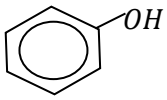
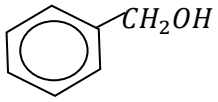
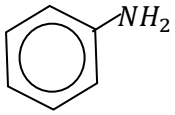
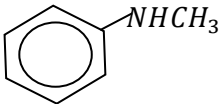
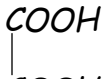
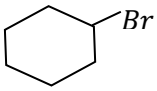
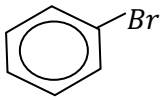
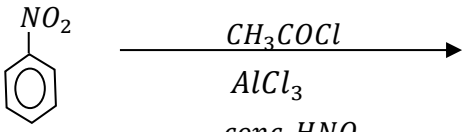
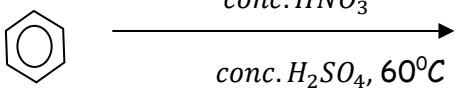
OLD KAMPALA SENIOR SECONDARY SCHOOL
A'LEVEL CHEMISTRY SEMINAR QUESTIONS, 2024

ORGANIC CHEMISTRY

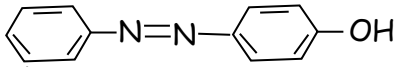
1. State what would be observed and write equations for the reaction(s) that would take place when the following pairs of substances are mixed.
   (a) $CH_3CH{=}CH_2$ and bromine water.
   (b) $HC{\equiv}CH$ and ammoniacal copper(I) chloride solution.
   (c) CH_3COCH_3 and sodium hydroxide in iodine solution.
   (d) CH_3CHO and ammoniacal silver nitrate solution.
   (e) $HCOOH$ and Fehlings solution on heating.

2. Name a reagent that can be used to distinguish between the following pairs of compounds and in each case state what would be observed if each member is separately heated with the reagent.
   (a)  and 
   (b)  and 
   (c) $HCOOH$ and 
   (d)  and 

3. Complete the following equations and in each case suggest a mechanism for the reaction
   (a) 
   (b) 
   (c) $CH_3CH_2CHO \xrightarrow{H^+/H_2NCONH_2}$
   (d) $CH_3CHO \xrightarrow{dil.NaOH}$
   (e) $CH_3COCl \xrightarrow{CH_3CH_2NH_2}$
   (f) $CH_3COCH_3 \xrightarrow{KCN/H^+_{(aq)}}$

4. Write notes on the following. (your answer should include suitable examples and mechanisms for the reaction)
   (a) Elimination reaction.
   (b) Electrophilic substitution reaction
   (c) Electrophilic addition reaction.

5. Write equations to show how the following conversions can be carried out. In each case, indicate the reagents and conditions for the reactions.
   (a) 2-chloropropane to $CH_3CH_2CH_2NH_2$

   (b) Nitrobenzene to 
   (c) Propan-2-ol to $(CH_3)_3COH$
   (d) Ethanol to CH_3COCH_3
   (e) Ethene to CH_3CH_2COOH
   (f) CH_3CH_2OH to CH_3OH
   (g) Calcium dicarbide to $CH_3C \equiv CCH_2CH_3$
6. (a) A compound A, $C_7H_{14}O_2$ reacted with sulphuric acid on heating to form compound B, $C_4H_{10}O$ and C, $C_2H_4O_2$ B reacted with sodium with effervescence but had no effect on litmus paper.
   i) Write the names and structural formulae of all possible isomers of B.
   ii) Name a reagent that can be used to distinguish between the isomers in (i) and state what would be observed if the isomers are reacted with the reagent.
   (b). B reacted with acidified dichromate solution to give compound D which formed a yellow solid with alkaline Iodine.
   Identify B, D and the yellow solid.

c) Write equations and indicate a mechanism for the reaction between B and;
   i) Concentrated orthophosphoric acid. ii)Ethanyl chloride.

(b) Write the structural formula of A.

