CHEMISTRY 101 EXAM 3

SECTIONS 572-580 Dr. Joy Heising

FORM 3N

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:

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

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$P_{tot} = P_a + P_b + \ldots$
$n_{tot} = n_a + n_b + \ldots$

PART 1

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

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

a) $HClO_4$
b) $HClO_3$
c) $HBrO_2$
d) ClO^-
e) HF

2. According to the **Lewis** theory, an acid is best described as _____.

a) an electron pair donor
b) a proton donor
c) an electron pair acceptor
d) a proton acceptor
e) any compound that contains H

3. One mole of H_2CO_3 has _____ equivalents of the acid.

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) $HClO_2$	ClO_2^-
b) CO_3^{2-}	HCO_3^-
c) NH_4^+	NH_3
d) H_2S	HS^-
e) HS^-	S^{2-}

5. Which one of the following **could not** be a Brönsted-Lowry acid?

a) H_2O
b) HN_3
c) H_3O^+
d) NH_4^+
e) BF_3

6. Which of the following is **not** an amphoteric acid salt?

a) NaH_2PO_4
b) Na_2HPO_4
c) Na_3PO_4
d) $KHCO_3$
e) $KHSO_4$

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_2O, forms H_2SO_3?

a) SO
b) SO_2
c) SO_3
d) HSO_4^-
e) H_2S

8. What is the oxidation number of Ce in $Ce(SO_4)_2$?

a) +1
b) +2
c) +6
d) +4
e) +8

9. In an oxidation/reduction reaction, the **reducing 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?

$$Pd^{2+}_{(aq)} + Al_{(s)} \rightarrow Pd_{(s)} + Al^{3+}_{(aq)} \quad \text{(UNBALANCED)}$$

a) 0
b) 2
c) 3
d) 5
e) 6

11. By international agreement the standard temperature and pressure (STP) for gases is

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

12. The molecules of all samples of ideal gases have the same average kinetic energies at the same _____.

a) volume
b) pressure
c) quantity of moles
d) density
e) temperature

13. The van der Waals constant, **b**, in the relationship

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

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. How many moles of an ideal gas are contained in 8.21 L at 73°C and 380 torr?

a) 0.250
b) 1.5×10^{23}
c) 0.144
d) 7.5×10^{23}
e) 4.2×10^{-25}

15. What volume of O_2 would be required to react with excess SO_2 at 273 K and 1.00 atm to produce 0.500 mole 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. A mixture of gases containing 0.75 mol of N_2, 1.50 mol of Cl_2 and 3.00 mol of He at 14°C is in a 50.0-L container. What is the total pressure in the vessel?

a) 1.8 atm
b) 2.2 atm
c) 2.5 atm
d) 2.7 atm
e) 3.2 atm

17. When CaC_2 is reacted with water, a gaseous product is formed. A small sample of this gas weighing 0.287 g is collected in a 500 ml flask at a pressure of 400 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) 8.37 g/mol

SCRAP PAPER (PART 1)

PART 2 FORM 3N

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NAME: _____

SID #: _____

SIGNATURE: _____

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

(6 pts) 18. At 25°C a sample of CO_2 occupies a volume of 500 ml under a pressure of 2.0 atm. What volume would it occupy at a pressure of 4.0 atm?

19. Oxalic acid, $H_2C_2O_4$, is a diprotic acid, molar mass = 90.0 g/mol.

(6 pts) a) If you dissolve 1.00 g of oxalic acid in enough water to make 100 ml of solution, what is the normality of the solution?

(6 pts) b) You have 20.0 ml of a 1.5N solution of oxalic acid. How many milliliters of 1.0 N NaOH are required to fully react with the oxalic acid?

20. One of the products formed upon the reaction of oxalic acid, $H_2C_2O_4$, a weak acid, with NaOH in aqueous solution is the soluble salt $Na_2C_2O_4$.

(6 pts) a) 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**:

$$Al_{(s)} + NO_3^-{}_{(aq)} \rightarrow Al(OH)_4^-{}_{(aq)} + NH_{3(g)}$$

(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)