

**Chemistry**

 **30/06/ 2021 08.30 AM - 11.30 AM**

S5 END OF YEAR EXAM, 2020/2021

SUBJECT: CHEMISTRY THEORY

DURATION: 3 HOURS

**Instructions:**

1. There are 2 sections in this paper:

 Section A (70 marks): Attempt all questions in this section

 Section B (30 marks): Attempt 3 questions in this section.

1. Do not use periodic tables
2. Non-programmable calculators may be used
3. Answers should be written on blank papers provided
4. Use a blue or black pen only

**SECTION A: Attempt all questions in this section (70 marks)**

1.a) Define the term organic chemistry. **(2 marks)**

 b) Give four differences between organic and inorganic compounds. **(2 marks)**

 c) Explain the reasons why carbon forms a large number of compounds.

 **(2 marks)**

2.a) Define the term **“isomerism”**. **(2 marks)**

 b) Consider the organic compound but-2-ene. Draw and give the names of

 stereoisomers shown by that molecule. **(2 marks)**

3) Determine the molecular formula of a compound with the following composition

 by mass: 60.0% C, 12.0% H, and 28.0% N if this compound has a molar mass

 of 300g.

 (Atomic mass: C=12, H=1, N=14)

 **(3 marks)**

4) An unsaturated alkyne hydrocarbon A of molar mass 82 gmol-1 reacts with

 bromine. If 0.250g of A reacts with 1.00g of bromine.

 a) Determine the molecular formula of the hydrocarbon A. **(2 marks)**

 b) Determine the atomic mass of bromine. **(2 marks)**

 c) Suggest the name of such a hydrocarbon when the triple bond is altered and

 has two methyl branches on carbon- 2 and carbon -5. **(1 mark)**

5 a) Explain why branched chain alkanes have less boiling point as compared to

 straight chain isomers. **(2 marks)**

 b) Explain why some traces of chloroethane may be formed when methane is

 chlorinated in addition to the normal chloromethane product. **(2 marks)**

 c) State one physical properties ofan alkane with the molecular formulae C7H16 .

 **(1 mark)**

6 a) Give two reasons why the addition of lead to petrol has been discontinued.

 **(2 marks)**

 b) The combustion of cyclohexane may be described by the following balanced

 equation:

 C6H12(*l*) + 9O2(*g*) → 6CO2(*g*) +6H2O(*l*)

Given that the heats of formation of cyclohexane, carbon dioxide and water

 are – 156, –394 and –286 kJ mol–1, respectively.

 Calculate the heat of combustion of cyclohexane. **(3 marks)**

7) A 75 cm3 mixture containing X cm3 of ethane and Y cm3 of hydrogen was burned

 in an excess of oxygen. The volume of carbon dioxide produced was 60 cm3$cm^{3}$ (all

 volumes measured at stp )

 a) Write the appropriate reaction equations. **(2 marks)**

 b) Deduce the volume of ethane in the mixture. **(1 mark)**

 c) Deduce the percentage composition of ethane by volume in the mixture.

 **(2 marks)**

8) Most of air pollutants in our environment include the so­called CFC.

 a) Write CFC abbreviation in full words. **(1 mark)**

 b) Suggest one use of CFCs. **(1 mark)**

 c) Describe the environmental effects caused by CFC and suggest the way these

 effects can be avoided. **(2 marks)**

 d) (i)Write the chemical formula for ozone molecule. **(1 mark)**

 (ii) State **one** beneficial presence of the ozone layer. **(1 mark)**

 9. a) Ethene, C2H4, reacts with bromine to give 1,2-dibromoethane.

 (i) State the name of the mechanism involved in this reaction. **(1 mark)**

 (ii) Write the mechanism for this reaction to get 1,2-dibromoethane.

 **(3 marks)**

 b) State the name of the reaction of ethane with bromine in the presence of

 sunlight to form bromoethane. **(1 mark)**

10) Answer the questions (a) to (b) with reference to the compounds A, B and C.