7. a) Differentiate between soap and soapless detergents.
   b) Write equations to show how alkyl benzene sulphonate can be prepared from octadecan-1-ol, $CH_3(CH_2)_{16}CH_2OH$
   c) Explain why the following compounds are added to soapless detergents;
   (i) polyphosphates (ii) sodium sulphate
8. a) Explain what is meant by ;
   i) Addition polymerization
   ii) Condensation polymerization
   b) Write the structural formula of;
   (i) Perspex
   (ii) terylene
   (iii)nylon 6,6
   c) Name the type of polymerization leading to the formation of polymers in (b).
   d) Explain the difference in properties of thermosetting and thermoplastics..
   e) State how;
   (i) vulcanisation of rubber is carried out.
   (ii) vulcanisation improves the properties of rubber.
9. a) Write equations to show how the following compounds can be prepared.
   i) Phenylamine
   ii) Ethalymine (aminoethane)

   b) Which one of phenylamine and ethylamine is a stronger base? Explain your answer.

10. a) Write equations for each of the compounds Phenylamine and ethyl amine reacting with;
    i) ethanoyl chloride
    ii) acidified sodium nitrite at 5^0C

    b) (i) Write a mechanism for the reaction of ethanoyl chloride with ethylamine.

    ii) How can the reaction in b(i) be used to distinguish between phenylamine and ethylamine.

    c) Phenylamine can be converted to benzene diazonium chloride, write equations (reagents and conditions to be given) for the conversion of diazonium salt into
    (i) iodobenzene
    (ii) benzoic acid
    (iii)an azo-dye
11. When 7.05g of an organic compound **T**, on complete combustion yielded 10.08dm^3 of carbon dioxide and 4.05g of water at s.t.p. 0.225g of **T** on vaporisation at 273°C and at 56.287kNm^{-2} occupied a volume of 193.04cm^3.
    (a) (i) Calculate the empirical formula of **T**
    (ii) Determine the molecular formula of **T**
    (b) **T** burns with a sooty flame. Identify **T**
    (c) Write equation and suggest a mechanism for the reaction to show how the following compounds can be synthesized from **T**
    (i) methoxy benzene
    (ii) phenyl propanoate
    (iii) 4- hydroxyphenylethanone
    (d) State what was observed and write equation for the reaction when aqueous bromine solution was added to **T**.
12. Using equations only show how the following conversions can be effected. Indicate conditions and suitable reagents.
    (a) Phenylmethanol from bromobenzene and zinc turnings.
    (b) 2- hydroxypropanoic acid from 1,2- dichloroethane.
    (c) 3-methylbutan-1-ol from ethyne
    (d) *N*- methyl- *N*- nitrosylphenylamine from nitrobenzene.
    (e) Animoethane from propanoic acid

13. Describe how these conversions can be effected. Equations are not required;
    a) Propanol to ethanol
    b) Ethyne to benzoic acid
    c) Butanoic acid to butan-2-ol
    d) Ethanol to propan-2-ol

14. (a) State what is meant by the term partition coefficient.

(b) 4.5g of an impure sample of nickel(II) Sulpide was dissolved in excess concentrated solution of ammonia and the solution diluted to 500cm^3. The resultant solution was shaken with 25cm^3 of carbon tetrachloride layer and allowed to settle. 12.5cm^3 of the aqueous layer required 20cm^3 of 0.25M hydrochloric acid for complete reaction while 25.0cm^3 of the carbon tetrachloride layer required 12.5cm^3 of a 0.025M hydrochloric acid for complete reaction.

Calculate the number of;

(i) free ammonia in aqueous layer. (K_D for ammonia between carbon tetrachloride and water is 0.04)

(ii) complexed ammonia.

(c) Determine the percentage by mass of nickel in the impure nickel(II) sulphide.

15. (a) Define the following terms

(i) solute

(ii) saturated solution

(b) The solubilities of potassium chloride and potassium nitrate at certain temperature are shown in the table below.

Temperature / °C	0	11	15	30	40	50	57
Solubility of potassium chloride / g per 100g of water	27.9	31.0	32.0	36.5	40.0	43.0	45.0
Solubility of potassium nitrate /g per 100g of water	14.0	21.5	25.0	43.0	63.0	84.0	102.0

(i) Plot on the same axes, a graph of solubility against temperature for solubilities of potassium chloride and potassium nitrate.

(ii) State which one of the two salts has a solubility which increases less rapidly with increase in temperature.

(iii) Determine the temperature at which the solubilities of the **two** salts are equal.

(iv) A saturated solution of potassium nitrate at 30°C was cooled to 5°C . Determine the number of moles of potassium nitrate crystals formed.

