	$\Delta H_f^\circ = - 635 \text{ kJ/mol}$
H₂O	$\Delta H_f^\circ = - 286 \text{ kJ/mol}$
Ca(OH)₂	$\Delta H_f^\circ = - 987 \text{ kJ/mol}$

Answer: _____

#4. (10 points) When Dr. Fox goes scuba diving, she uses NITROX, a special blend of enriched air that allows for more repetitive dives by reducing the build-up of nitrogen in the blood (that way, she won't get "the bends"!). The local scuba shop prepares 5.00 L tanks of NITROX by mixing 26.0 g of O₂ with 44.2 g of N₂ at a temperature of 25.0°C.

a) What is the mole fraction of each gas in the mixture?

χ of N₂ = _____

χ of O₂ = _____

b) What is the partial pressure of each gas, in atm?

P of N₂ = _____

P of O₂ = _____

c) What will be the total pressure left in the tank after Dr. Fox breathes 80% of it by volume during a dive?

P_T = _____

#5. (10 points) Steel is an alloy of iron and carbon, with iron being the major component. A steel ball has a radius of 5.85 mm and a density of 7.75 g/cm^3 . If the ball contains 0.25% carbon by mass, how many ^{13}C atoms are present in the ball? The percent natural abundance of carbon-13 is 1.108%. *Recall: volume of a sphere = $(4\pi r^3)/3$*

Answer: _____

Gas Laws

$$PV = nRT$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$P_T = P_1 + P_2 + P_3 + \dots$$

$$d = \frac{m}{V} = \frac{P \cdot MM}{RT}$$

$$E_K = \frac{1}{2}mv^2$$

$$u_{rms} = \sqrt{\frac{3RT}{MM}}$$

$$\frac{\text{Rate A}}{\text{Rate B}} = \sqrt{\frac{MM_B}{MM_A}}$$

$$\left(P + \frac{n^2 a}{V^2} \right) (V - nb) = nRT$$

Equilibrium

$$K_p = K_c(RT)^{\Delta n}$$

Acid/Base

$$pOH = -\log[OH^-]$$

$$pH = -\log[H^+]$$

$$pH + pOH = 14$$

$$K_a \times K_b = K_w$$

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

$$pH = \frac{pK_{a1} + pK_{a2}}{2}$$

Thermochemistry

$$\Delta U = q + W$$

$$W_{\text{system}} = -P\Delta V = -\Delta nRT$$

$$\Delta H = \Delta U + P\Delta V$$

$$q_p = \Delta U + P\Delta V$$

$$q = ms\Delta T$$

$$\Delta H_{\text{rxn}}^\circ = \sum n\Delta H_f^\circ(\text{pds}) - \sum n\Delta H_f^\circ(\text{rxts})$$

The atom

$$E = h\nu$$

$$c = \nu\lambda$$

$$E = -B/n^2$$

Kinetics

$$[A]_t = [A]_o - kt$$

$$\ln[A]_t = \ln[A]_o - kt$$

$$1/[A]_t = 1/[A]_o + kt$$

$$k = Ae^{(-E_a/RT)}$$

$$\ln(k_2/k_1) = (-E_a/R)(1/T_2 - 1/T_1)$$

Data For Water

Density = 1.00 g/mL (at 25°C)

 $s = 2.13 \text{ J g}^{-1} \text{ K}^{-1}$ (solid) $s = 4.184 \text{ J g}^{-1} \text{ K}^{-1}$ (liquid) $s = 2.01 \text{ J g}^{-1} \text{ K}^{-1}$ (gas) $\Delta H^\circ_{\text{fus}} = 6.02 \text{ kJ mol}^{-1}$ $\Delta H^\circ_{\text{vap}} = 40.7 \text{ kJ mol}^{-1}$ **Constants and Conversion Factors**

$1 \text{ mmHg} = 1 \text{ torr}$ $760 \text{ mmHg} = 1 \text{ atm}$ $1 \text{ atm} = 101.325 \text{ kPa}$ $1 \text{ atm} = 1.013125 \text{ bar}$
 $1 \text{ cm}^3 = 1 \text{ mL}$ $1000 \text{ mL} = 1 \text{ L}$ $1000 \text{ L} = 1 \text{ m}^3$

Avogadro's Number	N	$6.022 \times 10^{23} \text{ mol}^{-1}$	
Boltzmann's constant	k	$1.30866 \times 10^{-23} \text{ J} \cdot \text{K}^{-1}$	
Faraday's constant	F	$96,485 \text{ C} \cdot \text{mol}^{-1}$	
Gas constant	R	$8.31451 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$	
	R	$0.08206 \text{ atm} \cdot \text{L} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$	
	R	$8.31451 \text{ m}^3 \text{ Pa} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$	
	R	$0.0831451 \text{ bar L} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$	
Planck's constant	h	$6.62608 \times 10^{-34} \text{ J} \cdot \text{s}$	
Speed of Light	c	$2.99792458 \times 10^8 \text{ m} \cdot \text{s}^{-1}$	

Mokleur's Periodic table of the elements

18 VIIIA																	
He 2 4.002602 Helium																	
17 VIIA																	
F 9 18.9984032 Fluorine																	
16 VIA																	
O 8 15.9994 Oxygen																	
15 VA																	
N 7 14.00674 Nitrogen																	
14 IVA																	
C 6 12.011 Carbon																	
13 IIIA																	
B 5 10.811 Boron																	
12 IIB																	
Zn 30 65.39 Zinc																	
11 IB																	
Cu 29 63.546 Copper																	
10																	
Ni 28 58.6934 Nickel																	
9 VIII																	
Co 27 58.9332 Cobalt																	
8																	
Fe 26 55.847 Iron																	
7 VIIB																	
Mn 25 54.93805 Manganese																	
6 VIB																	
Cr 24 51.9961 Chromium																	
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V 23 50.9415 Vanadium																	
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