

P525/2  
CHEMISTRY  
Paper 2

Mar./April. 2021  
2  $\frac{1}{2}$  hours.

S.6

## THE CHEMISTRY DEPARTMENT

2021

CHEMISTRY

PRE-UNEB ASSESSMENT TESTS, TERM III, Paper 2

2 hours 30 minutes

### INSTRUCTIONS:

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

*Write the answers in the answer booklet(s) provided.*

***Begin each question on a fresh page.***

*Mathematical tables and graph papers are provided.*

*Non-programmable scientific calculators may be used.*

*Use equations where necessary to illustrate your answers.*

*Where necessary, use the following:*

## SECTION A : ( 60 MARKS)

Answer **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. ( $pK_a$  of ethanoic acid is 4.76 at 25°C) (03 marks)

(iii) State and explain how temperature affects the  $pK_a$  of ethanoic acid. (03 marks)

(b) Calculate the pH of the resultant solution when 25 cm<sup>3</sup> of 0.1M sodium ethanoate was added to 75cm<sup>3</sup> of 0.25M ethanoic acid. (04 marks)

(c) The table below shows pH values for the titration of sodium hydroxide solution against 25.0cm<sup>3</sup> of 0.1M ethanoic acid.

Volume of sodium hydroxide added(cm <sup>3</sup> )	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. (03 marks)

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

(iii) Calculate the molar concentration of sodium hydroxide solution. (03 marks)

(iv) Determine the ratio of  $[CH_3COO^-]:[CH_3COOH]$  when 5 cm<sup>3</sup> of sodium hydroxide solution has been added to 25 cm<sup>3</sup> of ethanoic acid. (02 marks)

2. (a) (i) What is meant by the term “**electrode potential**”? (01 mark)
- (ii) State any **two** factors which determine the value of the standard electrode potential of an electrode. (02 marks)
- (iii) With the aid of a well labelled diagram, briefly describe how the standard electrode potential of a silver electrode can be measured. (06 marks)

(b) The standard electrode potentials for some electrodes are given as:



Write equation for the reaction at the:

- (i) anode (01 mark)
- (ii) cathode (01 mark)

(c) The data below shows the variation of conductivity when  $25.0\text{cm}^3$  of  $0.25\text{M}$  solution of an acid  $H_nX$  was titrated with  $0.25\text{M}$  sodium hydroxide solution.

Volume of sodium hydroxide( $\text{cm}^3$ )	0	10	20	30	50	70
Conductivity( $\text{ohm}^{-1}\text{m}^{-1}$ )	180.0	130.0	78.0	52.0	70.0	80.0

- (i) Plot a graph of conductivity against volume of sodium hydroxide added. (03 marks)
- (ii) Explain the shape of the graph. (03 marks)
- (iii) Determine the basicity of the acid,  $H_nX$  (03 marks)
3. Write the equations and outline the mechanism for the reactions that take place when:
- (a) Bromoethane is heated with a solution of sodium hydroxide in ethanol. (02 marks)
- (b) 2-methylpropene is reacted with bromine water. (03 marks)

- (c) 2-bromo-2-methylbutane is heated with a solution of sodium ethoxide in ethanol. (03 marks)
- (d) Ethanoylchloride is reacted with phenol in the presence of sodium hydroxide solution. (04 marks)
- (e) Benzene is heated with bromine in presence of iron. (03 marks)
- (f) Excess ethanol is heated with concentrated sulphuric acid at 140°C. (03 marks)
- (g) Chloromethane is heated with methylamine. (02 marks)
4. The elements; carbon, silicon, tin and lead belong to group IV of the Periodic Table.
- (a) State the oxidation states of the elements. (01 mark)
- (b) Explain the trend in stability of the oxidation states. (03 marks)
- (c) (i) State the type of bonding that is in the chlorides of lead. (01 mark)
- (ii) State **two** physical properties of each chloride that show the type of bonding you have mentioned above. (04 marks)
- (d) Describe the reactions of the chlorides of these elements with water. Write equations for the reactions that take place. (04 marks)
- (e) Describe the reactions of the oxides of the elements with sodium hydroxide. Write equations for the reactions that take place. (07 marks)


