UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

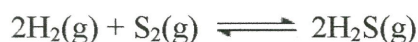|		
COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12203
PROGRAMME	:	1 DAM
EXAMINATION DATE	:	DECEMBER 2016/JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A: ANSWER **ALL** QUESTIONS. SECTION B: ANSWER **TWO (2)** QUESTIONS ONLY.

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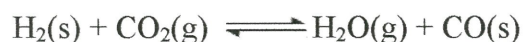THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

SECTION A

Q1 (a) Consider the following equilibrium process at 700°C:

$$2H_2(g) + S_2(g) \rightleftharpoons 2H_2S(g)$$

Analysis shows that there are 2.50 moles of H_2, 1.35×10^{-5} mole of S_2, and 8.70 moles of H_2S present in a 12.0L flask. Calculate the equilibrium constant K_c for the reaction.

(6 marks)

(b) For the reaction

$$H_2(s) + CO_2(g) \rightleftharpoons H_2O(g) + CO(s)$$

at 700°C, $K_c = 0.534$. Calculate the number of moles of H_2, that are present at equilibrium if a mixture of 0.300 mole of CO and 0.300 mole of H_2O is heated to 700°C in a 10.0L container.

(9 marks)

(c) Consider the following equilibrium process:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g) \qquad \Delta H° = 92.5 \text{ kJ/mol}$$

Predict the direction of the shift in equilibrium when
(i) the temperature is raised.

(ii) more chlorine gas is added to the reaction mixture.

(iii) some PCI, is removed from the mixture.

(iv) the pressure on the gases is increased.

(v) a catalyst is added to the reaction mixture.

(5 marks)

Q2 (a) Define an acid and base according to the theory of Arrhenius.

(2 marks)

(b) Given the following acid base-reaction:

$$H_2SO_4 \, (aq) + NaH_2PO_4 \, (aq) \rightleftharpoons NaHSO_4 \, (aq) + H_3PO_4 \, (aq)$$

(i) Write the overall ionic equation for the reaction.

(ii) Identify the Brønsted-Löwry acid and base.

(6 marks)

(c)   In a NaOH solution, [OH⁻] is 2.9×10^{-4} M. Calculate the pH of the solution.

(5 marks)

(d)   The pH of a 0.25 M aqueous HF solution is 1.92. Calculate K_a for this weak acid.

(7 marks)

Q3   (a)   Calculate the standard emf of a cell that uses the Mg/Mg^{2+} and Cu/Cu^{2+} half-cell reactions at 25°C. Write the equation for the cell reaction that occurs under standard-state conditions.

(5 marks)

(b)   Determine the potential of a cell made up of Zn/Zn^{2+} and Cu/Cu^{2+} half-cells at 25°C if $[Zn^{2+}] = 0.25$ M and $[Cu^{2+}] = 0.15$ M?

(7 marks)

(c)   Explain the differences between a primary galvanic cell - one that is not rechargeable and a storage cell (for example, the lead storage battery), which is rechargeable.
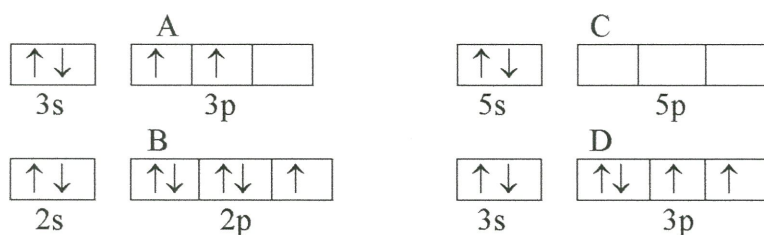
(8 marks)

SECTION B

Q4   (a)   Consider the reaction

$$KMnO_4 + 5FeCl_2 + 8HCl \longrightarrow MnCl_2 + 5FeCl_3 + 4H_2O + KCl$$

If 70.0 mol of $FeCl_2$ and 15.0 mol of $KMnO_4$ are mixed with excess HCl, determine the moles of $MnCl_2$ that can be formed?

