Chemistry 161 Exam II March 20, 2007

Student Name (Print): ______________________________

Student Signature: ____________________________________

Recitation Section Number: [ ][ ]

Recitation Instructor: __________________

The exam booklet has 25 questions for credit and one additional question to check the color of your exam booklet. Please answer all 26 questions **on the OpScan sheet.** There is no penalty for guessing. Answer each question with the **best** choice from those provided. At the end of the 80-minute exam period, please hand in only *this* top sheet and your OpScan form. Please be sure to sign your name above your printed name on the Opscan form. If you finish early, please do not disturb your fellow students. A proctor will check your picture ID, OpScan form, signature and calculator during the exam. **The use of calculators with permanent memories (graphing calculators), cell phones, pagers, PDAs or other electronic devices other than a basic scientific calculator is expressly forbidden.** The last page of the booklet contains a periodic table along with other useful data. The use of any other notes or information on this test will be considered a violation of the Academic Honesty provisions of the student code. Exam scores will be posted as soon as possible.

ON THE OpScan FORM (Use a #2 pencil or darker)

1. SIGN your name across the top of the form.
2. Code the following information (**blacken** circles)
   Your Name (LAST NAME FIRST)
   Your RU ID
   [Start under Box **A** and continue to Box **I**]
3. Your RECITATION SECTION NUMBER in **K & L**
   [Sections 01-08, code a 0 under box **K**]
   4.Your EXAM FORM NUMBER under box **P**

BL = Bryan Langowski, RP = Bob Porcja, JW = Judy Waidlich

Periods: 6 = 5:50 -6:45, 8 = 8:45-9:40

Sec	Per.	Instr
01	T6	JW
02	T6	RP
06	Th6	BL
07	Th6	JW
08	Th6	RP
10	T8	JW
11	T8	RP
12	T8	BL
13	Th8	JW
14	Th8	RP
15	Th8	BL

Your EXAM FORM is: ①

BEFORE STARTING THE EXAM PUT YOUR FORM # IN COLUMN P AND YOUR SECTION # IN COLUMN K AND L ON THE SCANTRON. ALSO DARKEN THE CIRCLES PLEASE.

1. What volume of 0.0250 M $MgCl_2$ should be diluted to 250 mL to obtain a solution with $[Cl^-] = 0.0135$ M?

   A. 135 mL
   B. 67.5 mL
   C. 270 mL
   D. 33.7 mL
   E. 325 mL

2. What is the density of Ne (MM = 20.18 g/mol) at STP?

   A. 0.823 g/L
   B. 0.901 g/L
   C. 0.741 g/L
   D. 0.985 g/L
   E. 0.876 g/L

3. Given the following equations:

   $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$ $\Delta H = -571.6$ kJ
   $N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\Delta H = +180.5$ kJ
   $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta H = -92.22$ kJ

   Determine the enthalpy change, ΔH, for the reaction:

   $2NO(g) + 5H_2(g) \rightarrow 2NH_3(g) + 2H_2O(\ell)$

   A. 844.3 kJ/mol
   B. 483.3 kJ/mol
   C. -241.3 kJ/mol
   D. -483.3 kJ/mol
   E. -844.3 kJ/mol

4. A 0.2865 g sample of an iron ore is dissolved in acid and the iron is converted entirely to $Fe^{2+}(aq)$. To titrate the resulting solution, 0.02645 L of 0.02250 M $K_2Cr_2O_7(aq)$ is required. What is the mass percent of iron in the ore?

$$6Fe^{2+}(aq) + Cr_2O_7^{2-}(aq) + 14H^{+}(aq) \rightarrow 6Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7H_2O(\ell)$$

A. 34.5 %
B. 79.8 %
C. 44.3 %
D. 11.6 %
E. 69.6 %

5. It took 49 seconds for 1.0 L of helium to effuse through a pin hole. How long will it take for 1.0 L of methane, CH_4, to effuse under identical conditions?

A. 196 s
B. 98 s
C. 49 s
D. 25 s
E. 12 s

6. Consider the following reaction:

$$2H_2O_2(aq) \rightarrow 2H_2O(\ell) + O_2(g)$$

Which statements are true?

