UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

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COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12102
PROGRAMME	:	DAE
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	**SECTION A**: ANSWER **ALL** QUESTIONS.
		SECTION B: ANSWER **TWO (2)** QUESTIONS ONLY.

TERBUKA

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

SECTION A

Q1 (a) Heterogeneous and homogeneous equilibrium are two possible types of chemical equilibrium. Given:

$$CaCO_3 (s) \rightleftharpoons CaO (s) + CO_2 (g)$$
$$4NH_3 (g) + 5O_2 (g) \rightleftharpoons 4NO (g) + 6H_2O (g)$$
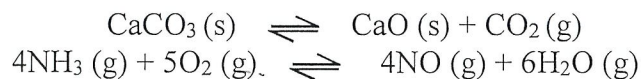
Differentiate and explain the equilibriums.

(5 marks)

(b) The manufacture of methanol can be achieved in two stages. In the first stage, methane and steam react according to the following equation.

$$CH_4 (g) + H_2O (g) \rightleftharpoons CO (g) + 3H_2 (g) \quad \Delta H^\circ = +210 \text{ kJ mol}^{-1}$$
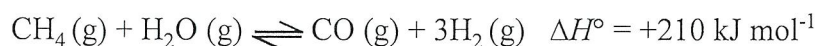
Based on Le Chatelier principle, discuss with reasons, the effects of increasing separately the temperature and the pressure on the yield of the products and on the direction of the reaction.
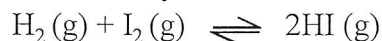
(6 marks)

(c) 0.218 mol sample of hydrogen iodide was heated in a flask, the following equilibrium was established at 700 K.

$$2HI (g) \rightleftharpoons H_2 (g) + I_2 (g)$$
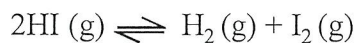
The equilibrium mixture was found to contain 0.023 mol of hydrogen.

(i) Calculate the number of moles of iodine and the number of moles of hydrogen iodide in the equilibrium mixture.

(ii) Write an expression for K_c for the equilibrium.

(iii) Calculate the value of K_c at 700 K.

(iv) Calculate the value of K_c at 700 K for the equilibrium
$$H_2 (g) + I_2 (g) \rightleftharpoons 2HI (g)$$

(9 marks)

Q2   (a)   Identify the conjugate acid-base pairs in the reaction between ammonia and water

$$NH_3 \text{ (aq)} + H_2O \text{ (l)} \rightarrow NH_4^+ \text{ (aq)} + OH^- \text{ (aq)}$$
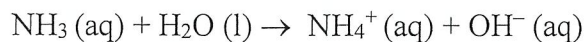
(4 marks)

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

        (i)   pOH

        (ii) $[H^+]$

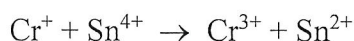   (iii) $[OH^-]$

(12 marks)

     (c)   The concentration of OH^- in certain household ammonia cleaning solution is 0.0025 M. Calculate the concentration of H^+ .

(4 marks)

Q3   (a)   (i)   Define a redox reaction.

(2 marks)

        (ii)   Identify the species being oxidized and reduced in the following reaction.
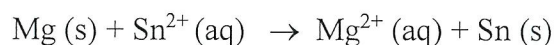
$$Cr^+ + Sn^{4+} \rightarrow Cr^{3+} + Sn^{2+}$$

(2 marks)

        (iii)   Give the reason for your answers in **Q3 (a) (ii).**

(6 marks)

     (b)   A voltaic cell is assembled as follows:

$$Mg \text{ (s)} + Sn^{2+} \text{ (aq)} \rightarrow Mg^{2+} \text{ (aq)} + Sn \text{ (s)}$$

        (i)   Identify the half cell reactions for each electrode.

        (ii)   Determine the cell notation of the reaction.

        (iii)   Calculate the E^o_{cell} of this cell at 25 °C.

        (iv)   Calculate E_{cell} , given $[Mg^{2+}] = 0.015$ M, and $[Sn^{2+}] = 0.200$ M.