 C3H6 C3H7OH CH3COCH3

 A B C

1. (i) Identify the compound that you would expect to be the least soluble in

 water.  **(1 mark)**

 (ii) Give a reason for your answer in 11a) (i) above. **(1 mark)**

 b) (i) Give the IUPAC names of compounds A and C. **(1 mark)**

 (ii) Name one compound of the isomer of compound C. **(1 mark)**

11) a) State the IUPAC name of the aldehyde with the molecular formula of C3H6O.

 **(1 mark)**

1. Draw the structural formula and state the name of another carbonyl compound that has the same molecular formula as C3H6O. **(2 marks)**

 c) Write the chemical equation of the possible C3H6O carbonyl compound with

 acidified K2Cr2O7. **(2 marks)**

12) Compound A has the molecular formula C5H10O

 a) Write down the structural formula of the possible isomer of A that reacts

 with iodine in aqueous NaOH to give a yellow precipitate but which does

 not react with Tollen’s reagent. **(1 mark)**

 b) Write the chemical equation between compound A and iodine in aqueous

 NaOH. **(2 marks)**

13) Give the chemical test to distinguish between the following pair of

 compounds and state the observable change for a positive test:

 a) Methylamine and dimethylamine. **(2 marks)**

 b) Propanal and propanone.  **(3 marks)**

14) The following figure shows the pressure-temperature phase diagram for

 substance, X.



1. Copy the diagram on your answer sheet and label the area representing the solid (S), liquid (L) and gas (G) phase respectively. **(2 marks)**

 b) State the name of point A and explain its significance. **(2 marks)**

 c) State 2 examples gadgets (instruments) which are used by man in daily life that function by applying the principle of phase change. **(2 marks)**

15.a) Define the **“second law of thermodynamics”**. **(1 mark)**

 b) Describe the term **“spontaneous reaction”** and give an example of such a

 reaction. **(2 marks)**

**SECTION B: Attempt three questions in this section (30 marks)**

16) An experiment was carried out to determine the percentage composition of

 water of crystallization ,**x** in a sample of hydrated sodium carbonate

 crystals (**Na2CO3.xH2O**).

 A sample of 8.20 g of the Na2CO3.xH2O crystals was dissolved in 300 cm3 of

 water and the resultant solution was made up to 500 cm3by addition of

 more water in a volumetric flask. A pipette was used to transfer 25.0 cm3

 portion of this solution into a conical flask. A solution of 0.11 M

 hydrochloric acid (**HCl**) solution was used to titrate against the

 Na2CO3.xH2O solution.

 Three titrations were carried out. The average volume of HCl (hydrochloric

 acid) solution required in the titration was 26.05 cm3.

 Na2CO3 + 2HCl → 2NaCl + CO2 +H2O

1. Name a suitable indicator for the titration and state the colour change

observed in the conical flask at the end point. **(1 mark)**

 b) Calculate the number of moles of HCl used in 26.05 cm3. **(2 marks)**

 c) Calculate the number of moles of Na2CO3 in 25 cm3 of solution.

 **(2 marks)**

 d) Calculate the number of moles of Na2CO3 in 500 cm3 of solution in the

 volumetric flask. **(1 mark)**

 e) Calculate the molarity of Na2CO3 solution. **(2 marks)**

 f) Determine the number of moles of crystallization **X** inNa2CO3.xH2O

 **(2 marks)**

 (Atomic mass: Na=23, C=12, O=16, H=1)

17) Chromium is used to electroplate steel objects. The diagram below shows

 how this can be done.

 

 a) Give two reasons why steel objects are plated (covered) with chromium.

 **(2 marks)**

1. The symbol of the chromium (III) ion is Cr3+ and of the sulfate ion is

SO42–..

 ( i) Write the ionic half-equation for the reaction at the negative electrode

 (cathode). **(2 marks)**

 (ii) A colorless gas which relights a glowing splint is formed at the

 ositive electrode (anode). State the name of this gas. **(1 mark)**

 (iii) During electroplating, it is necessary to add more chromium(III)

 sulfate but during copper plating using a copper anode, it is not

 necessary to add more copper(II) sulfate. Explain this difference.

