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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018**

COURSE NAME : CHEMISTRY
COURSE CODE : DAS 12102
PROGRAMME CODE : DAE
EXAMINATION DATE : DECEMBER 2017 / JANUARY 2018
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER FIVE (5) QUESTIONS ONLY

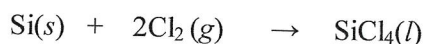
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THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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- Q1 (a) Water is added to 25.00 mL of 0.250 M KNO_3 solution until the volume of the solution is exactly 500.00 mL. Calculate the concentration of the final solution. (3 marks)

- (b) Silicon tetrachloride (SiCl_4) can be prepared by heating Si in chlorine gas through the following reaction.



In one reaction, 0.500 mol of SiCl_4 is produced. Find the number of mole of chlorine gas used in the reaction.

(3 marks)

- (c) Peroxyacetyl nitrate (PAN) is one of the components of smog. It is a compound of C, H, N, and O. Given the original mass composition is 100% and mass percent of C = 19.8% ; H = 2.50% and N = 11.6%.

- (i) Find the percent mass composition of oxygen atom.

(2 marks)

- (ii) If the molar mass of peroxyacetyl nitrate is 121 g, find the molecular formula.

(7 marks)

- (d) Urea (NH_2)₂CO is used for the production of fertilizer and many other products. Calculate the mass (in gram) of N, C, O and H atoms in 120 g of urea.

(5 marks)

- Q2 (a) Atomic number (Z) of two elements, magnesium (Mg) and chlorine (Cl) are 12 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 ionic compound magnesium chloride.

(3 marks)

- (b) Draw the Lewis structure formula of carbonate ion, CO_3^{2-} . Atomic number of C = 6 and O = 8.

(9 marks)

- Q3** (a) State the following gas laws.
- (i) Boyle's Law.
 - (ii) Charles's Law.
 - (iii) Avogadro's Law.
- (6 marks)
- (b) A sample of gas occupies a volume of 754 mL at 22 °C and a pressure of 165 mmHg. Determine the volume if the temperature is increased to 42 °C and the pressure increased to 265 mmHg?
- (4 marks)
- (c) (i) Calculate the mass (in gram) of 15.50 L NO₂ gas at STP.
- (4 marks)
- (ii) A 50 L sealed cylinder contains 100 moles of helium gas. Its pressure at 0 °C is 44.80 atm. Find the change in pressure when the gas is heated to 250 °C.
- (6 marks)
- Q4** (a) Define the following terms and give their unit.
- (i) Heat capacity.
- (2 marks)
- (ii) Specific heat.
- (2 marks)
- (b) Calculate the final temperature of 50.0 g of water if 1.22 kJ of heat is transferred to the water at 25.0 °C. Given the specific heat of water, $s = 4.18 \text{ J/g}\cdot^\circ\text{C}$.
- (4 marks)
- (c) Define standard enthalpy of combustion. Give the reasons why most of the enthalpy is negative in value.
- (4 marks)
- (d) Given the following thermochemical reaction:
- $$2(\text{CH}_3)_2\text{CHOH} + 9\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 8\text{H}_2\text{O}(\text{g}); \Delta H_{\text{rxn}}^\circ = -4011 \text{ kJ.}$$
- Calculate the standard state heat of formation (ΔH_f°) of (CH₃)₂CHOH by using the following standard heat of formation.
- $$\Delta H_f^\circ(\text{H}_2\text{O}) = -285.8 \text{ kJ}\cdot\text{mol}^{-1}; \Delta H_f^\circ(\text{CO}_2) = -393.5 \text{ kJ}\cdot\text{mol}^{-1}$$
- (8 marks)

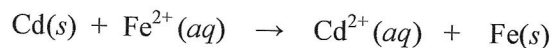
- Q5** (a) (i) Write the definition of strong acid. Give one (1) example of strong acid and write its dissociation equation in solution. (3 marks)
- (ii) Find the conjugate base and acid of the equations illustrating the following Bronstead-Lowry acid-base reactions between H_2S as an acid with H_2O .



