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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015**

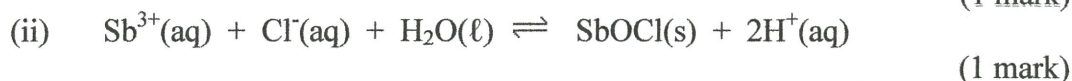
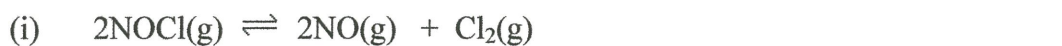
COURSE NAME : CHEMISTRY
COURSE CODE : DAS 12203
PROGRAMME : 1 DAM / 2 DAM / 3 DAM
EXAMINATION DATE : DECEMBER 2014/JANUARY 2015
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : A) ANSWER ALL QUESTIONS
B) ANSWER TWO (2) QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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SECTION A

Q1 (a) Write the equilibrium expression K_c for the following reactions :



(b) Consider the following equilibrium:



Calculate the equilibrium concentration of $\text{N}_2\text{O}_4\text{(g)}$ if the equilibrium concentration of NO_2 is 0.50 M.

(3 marks)

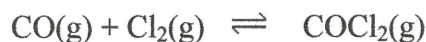
(c) Consider the following heterogeneous equilibrium



At 800°C the pressure of CO_2 is 0.236 atm. Calculate K_p and K_c for the reaction.
($R = 0.0821 \text{ L}\cdot\text{atm/mol}\cdot\text{K}$)

(6 marks)

(d) Phosgene, COCl_2 , forms from CO and Cl_2 according to the equilibrium



At 600°C, this gas mixture has initial partial pressures of 0.60 atm for CO and 1.10 atm for Cl_2 . After it has reached equilibrium, the partial pressure of $\text{COCl}_2\text{(g)}$ at this temperature is measured to be 0.10 atm. Calculate the equilibrium constant, K_p for this reaction.

(8 marks)

(e) Heating solid sodium bicarbonate in a closed vessel establishes the following equilibrium:



Predict the shift in equilibrium position if

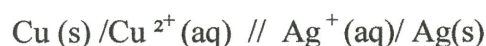
- (i) CO_2 is removed from the system,
- (ii) Na_2CO_3 is added to the system,
- (iii) NaHCO_3 is removed from the system,
- (iv) $\text{H}_2\text{O(g)}$ is added to the system.
- (v) Pressure is increased.

(5 marks)

Q2 (a) Calculate :

- (i) The pH of 0.02 M sulphuric acid, H_2SO_4 . (4 marks)
- (ii) The pH of a sample of lemon juice given the concentration of hydroxonium ion (H_3O^+) is $8.1 \times 10^{-3}\text{M}$. (2 marks)
- (iii) The hydroxonium ion (H_3O^+) concentration of a sample of soap given the pH is 6.8. (3 marks)
- (iv) the hydroxide ion concentration of a blood sample given the hydroxonium ion concentration is $5.5 \times 10^{-8}\text{M}$. ($K_w = 1.0 \times 10^{-14}$) (3 marks)

(b) A galvanic cell is set up using copper and silver half-cells.



- (i) Write the overall cell reaction. (2 marks)
- (ii) Calculate the cell potential under standard conditions, E_{cell}° . ($E_{\text{Ag}^+/\text{Ag}}^\circ = 0.8\text{ V}$, $E_{\text{Cu}^{2+}/\text{Cu}}^\circ = 0.34\text{ V}$) (3 marks)
- (iii) Calculate E_{cell} given $[\text{Cu}^{2+}] = 1.1\text{ M}$ and $[\text{Ag}^+] = 0.7\text{ M}$. (5 marks)
- (c) State 3 prevention steps that should be taken to avoid corrosion. (3 marks)

SECTION B

- Q3** (a) (i) Define empirical formula. (2 marks)
- (ii) Determine the empirical formula of an organic acid given the following composition by mass

H.	C	O
2.20 %	26.70 %	71.10%.

(Relative atomic mass : H = 1, C = 12 , O =16 ,)

(6 marks)

- (iii) The molar mass of acid is 90.0 gmol^{-1} , find the molecular formula. (2 marks)

- (b) State Dalton's Law of partial pressure. (2 marks)

- (c) A mixture of gases contains 30% by volume of carbon dioxide (CO_2), 20 % by volume of oxygen (O_2) and 50 % by volume of carbon monoxide (CO). The total pressure of the gases is 101 kPa.

