Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12203
PROGRAMME	:	DAA
EXAMINATION DATE	:	JUNE/JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN SECTION A AND **TWO (2)** QUESTIONS IN SECTION B.

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

SECTION A

Q1 (a) Define the term *Homogeneous* and *Heterogeneous* equilibrium.

(2 marks)

(b) At 80°C, a 5000 mL flask contains 2.6 M HCl, 2.0 M H_2 and 0.75 M Cl_2. The equation for the reaction is:

$$2HCl\ (g) \rightleftharpoons H_2\ (g) + Cl_2\ (g) \qquad \textit{Equation 1}$$

(i) Identify whether the equilibrium in *Equation 1* is homogeneous or heterogeneous.

(1 mark)

(ii) Find the K_c for both forward and reverse reactions in *Equation 1*.

(3 marks)

(iii) Calculate the K_c for the given reaction in *Equation 1* if the value of K_p at 270°C is 2.6×10^{-4}.

(3 marks)

(iv) Calculate K_c if the partial pressures in *Equation 1* are 1.2 atm HCl, 1.0 atm H_2 and 1.5 atm Cl_2.

(4 marks)

(v) If the reaction in *Equation 1* is reduced to half, find K_c for the forward reaction.

(2 marks)

(c) (i) State the Le Chatelier's principle.

(2 marks)

(ii) Given a system in equilibrium:

$$2NO\ (g) + O_2\ (g) \rightleftharpoons 2NO_2\ (g),\ \Delta H° = -112\ kJ$$

Predict the shift on the equilibrium position when

(1) Pressure of the system is increased at constant temperature.
(2) NO gas is removed.
(3) Catalyst is added.

(3 marks)

Q2 (a) Define acid and base according to the theory of Arrhenius and give the related examples.

(4 marks)

(b) (i) The concentration of hydrogen ion, H^+ for a sample of nitric acid is 6.213×10^{-3} M . Calculate the pH of the acid.

(2 marks)

(ii) Calculate the pOH of a sample of mineral water with the concentration of hydrogen ion 7.415×10^{-10} M.

(3 marks)

(c) A 0.0853 g quantity of acetic acid, CH_3COOH is dissolved in enough water to make 250.0 mL of solution. Calculate the concentration of H^+, $HCOO^-$ and CH_3COOH at equilibrium.

[Atomic mass, A: C=12, H=1, O=16; $K_a = 1.8 \times 10^{-5}$]

(11 marks)

Q3 (a) (i) Define oxidizing agent and reducing agent in terms of electron gain or loss.

(2 marks)

(ii) Write the relationship between the numbers of electrons gained and lost in a redox reaction.

(1 mark)

(b) Assume that a voltaic cell utilizes the redox reaction.

$$2\ Al(s) + 3\ Ni^{2+}(aq) \longrightarrow 2\ Al^{3+}(aq) + 3\ Ni(s)$$

(i) Write the reactions occur and identify the electrodes.

(6 marks)

(ii) Construct the cell diagram for the above reaction.

(2 marks)

(c) Given an ionic equation for an electrochemical cell:

$$Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$$

(i) Write half – reaction for the anode and cathode.

(4 marks)

(ii) Determine the $E°_{cell}$ for this reaction.

(2 marks)

(iii) Calculate the cell potential, E_{cell} when $[Zn^{2+}] = 1.0$ M and $[H^+] = 6.3 \times 10^{-6}$ M.

(3 marks)

SECTION B

Q4 (a) Given the combustion reaction of glucose in our daily meal:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

If 856.0 g of glucose, $C_6H_{12}O_6$ is consumed by a person over a certain period, calculate the mass of carbon dioxide produced.
[Relative atomic mass: C = 12, H = 1, O = 16]

(5 marks)

(b) (i) Write the balanced equation for:

$$Cu(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + NO(g) + H_2O(g)$$

(5 marks)

(ii) Calculate the number of mole of $Cu(NO_3)_2$ that can be produced by the reaction of 123.50 g Cu with 1.45 mole HNO_3.
[Relative atomic mass: Cu = 63.55, H = 1, N = 14.01, O = 16]

(6 marks)

(c) Given a balanced neutralization reaction:

$$H_2SO_4(aq) + Ca(OH)_2(aq) \rightarrow CaSO_4(aq) + 2H_2O(l)$$

Calculate the volume of 0.125 M H_2SO_4 that will completely react with 200 mL of 0.30 M $Ca(OH)_2$.
[Relative atomic mass: Ca = 40, H = 1, O = 16, S = 32]

(4 marks)

Q5 (a) The atomic number of magnesium, Mg is 12.

