



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016**

COURSE NAME : CHEMISTRY
COURSE CODE : DAS 12102
PROGRAMME : 2 DAE
EXAMINATION DATE : DECEMBER 2015/JANUARY 2016
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : SECTION A
ANSWER ALL QUESTIONS

SECTION B
ANSWER **TWO (2)** QUESTIONS
ONLY

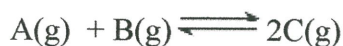
THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

SECTION A

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



(b) Consider the following reaction between A and B to give C.



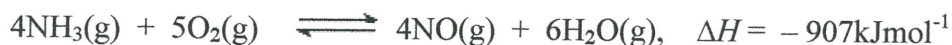
5 moles of A are allowed to mix and react with 3 moles of B in a 1.00 L container. At equilibrium, 2 moles of C are produced.

(i) Find the molarity (M) of A, B and C. (3 marks)

(ii) Create the ICE table for the reaction and determine the concentration of A, B and C at equilibrium. (8 marks)

(iii) Calculate K_c for this reaction. (3 marks)

(c) Given the following reaction :



Predict the shift in equilibrium position due to the following changes :

(i) Gaseous O_2 is added (1 mark)

(ii) Gaseous NO is removed (1 mark)

(iii) Temperature is increased (1 mark)

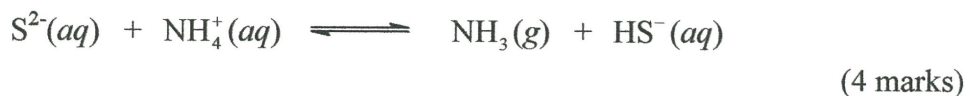
(iv) Pressure of the system is increased. (1 mark)

Q2 (a) Define the following:

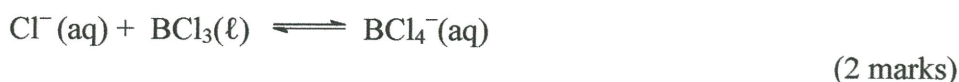
(i) A Brønsted-Lowry acid and base (2 marks)

(ii) A Lewis acid and base (2 marks)

(b) (i) Identify the Brønsted-Lowry acid and base and their conjugate acid-base pairs for the reaction :



(ii) Identify the Lewis acid and base for the reaction:



(c) Given the pH of a solution is 9.08.

(i) Classify the sample as acidic, basic or neutral. Give reasons for your choice of answer. (2 marks)

(ii) Find pOH, $[H^+]$ and $[OH^-]$.
($K_w = 1.0 \times 10^{-14}$) (8 marks)

Q3 (a) For a galvanic cell based on the reaction :



(i) Identify the anode and cathode and state the type of reaction at the anode and cathode. (4 marks)

(ii) Write the half-cell reaction at the anode and cathode. (2 marks)

(iii) Write the cell diagram for the galvanic cell. (2 marks)

(iv) Find the standard emf value, E_{cell}° . (2 marks)

(v) Calculate E_{cell} when $[Cu^{2+}] = 0.30$ M and $[Mg^{2+}] = 0.020$ M.



(5 marks)

(b) A current of 100.0 A is passed through an electrolytic cell containing aqueous Ag^+ solution.

(i) Name the electrode at which reduction occurs and write the half-cell reaction for the reduction process.

(1 mark)

(ii) Find the time taken (in hours) to deposit 5 g Ag.
(Relative atomic mass : $\text{Ag} = 108$, $1F = 96500 \text{ C}$)

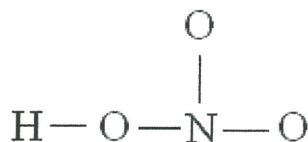
(4 marks)