 **(2 marks)**

 c) State 3 examples of applications of electrolysis on a large scale. **(3 marks)**

 18.Enthalpy change of neutralization can be determined easily by

 experimentation.

 a) Define the term “enthalpy change of neutralization”. **(2 marks)**

 b) The simplest experiment uses a plastic coffee cup to keep the reactants

 and in which the reactions are carried out. 75.0 cm3$cm^{3}$ of a 4.00 mole dm-3

 dilute hydrochloric acid HCl solution was added to 75.0 cm3 of a 4.0 mole

 dm-3 sodium hydroxide NaOH.

 The temperature increased from 21.0 0C to 48.5 0C.

 The specific heat capacity, C of the solution is 4.18 Jg-1K-1 and its density

 is 1.0 gcm-3.

1. Explain the importance of choosing the plastic coffee cup container in

this experiment. **(1 mark)**

 (ii) Determine the mass of the solution mixture. **(1 mark)**

1. Calculate the quantity of heat liberated (heat change) in this

 experiment. **(2 marks)**

1. Calculate the number of moles of H2O which were $H\_{2}O$formed during this

 experiment. **(2 marks)**

1. Calculate the standard enthalpy change of neutralization to form 1

 mole of water H2O, in KJmol-1. **(2 marks)**

19.a) ( i) Write the structural formula of methyl propanoate. **(1 mark)**

 (ii) Write the chemical equation for the reaction between methyl

 propanoate and sodium hydroxide. **(2 marks)**

 b) Write appropriate equations for the synthesis of amino ethane, CH3CH2NH2

 from methyl propanoate indicating the reactants and conditions required.

 **(4 marks)**

 c) Give a chemical test that can be used to distinguish between amino ethane,

 CH3CH2NH2 and ethanol , CH3CH2OH and state the observable changes for

 a positive test. **(2 marks)**

 d) Write the zwitterion form of cysteine amino acid.. **(1 mark)**

20.a) Compound A is a hydrocarbon with a relative atomic mass of 56. Compound

 A contains 85.63% carbon by mass.

 (i) Describe the term “hydrocarbon”. **(2 marks)**

 (ii) Determine the molecular formula of compound A. **(2 marks)**

 b) Compound A reacts with hydrogen bromide to form a single monosubstituted

 compound B. Identify A and B by using an appropriate chemical equation.

 **(3 marks)**

 c) Compound B reacts with hot aqueous sodium hydroxide to produce an

 alcohol C.

 Write a balanced chemical equation for the reaction between B and hot NaOH

 to give C. **(2 marks)**

 d ) C reacts with ethanoic acid in the presence of an acid as catalyst to form the

 sweet-smelling compound D.

 Write the appropriate balanced chemical equation to obtain D. **(1 mark)**

**MARKING SCHEME:CHEMISTRY (S5)**

**End of Year Examination: (100 marks)**

**End of Year Examination: 2020**

**SECTION A: (70 marks)**

1.a) Organic chemistry is the study of the structure, properties, composition, reactions and preparation of **carbon-containing** compounds **with the exception of simple salts such as carbonates, hydrogen carbonates and carbides.(2 marks)**

**(Give 1 mark for each underlined statement)**

b) Four differences between organic and inorganic compounds:**(2 marks)**

**-**All organic compounds contain carbon atoms while most inorganic compounds do not contain carbon atoms.

**-** Organic compounds are volatile and highly inflammable while inorganic compounds are not.

**-** Organic compounds are insoluble in water but soluble in organic solvents while inorganic compounds are insoluble in water but soluble in organic compounds.

**-**Most organic compounds exhibit isomerism while very few inorganic compounds do exhibit isomerism.

**(Give 0.5 mark for each correct statement)**

**(Accept other correct answers)**

c) The reasons why carbon forms a large number of compounds:**(2 marks)**

-Carbon can form four chemical bonds to other atoms.

-Carbon atoms are small and therefore very fit to form large molecules.

-Carbon atoms can join head to tail to form rings of carbon atoms.