X. H_2O_2 is the oxidizing agent
Y. H_2O_2 is the reducing agent
Z. H_2O_2 is both oxidized and reduced

A. X and Y only
B. Y and Z only
C. X and Z only
D. X, Y and Z
E. All statements are false

7. Consider four identical 1.0 L flasks containing the following gases each at 0°C and 1.0 atm pressure. Which sample has the most molecules?

A. H_2
B. O_2
C. Cl_2
D. SO_2
E. Same for all gases

8. When a 18.5 g of copper originally at 99.5°C is placed in 58.5 g of water at 24.0°C, the temperature of the water rises to 26.1°C. If the specific heat of water is 4.180 J g^{-1} $°C^{-1}$, calculate the specific heat of copper.

A. 0.38 J g^{-1} $°C^{-1}$
B. 0.45 J g^{-1} $°C^{-1}$
C. 0.29 J g^{-1} $°C^{-1}$
D. 0.31 J g^{-1} $°C^{-1}$
E. 0.49 J g^{-1} $°C^{-1}$

9. In which of the following is a reaction <u>not</u> likely to occur? (i.e., there is no net reaction)

A. $Mg(OH)_2(s) + HI(aq)$
B. $CH_3COOH(\ell) + NH_3(aq)$
C. $AgNO_3(aq) + CH_3COONa(aq)$ (sodium acetate)
D. $KI(aq) + Pb(CH_3COO)_2$
E. $Na_2S(aq) + HCl(aq)$

10. Consider the reaction:

$$Cl_2(g) + 3F_2(g) \rightarrow 2ClF_3(g)$$

If 3.00 mol of each reactant are placed in 3.00 L container at 300 K and allowed to react, what is the final pressure in the container? (Assume reaction gases 100 % to completion)

A. 10.6 atm
B. 32.8 atm
C. 21.7 atm
D. 35.9 atm
E. 17.7 atm

11. In a particular process, the internal energy of a system increases by 41.4 J and the quantity of work the system does on its surrounding is 81.2 J. Which of the statements below is correct?

A. 122.6 J of energy is absorbed by the system
B. 122.6 J of energy is released by the system
C. 398 J of energy is absorbed by the system
D. 39.8 J of energy is released by the system
E. $\Delta U = +122.6$ J

12. A 0.828 g sample of gasoline is burned in a bomb calorimeter with a heat capacity of 9.89 kJ/°C. The temperature in the calorimeter rises from 22.75°C to 26.37°C. What is the heat of combustion of the gasoline in kJ/g?

A. +43.2 kJ/g
B. -38.5 kJ/g
C. +38.5 kJ/g
D. -9.89 kJ/g
E. -43.2 kJ/g

13. How many of the following statements is(are) true? (Hint: check the bold typed atoms)

X. $\mathbf{Cl}O_2^-$ can act as an oxidizing agent and reducing agent
Y. $\mathbf{S}O_4^{2-}$ can act only as oxidizing agent
Z. $\mathbf{N}H_3$ can act only as a reducing agent
N. $\mathbf{N}O_3^-$ can act both as oxidizing and reducing agent

A. 0
B. 1
C. 2
D. 3
E. 4

14. A sample of $Cl_2O_7(g)$ completely decomposes to chlorine and oxygen in a closed container. When the reaction is complete, the total pressure in the container is 3.0 atm. What is the partial pressure of chlorine?

A. 0.11 atm
B. 1.0 atm
C. 0.25 atm
D. 2.7 atm
E. 0.67 atm

15. Consider the combustion of octane:

$$C_8H_{18}(\ell) + \frac{25}{2}O_2(g) \rightarrow 8CO_2(g) + 9H_2O(\ell) \qquad \Delta H = -5470 \text{ kJ}$$

Assume that 0.100 gallon of octane (d = 2.66 kg/gal) undergoes combustion and all the heat released is used to warm a 800 kg block of brass initially at 20°C. What is the final temperature of the brass block? (The specific heat of brass is 0.37 J g^{-1} $°C^{-1}$)

A. 63°C
B. 72°C
C. 89°C
D. 91°C
E. 99°C

16. Which one of the following is a weak electrolyte?

A. CH_3OH, methyl alcohol
B. CH_3COOH, acetic acid
C. Sucrose
D. NaCl
E. HCl

17. A comparison is made at STP of 0.50 mol $H_2(g)$ and 1.0 mol He(g). Which of the following statements is correct?

A. Both gases have equal average molecular kinetic energies.
B. Both gases have equal average molecular speeds.
C. Both gases occupy equal volumes.
D. Both gases have equal effusion rates.
E. Both gases have equal diffusion rates.