            Given: $E^o_{Mg^{2+}/Mg} = -2.37$V

                  $E^o_{Sn^{2+}/Sn} = -0.14$V
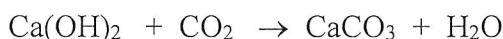
(10 marks)

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SECTION B

Q4 (a) 16 g of C_2H_4 gas was burnt with excess O_2 gas to produce CO_2 gas and water,

   (i) Rewrite and balance the equation:
   $$C_2H_4\,(g) + O_2\,(g) \rightarrow CO_2\,(g) + H_2O\,(g)$$
   (3 marks)

   (ii) Determine the mass (gram) of CO_2 and H_2O produced.
   (Relative atomic mass: C = 12, H = 1, O = 16)
   (8 marks)

(b) 750 mL 2.0 M HCl solution is required for analysis. Suggest the weight (gram) of HCl to prepare the solution.
(Relative atomic mass: Cl = 35.5, H = 1)
(5 marks)

(c) Calculate the volume of a 16 M stock solution should be added to make a 4 L of a 1 M diluted solution.
(4 marks)

Q5 (a) Determine the values of n and ℓ of the following sublevels:
   (i) $4f$
   (ii) $3d$
   (4 marks)

(b) Determine whether the following set are allowable or not. If it is not, give reason.
   (i)   (5, 0, 1, ½)
   (ii) (4, 1, 1, ½)
   (3 marks)

(c) Ferum has the tendency to form Fe^{2+} and Fe^{3+} when it loses 2 or 3 electrons.
   (i) Write the electron configuration of Fe^{2+} and Fe^{3+}.
   (4 marks)

   (ii) Identify the orbital of the outermost shell in Fe^{2+} and Fe^{3+}.
   (2 marks)

   (iii) Write the complete set of four quantum numbers for the dismissed electron when Fe^{2+} and Fe^{3+} are formed and determine the magnetic properties.
   (Atomic number: Fe = 26)
   (7 marks)

Q6   (a)   Identify the type of bonding that occurs in the compounds:
       (i) $CaCl_2$

       (ii) SO_2

(4 marks)

(b)   Draw the Lewis structures for each of the SO_4^{2-} (your answers must include atomic number and electron valence for each element).
(Atomic Number : S = 16, O = 8)

(6 marks)

(c)   720 mL of carbon dioxide are present in the vessel at 10 °C and a pressure of 0.987 atm.
       (i)   Determine the mole of carbon dioxide are present in the vessel.

       (ii)   The reaction between carbon dioxide and limewater is represented by the following balanced equation.

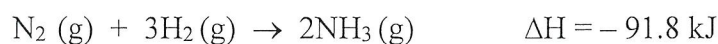$$Ca(OH)_2 \ + \ CO_2 \ \rightarrow \ CaCO_3 \ + \ H_2O$$

Calculate the mass of calcium hydroxide is required to react completely with the quantity of carbon dioxide gas above.
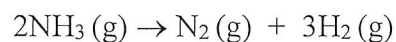(Relative atomic mass : Ca = 40, O = 16, H = 1),
Gas constant : R = 0.0821 L.atm/mol.K

(10 marks)

Q7   (a)   Given the thermochemical equation:

$$N_2 \,(g) \ + \ 3H_2 \,(g) \ \rightarrow \ 2NH_3 \,(g) \qquad \Delta H = -\,91.8 \text{ kJ}$$

       (i)   Determine the ΔH of the reaction below:

$$2NH_3 \,(g) \rightarrow N_2 \,(g) \ + \ 3H_2 \,(g)$$

(3 marks)

       (ii)   Identify whether the reaction in (i) exothermic or endothermic.

(1 mark)

       (iii)   Calculate the energy that is given off when 222.4 g of N_2 reacts.

(6 marks)

(b) Given the Rate law = k $[NO]^2$ $[Cl_2]$; find the order of NO, Cl_2 and overall.

(3 marks)

(c) (i) Determine the final concentration after 10 seconds for a first order reaction that has an initial concentration of 3.10 M and a rate constant equal to 0.11 sec^{-1}.

(5 marks)

(ii) Calculate $t_{1/2}$ for the reaction in **Q7 (c) (i)**.

(2 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

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FORMULAE

1. $n = \dfrac{MV}{1000}$

2. $M_1V_1 = M_2V_2$

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

4. $pH + pOH = 14$

5. $P_1V_1 = P_2V_2$

6. $\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$

7. $\dfrac{P_1V_1}{T_1} = \dfrac{P_2V_2}{T_2}$

8. $PV = nRT$

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

10. $q = ms\Delta T$

11. $E^o_{cell} = E^o_{SRP} + E^o_{SOP}$

12. $E_{cell} = E^o_{cell} - \dfrac{0.0592}{n}\log\dfrac{[\text{product}]}{[\text{reactant}]}$