(2 marks)

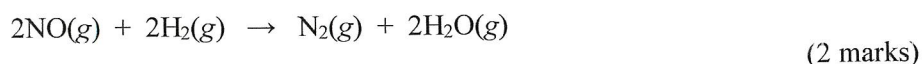
- (b) Calculate the pH and pOH of a 1.5×10^{-2} M solution of strong acid, HClO_4 . (6 marks)
- (c) (i) Write the ion dissociation of formic acid in solution. (1 mark)
- (ii) Write the equilibrium expression of formic acid in solution. (1 mark)
- (iii) Find the pH of 0.18 M formic acid, HCOOH . $K_a = 1.77 \times 10^{-4}$. (7 marks)

- Q6** (a) Differentiate a reduction and oxidation reactions in the electrochemical process. (6 marks)
- (b) Draw a diagram of NaCl electrolytic cell and explain what happen in the cell when an electric current is passing through. (4 marks)
- (c) A voltaic cell is represented by following redox reaction.



- (i) Write the half cell reactions at the anode and cathode. (3 marks)
- (ii) Calculate the E°_{cell} of this reaction at 298 K. (3 marks)
- (iii) Calculate E_{cell} , given $[\text{Cd}^{2+}] = 0.015$ M, and $[\text{Fe}^{2+}] = 0.200$ M (4 marks)
- Given: $E^\circ(\text{Fe}^{2+}/\text{Fe}) = 0.77$ V and $E^\circ(\text{Cd}^{2+}/\text{Cd}) = -0.40$ V

- Q7** (a) Write the rate expression for the following reaction in terms of the disappearance of reaction and the appearance of product.



- (b) Referring to **Q7(a)**, suppose that at a particular moment during the reaction, molecular nitrogen is formed at the rate of 0.035 M/s. Calculate the rate of

(i) H_2O being formed. (2 marks)

(ii) NO reacting. (2 marks)

- (c) Nitrosyl chloride, NOCl , decomposes slowly to NO and Cl_2 as follows:



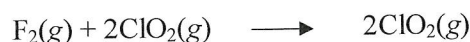
The rate law shows that the rate is second order in NOCl .

$$\text{Rate} = k [\text{NOCl}]^2$$

The rate constant $k = 0.020 \text{ L}\cdot\text{mol}^{-1}\cdot\text{s}^{-1}$ at a certain temperature. If the initial concentration of NOCl in a closed reaction vessel is 0.050 M, determine the concentration after 30 minutes?

(4 marks)

- (d) The reaction of fluorine with chlorine dioxide is given as follows:



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

Experiment	$[\text{F}_2]$ (M)	$[\text{ClO}_2]$ (M)	Reaction rate (M/s)
1	0.10	0.010	1.2×10^{-3}
2	0.10	0.040	4.8×10^{-3}
3	0.20	0.010	2.4×10^{-3}

- (i) Write the general rate law. (1 mark)
- (ii) Find the rate constant, k . (7 marks)
- (iii) Calculate the reaction rate when $[\text{F}_2] = 12.0 \times 10^{-3} \text{ M}$ and $[\text{ClO}_2] = 6.0 \times 10^{-3} \text{ M}$. (2 marks)

– END OF QUESTION –

FINAL EXAMINATION

SEMESTER / SESSION: I/ 2017/2018

PROGRAMME : 2 DAE

COURSE : CHEMISTRY

COURSE CODE: DAS 12102

TABLE OF DATAAtomic Mass

Atom	Symbol	Mass / amu
Carbon	C	12
Chlorine	Cl	35.5
Hydrogen	H	1
Nitrogen	N	14
Oxygen	O	16
Silicon	Si	28

Constant

Gas constant	R	0.0821 L.atm / mol.K
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