SECTION B

- Q4** (a) Pyridine has a molecular formula C_5H_5N . When pyridine reacts with O_2 , the products are CO_2 , H_2O and N_2 . Write a balanced equation for the reaction. (5 marks)
- (b) Cumene is a hydrocarbon, meaning that it contains only carbon and hydrogen. Given that cumene is 89.94 % by mass carbon, determine
- (i) the empirical formula (5 marks)
- (ii) the molecular formula if the molar mass is 120.2 g/mol.
(Relative atomic mass : H = 1, C = 12) (3 marks)
- (c) A solution is prepared by dissolving 45.0 g of NaClO in distilled water to produce 750 mL of solution.
- (i) Find the number of moles of NaClO.
(Relative atomic mass : O = 16, Na = 23, Cl = 35.5) (2 marks)
- (ii) Calculate the molarity of the solution. (2 marks)
- (iii) Determine the volume of the solution in (ii) required to prepare 100 mL of 0.1 M NaClO solution. (3 marks)
- Q5** (a) Determine whether the following contains combinations of quantum numbers are allowed. Explain your reasons.
- (i) $n = 3, l = 0, m = -1$ (2 marks)
- (ii) $n = 4, l = 4, m = 0$ (2 marks)
- (b) Write the electron configuration of the atom potassium, K ($Z=19$) and determine the number of electrons which has the quantum number of $l = 0, m_s^l = +\frac{1}{2}$. (2 marks)

- (c) An atom Q have the quantum numbers $n = 4$ and $l = 0$.
- Name the subshell (1 mark)
 - Determine the number of orbital and maximum number of electrons (2 marks)
 - Write the possible set of 4 quantum numbers for an electron in this subshell. (1 mark)
- (d) Given 3 atoms with the following electron configurations, determine:
- A : $1s^2 2s^2 2p^5$
 B : $1s^2 2s^2 2p^6 3s^1$
 C : $1s^2 2s^2 2p^6 3s^2 3p^3$
- the group and period of each atom. (6 marks)
 - the atom that has the lowest first ionization energy (1 mark)
 - the atom that has the most negative electron affinity (1 mark)
 - the atom that forms an anion with a charge of -3 (1 mark)
 - the atom with the largest radius. (1 mark)

- Q6** (a) (i) Use Lewis dot symbols to show bonding between H and Cl. (2 marks)
- (ii) Name the type of bond formed and give your reasons.
 (Atomic number, Z : H = 1, Cl = 17) (2 marks)
- (b) Given the skeleton for nitric acid, HNO_3 . Complete the Lewis structure and calculate formal charges for all atoms.
 (Atomic number, Z : H = 1, N = 7, O = 8)



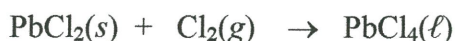
(6 marks)

- (c) A sample of a certain gas has a volume of 452 mL at 711 mm Hg and 26.0 °C. Find the volume of this same sample of gas at STP. (5 marks)
- (d) Calculate the pressure exerted by 12.5 grams of carbon dioxide gas, CO₂ placed in a 500.0 mL container at a temperature of 55.0 °C. (Relative atomic mass : C = 12, O = 16, R = 0.0821 L.atm/mol.K) (5 marks)

Q7 (a) The enthalpy change for the reaction :



- (i) Write the thermochemical equation for the reverse reaction. (2 marks)
- (ii) Given $\Delta H_f^\circ \text{POCl}_3(g) = -558.48 \text{ kJ/mol}$, find ΔH_f° for $\text{PCl}_3(g)$. (4 marks)
- (b) Find the enthalpy change for the reaction :



Given the following reactions :



(4 marks)

(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, Cl₂ and the overall order. (3 marks)
- (ii) Determine the rate constant, k when $[\text{NO}] = 0.250 \text{ M}$, $[\text{Cl}_2] = 0.250 \text{ M}$ and rate = $1.43 \times 10^{-6} \text{ M/s}$. (3 marks)
- (iii) Find the rate of the reaction when $[\text{NO}] = 0.750 \text{ M}$ and $[\text{Cl}_2] = 0.250 \text{ M}$. (2 marks)

- END OF QUESTION -