**(Give 1 mark for each of the two correct statements)**

**(Consider only two correct answers)**

2.a) Isomerism is the existence of two or more compounds having **the same molecular formula** but with **different arrangement of atoms** within the molecule. **(2 marks)**

**(Give 1 mark for each underlined statement)**

b) Drawing of but-2-ene:

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Names of stereoisomers:

-Cis but-2-ene

-Trans but-2-ene **(2 marks)**

**(Give 1 mark for the drawing and 1 mark for the names)**

3. The molecular formula of the compound: **(3 marks)**

 C : H : N

$\frac{60}{12}$ : $\frac{12}{1}$ : $\frac{28}{14}$

 5 : 12 : 2

Empirical formula: C5H12N2

Molecular formula: (C5H12N2)n =300

((12X5)+(12)+(14X2))n = 300

100n = 300

n = 3

**Molecular formula = C15H36N6**

**(Give 2 marks for the working method and 1 mark for the final answer)**

4. a) The molecular formula of the hydrocarbon A. **(2 marks)**

Formula of an alkyne is given by:

CnH(2n-2) = 82

12n +1(2n-2) = 82

14n=82

n= 6

**Molecular formula : C6H10**

**(Give 1 mark for the working method and 1 mark for the final answer)**

b) The atomic mass of bromine. **(2 marks)**

Since 1 mole of the hydrocarbon reacts with 4 bromine atoms to be saturated:

0.25 →82

1→ 4 X atomic mass of bromine (AM)

AM=82

**The atomic mass of bromine = 82**

**(Give 1 mark for the working method and 1 mark for the final answer)**

c) Name: **2,5-dimethyl hex-3-yne (1 mark)**

5. a) Branched chain alkanes have less boiling point as compared to straight chain isomers because:**(2 marks)**

-In the linear alkanes, the **inter-molecular surface of contact is larger** than in branched chain alkanes with the same molar mass.

-As the **inter-molecular surface of contact becomes larger**, the **forces of attraction between molecules increase** and therefore **the boiling point increase much more in linear chain alkanes**.

**(Give 1 mark for each underlined statement)**

b) Some traces of chloroethane may be formed when methane is chlorinated in addition to the normal chloromethane product because:**(2 marks)**

-During the free radical halogenation of methane, a **methyl radical may react with another methyl radical** in the chain termination step **to form ethane**.

-The **formed ethane can therefore also react** with a **chlorine radical to form chloroethane**.

**(Give 1 mark for each underlined statement)**

c) -It is liquid at room temperature and pressure. **(1 mark)**

**(Accept other correct answers)**

6. a) Two reasons why the addition of lead to petrol has been discontinued: **(2 marks)**

-Lead emitted by combustion of petrol results in the cause of central nervous system damage in humans.

-Lead emitted by combustion of petrol results in the cause of accelerated ageing in humans.

-Lead emitted by combustion of petrol results in the cause of high blood pressure in humans.

**(Give 1 mark for each correct answer)**

**(Accept other correct answers)**

b) The heat of combustion of cyclohexane:**(3 marks)**

The heat of combustion of cyclohexane = ∆Hf(6CO2) + ∆Hf(6H2O)- ∆Hf(C6H12)

 = (6 X -394) +(6 X -294) – (-156)

**= -3924 KJ mol-1**

**(Give 2 marks for the working method and 1 mark for the final answer)**

7. a) Appropriate reaction equations.:

Reaction equations:**(2 marks)**

 C2H6(g) + $\frac{7}{2}$O2(g) → 2CO2(g) + 3H2O(l)

 2H2(g) + O2(g) → 2H2O(l)

**(Give 1 mark for each equation)**

b)The volume of ethane in the mixture:

Since 1 volume of ethane reacts to give 2 volumes of CO2 ;

The volume of ethane= 60/2

= **30 cm3(1 mark)**

**(Give 0.5 mark for the working method and 0.5 mark for the final answer)**

c)The percentage composition of ethane by volume in the mixture:**(2 marks)**

$\frac{30}{75}$X 100%

**= 40%**

**(Give 1 mark for the working method and 1 mark for the final answer)**

8. a) CFC abbreviation in full words. **(1 mark)**

CFC :Chlorofluoro carbons

b) One use of CFCs. **(1 mark)**

 -Blowing agents for packing materials

-Are used as refrigerants

- Are used as solvents

**(Give 1 mark for any of the correct answers)**

**(Accept other correct answers)**

c) -The environmental effects caused by CFC:**CFCs react with ozone layer of the atmosphere and destroy this layer. (1 mark)**

-The way these effects can be avoided:

People can avoid emitting the CFCs iin the atmosphere by using other chemicals that substitute CFCs during use.**(1 mark)**

d) i) The chemical formula for ozone molecule:**(1 mark)**

**O3**

 ii) One beneficial presence of the ozone layer:**(1 mark)**

Ozone layer protects humans from ultraviolet rays of the sun.

