#### CHEMISTRY 101 EXAM 3

SECTIONS 572-580 Dr. Joy Heising

#### FORM 3M

November 20, 2001

#### Directions:

- 1. This examination consists of two parts: **17 multiple choice questions** (6 points each) in **Part 1** and **4 free response questions** (48 points total) in **Part 2**. The total point value for the exam is **150 points**.
- 2. Fill out your scantron sheet to be used for Part 1.
  - a. Do not forget to include your SIGNATURE and ID number.
  - b. Dept = CHEM, Course No. = 101
  - c. If you want your scores posted, mark A under the option column
- 3. Fill in your **NAME**, **SIGNATURE** and **ID** number at the beginning of Part 2 (stapled separately).
- 4. Use a #1 or #2 pencil for marking the scantron. Fill in the appropriate circles completely. You may write on the multiple choice questions.
- 5. Read each question **carefully**, then choose the **best answer** for each question. There is no penalty for guessing.
- 6. Write your answers in Part 2 clearly and neatly. Show your work for partial credit.
- 7. DO NOT write on the envelope.
- 8. The last page of each Part is a sheet of scrap paper. You may tear it off.
- 9. When finished, put the SCANTRON SHEET AND PART 2 back in the envelope and turn it in. You may keep Part 1 (this stapled portion).

Some Helpful Equations/Constants:

 $PV = nRT \qquad R = 0.0821 \underline{atm \cdot L} \qquad R = 62.4 \underline{torr \cdot L} \\ mol \cdot K \qquad mol \cdot K$ 

 $\frac{\underline{P}_1 \underline{V}_1}{T_1} = \frac{\underline{P}_2 \underline{V}_2}{T_2}$ 

$$\begin{split} P_{tot} &= P_a + P_b + \dots \\ n_{tot} &= n_a + n_b + \dots \end{split}$$

### PART 1

Multiple Choice (6 points each). Choose the BEST answer.

1. Which of the following is the **strongest** acid?

- a)  $H_2$ SeO<sub>3</sub>
- b) HSO<sub>4</sub><sup>-</sup>
- c) H<sub>2</sub>SO<sub>3</sub>
- d) H<sub>2</sub>SO<sub>4</sub>
- e) H<sub>2</sub>S

2. According to the **Lewis** theory, a base is best described as \_\_\_\_\_.

a) a proton acceptorb) an electron pair acceptorc) a proton donord) an electron pair donore) any compound that contains OH

3. One mole of Al(OH)<sub>3</sub> has \_\_\_\_\_\_ equivalents of the base.

- a) 1/3
- b) 1/2
- c) 1
- d) 2
- e) 3

4. Which one of the following pairs of acids and conjugate bases is incorrect?

Acid	Conjugate Base		
a) HF	F⁻		
b) HClO	ClO		
c) H <sub>2</sub> O	$OH^{-}$		
d) NH <sub>4</sub> <sup>+</sup>	$\mathrm{NH}_2^-$		
e) $H_3O^+$	$H_2O$		

5. Which of the following is the best example of a Brönsted-Lowry acid?

a) AlCh<sub>3</sub>

b) CH<sub>4</sub>

c) NaOH

- d)  $H_2O$
- e) H<sub>2</sub>

- 6. Which of the following is **not** an amphoteric acid salt?
- a) NaHSO<sub>4</sub>
  b) NaHCO<sub>3</sub>
  c) KH<sub>2</sub>PO<sub>4</sub>
  d) K<sub>2</sub>HPO<sub>4</sub>
  e) K<sub>3</sub>PO<sub>4</sub>
- 7. Acid rain is formed when assorted gaseous nonmetal oxides (the combustion products of nonmetal impurities in gasoline) react with atmospheric water. Which nonmetal oxide, when reacted with H<sub>2</sub>O, forms H<sub>2</sub>SO<sub>4</sub>?
- a) SO
- b) SO<sub>2</sub>
- c) SO<sub>3</sub>
- d) HSO<sub>3</sub><sup>-</sup>
- e)  $H_2S$
- 8. What is the oxidation number of tin in  $H_2SnO_3$ ?
- a) +1
- b) +2
- c) +3
- d) +4
- e) +5

9. In an oxidation/reduction reaction, the oxidizing agent

- a) loses electrons
- b) gains electrons
- c) adds  $H_2O$ ,  $OH^-$  or  $H^+$  to balance the charge and/or atoms
- d) is a government spy
- e) all of the above
- 10. When balanced, what is the total number of electrons transferred?

 $Hg_2^{2+}(aq) + Cr^{2+}(aq)$  →  $Hg_{(l)} + Cr^{3+}(aq)$  (UNBALANCED) a) 0 b) 2 c) 3 d) 5 e) 6 11. By international agreement the standard temperature and pressure (STP) for gases is

- a) 298.15 K and 760 torr.b) 0°C and 700 torr.
- c) 25°C and one atmosphere.
- d) 273.15 K and 760 torr.
- e) 293 K and one atmosphere.