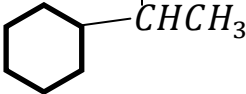
## SECTION B : (40 MARKS)

Answer any **two** questions from this section

5. Using equations only, show how the following conversions can be effected. Indicate the reagents and conditions.


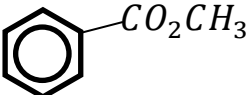
(a)  $H_2C = CH_2$  to  $(CH_3CH_2)_2O$  (02 marks)

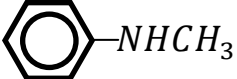
(b)  to  (04 marks)

(c)  to  (03 marks)

(d)  $CH_3CH_2OH$  to  $CH_3CH_2CH_2OH$  ( $3\frac{1}{2}$  marks)

(e)  $CH_3CH_2CH_2OH$  to  $(CH_3)_2C = O$  (03 marks)

(f)  to  (03 marks)

(g) Benzene to  (03 marks)

6. (a) (i) Write the electronic configuration of chromium. (Atomic number of Chromium is 24) ( $\frac{1}{2}$  mark)

(ii) State the oxidation states of chromium. ( $1\frac{1}{2}$  marks)

(b) Explain why chromium has a high melting point. (02 marks)

(c) Describe the reaction of chromium with:

(i) water (02 marks)

(ii) sulphuric acid. (04 marks)

(d) Explain the reactions that take place when the following are separately added to an aqueous solution of potassium chromium(III) sulphate. Write the equations for the reactions that take place.

(i) sodium hydrogencarbonate solution. (04 marks)

(ii) sodium hydroxide solution until in excess. (04 marks)

(e) Hydrogen peroxide was heated with the solution formed in (b)(ii) above.

(i) State what was observed. (01 mark)

(ii) Write the equation for the reaction that took place. (01mark)

7. (a) Define the term **standard enthalpy of combustion**. Illustrate your answer using methane. (02 marks)

(b) Describe an experiment to determine enthalpy of combustion of hexane. ( *Diagram not required*) (05 marks)

(c) The standard enthalpies of combustion of the first five straight chain alkanes and alcohols are shown in the table below

Number of carbon atoms	1	2	3	4	7
Enthalpy of combustion of alkanes( $\text{kJmol}^{-1}$ )	-890	-1560	-2220	-2877	-4800

(i) Plot a graph of enthalpies of combustion of alkanes against the number of carbon atoms. (03 marks)

(ii) Use the graph to determine the enthalpy of combustion of hydrogen and hexane. (02 marks)

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

(d) (i) The standard enthalpy of combustion of carbon is  $-393 \text{ kJmol}^{-1}$ . Calculate the standard enthalpy of formation of hexane. (03 marks)

(ii) From your answer in (d)(i), state whether hexane is a stable compound or not. (  $\frac{1}{2}$  mark)

(iii) Give a reason for your answer in (d)(ii). (01 mark)

(iv) Apart from being used as a fuel, state **one** other use of hexane. (  $\frac{1}{2}$  mark)

8. Explain the following observations;

- (a) An aqueous solution of potassium nitrate is neutral to litmus whereas an aqueous solution of potassium nitrite turns red litmus paper blue. *(04 marks)*
- (b) When dilute sulphuric acid was added to potassium manganate(VI) solution, the green solution turned purple and a black solid was formed. *(04 marks)*
- (c) When sodium hydroxide solution was added to aluminium sulphate solution, a white precipitate was formed which dissolved to form a colourless solution. *(05 marks)*
- (d) When sodium iodide solution was added to copper(II) sulphate solution, a white precipitate in a brown solution was formed. *(04 marks)*
- (e) Phenol is sparingly soluble in water but very soluble in dilute sodium hydroxide solution. *(03 marks)*

**END**