 9. a) i) The name of the mechanism involved in this reaction. **(1 mark)**

-Electrophilic addition reaction

 ii) The mechanism for the reaction to get 1,2-dibromoethane. **(3 marks)**

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**(Give 1 mark for each step of the mechanism)**

 b) The name of the reaction of ethane with bromine in the presence of sunlight to form bromoethane. **(1 mark)**

**-Free radical substitution reaction**

10.a)i) The compound that you would expect to be the least soluble in water: **A(1 mark)**

1. A reason for your answer in 11a)i) above: **(1 mark)**

-It is because there are **no partial positive charges** nor **partial negative charges** on the atoms in the molecule.

(b) i) The IUPAC names of compounds A and C.**(1 mark)**

A: Propene

C: Propanone

**(Give 0.5 mark for each answer)**

ii) Name of one isomer of compound C:**(1 mark)**

-**Propanal**

11.a) IUPAC name of the aldehyde with the molecular formula of C3H6O:  **(1 mark)**

**-**Name: Propanal

b) Structural formula and name: **(2 marks)**

**(Give 1 mark for the structural formula and 1 mark for the name)**

c) Chemical equation: **(2 marks)**

3CH3CH2CHO + Cr2O72-(aq) + 8H+ → 3CH3CH2COOH + 2Cr3+(aq) + 4H2O(l)

12. Compound A has the molecular formula C5H10O

a) Structural formula of the possible isomer of A: **(1 mark)**

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b) Chemical equation between compound A and iodine in aqueous NaOH:  **(2 marks)**

 CH3CH2CH2COCH3 +4OH- + 3I2 → CH3CH2CH2COO- + 3I- + 3H2O + CHI3

**(Give 1 mark for unbalanced equation)**

13. a) Chemical test to distinguish between methyl amine and dimethyl amine:  **(2 marks)**

**-Test: HNO2**

**-**Observation: A **yellow oily liquid** is formed **with dimethylamine** but **with methylamine**, it is a **colourless gas** that is given off.

**(Give 1 mark for the test reagent and 1 mark for the observations)**

b) Chemical test to distinguish between propanal and propanone:  **(3 marks)**

-Test: Tollens reagent

-Observation: A **silver mirror** is formed **with propanal** but **not with propanone** .

**(Give 1 mark for the test reagent and 2 marks for the observations)**

14. The pressure-temperature phase diagram for

 substance, X.

1. **** **(2 marks)**

b) The name of point A and its significance. **(2 marks)**

Point A: Triple point

Significance of point A: It is a point at which the **solid, liquid and gas** phases **coexist in equilibrium**.

**(Give 1 mark for each underlined statement)**

1. Examples gadgets (instruments) which are used by man in daily life that function by applying the principle of phase change. **(2 marks)**

-Refrigerator

-Combustible gas cylinder

**(Accept other correct examples)**

**(Give 1 mark for each answer)**

15.a) The second law of thermodynamics states that the **total entropy of an isolated system can never decrease** over time and **is constant if all processes are reversible**. **(1 mark)**

**(Give 0.5 mark for each underlined statement)**

1. Spontaneous reaction is a reaction that favours the formation of products at the conditions under which the reaction is occurring.

An example of such a reaction: Reaction between sodium and water. **(2 marks)**

**(Give 1 mark for the description and 1 mark for the example)**

**SECTION B: Attempt three questions in this section (30 marks)**

16. a) **-** Suitable indicator: Phenolphthalein **(0.5 mark)**

**-**Colour change observed: The pink colour changes to colourless at the end-point . **(0.5 mark)**

b) The number of moles of HCl used in 26.05 cm3. **(2 marks)**

$\frac{0.11}{1000}$ X 26.05

=**0.0028655 mole**

c)The number of moles of Na2CO3 in 25 cm3 of solution. **(2 marks)**

$\frac{0.0028655}{2}$ = **0.00143275 mole**

d) The number of moles of Na2CO3 in 500 cm3 of solution in the volumetric flask. **(1 mark)**