18. What volume of $CH_4(g)$ measured at 25°C hadn 745 Torr, must be burned in excess oxygen to release 1.00×10^6 kJ of heat to the surroundings in the reaction

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell) \qquad \Delta H = -890.3 \text{ kJ}$$

A. 1.42×10^3 L
B. 2.80×10^4 L
C. 3.60×10^4 L
D. 4.85×10^4 L
E. 6.22×10^4 L

19. Consider the reaction:

$$Cu(s) + 4H^+(aq) + SO_4^{2-}(aq) \rightarrow Cu^{2+}(aq) + 2H_2O(\ell) + SO_2(g)$$

Which of the statement below is(are) correct?

X. H^+ is the reduced
Y. $SO_4^{2-}(aq)$ is reduced
Z. $SO_4^{2-}(aq)$ is the oxidizing agent

A. X only
B. X and Y only
C. Y only
D. Y and Z only
E. all of them

20. Consider a system made of a rigid container of constant volume containing some gas being heated up. Which of the following statements are correct

L. q = (-) X. q = 0 Y. q = (+) Z. W = 0 N. $\Delta U = 0$

A. Y and Z
B. Y and N
C. X and Z
D. L and Z
E. Z and N

21. Which of the following statements is <u>false</u>?

A. During an exothermic reaction, chemical energy in a system is converted to thermal energy.
B. An exothermic rection in an isolated system produces a temperature increase in the system.
C. An endothermic reaction in an isolated system produces a temperature decease in the system.
D. In an exothermic reaction at constant volume, $\Delta U = q_v$ and both q_v and ΔU are negative.
E. Circle this choice if all the other choices are correct.

22. The oxidation number of Ti in $SrTiO_3$ is:

A. +2
B. +4
C. +6
D. +8
E. +5

23. To establish a pressure of 2.00 atm in 2.24 L cylinder containing 1.60 g of O_2 at 0°C, one must

A. add 1.60 g O_2
B. release 0.80 g of O_2
C. add 2.00 g of He
D. add 0.60 g of He
E. add 2.00 g of H_2

24. Consider a gas in a cylinder that expands to do work on the surrounding without adding heat to it (an adiabatic process). Which one of the following is(are) correct?

X. The temperature of the system deceases
Y. ΔU decreases
Z. $q = 0$ and $w = (+)$

A. X only
B. X and Y only
C. Y and Z only
D. Y only
E. X, Y, and Z

25. To a solution of $MgSO_4$, a solution of $ZnCl_2$ was added. The spectator ions are:

A. Mg^{2+}(aq), Cl^-(aq)
B. Zn^{2+}(aq), SO_4^{2-}(aq)
C. Mg^{2+}(aq), SO_4^{2-}(aq)
D. Mg^{2+}(aq), SO_4^{2-} (aq), Zn^{2+}(aq), Cl^-(aq)
E. Zn^{2+}(aq), Cl^-(aq)

26. What is the color of your exam?

A. White
B. Yellow
C. Pink
D. Blue

DATA AND FORMULAS

K = 273.15 + °C 1 atm = 760 mmHg
= 760 Torr

N_A = 1 mol = 6.022×10^{23} objects R = 0.0821 L.atm/mol•K
= 8.31 J/mol•K

1 L =1000 cm^3 M.M. = molar mass $\% \text{ yield} = \dfrac{\text{actual yield} \times 100\%}{\text{theoretical yield}}$

$\text{Molarity} = \dfrac{\#\text{ moles}}{\text{L. of solution}}$ PV = nRT P = hdg d = m/V

$\bar{u} = \sqrt{3RT/M.M.}$ $R_2/R_1 = \sqrt{M_1/M_2}$ (T constant)

1 L.atm = 101.3 J $\dfrac{P_1V_1}{n_1T_1} = \dfrac{P_2V_2}{n_2T_2}$ $\varepsilon_k = \dfrac{3}{2}\dfrac{R}{N}T$

$\Delta U = q + w$ $\Delta U = q_v$, $\Delta H = q_p$ $w = -P\Delta V$, $H = U + PV$,