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UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015**

COURSE NAME : CHEMISTRY
COURSE CODE : DAS 12102
PROGRAMME : 2 DAE
EXAMINATION DATE : DECEMBER 2014 / JANUARY 2015
DURATION : 2½ HOURS
INSTRUCTION : ANSWER FOUR (4) QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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- Q1** (a) Determine the empirical formula of a compound with the following weight percent composition.

$$C = 40.1\% ; H = 6.6\% \text{ and } O = 53.3\%$$

(7 marks)

- (b) Sodium hydroxide (NaOH) reacted with sulphuric acid (H_2SO_4) forming sodium sulphate (Na_2SO_4) and water molecule (H_2O).

- (i) Write a balance chemical equation of the reaction.

(3 marks)

- (ii) From **Q1(b)(i)**, find the number of gram of Na_2SO_4 being formed when 4 mole of NaOH reacted.

(6 marks)

- (c) A container with a volume of 10 L has a mixture of two gases, H_2 (hydrogen) and O_2 (oxygen). At $65^\circ C$, the partial pressures of the hydrogen and oxygen are 0.250 and 0.500 atm respectively. Find the total number of mole of the gas in the mixture. Gas constant, $R = 0.0821 \text{ L.atm/mol.K}$.

(9 marks)

(Atomic Mass: C = 12 ; H = 1 ; O = 16 ; Na = 23 ; S = 32)

- Q2** (a) Atomic number (Z) of two elements, calcium (Ca) and chlorine (Cl) are 20 and 17 respectively.

- (i) Write the electron configuration of both elements.

(4 marks)

- (ii) Determine the group and period of both elements.

(4 marks)

- (iii) Write equations showing the formation of calcium and chlorine ions and ionic compound calcium chloride.

(6 marks)

- (b) Draw the Lewis structure formula of chlorate ion, ClO_3^- . Atomic number of Cl = 17 and O = 8.

(6 marks)

- (c) A gas occupies a volume of 50 L at a pressure of 5 atm and temperature of $60^\circ C$. Find the temperature if both the volume and pressure were raised to 100 L and 50 atm respectively.

(5 marks)

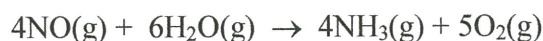
Q3 (a) Define the following terms complete with the correct unit.

(i) Heat capacity, C . (3 marks)

(ii) Specific heat, s . (3 marks)

(iii) Calculate the specific heat of iron if 10 gram of it needs 500 J of heat to increase the temperature from 20 °C to 50 °C. (5 marks)

(b) Find ΔH_{rxn}° of the following reaction.



Given:

$$\Delta H_f^{\circ}(\text{NH}_3) = -45.9 \text{ kJ/mol} \quad ; \quad \Delta H_f^{\circ}(\text{H}_2\text{O}) = -241.8 \text{ kJ/mol}$$

$$\Delta H_f^{\circ}(\text{NO}) = 90.3 \text{ kJ/mol} \quad ; \quad \Delta H_f^{\circ}(\text{O}_2) = 0$$

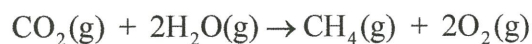
(5 marks)

(c) Using Hess's Law and the following thermochemical reactions, find the heat of formation (ΔH_f°) of pentane (C_5H_{12}).



(9 marks)

- Q4** (a) Write the rate expression for the following reaction.



(4 marks)

- (b) Consider the following reaction:



A rate study of this reaction was conducted at 298 K. The data that were obtained are shown in the table.