$\frac{0.00143275}{25}$ X 500

**= 0.028655 mole**

1. The molarity of Na2CO3 solution. **(2 marks)**

$\frac{0.00143275}{25}$ X 1000

$=$ **0.05731 mole/litre**

f) The number of moles of crystallization **X** inNa2CO3.xH2O **(2 marks)**

Mass of Na2CO3 in the sample = 0.05731 X 106/2 = 3.03743g

Mass of H2O = 8.2 -3.03743 = 5.16257 g

Number of moles of H2O in 500 ml= 0.2868 mole

X= $\frac{0.2868}{0.028655}$

**X= 10**

**(Give 1.5 mark for the working method and 0.5 mark for the final answer)**

**(Accept other correct working methods)**

17.

a)Two reasons why steel objects are plated (covered) with chromium. **(2 marks)**

-Chromium does not rust

- Chromium makes objects look attractive.

**(Give 1 mark for each answer)**

b) i) The ionic half-equation for the reaction at the negative electrode (cathode). **(2 marks)**

 Cr3+(aq) + 3e → Cr(s)

 ii) Name of this gas: Oxygen **(1 mark)**

iii) Explanation:

Chromium anode does not dissolve properly into the solution. **(2 marks)**

c) 3 examples of applications of electrolysis on a large scale. **(3 marks)**

-Electroplating of coins

-Production of aluminium

-Production of chemicals.

**(Give 1 mark for each answer)**

18.a)Enthalpy change of neutralization is that which occurs when one mole of H+ ions react with one mole of OH- ions to form one mole of H2O. **(2 marks)**

b)i) The plastic coffee cup container does not let much heat to escape from the container to the surroundings. **(1 mark)**

 ii) The mass of the solution is: 75+ 75 = 150 cm3 **(1 mark)**

iii) The quantity of heat liberated (heat change) in this experiment. **(2 marks)**

Quantity of heat liberated= m.c.Өt

Quantity of heat liberated= 150 X 4.18 X (48.5-21)

Quantity of heat liberated= 150X4.18X 27.5

Quantity of heat liberated= 17242.5 J =**17.2425 KJ**

iii) The number of moles of H2O which were $H\_{2}O$formed during this experiment. **(2 marks)**

= $\frac{4}{1000}$ X75 = **0.3 mole**

**(Give 1 mark for the working method and 1 mark for the final answer)**

v) The standard enthalpy change of neutralization to form 1 mole of water H2O, in KJmol-1. **(2 marks)**

$\frac{17.2425}{0.3}$ **= 57.4775 KJ mol-1**

**(Give 1 mark for the working method and 1 mark for the final answer)**

19.*a*) i) The structural formula of methyl propanoate. **(1 mark)**

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ii) The chemical equation for the reaction between methyl propanoate and sodium hydroxide. **(2 marks)**

CH3CH2COOCH3 + NaOH → CH3CH2COO- Na+ + CH3OH

b) Appropriate equations for the synthesis of amino ethane, CH3CH2NH2 from methyl propanoate indicating the reactants and conditions required. **(4 marks)**

 

**(Give 1 mark for each step)**

**(Accept other correct methods)**

c) Chemical test: I2 in NaOH**(1 mark)**

Observable changes for a positive test: A yellow precipitate is formed with ethanol but not with amino ethane. **(1 mark)**

**(Accept other correct answers)**

d)The zwitterion form of cysteine amino acid. **(1 mark)**

 

20.a) i) The term hydrocarbon:

A hydrocarbon is a compound consisting entirely of hydrogen and carbon.  **(2 marks)**

 ii) The molecular formula of compound A. **(2 marks)**

C : H

 $\frac{85.63}{12}$ : $\frac{14.37}{1}$

$\frac{ 7.135}{ 7.135}$ : $\frac{14.37}{7.135}$

 1 : 2

Empirical formula is: CH2

Molecular formula is: (CH2)n = 86

(12+2)n = 86

 n = 6

**Molecular formula: C6H12**

 b)

