WESTLANE SECONDARY SCHOOL
Final Exam Chemistry – SCH 4U1

Term:	70%	Date: June 2007
Performance Assessment:	10%	Time: 2 Hours
Written Examination	20%	Teacher: Mrs Worman-Purnell
Marks:	83	Dept. Head: Mrs Worman-Purnell

STUDENT'S NAME : _____

Instructions:

1. All questions are to be answered on the examination paper.
2. All examination papers must be handed in at the end of the examination.

PART A: MULTIPLE CHOICE (30 Marks). Indicate the correct answer by placing the letter in the space provided.

There will be no multiple choice practice questions available so just print out the following pages.

PART B: SHORT ANSWER (60 MARKS) Pay attention to the directions in the questions as some indicate choice. If you attempt more than the required number of questions and do not indicate which ones you would like to have marked, the <u>first two attempted</u> will be chosen.

1a. Write the electron configuration and energy level diagram for vanadium. (label completely)
1b. Write electron configuration for the vanadium 5+ ion
1c. Draw the energy level diagram for the vanadium 2+ ion

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2a. Draw the lewis structure and then identify the VSEPR shape **for 2** of the following compounds. Identify if the structure is polar or non-polar.

i) H_2O

ii) CO_2

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iii) PCl_5

iv) BI_3

2b. List the types of intermolecular forces present in i) and ii) . Which one will have the highest boiling point?

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3. **Complete 2 of the following 3 types of enthalpy questions.**

a. Use Hess's Law to calculate the enthalpy of reaction from the following thermochemical equations:

$2C_{(s)} + O_{2(g)} \leftrightarrow 2CO_{(g)}$)H = -221.0 kJ

$C_{(s)} + O_{2(g)} \leftrightarrow CO_{2(g)}$)H = -393.5 kJ

$2H_{2(g)} + O_{2(g)} \leftrightarrow 2H_2O_{(g)}$)H = -483.6 kJ

for the reaction:

$CO_{(g)} + H_{2(g)} + O_{2(g)} \leftrightarrow CO_{2(g)} + H_2O_{(g)}$

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3b. In a calorimeter, a 1.0g sample of magnesium is burned to form MgO. In doing so 100g of water in the calorimeter had a temperature increase of 60^{o}C. What is the molar heat of combustion for magnesium in kJ/mol? (C_{H20}=4.18J/g^{o}C)

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3c. Use the standard enthalpies of formation to calculate the enthalpy of reaction for the following reaction;

$3\ NO_{2(g)} + H_2O_{(l)} \longrightarrow 2HNO_{3(l)} + NO_{(g)}$

$\Delta H_f\ NO_{2(g)}$ = +33.2kJ/mol , $\Delta H_f\ H_2O_{(l)}$ = -285.65kJ/mol , $\Delta H_f\ HNO_{3(l)}$ =-174.1kJ/mol, $\Delta H_f\ NO_{(g)}$=90.2 kJ/mol

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4a. For the reaction

$ClO_{2\,(aq)} + 2OH^-_{(aq)} \rightarrow ClO_3^-{}_{(aq)} + ClO_2^-{}_{(aq)}$

The rate data in the table below were determined at a constant temperature. Find the rate law equation and the value of k

Initial concentration of reactants and rate of production of products

Trial	Initial $[ClO_2]$ mol/L	Initial $[OH^-]$ mol/L	Initial rate of products mol/(L·s)
1	0.0150	0.0250	1.30×10^{-3}
2	0.0150	0.0500	2.60×10^{-3}
3	0.0450	0.0250	1.30×10^{-3}

/4

4b. Consider the following;

NO	→	N + O	slow
N + O_3	→	NO_2 + O	fast
O + O	→	O_2	fast

What is the overall reaction that the above reaction was proposed for?

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What is the rate law expression for the reaction?

/1

5. For the following reaction,

$2NO_{2(g)} + 7H_{2(g)} \leftrightarrow 2NH_{3(g)} + 4H_2O_{(l)} + \text{heat}$

a) Write an equilibrium constant expression
b) State **one** method of increasing the concentration of ammonia
c) Explain the effect an increase in pressure would have on the concentration of ammonia

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Do Only 2 of the next 3 questions (Questions 6,7 and 8)

6. At a certain fixed temperature, you have the following equilibrium

$CO_{2(g)} + H_{2(g)} \leftrightarrow CO_{(g)} + H_2O_{(g)}$

If you originally start with 4 moles of CO_2 and H_2 in a 10L container, find the equilibrium concentrations of all four substances given that the $K_{eq} = 8.3$

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7a. Calculate the molar solubility of magnesium carbonate ($MgCO_3$) if the k_{sp} is 6.2×10^{-8}.

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b. If a small amount of 0.6mol/L Na_2CO_3 solution were added to the magnesium carbonate solution what would happen to the molar solubility of magnesium carbonate? What is the term for this?

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8. Calculate the pH of a 0.75mol/L solution of acetic acid ($HC_2H_3O_2$) given that the k_a for the acid is 1.8×10^{-5}

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9. Are the following salts acidic, neutral or basic? Show your work.

i) NaCl

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ii) NH_4Br

Do Only 2 of the next 3 questions (Questions 10,11 and 12)

10. Use half-cell potentials to predict whether the following reactions are spontaneous or not.

a) $Cu^{2+}_{(aq)} + Fe^{2+}_{(aq)} \rightarrow Fe^{3+}_{(aq)} + Cu_{(s)}$

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b) $Ni_{(s)} + Ag^{+}_{(aq)} \rightarrow Ni^{2+}_{(aq)} + Ag_{(s)}$

11. Given the following short form cell notation for the **spontaneous** galvanic cell and the following reduction potentials calculate the cell potential.

$Sc^{3+} + 3e^- \leftrightarrow Sc_{(s)}$ $E_o = -0.74V$
$Cu^{2+} + 2e^- \leftrightarrow Cu_{(s)}$ $E_o = 0.34V$

$Sc \,|\, Sc^{2+}(1mol/L) \,\|\, Cu^{2+}(1mol/L) \,|\, Cu$

/2

12. Balance the following oxidation-reduction reaction using either the oxidation number method or the half-cell reaction method.

$$Ni_{(s)} + MnO_4^{2-}{}_{(aq)} \rightarrow NiO_{(s)} + MnO_{2(s)}$$

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13. Identify the functional group for the following compounds
a) an ether b) a ketone c) an alkene d) an aromatic ring

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14. Draw the products and name them for the following reactions

a)

$$CH_3{-}CH{=}CH_2 + HBr_{(aq)} \rightarrow$$

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b)

$$CH_3{-}CH_2{-}CH_2{-}OH \xrightarrow{\text{gentle oxidation}} \xrightarrow{\text{further oxidation}}$$

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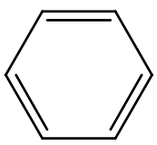
c)



$$+ Br_{2(aq)} \rightarrow$$

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THE END!
GOOD LUCK NEXT YEAR