UNIVERSITI TUN HUSSEIN ONN MALAYSIA

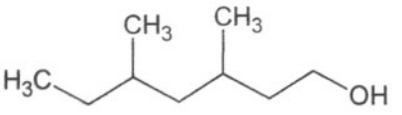
FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	CHEMISTRY
CODE	:	DSK 1913
COURSE	:	1 DDM/DDT/DFA/DFT 2 DDM/DFA 3 DFT
DATE	:	APRIL 2010
DURATION	:	2½ HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **FOUR (4)** QUESTIONS IN **PART B**

THIS EXAMINATION PAPER CONSISTS OF 6 PAGES

Q3 (a) (a) Name the following structure:

(i)



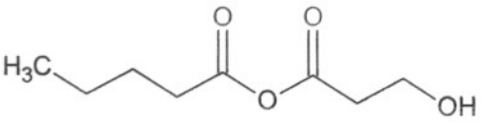
(ii)

(2 marks)

(b) **Describe the differences between an alkane and an alkene.**

(3marks)

(c) **Redraw the following structure, circle and name the functional groups present in the compound.**

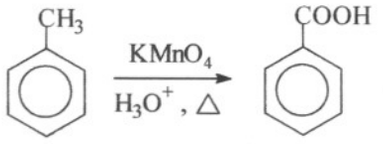


(3 marks)

(d) Determine whether the following reaction is oxidation or reduction.

(i) $CH_3\text{-}CH_2\text{-}CO\text{-}CH_3 \xrightarrow{NaBH_4} CH_3\text{-}CH_2\text{-}CHOH\text{-}CH_3$

(ii)



Toluene Benzoic acid

(2 marks)

PART B

Q4 (a) Define Dalton's Law of partial pressure and Graham's Law of effusion. (2 marks)

(b) A student needs to prepare some CO_2 which is collected in a flask according to the following reaction.

$$CaCO_3\,(s) \longrightarrow CO_2\,(g) + CaO\,(s)$$

The pressure of the CO_2 is to be 740 torr, and its final temperature is to be 25 °C if 1.25 g of $CaCO_3$ is used.

(i) How many moles of $CaCO_3$ are used?
(ii) How many moles of CO_2 are produced in this reaction?
(iii) What is the volume of the flask that can hold the CO_2?
(Relative atomic mass : C = 12, O = 16, Ca = 40, R = 0.0821 L.atm/mol.K)
(7 marks)

(c) Calculate the approximate molar mass of a gas, if the measured density is 3.33 g/L at 30 °C and 780 mmHg.
(6 marks)

Q5 (a) List all possible values of the four quantum numbers for an electron in the 4*p* orbital. (7 marks)

(b) Which atom should have higher second ionization energy; lithium or beryllium? Explain.
(Atomic number, *Z* : Li = 3, Be = 4)
(4 marks)

(c) Arrange the following isoelectronic species O^{2-}, F^-, Na^+, Mg^{2+} in order of:
(i) increasing ionic radius,
(ii) increasing ionization energy.
(Atomic number, *Z* : O = 8, F = 9, Na = 11, Mg = 12)
. (4 marks)

Q6 Draw resonance structures for the nitrate ion, NO_3^- and calculate the formal charges. (Atomic number, Z: N = 7, O = 8)

(15 marks)

Q7 (a) Given the following thermochemical equation:

$$2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(\ell), \quad \Delta H^o = -2{,}856.0 \text{ kJ}$$

Write the thermochemical equation for the formation of
(i) 1 mol $CO_2(g)$ by burning $C_2H_6(g)$
(ii) 1 mol $C_2H_6(g)$ by reacting $CO_2(g)$ with $H_2O(\ell)$.

(4 marks)

(b) Benzene, C_6H_6 is an important hydrocarbon in gasoline. Calculate the enthalpy of combustion, ΔH_c^o.

$$C_6H_6(\ell) + {}^{15}\!/_{2}\, O_2(g) \rightarrow 6CO_2(g) + 3H_2O(\ell)$$

Given the following data :
ΔH_f^o $C_6H_6(\ell)$ = 49.0 kJ/mol
ΔH_f^o $H_2O(\ell)$ = - 285.8 kJ/mol
ΔH_f^o $CO_2(g)$ = - 393.5 kJ/mol

(5 marks)

(c) Calculate the standard enthalpy change, ΔH_f^o for the formation of 1 mol strontium carbonate, $SrCO_3$ (compound that gives the red colour in fireworks).

$$Sr(s) + C(\text{graphite}) + {}^{3}\!/_{2}\, O_2(g) \rightarrow SrCO_3(s)$$

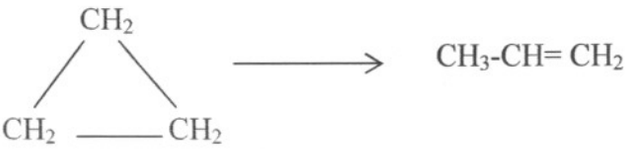
Given the following data :
$Sr(s) + \frac{1}{2} O_2(g) \rightarrow SrO(s), \quad \Delta H^o = -592.0$ kJ
$SrCO_3(s) \rightarrow SrO(s) + CO_2(g), \quad \Delta H^o = 234.0$ kJ
$C(\text{graphite}) + O_2(g) \rightarrow CO_2(g), \quad \Delta H^o = -394.0$ kJ

(6 marks)

Q8 (a) Write the rate expression for the following reactions:
(i) $H_2(g) + I_2(g) \rightarrow 2HI(g)$
(ii) $3O_2(g) \rightarrow 2O_3(g)$

(2 marks)

(b) The conversion of cyclopropane to propene in the gas phase is a first-order reaction with a rate constant of $6.7 \times 10^{-4}\ s^{-1}$ at 500 °C.



(i) If the initial concentration of cyclopropane was 0.25 M, what is the concentration after 8.8 minutes.

(4 marks)

(ii) How long (in minutes) will it take for the concentration of cyclopropane to decrease from 0.25 M to 0.15 M?

(3 marks)

(iii) How long will it take to convert 74% of the starting material?

(3 marks)

(c) Calculate the half life of the decomposition of N_2O_5 (a first-order reaction) with a rate constant of $6.7 \times 10^{-4}\ s^{-1}$ at 500 °C.

(3 marks)

Q9 (a) Write the equilibrium expression K_c and/or K_p for the following equation:

$$NH_3(g) \rightleftharpoons NH_3(\ell)$$

(2 marks)

(b) K_c for the reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is 3.5×10^8 at 25°C. Calculate K_p.
($R = 0.0821$ L.atm/mol.K)

(4 marks)

(c) For the reaction: $N_2O_4(g) \rightleftharpoons 2\,NO_2(g)$

1.0×10^{-2} mole of $N_2O_4(g)$ is placed in a 2.0 litre flask at 50°C and allowed to achieve equilibrium. At equilibrium, $[N_2O_4]$ is 9.0×10^{-4} M. Calculate K_c.

(6 marks)

(d) The oxidation of NO to NO_2,

$$2\,NO(g) + O_2(g) \rightleftharpoons 2\,NO_2(g)$$

is exothermic. Predict how the equilibrium position would change if

(i) more NO_2 gas is added to the system,
(ii) temperature of the system is lowered,
(iii) more O_2 gas is added to the system.

(3 marks)