 **(3 marks)**

 c) The reaction between B and hot NaOH to give C. **(2 marks)**

CH3CHBrCH2CH2CH2CH3 + OH- → CH3CHOHCH2CH2CH2CH3 (Alcohol C)

d ) Balanced chemical equation to obtain D. **(1 mark)** CH3COOH**+** CH3CHOHCH2CH2CH2CH3 H+ H3COOCH(CH3)CH2CH2CH2CH3 (Compound D)

**……………………………………………………………………………………….**

 

**Chemistry**

 **24/06/ 2021 08.30 AM - 11.30 AM**

**S5 END OF YEAR EXAM, 2020/2021**

**SUBJECT: PRACTICAL EXAM**

**COMBINATIONS:** -**BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)**

 **-MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)**

 **-PHYSICS-CHEMISTRY-BIOLOGY (PCB)**

 **- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**

**INSTRUCTIONS:**

1. Please read carefully before you start and make sure that you have all the apparatus and chemicals that you may need.
2. This paper has one question.
3. Answer the questions in this paper and record your answers in the spaces provided.

**Titration experiment to:**

**Titration of an acid (H2SO4) against a base (NaOH)**

 Procedures: (**NaOH)**

i) Pour 25 ml of the NaOH solution in a conical flask or beaker.

ii) Add 4 drops of phenolphthalein indicator in NaOH solution.

ii) Fill the 50 ml burette with a 0.1 mole/litre solution of H2SO4.

iii) Titrate the 0.1 mole/litre solution of H2SO4 into the NaOH solutionin the conical flask until the pink colour turns colourless.

iv) Record the volume of H2SO4 used in a table of results.

v) Repeat procedures i) to iv) **three** times.

Equation: H2SO4(aq) +2 NaOH (aq) → Na2SO4(aq) + 2H2O(l)

**a)Table of results: (12 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Experiment** | **1** | **2** | **3** | **4** |
| Final volume of H2SO4 (ml) |  |  |  |  |
| Initial volume of H2SO4 (ml) |  |  |  |  |
| Volume of H2SO4 used (ml) |  |  |  |  |

b) Determine the average volume of H2SO4 used: **(2 marks)**

c) Calculate the number of moles of the 0.1 mole/litre H2SO4 used in titration. **(3 marks)**

d) Determine the number of moles of NaOH in 25 ml which reacted with H2SO4. **(2 marks)**

e) Calculate the number of moles of NaOH in1 litre of solution (molarity).  **(3 marks)**

f) Determine the mass of NaOH which was dissolved in 1 litre of solution.

(Atomic mass: Na=23, O=16, H=1) **(3 marks)**

 

**Chemistry**

 **24/06/ 2021 08.30 AM - 11.30 AM**

**S5 END OF YEAR EXAM, 2020/2021**

**SUBJECT: PRACTICAL EXAM**

**COMBINATIONS:** -**BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)**

 **-MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)**

 **-PHYSICS-CHEMISTRY-BIOLOGY (PCB)**

 **- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**

**DURATION: 1 HOUR 30 MINUTES**

**INSTRUCTIONS:**

1. Please read carefully before you start.
2. This paper has one question.
3. Answer the questions appropriately.

**Titration question: (15 marks)**

**To determine the value of x and n in the oxalate KH3(C2O4)x.nH2O:**

Procedure:

i) Solution FA1 is 8.0 g of the oxalate KH3(C2O4)x.nH2O in 1 dm3 of solution.

ii) Solution FA2 is 0.1 mole/litre NaOH

iii) Solution FA3 is 0.02 mole/litre KMnO4

**Experiment 1:**

25 cm3 of FA1 is pipetted in a clean conical flask and 3 drops of phenolphthalein indicator are added then the solution is titrated with 23.8 cm3 of FA2 to reach the equivalence point.

**Experiment 2:**

The burette is filled with FA3.

25 cm3 of FA1 is pipetted then it is added to 25 cm3 of 2 mole/litre H2SO4.

This resultant solution is heated to about 70 0C then it is titrated with 31.75 cm3 of FA3 while hot to reach the equivalence point.