(i) Write the electron configuration for Mg^{2+} ion.

(2 marks)

(ii) Draw the orbital diagram for all electrons in Mg^{2+} ion according to Hund's rule.

(2 marks)

(iii) Determine the magnetic property of the ion.

(1 mark)

(iv) Determine the four quantum numbers of Mg^{2+} ion.

(5 marks)

(b) The following sets of quantum numbers are incorrect. Identify the incorrect quantum number and explain why it is incorrect.

(i) (2, 1, 2, +½)

(3 marks)

(ii) (1, 0, 0, 1)

(3 marks)

(c) Two electrons in the same atom have the following set of quantum numbers.

Electron A : (3, 1, 0, +½)
Electron B : (3, 1,-1, +½)

(i) Identify the subshell for these electrons.

(2 marks)

(ii) Verify that the electrons are in the same orbital. Give your reason.

(2 marks)

Q6 (a) The atomic number of Silicone, Si is 14 and Oxygen, O is 8.

(i) Write the Lewis dot symbol for Si and O atoms.

(2 marks)

(ii) Draw the Lewis dot symbol to show the formation of silicon dioxide, SiO_2 .

(4 marks)

(iii) Calculate the formal charge for each atom of SiO_2 .

(4 marks)

(b) Ethylene dibromide (EDB) was formerly used as a fumigant for fruits and grains, but now it is banned because it is a potential health hazard. EDB is a liquid that boils at 109 °C. Its molecular weight is 188 g/mol. Compute its density as at 165 °C and 1.00 atm.

(6 marks)

(c) A 10 L flask contains 0.200 moles of methane, CH_4, 0.300 mole of hydrogen, H_2 and 0.400 mole of nitrogen, N_2 at 25 °C.

(i) Determine the pressure inside the flask (in *atmosphere*).

(2 marks)

(ii) Calculate the partial pressure of each component in the mixture of gases

[R = 0.0821 L.atm / mol.K]

(2 marks)

Q7 (a) (i) Sodium hydrogen carbonate, $NaHCO_3$ dissociates to $Na_2CO_3(s)$, $CO_2(g)$ and $H_2O(l)$. From the following ΔH_f^o , calculate ΔH^o for the dissociation of $NaHCO_3(s)$.

ΔH_f^o $Na_2CO_3(s)$ = -1429.0 kJ/mol,
ΔH_f^o $NaHCO_3(s)$= -710.0 kJ/mol,
ΔH_f^o $CO_2(g)$= -393.0 kJ/mol,
ΔH_f^o $H_2O(l)$. = -286.0 kJ/mol.

(4 marks)

(ii) By using the following data, calculate the standard enthalpy change, ΔH_f^o for the reaction of

$BrCl(g) \rightarrow Br(g) + Cl(g)$, $\Delta H_f^o = ?$

$Br_2(l) \rightarrow Br_2(g)$, $\Delta H_f^o = +30.91$ kJ
$Br_2(g) \rightarrow 2Br(g)$, $\Delta H_f^o = +192.90$ kJ
$Cl_2(g) \rightarrow 2Cl(g)$, $\Delta H_f^o = +243.40$ kJ
$Br_2(l) + Cl_2(g) \rightarrow 2BrCl(g)$, $\Delta H_f^o = +29.20$ kJ

(6 marks)

(b) (i) Consider the reaction

$4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g)$

Given, at a particular moment during the reaction, molecular oxygen is reacting at the rate of 0.0235 M/s. Determine at what rate is

(1) N_2O_5 being form.
(2) NO_2 reacting.

(3 marks)

(ii) For the reaction of nitric oxide with hydrogen at 1280°C,

$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$,

the following data are obtained.

Experiment	[NO] ($mol.L^{-1}$)	[H_2] ($mol.L^{-1}$)	Rates ($mol.L^{-1}s^{-1}$)
1	0.005	0.002	1.3×10^{-5}
2	0.010	0.002	5.0×10^{-5}
3	0.010	0.004	10.0×10^{-5}

Determine (1) the rate law,
(2) the rate constant,
(3) the rate of the reaction when [NO] = 0.012 M and [H_2] = 0.006 M.

(7 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

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FORMULA

1. $n = \frac{MV}{1000}$
2. $M_1V_1 = M_2V_2$
3. $\frac{M_aV_a}{a} = \frac{M_bV_b}{b}$
4. $pH = - \log [H^+]$
5. $pH + pOH = 14$
6. $P_1V_1 - P_2V_2$
7. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
8. $PV=nRT$
9. $K_p = K_c(RT)^{\Delta n}$
10. $Q=ms\Delta T$