- (i) Calculate the partial pressure of each gas. (6 marks)

- (ii) If carbon dioxide is removed from the mixture determine the partial pressures of oxygen and carbon monoxide. (2 marks)

- (d) The density of a gas is 2.6 g/L at a temperature of 25°C and pressures of 101 kPa. Calculate the relative molecular mass of the gas. ($R = 8.315 \times 10^3 \text{ L.Pa/mol.K}$) (5 marks)

- Q4** (a) A neutral atom has two (2) electrons with $n = 1$, eight (8) electrons with $n = 2$, eight (8) electrons with $n = 3$, and two (2) electrons with $n = 4$.

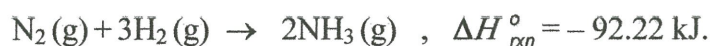
- (i) Write the ground state electron configuration of the atom. (2 marks)

- (ii) Identify the group and period of the element. (2 marks)

- (iii) Write the set of quantum numbers (n, ℓ, m_ℓ, m_s) for an electron in the $2s$ and $3p$ subshell (4 marks)

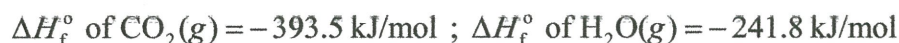
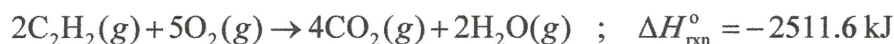
- (b) Arrange the following ions in order of increasing ionic radii. Give your reasons.
 Ca^{2+} , Be^{2+} , Ba^{2+} , Mg^{2+}
 (Atomic number, Z : Ca = 20, Be = 4, Ba = 56, Mg = 12)
 (4 marks)
- (c) (i) Describe covalent and ionic bonding using Cl_2 and NaCl as examples.
 (4 marks)
- (ii) Use Lewis dot symbols to show bonding in both examples.
 (Group in Periodic Table: Cl = 17; Na = 1)
 (3 marks)
- (d) Draw the Lewis structure of HOBr and calculate the formal charges.
 (Group in Periodic Table: H = 1; Br = 17; O = 16)
 (6 marks)

- Q5** (a) A 100.0 g copper sample at 100 °C is added to 50.0 g of water at 26.5 °C.
 Determine the final temperature of the copper-water mixture.
 ($s_{\text{Cu}} = 0.385 \text{ J}\cdot\text{g}^{-1}\cdot\text{°C}^{-1}$, $s_{\text{water}} = 4.184 \text{ J}\cdot\text{g}^{-1}\cdot\text{°C}^{-1}$)
 (5 marks)
- (b) Given the following thermochemical equation:



Write the thermochemical equation for:

- (i) the formation of 1 mol of $\text{NH}_3(\text{g})$
 (2 marks)
- (ii) the dissociation of 4 mol of $\text{NH}_3(\text{g})$
 (3 marks)
- (c) Use the following information to find ΔH_f° of acetylene, C_2H_2 .

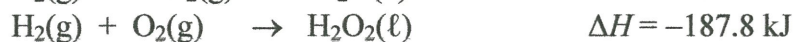
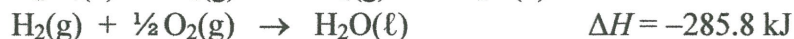
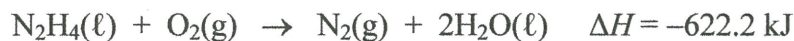


(5 marks)

- (d) Calculate
- ΔH
- for the reaction



Given the following set of reactions:



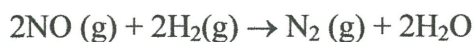
(10 marks)

- Q6** (a) Dinitrogen pentoxide gas decomposes to nitrogen dioxide gas and oxygen gas according to the following balanced equation.



- (i) Write the differential rate equation for the dissociation of N_2O_5 gas .
(3 Marks)
- (ii) If the rate of disappearance of N_2O_5 gas is $1.0 \times 10^2 \text{ mol dm}^{-3} \text{ s}^{-1}$ determine the rate of formation of NO_2 gas under the same conditions of temperature and pressure.
(3 Marks)

- (b) The reaction of nitric acid with hydrogen at
- 1280°C
- is as follows :



Experiment	$[\text{NO}](\text{M})$	$[\text{H}_2](\text{M})$	Initial Rate (M/s)
1	5.00×10^{-3}	2.00×10^{-3}	1.25×10^{-5}
2	10.00×10^{-3}	2.00×10^{-3}	5.00×10^{-5}
3	10.00×10^{-3}	4.00×10^{-3}	10.00×10^{-5}

From the data collected at the specific temperature , determine

- (i) The rate law.
(10 Marks)
- (ii) The rate constant, k (complete with units)
(4 Marks)
- (c) Explain briefly 3 reasons that affect the reaction rate based on the following factors :
- (i) Concentration
- (ii) Particle surface area
(5 marks)

- END OF QUESTION -