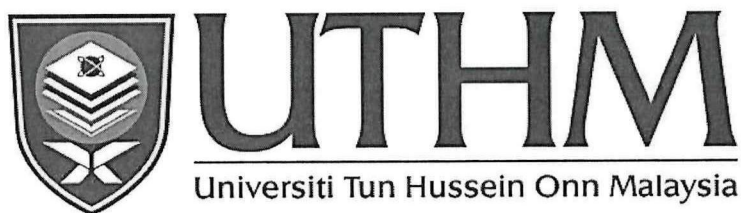


**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2019/2020**

COURSE NAME : CHEMISTRY  
COURSE CODE : DAM 10403  
PROGRAMME CODE : DAM  
EXAMINATION DATE : DECEMBER 2019 / JANUARY 2020  
DURATION : 2 HOURS 30 MINUTES  
INSTRUCTION : PART A: ANSWER **ALL** QUESTIONS  
PART B: ANSWER **TWO (2)** QUESTIONS  
ONLY

**TERBUKA**

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

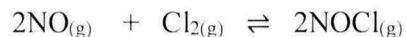
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## PART A

**Q1** (a) 20 mol of nitrosyl chloride (NOCl) is placed inside an empty 4L container. At equilibrium, 8 mol of chlorine (Cl<sub>2</sub>) and 2x mol of nitric oxide (NO) was found in the container. Calculate the value of K<sub>c</sub> for this reaction.

(9 marks)

(b) The equilibrium constant (K<sub>c</sub>) for the formation of nitrosyl chloride from nitric oxide and molecular chlorine is 6.5 x 10<sup>4</sup> at 35 °C.



In a certain experiment, 2.0 x 10<sup>-2</sup> mol of NO, 8.3 x 10<sup>-3</sup> mol of Cl<sub>2</sub> and 6.8 mol of NOCl are mixed in a 2L flask. Determine the direction of the system to reach equilibrium.

(7 marks)

(c) The reaction between carbon monoxide (CO) and hydrogen (H<sub>2</sub>) gas will produce methane gas (CH<sub>4</sub>) and water vapour. The K<sub>c</sub> for this reaction is 2.41 x 10<sup>-2</sup>. Determine the K<sub>p</sub> of the reaction at 25 °C.

(4 marks)

**Q2** (a) Write

(i) the conjugate base of H<sub>2</sub>S

(ii) the conjugate acid of HCO<sub>3</sub><sup>-</sup>

(2 marks)

(b) A solution formed by dissolving an antacid tablet has a pH of 9.18. Calculate

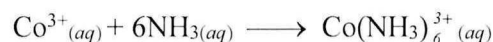
(i) pOH

(ii) [H<sup>+</sup>]

(iii) [OH<sup>-</sup>]

(6 marks)

(c) Rewrite the following equation and identify the Lewis acid and base.



(2 marks)

(d) Calculate the pH of a 0.100 M NH<sub>3</sub>.  
(K<sub>b</sub> = 1.8 x 10<sup>-5</sup>)

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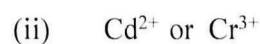
(10 marks)

**Q3** (a) Determine the oxidation number of the underlined element in the following compounds.



(4 marks)

(b) Determine the species with better oxidizing agent under standard-state conditions.



(5 marks)

(c) An electrochemical cell is made up of a Zn electrode in a 1.0 M  $\text{ZnSO}_4$  solution and a Cu electrode in a 1.0 M  $\text{CuSO}_4$  solution.

(i) Write the anode, cathode and the overall cell reactions.

(ii) Calculate the standard *emf* of the cell.

(5 marks)

(d) A current of 12 A is passed through  $\text{SnCl}_2$  solution for 50 minutes.

(i) Determine the mass of Sn deposited on the cathode

(ii) Determine the number of moles of  $\text{Cl}_{2(g)}$  that is liberated at the anode

(iii) Calculate the volume of  $\text{Cl}_{2(g)}$  at STP.

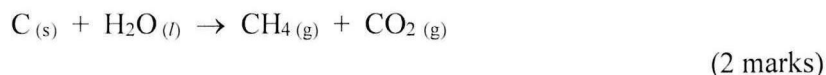
(6 marks)

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## PART B

**Q4** (a) Coal can be converted to methane gas by a process called gasification. The equation for the is as shown below.

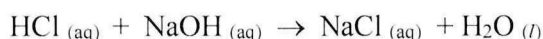
(i) Rewrite and balance the equation:



(ii) Determine the mass (gram) of carbon, C is required to react with water,  $\text{H}_2\text{O}$  to form 32 gram of  $\text{CH}_4$ . (8 marks)

(b) An analysis required 0.2 M  $\text{AgNO}_3$ . Calculate the volume of a 0.2 M in mL  $\text{AgNO}_3$  solution containing 8.5 grams of  $\text{AgNO}_3$ . (5 marks)

(c) In a titration, 0.2 M  $\text{HCl}$  is titrated with 0.1 M  $\text{NaOH}$  as the following equation.