(Atomic mass: K=39, H=1, C=12, O=16)

**Equations:**

 Acid-base reaction:

 H+(aq) + OH-(aq) → H2O(l)

 Redox reaction:

 5C2O42-(aq) + 2MnO4- (aq)+ 16H+(aq) → 10CO(g) + 2Mn2+(aq) + 8H2O(l)

Calculate the:

a) Number of moles of H+ ions in the KH3(C2O4)x.nH2O sample. **(3 marks)** b) Number of moles of C2O42- ions in the KH3(C2O4)x.nH2O sample. **(3 marks)**

c) Value of X in the KH3(C2O4)x.nH2O formula. **(3 marks)**

d) Molecular mass of the KH3(C2O4)x.nH2O sample. **(3 marks)**

e) Number of water of crystallization **n**. **(3 marks)**

**MARKING SCHEME CHEMISTRY (ALTERNATIVE)**

 **S5: ADVANCED LEVEL EXAMINATION 2020/2021**

**SUBJECT: CHEMISTRY**

**COMBINATIONS:** -**BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)**

 **-MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)**

 **-PHYSICS-CHEMISTRY-BIOLOGY (PCB)**

 **- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**

**DURATION: 1 HOUR 30 MINUTES**

**INSTRUCTIONS:**

1. Please read carefully before you start.
2. This paper has one question.
3. Answer the questions appropriately.

**Titration question: (15 marks)**

**To determine the value of x and n in the oxalate KH3(C2O4)x.nH2O:**

Procedure:

i) Solution FA1 is 8.0 g of the oxalate KH3(C2O4)x.nH2O in 1 dm3 of solution.

ii) Solution FA2 is 0.1 mole/litre NaOH

iii) Solution FA3 is 0.02 mole/litre KMnO4

**Experiment 1:**

25 cm3 of FA1 is pipetted in a clean conical flask and 3 drops of phenolphthalein indicator are added and then the solution is titrated with 23.8 cm3 of FA2 to reach the equivalence point.

**Experiment 2:**

The burette is filled with FA3.

25 cm3 of FA1 is pipetted then it is added to 25 cm3 of 2 mole/litre H2SO4.

This resultant solution is heated to about 70 0C then it is titrated with 31.75 cm3 of FA3 while hot to reach the equivalence point.

**Equations:**

 Acid-base reaction:

 H+(aq) + OH-(aq) → H2O(l)

 Redox reaction:

 5C2O42-(aq) + 2MnO4- (aq)+ 16H+(aq) → 10CO(g) + 2Mn2+(aq) + 8H2O(l)

Calculate the:

a) Number of moles of H+ ions in the KH3(C2O4)x.nH2O sample. **(3 marks)**

$\frac{0.1X23.8}{1000}$ **= 0.00238 mole**

**(Give 2 marks for the working method and 1 mark for the final answer)**

b) Number of moles of C2O42- ions in the KH3(C2O4)x.nH2O sample. **(3 marks)**

Number or of moles of Mno4- = $\frac{0.02X31.75}{1000}$ = 0.000635 mole

Number or of moles of C2O42- = $\frac{0.000635X5}{2}$= **0.0015875 mole**

**(Give 2 marks for the working method and 1 mark for the final answer)**

c) Value of X in the KH3(C2O4)x.nH2O formula. **(3 marks)**

 The number of positive charges in the compound (KH3) = (+1)+(+3) =+4

Since the C2O42- carries the charge of -2, then there must be 2 C2O42- = **x**

The value of X = **2**

**(Give 2 marks for the working method and 1 mark for the final answer)**

d) Molecular mass of the KH3(C2O4)x.nH2O sample. **(3 marks)**

Number of moles of KH3(C2O4)x.nH2O in 1 litre = $\frac{0.0015875 X1000}{2X 25}$= 0.03175 mole

Molecular mass of KH3(C2O4)x.nH2O = $\frac{8}{0.03175}$ = **252 g/mole**

**(Give 2 marks for the working method and 1 mark for the final answer)**

e) Number of water of crystallization **n**. **(3 marks)**

**(Give 2 marks for the working method and 1 mark for the final answer)**

Mass of KH3(C2O4)2 in 1 mole = 39+3+(24+64)X2= **218**

Mass of H2O in 1 litre = 252-218 = 34

n= $\frac{34}{18}$ = 1.88

**n= 2**

**(Give 2 marks for the working method and 1 mark for the final answer)**