(6 marks)

(b)   Write a balance equation for chemical reaction below. Calculate the number of mole of H_2 that can be prepared by treating 15.00 g K with 30.00 g H_2O.
(Relative atomic mass : K = 23, O = 16, H = 1)

$$K + H_2O \longrightarrow KOH + H_2$$

(8 marks)

(c)   A sample of oxygen gas occupies a volume of 2.55 L at 24.0 °C and 0.679 atm pressure. Calculate the volume of this sample at STP?

(6 marks)

Q5   (a)   Determine the values of n and l of the following sublevels.
(i) $4d$

(ii) $3p$

(4 marks)

(b)   Write the electron configuration of Mg, Cr^{2+} and Cu^{+}.
(Atomic number: Mg = 12, Cr = 24, Cu = 29)

(6 marks)

(c)   Arrange the following atoms in order of increasing atomic radius:
Si, Mg, Cl, P, Al.

(3 marks)

(d)   Given the following valence orbital diagrams, rank these elements in order
of increasing atomic size and ionization energy.

(4 marks)

(e)   Indicate which one of the two species in each of the following pairs is
smaller:
(i)   Na or Na^{+}

(ii) O^{2-} or S^{2-}

(iii) Mg^{2+} or Al^{3+}

[Atomic number, Z: Al = 13, Mg = 12, Na = 11, O = 8 , S = 16]

(3 marks)

Q6   (a)   Classify the following bonds as ionic, polar covalent, or nonpolar covalent
(i)   SiSi bond in $Cl_3SiSiCl_3$,

(ii)   CaF bond in CaF_2,

(iii)   NH bond in NH_3.

(3 marks)

(b)   Draw Lewis structures for the following molecules and ions:
   (i) N_2F_2,

   (ii) Si_2H_6,

   (iii) CH_2ClCOO^-

   [Atomic number, Z : F = 9, N = 7, Si = 14, C = 6, Cl = 17, H = 1, O = 8]
   (6 marks)

(c)   Calculate the density of hydrogen bromide (HBr) gas in g/L at 733 mmHg and 46°C.

   (6 marks)

(d)   In alcohol fermentation, yeast converts glucose to ethanol and carbon dioxide:

   $$C_6H_{12}O_6(s) \rightarrow 2C_2H_5OH(l) + 2CO_2(g)$$

   If 5.97 g of glucose reacts and 1.44 L of CO_2 gas is collected at 293 K and 0.984 atm, what is the percent yield of the reaction?
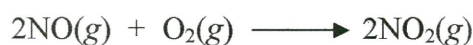
   (5 marks)

Q7   (a)   Calculate how much heat is released when 235.0 g glucose is burned in this reaction:

   $$C_6H_{12}O_6\ (s)\ +\ 6O_2(g) \longrightarrow 6CO_2 + 6H_2O(g), \quad \Delta H = -2801\,kJ$$

   (Relative atomic mass: C = 12.00, H = 1.00, O = 16.00)
   (5 marks)

   (b)   Consider the reaction

   $$2NO(g)\ +\ O_2(g) \longrightarrow 2NO_2(g)$$

   Data for the above reaction are given in the table.

Experiment	Concentration (mol/L)		Initial Rate (mol/L.hour)
	[NO]	[O$_2$]	
1	3.6×10^{-4}	5.2×10^{-3}	3.4×10^{-8}
2	3.6×10^{-4}	1.04×10^{-2}	6.8×10^{-8}
3	1.8×10^{-4}	1.04×10^{-2}	1.7×10^{-8}
4	1.8×10^{-4}	5.2×10^{-3}	?

   (i)   Write the rate law for this reaction.

   (ii)   Determine the order of NO, O_2 and overall reaction.

   (iii)   Calculate the rate constant, k.

   (iv)   Calculate the initial rate of the reaction in experiment 4.
   (15 marks)

– END OF QUESTIONS –

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FINAL EXAMINATION		
SEMESTER: **1**	SESSION : **2016/2017**	PROGRAMME: 1 DAM
COURSE : **CHEMISTRY**	COURSE CODE: **DAS 12203**	

FORMULAE

1. Number of moles $= \dfrac{MV}{1000}$

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

3. $pH + pOH = 14$

4. $P_1V_1 = P_2V_2$

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

6. $PV = nRT$

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