Determine the volume of 0.200 M  $\text{HCl}$  that is required to react completely with 50 mL of 0.100 M  $\text{NaOH}$ . (5 marks)

**Q5** (a) The electron configuration of  $\text{Se}^{2-}$  is  $1s^2 2s^2 2p^8 3s^2 4s^2 3p^6 3d^{12}$ . Explain briefly the mistake in the configuration. (5 marks)

(b) Illustrate the electron configuration of  $\text{Co}$ , write the electron configuration and determine if the element is paramagnetic of diamagnetic. (5 marks)

(c) Determine the maximum number of electron in a  $3d^8$  orbital. Write all possible quantum number for this orbital. (8 marks)

(d) Calculate how many electrons can inhabit the  $n = 4$  orbital. (2 marks)

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**Q6** (a) Give definition of the following chemical bonding

(i) A covalent bond

(ii) An ionic bond

(4 marks)

(b) Draw the Lewis structures for ammonium ion,  $\text{NH}_4^+$  (your answers must include atomic number and electron valence for each element).

(7 marks)

(c) 10.0 g of calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$  is heated at 1 atm and a temperature of 300 °C, at which temperature it fully decomposes. The reaction of calcium nitrate heated is represented by the following balanced equation.



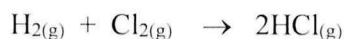
(i) Determine the volume of nitrogen dioxide produced

(6 marks)

(ii) Calculate the mass of calcium oxide, CaO is produced if calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$  is fully decomposed.

(3 marks)

**Q7** (a)  $\Delta H_f$  for the following reaction is  $-186$  kJ.



(i) Determine the kJ of heat produced from the reaction of 25 g  $\text{Cl}_2$ .

(ii) Write the thermochemical equation for the reverse reaction.

(5 marks)

(b) Calculate  $\Delta H$  combustion for the reaction :



Given:

$$\Delta H_f \text{CH}_3\text{OH}(\text{l}) = -239 \text{ kJ/mol}$$

$$\Delta H_f \text{CO}_2(\text{g}) = -393.5 \text{ kJ/mol}$$

$$\Delta H_f \text{H}_2\text{O}(\text{l}) = -286.0 \text{ kJ/mol}$$

(5 marks)

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- (c) Write the rate expression for the reaction :



(2 marks)

- (d) The rate law for the reaction  $2\text{NO}_{(g)} + \text{Cl}_{2(g)} \rightarrow 2\text{NOCl}_{(g)}$  is

$$\text{Rate} = k [\text{NO}]^2 [\text{Cl}_2]$$

- (i) Determine the order with respect to NO, Cl<sub>2</sub> and the overall order.
- (ii) Calculate the rate constant, k when [NO] = 0.250 M, [Cl<sub>2</sub>] = 0.250 M and rate = 1.43 x 10<sup>-6</sup> Ms<sup>-1</sup>.
- (iii) Determine rate of the reaction when [NO] = 0.750 M and [Cl<sub>2</sub>] = 0.250M.

(8 marks)

– END OF QUESTIONS –

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## FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2019/2020  
COURSE NAME : CHEMISTRYPROGRAMME CODE : DAM  
COURSE CODE : DAM 10403ATOMIC NUMBER OF ELEMENTS

Name of Atom	Atomic Symbol	Atomic Number
Hydrogen	H	1
Oxygen	O	8
Cobalt	Co	27
Selenium	Se	34
Nitrogen	N	7

ATOMIC MASS OF ELEMENTS

Name of Element	Element Symbol	Atomic Mass /a.m.u
Argentum	Ag	108
Stannum	Sn	118.7
Calcium	Ca	40
Chlorine	Cl	35.5
Hydrogen	H	1
Carbon	C	12
Oxygen	O	16
Nitrogen	N	14

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## FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2019/2020  
 COURSE NAME : CHEMISTRY

PROGRAMME CODE : DAM  
 COURSE CODE : DAM 10403

## FORMULAE

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$

$$pK_w = pH + pOH = 14$$

$$pH = -\log[H^+]$$

$$pOH = -\log[OH^-]$$

$$\Delta H_{\text{rxn}} = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$K_p = K_c (RT)^{\Delta n}$$

$$E_{\text{cell}}^\circ = E_{\text{SRP}}^\circ + E_{\text{SOP}}^\circ$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.0592}{n} \log \frac{[\text{product}]}{[\text{reactant}]}$$

$$m = \frac{MIt}{ZF} \quad 1 F = 96\,500 \text{ coulomb}$$

$$\text{Molarity (M) of compound A} = \frac{\text{mol of solute (mol)}}{\text{volume of solution (L)}}$$

$$\text{Dilution : } M_1V_1 = M_2V_2 \quad \text{Acid-Base Titration : } \frac{M_a V_a}{a} = \frac{M_b V_b}{b}$$

Quantum numbers :  $(n, l, m_l, m_s)$

$$PV = nRT$$

$$1 \text{ mol gas at STP} = 22.4\text{L} \quad R = 0.0821 \text{ Latm/mol.K}$$

$$\text{Rate (R)} = k[A]^x[B]^y$$

Standard Reduction Potentials  $E_{\text{SRP}}^\circ$

$$E_{(\text{Zn}^{2+}/\text{Zn})}^\circ = -0.76\text{V}$$

$$E_{(\text{Br}_2/\text{Br}^-)}^\circ = +1.07\text{V}$$

$$E_{(\text{Au}^{3+}/\text{Au})}^\circ = +1.50\text{V}$$

$$E_{(\text{Cu}^{2+}/\text{Cu})}^\circ = +0.34\text{V}$$

$$E_{(\text{Cd}^{2+}/\text{Cd})}^\circ = -0.40\text{V}$$

$$E_{(\text{Cr}^{3+}/\text{Cr})}^\circ = -0.74\text{V}$$

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