

CHEM 101 Exam 2**Page 1****October 12, 2001****Name** _____**Section** _____

This exam consists of 7 pages. When the exam begins make sure you have one of each. Print your name at the top of each page now The last page is blank and you may tear it off and use it for scratch paper. Show your work on calculations, this is the only way partial credit can be given. Be sure to include units on calculations, and give answer to the correct number of significant figures. When a blank is not provided make sure you place a box around the correct answer. The exam is 100 points and 50 minutes.

Page Points

2	_____
3	_____
4	_____
5	_____
6	_____
7	_____

If anything confuses you or is not clear, raise your hand and ask!**Total** _____**USEFUL INFORMATION**Avogadro's number = 6.022×10^{23} $R = 0.082057 \text{ L atm mol}^{-1} \text{ K}^{-1}$ $R = 8.3145 \text{ J mol}^{-1} \text{ K}^{-1}$

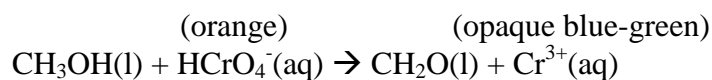
1 atm = 760 torr

 $K = ^\circ\text{C} + 273.15$ Ideal Gas Law: $PV = nRT$; $P = (d/M)RT$ Average Kinetic Energy: $(KE)_{\text{avg}} = (3/2)RT$ Root-mean-square velocity: $u_{\text{rms}} = [3RT/M]^{1/2}$ Effusion rate: $r(1)/r(2) = [M_m(2)/M_m(1)]^{1/2}$

Page 2

Points

- 8 1) A 3.664 g sample of a monoprotic (one acidic proton) is dissolved in 0.120 L of water. 20.7 mL of a 0.1578 M NaOH solution is required for complete neutralization in a titration. Calculate the concentration (molarity) and molar mass of the acid.
- 12 2) A test for alcohols (and one you are likely to do in organic chemistry) is the chromic acid test. In this test an alcohol is treated with chromic anhydride ion, HCrO_4^- , which is orange. If the reaction turns an opaque blue-green an alcohol was present. Balance the redox reaction under acidic conditions.



Identify the oxidizing agent _____

Identify the reducing agent _____

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Points

12 3)

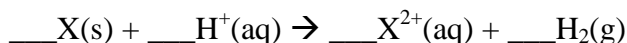
Qualitative analysis (QA) is an important way of determining what ions are in solution. You will do experiments using QA next semester in the laboratory. One of the critical aspects of QA is using selective precipitation to determine if certain ions are present. To prove to yourself it works you do the following experiment. In a beaker you dissolve equal amounts of AgNO_3 , $\text{Pb}(\text{NO}_3)_2$, and $\text{Ca}(\text{NO}_3)_2$. To this mixture you add excess HCl and a precipitate is formed which you filter and label precipitate 1. To the leftover solution you add excess H_2S and another precipitate is formed. You filter and label it precipitate 2. Finally, you add excess $(\text{NH}_4)\text{CO}_3$ to the solution that remains after the first two filtrations and a precipitate is formed that you label 3.

- Write down the net ionic reaction that resulted in precipitate 1. Underline the precipitate.
- Write down the net ionic reaction that resulted in precipitate 2. Underline the precipitate.
- Write down the net ionic reaction that resulted in precipitate 3. Underline the precipitate.

12 4)

A 1.00 g sample of metal X (that is known to form X^{2+} ions) was added to HCl . Immediately bubbles of H_2 gas are seen evolving from the mixture. After all the metal had reacted, the H_2 gas was collected in a 750. mL container and found to have a pressure of 1.34 atm at 298 K.

- Balance (by inspection) the net ionic reaction for this reaction?

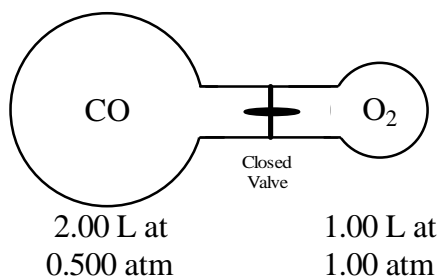


- Is the reaction in a) a redox reaction? (Circle one) YES NO
- Calculate the molar mass of the metal X. What is the identity of X?

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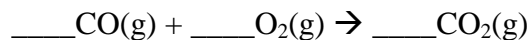
Points

- 14 5) Carbon monoxide, $\text{CO}(\text{g})$, reacts with molecular oxygen, $\text{O}_2(\text{g})$, to give carbon dioxide, $\text{CO}_2(\text{g})$. Initially CO and O_2 are separated as shown below with the conditions as given.



When the valve is opened, the reaction quickly goes to completion.

- a) Write a balanced chemical reaction for this process.



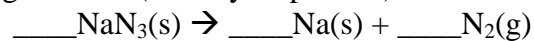
- b) Determine what gases remain at the end of the reaction and calculate their partial pressures. The temperature for the reaction is 25°C .
- c) What is the total pressure at the end of the reaction?
- d) What is the mole fraction of CO_2 after the reaction is complete?

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Points

25 6) Nitrogen is the gas used to inflate air bags required in automobiles. Air bags contain sodium azide, NaN_3 . The azide ion is N_3^- . When a sensor detects a sudden deceleration, it activates an electrical heater which initiates the decomposition of the sodium azide.

a) Balance the air bag reaction (do it by inspection).



Is this reaction a redox reaction? Circle one.

Yes

No

a) If the air bag is 13.6 L and bag needs to be inflated to 2.00 atm at 25.0 °C, how many grams of NaN_3 are necessary if you assume the reaction goes to completion? How many grams of Na are produced?

b) If the minimum pressure to which the bag can be inflated to be functional is 1.35 atm, what is the minimum temperature which will allow the airbag to be functional?

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Points

- c) Na metal is undesirable, especially if the air bag tears. Thus, an additional reaction to remove the Na with KNO_3 is initiated after the air bag is inflated. The balanced reaction is shown below.



Is this a redox reaction? Circle one.

Yes

No

- d) What pressure of $\text{N}_2(\text{g})$ is produced by this reaction using your result in b). (If you did not get b) assume you have 20.00 g of Na).

- 10 7) You have two identical flasks at the same temperature. One contains 6.0474 g of $\text{H}_2(\text{g})$ and the other contains 84.042 g of $\text{N}_2(\text{g})$. In the blank provided determine whether the property listed for $\text{H}_2(\text{g})$ is less than, equal to, or greater than that same property in $\text{N}_2(\text{g})$. An example is given below. Show work for partial credit.

Mass: $\text{H}_2(\text{g})$ is less than $\text{N}_2(\text{g})$

a) Pressure: $\text{H}_2(\text{g})$ _____ $\text{N}_2(\text{g})$

b) Average Kinetic Energy: $\text{H}_2(\text{g})$ _____ $\text{N}_2(\text{g})$

c) Density: $\text{H}_2(\text{g})$ _____ $\text{N}_2(\text{g})$

d) RMS velocity: $\text{H}_2(\text{g})$ _____ $\text{N}_2(\text{g})$

e) Rate of Effusion: $\text{H}_2(\text{g})$ _____ $\text{N}_2(\text{g})$