12. The average kinetic energy of ideal gas molecules is directly proportional to the \_\_\_\_\_.

- a) volume of the sample
- b) pressure of the sample
- c) mass of the molecule
- d) density of the sample
- e) absolute temperature of the sample

13. The van der Waals constant, a, in the relationship

+ 
$$n^2 \mathbf{a}$$
 +  
 $P + \frac{\mathbf{n}^2 \mathbf{a}}{\mathbf{V}^2}$  + (V - nb) = nRT is a factor that corrects for  
+  $V^2$  +

- a) deviations in the gas constant, R.
- b) the attractive forces between gas molecules.
- c) the tendency of the gas molecules to ionize.
- d) the average velocities of the gas molecules.
- e) the volume occupied by the gas molecules.
- 14. A sample of a gas occupies a volume of 0.350 L at 3000 torr and 25°C. Calculate the number of moles of gas present.
- a)  $5.65 \times 10^{-2}$  mol b)  $8.39 \times 10^{-3}$  mol c)  $1.25 \times 10^{-2}$  mol d)  $1.38 \times 10^{-2}$  mol e)  $2.19 \times 10^{-3}$  mol
- 15. What volume of  $O_2$  would be required to react with excess  $SO_2$  at 273 K and 1.00 atm to produce 2.00 moles of  $SO_3$ ?

$$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$$

a) 44.8 L

- b) 22.4 L
- c) 33.6 L
- d) 5.60 L
- e) 11.2 L

- 16. What is the pressure exerted by 0.41 mol SO<sub>2</sub>, 2.00 mol H<sub>2</sub>, and 1.00 mol Ne in a 10.0-liter container at 50.0°C?
- a) 9.04 atm
- b) 10.1 atm
- c) 14.4 atm
- d) 18.6 atm
- e) 26.3 atm
- 17. When aluminum carbide is reacted with water, a gaseous product is formed. A small sample of this gas weighing 0.0771g is collected in a 250 ml flask at a pressure of 350 torr. The temperature is 18.0°C. What is the molar mass of the gas?
- a) 16.0 g/mol
- b) 36.6 g/mol
- c) 26.0 g/mol
- d) 11.0 g/mol
- e) 4.82 g/mol

# **SCRAP PAPER (PART 1)**

### PART 2 FORM 3M

Dr. Heising	CHEM 101	Sections 572-580	EXAM 3	November 20, 2001
NAME:				
<u>SID #:</u>				
SIGNATURI	E:			

Free Response (48 pts total, see margin for point values). Show all work for partial credit!

(6 pts) 18. At 30 °C a sample of CH<sub>4</sub> occupies a volume of 250 ml under a pressure of 4.0 atm. What volume would it occupy at a pressure of 2.0 atm?

19. Succinic acid,  $H_2C_4H_4O_4$ , is a diprotic acid, molar mass = 118.1 g/mol.

(6 pts) a) If you dissolve 2.00 g of succinic acid in enough water to make 100 ml of solution, what is the normality of the solution?

(6 pts) b) You have 10.0 ml of a 2.5N solution of succinic acid. How many milliliters of 1.0 N NaOH are required to fully react with the succinic acid?

- 20. One of the products formed upon the reaction of succinic acid,  $H_2C_4H_4O_4$ , a weak acid, with NaOH in aqueous solution is the soluble salt  $Na_2C_4H_4O_4$ .
- (6 pts) a) write a balanced formula equation to describe the reaction complete with phase labels (*s*, *l*, *aq*, etc.). write a balanced formula equation to describe the reaction complete with phase labels (*s*, *l*, *aq*, etc.).

- (2 pts) b) Label the acid/conjugate base and the base/conjugate acid pairs on the equation.
- (4 pts) c) write the total ionic equation for the reaction.

(2 pts) d) write the net ionic equation.

(2 pts) e) which of the three acid/base theories best describes this reaction?

21. Consider the following **unbalanced** redox reaction in **basic solution**:

 $Zn_{(s)} + NO_{3}(aq) \rightarrow Zn(OH)_{4}(aq) + NH_{3(g)}$ (6 pts) a) The \_\_\_\_\_\_ atom is oxidized from \_\_\_\_\_\_ to \_\_\_\_\_. (*oxidation numbers*) The \_\_\_\_\_\_ atom is reduced from \_\_\_\_\_\_ to \_\_\_\_\_. (*oxidation numbers*)

(8 pts) b) balance the reaction using the method of your choice. SHOW YOUR WORK.

# SCRAP PAPER (PART 2)