P525/ 2

CHEMISTRY

Paper 2

Oct. 2016

2½ hours

UACE MOCK EXAMINATION

CHEMISTRY

PAPER 2

2 hours 30 minutes

INSTRUCTIONS TO THE CANDIDATES

Answer **five** questions including **three** questions in section **A** and any **two** questions in section **B**.

Write the answers in the answer booklet provided.

Mathematical tables and graph papers are provided.

Begin each question on a fresh page.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Indicate the questions in the grid below.

Where necessary use C = 12 , O = 16 , H =1 , 1F = 96500C

Question						Total
Marks						

Turn Over

SECTION A

Attempt three questions from this section.

1. (a) Ethanoic acid is a weak acid.

    (i) What is meant by the term weak acid?   (01 mark)

    (ii) Calculate the pH of 0.25M ethanoic acid. (pKa of ethanoic acis is 4.76 at 25^0C)
    (03 marks)

    (iii) State and explain how temperature affects the pKa of ethanoic acid.

                                                                          (03marks)

    (b) Calculate the pH of the resultant solution when 25cm^3 of 0.1M sodium ethanoate was added to 75cm^3 of 0.25M ethanoic acid.

    (04marks)

    (c) The pH readings below refer to the titration of sodium hydroxide solution against 25.0cm^3 of a 0.1M ethanoic acidacid.

Volume of NaOH added / cm^3	0	4.0	6.0	8.0	10.0	12.0	14.0	14.6	14.8	15.0	15.2	15.4	16.0
pH	2.8	3.8	4.2	4.6	5.1	5.5	6.2	6.8	7.6	9.0	9.8	10.5	11.4

    (i) Plot a graph of pH against volume of sodium hydroxide added.

(03marks)

(ii) From the graph, determine the volume of sodium hydroxide needed to neutralize the acid.
(01 mark)

(iii) Calculate the molar concentration of the sodium hydroxide solution.

(03 marks)

(iv) Determine the ratio of $[CH_3COO^-]$: $[CH_3COOH]$ when 5 cm^3 of sodium hydroxide solution has been added to 25cm^3 of ethanoic acid.

(02 mark)

2. (a) The boiling points of group (VII) elements are in the order I_2> Br_2>Cl_2 >F_2 whereas the dissociation energy is in the reverse order.
Briefly explain this observation. (06 marks)

(b) Discuss the chemical differences between fluorine and chlorine with respect to
(i) water
(ii) sodium hydroxide solution (08 marks)

(c) The oxy- acids of chlorine include: $HClO$, $HClO_2$, $HClO_3$ and $HClO_4$
(i) Write and name the shapes adopted by the oxy- acids.

(04marks)
(ii) Which of the oxy- acid is the strongest acid? Give reason for your answer.
(02marks)

3. (a) Explain the terms
(i) Standard state of a substance.
(01mark)
(ii) Standard enthalpy of formation
(01mark)

(iii)   Standard enthalpy of combustion.   (01mark)

(b)   The standard enthalpy of combustion of carbon disulphide (CS_2), graphite and sulphur are. -1075 , -393.0 and , $-296.6 kJmol^{-1}$ respectively at 298K.

  (i)   Describe briefly how the standard enthalpy of combustion of carbon disulphide can be determined in the laboratory.

      (06marks)

  (ii) Calculate the standard enthalpy of formation of carbon disulphide at 298K.   (04marks)

(c)   The standard enthalpies of combustion of some substances are given below

Substance	ΔH combustion/ Kjmol -1
Hydrogen	- 286
Benzene	- 3302
Cyclohexene	- 3746
Cyclohexane	- 3940

Calculate the enthalpy of hydrogenation of

  (i)   cyclohexene
  (ii) Benzene   (05marks)

(d)   Comment on the relative stability of the benzene ring. (03marks)

4.   Write equation and outline a mechanism for the reaction between:

(a)   2- bromo- 2- methyl propane and hot aqueous potassium hydroxide.
(03½ marks)

(b)   Ethanal and acidified solution of sodium sulphite   (03½ marks)

(c)   Benzene and chlorine in the presence of hot aluminium metal.

(04marks)

(d)   Ethyl propanoate and alcoholic ammonia solution.

(04marks)

   (e)   Benzaldehyde and acidified solution of hydrazine.
(05marks)

SECTION B

Answer **two** questions from this section

5.   (a)   Define the following terms:

   (i)   Colligative property   (01mark)

   (ii)   Osmotic pressure.   (01mark)

   (b)   (i)   Describe an experiment to determine the molecular mass of

         mannitol by osmotic pressure method.
    (06marks)

   (ii)   State **three** limitations of this method.
    (1½ marks)

   (c)   The below shows the osmotic pressures of a solution of mannitol
       of various concentrations at 25°C.

Concentration of the solution (gdm^{-3})	1.5	3.0	4.5	6.0	7.5	9.0	10.5
Osmotic pressure of the solution (atm)	0.20	0.40	0.60	0.81	1.05	1.20	1.40

   (i)   Plot a graph of osmotic pressure against concentration of
       the solution.
       (3½ marks)

   (ii)   Explain the shape of the graph.
       (03marks)

(iii)   Use the graph to determine the relative molecular mass of mannitol.(R = 0.0821)   (03marks)

6.   An organic compound , molecular formula C_7H_7Br burns with a sooty flame and has two isomers **P** and **Q**.

(a)   **P** and **Q** are separated treated with hot aqueous potassium hydroxide solution followed dilute nitric acid and then silver nitrate solution.
P formed a pale yellow precipitate while with Q there was no observable change.
Identify
   (i)   **P**
   (ii) **Q**   (02marks)

(b)   Explain why **P** and **Q** showed differences in the reactivity with the reagent.   (05marks)

(c)   (i)   State the role of nitric acid in the reagent that distinguishes between **P** and **Q**.   (01marks)
      (ii) Write equations for the reactions that took place when **P** was treated with the reagent.
      (03marks)

(d)   Write equations to show how:
     (i)   **P** can be converted to phenylethene.
(5marks)
     (ii) **Q** can be prepared from benzoic acid
(04marks)

7.   Explain the following observations.
(a)   Lithium chloride is more soluble in ethanol than water whereas sodium chloride is more soluble in water than in ethanol.
                          (04marks)

(b)   An aqueous solution of sodium sulphate is neutral to litmus whereas an aqueous solution of sodium sulphite turns red litmus

blue.

(3marks)

(c) when dilute sulphuric acid was added to copper(I) oxide , blue solution and reddish brown solid were formed.   (03marks)

(d) When aqueous ammonia solution was added to nickel (II) sulphate solution a green precipitate was formed which dissolved to form a blue solution.   (05marks)

(e) When both sodium and magnesium were burnt in excess air and the products treated with water , there was effervescence of a gas in each case.   05marks)

8. (a) Describe briefly how concentrated nitric acid is manufactured from ammonia   (06marks)

(b) Discuss the reactions of nitric acid with:
    (i) copper
    (ii) sulphur   (06marks)

(c) The standard reduction potentials of some half reactions are shown below.

$I_2 (aq) + 2e \longrightarrow 2I^- (aq)$ $E^0 = + 0.54v$

$NO_3^- (aq) + 4H^+ (aq) + 3e \longrightarrow NO(g) + 2H_2O(l)$ $E^0 = +0.96v$

   (i) Write the overall cell reaction for the cell. (1½ marks)
   (ii) Determine the emf of the cell.   (1marks)
   (iii) Write the cell notation for the cell.   (1½ marks)
   (iv) State what would be observed at each half –cell. (02marks)
   (v) Calculate the standard free energy for the cell. (02marks)

END