Experiment	[NO]/M	[H ₂]/M	Initial Rate/Ms ⁻¹
1	0.30	0.35	2.835 x 10 ⁻³
2	0.60	0.35	11.340 x 10 ⁻³
3	0.60	0.70	22.680 x 10 ⁻³

- (i) Find the reaction order of NO and H₂.
(8 marks)
- (ii) Write the rate law of the reaction.
(1 mark)
- (iii) Find the value of rate constant, *k*.
(3 marks)
- (c) (i) Explain the effects of increasing temperature on the reaction rate.
(3 marks)
- (ii) Define a catalyst.
(2 marks)
- (iii) Draw an energy diagram showing the path of a reaction with and without a catalyst.
(4 marks)

- Q5** (a) Phosgene decomposes at high temperatures to carbon monoxide and chlorine:



At 600 K, 0.124 M (mol/L) of COCl_2 is placed in a container and allowed to achieve equilibrium.

- (i) Redraw and complete the following table:

Table Q5(a)

	$\text{COCl}_2(\text{g})$	$\text{CO}(\text{g})$	$\text{Cl}_2(\text{g})$
Initial/M	0.124	0	0
Change/M	-x		
Equilibrium			

(5 marks)

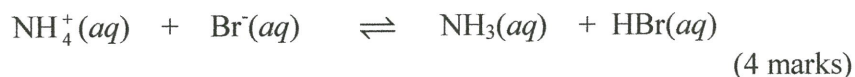
- (ii) Assuming $x \ll 0.124$, find x , given $K_c = 0.0041$ at 600 K.
(6 marks)

- (b) Define

- (i) Lewis acid.
(2 marks)

- (ii) Lewis base.
(2 marks)

- (c) Identify the Bronsted Lowry acid and base and their conjugate pairs in the following reaction:



- (d) Concentration of OH^- ion in a detergent solution is equal to 0.0025 M. Given, $\text{p}K_w = 14$ for neutral water at 25 °C, find the

- (i) Concentration of H^+ ion in the detergent solution.
(3 marks)

- (ii) pH of the detergent solution.
(3 marks)

- Q6** (a) (i) Define the redox reaction. (3 marks)
- (ii) Given the following redox reaction of
- $$2\text{Ag}(s) + \text{Cu}^{2+}(aq) \rightarrow 2\text{Ag}^+(aq) + \text{Cu}(s)$$
- Write the oxidation and reduction reactions. (2 marks)
- (b) Explain the following electrochemical cells.
- (i) Galvanic/voltaic cell. (3 marks)
- (ii) Electrolytic cell. (3 marks)
- (c) Given the voltaic cell reaction of
- $$2\text{Al}(s) + 3\text{Mn}^{2+}(aq) \rightarrow 2\text{Al}^{3+}(aq) + 3\text{Mn}(s)$$
- (i) Write the anode and cathode reactions. (4 marks)
- (ii) Find E_{cell}° . Given $E_{\text{Al}^{3+}/\text{Al}}^{\circ} = -1.66 \text{ V}$ and $E_{\text{Mn}^{2+}/\text{Mn}}^{\circ} = -1.18 \text{ V}$ (5 marks)
- (d) (i) Define the term corrosion. (3 marks)
- (ii) Explain two methods to prevent corrosion. (2 marks)

- END OF QUESTION -

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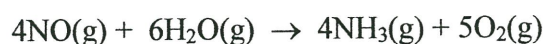
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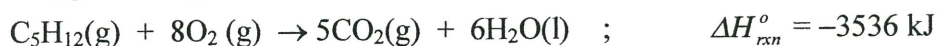
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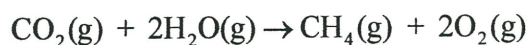
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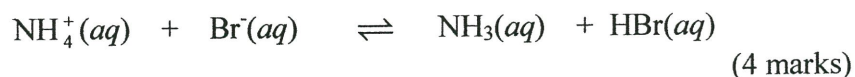
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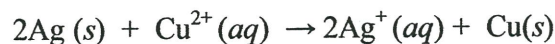
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(2 marks)

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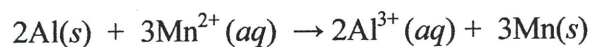
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(2 marks)

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