Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAS 12102
PROGRAMME	:	2 DAE
EXAMINATION DATE	:	DECEMBER 2016 / JANUARY 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) A sample of an oxide of nitrogen is found to contain 30.4 % nitrogen. Determine the empirical formula of the nitrogen oxide. Atomic mass/amu: N = 14, O = 16.

(8 marks)

(b) Element *X* consists of two isotopes with masses of 62.9 amu and 64.9 amu respectively . The relative atomic mass of *X* is 63.6 amu. Calculate the abundance percentage of the isotopes.

(7 marks)

(c) An iodized salt contains 0.5 % of NaI. A person consumes 3 g of salt every day. Calculate the number of iodide ions (in gram) going into his body every day. Atomic mass/amu: Na = 23, I = 127)

(5 marks)

Q2 (a) (i) Write the electron configuration of vanadium atom. Atomic number of vanadium is 23.

(4 marks)

(ii) Determine the magnetic property of vanadium atom. State your reason.

(2 marks)

(b) (i) Discuss the change in atomic radius down the group and across the period of periodic table.

(4 marks)

(ii) Define ionization energy of an atom.

(2 marks)

(c) (i) Determine the valence electrons of phosphorus and chlorine atoms. Atomic number: P = 15, Cl = 17.

(4 marks)

(ii) Draw the Lewis structural formula of PCl_3 molecule.

(4 marks)

Q3 (a) A gas sample occupies a volume of 350 mL at 546 mmHg and 25 °C. Find the volume of the gas at 652 mmHg and 35 °C.

(6 marks)

(b) A birthday party balloon is filled with 0.045 g of helium gas. If the volume takes up 750 mL of space and has a pressure of 325 mmHg, determine the temperature (in °C) inside the balloon. Molar mass of helium = 4 g/mol and gas constant, R = 0.0821 L.atm/mol.K

(8 marks)

(c) (i) State the volume of one mole of any gas at STP?

(1 mark)

(ii) Calculate the number of mole contained in 2.5 L of CO_2 at STP.

(5 marks)

Q4 (a) Define

(i) exothermic reaction.

(2 marks)

(ii) specific heat capacity.

(2 marks)

(b) Baking powder, $NaHCO_3$ dissociates to $Na_2CO_3(s)$, $CO_2(g)$ and $H_2O(g)$ when was heated.

(i) Write a balance dissociation equation of $NaHCO_3$.

(2 marks)

(ii) Calculate the enthalpy change (ΔH^o) for the dissociation of $NaHCO_3(s)$.
Given:
$\Delta H^\circ_f (Na_2CO_3)(s) = -1429.0$ kJ mol^{-1}
$\Delta H^\circ_f (NaHCO_3)(s) = -710.0$ kJ mol^{-1}
$\Delta H^\circ_f (CO_2)(g) = -393.0$ kJ mol^{-1}
$\Delta H^\circ_f (H_2O)(l) = -286.0$ kJ mol^{-1}.

(5 marks)

(c) From the given thermochemical reaction data, calculate the $\Delta H^\circ_f (C_2H_2)$ from the formation reaction

$$2C(\text{graphite}) + H_2(g) \rightarrow C_2H_2(g)$$

$C(\text{graphite}) + O_2(g) \rightarrow CO_2(g)$, $\Delta H^\circ_{rxn} = -393.5$ kJ
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$, $\Delta H^\circ_{rxn} = -285.8$ kJ
$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(\ell)$, $\Delta H^\circ_{rxn} = -2598.8$ kJ

(9 marks)

Q5 (a) (i) Write the equilibrium constant (K_c) expression for the reaction

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(2 marks)

(ii) 3 moles of N_2 gas and 9 moles H_2 gas were mixed in a 1 L vessel at a temperature *T*. There were 2 moles of ammonia in the vessel at equilibrium. Calculate the value of K_c of the reaction.

(10 marks)

(b) Define acid and base according to Bronsted-Lowry theory.

(2 marks)

(c) Calculate the pH of 0.5 M NaOH solution. Given $K_w = 1.0 \times 10^{-14}$.

(6 marks)

Q6 (a) Define the following terms.

(i) Voltaic cell.

(2 marks)

(ii) Electrolytic cell.

(2 marks)

(b) Given the following standard state reduction reactions.

$$Ag^+ + e \rightarrow Ag \quad , \quad E^o = 0.80 \text{ V}$$
$$Fe^{3+} + e \rightarrow Fe^{2+} \quad , \quad E^o = 0.77 \text{ V}$$

(i) If the given reactions forming a voltaic cell, write the oxidation and reduction reactions of the cell.

(3 marks)

(ii) Determine the anode and cathode.

(2 marks)

(iii) Calculate the cell voltage.

(3 marks)

(c) Given the following electrochemical cell reaction at 298 K.

$$Co^{2+}(aq) + Fe(s) \longrightarrow Co(s) + Fe^{2+}(aq)$$

(i) Write the anode and cathode reactions.

(2 marks)

(ii) Using Nernst's equation, calculate the cell voltage at 298 K when $[Fe^{2+}] = 0.68$ M and $[Co^{2+}] = 0.15$ M. Given: $E^o_{Co^{2+}/Co} = -0.2$, $E^o_{Fe^{2+}/Fe} = -0.44$ V.

(6 marks)

Q7 (a) Consider the reaction below and the rate reaction data.

$$X + Y \rightarrow Z$$

Experiment	Rate of reaction (M/s)	[X] (M)	[Y] (M)
1	1.35×10^{-1}	0.10	0.0050
2	2.70×10^{-1}	0.10	0.010
3	5.40×10^{-1}	0.20	0.010

Given the reaction rate equation is

$$R = k[X]^x [Y]^y$$

where k is the rate constant, x and y are the order of X and Y respectively.

(i) Determine x and y.

(8 marks)

(ii) Calculate the rate constant, k.

(3 marks)

(iii) Calculate the rate of reaction when the concentration of X is 0.030 M and Y is 0.040 M.

(3 marks)

(b) (i) Define a catalyst.

(2 marks)

(ii) Draw the energy diagram showing the path of a reaction with and without a catalyst.

(4 marks)

– END OF QUESTION –