(c) 25.2g of a solution saturated with copper(II) sulphate at 35°C was made up to 200cm^3 with de-ionised water. 25.0cm^3 of the diluted solution reacted with excess potassium iodide solution to liberate iodine which titrated against 33.5cm^3 of 0.118M sodium thiosulphate solution. Calculate the solubility of copper(II) sulphate in grams per 100g of water.

(d) Explain what would be observed when sodium chloride solution was added to lead(II) nitrate solution and the mixture boiled and then allowed to cool.

16. (a) State distribution law.

(b) Describe how the distribution coefficient of butanedioic acid can be determined between ethoxyethane and water.

(c) An aqueous solution containing 5.0g of Q in $100cm^3$ of solution. The partition coefficient of Q between water and ethoxyethane is 0.20. Calculate the mass of Q extracted by shaking $100cm^3$ of the aqueous solution with.

(i) $50cm^3$ of ether

(ii) two successive $25cm^3$ portions of ether.

(d) $25cm^3$ of 0.2M X^{2+} solution were mixed with $25cm^3$ of 1M ammonia solution. The total $50cm^3$ of the deep blue aqueous layer was shaken with $50cm^3$ of trichloromethane until equilibrium was attained. After the layers had settled, the whole of the organic layer required $4.0cm^3$ of 0.05M hydrochloric acid using phenolphthalein indicator. The K_D of ammonia between water and trichloromethane is 25.0 at room temperature. Determine the value of n in the complex, $[X(NH_3)_n]^{2+}$.

17. (a) What is meant by the term **standard enthalpy of displacement?**

(b) The table shows the results of an investigation of the reaction of copper(II) sulphate solution with two divalent metals **X** and **Y**.

Time (minutes)	0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
Temperature of mixture of **X** and $50cm^3$ of 0.5M $CuSO_4$	26.5	38.0	42.5	43.5	44.0	43.0	42.0	41.0
Temperature of mixture of **Y** and $50cm^3$ of 0.5M$CuSO_4$	26.5	33.5	35.0	36.0	37.0	38.0	38.0	38.0

(i) On the same axes plot graphs of temperature against time for the two separate mixtures.

(ii) From the graphs determine the maximum temperature attained by each mixture.

(iii) Calculate the molar heat of displacement for each metal.

(iv) Write equation for the reaction in each mixture.

(v) What does 26.5°C in the table represent?

(vi) Which of the metals is more reactive? Give a reason for your answer

(d) Calculate the Gibbs free energy for the cell formed between each metal and copper(II) sulphate solution. Given that the standard reduction potentials for the half cells are; X is -0.76V, **Y** is -0.44V and copper is +0.34V.

18. (a) State what is meant by the term eutectic mixture.

(b) Table 1 below shows how the melting points of mixtures of copper and silver vary with composition.

Percentage of copper in the mixture	0	20	40	70	80	100
Melting point (°C)	961	830	830	955	1000	1085

(i) Draw a fully labelled diagram for the copper- silver system

(ii) Determine the eutectic temperature and the composition of the eutectic mixture.

(c) (i) Describe the changes that would take place when a liquid mixture of the above system containing 50% copper is cooled from 1000°C to 700°C.

(ii) Calculate the mass of silver that precipitated if 200g of the liquid mixture containing 10% copper was cooled from 1000°C to 800°C.

(d) Equations for some half – cell reactions are shown below

$Ag^{+}(aq) + e \longrightarrow Ag(s)$ $\quad E^{\ominus} = +0.80V$

$Cu^{2+}(aq) + 2e \longrightarrow Cu(s)$ $\quad E^{\ominus} = +0.34V$

(i) Write an equation for the overall cell reaction.

(ii) Calculate the $E^{\ominus}_{cell}$ in (d)(i).

(iii) Calculate the Gibb's free energy of the cell and state whether the reaction is feasible or not. Give a reason for your answer.

(e) Discuss the reactions of copper with sulphuric acid.

19. a) Silver ethanedioate is sparingly soluble in water. Write;

i) equation for the solubility of silver ethanedioate in water.

ii) the expression for the solubility product, *Ksp*, of silver ethanedioate.

b) The solubility product,*Ksp*, of Silver ethanedioate in 5.3×10^{-3} $mol^{-3}l^{-3}$at 25°C. Calculate the concentration of the following ions in a saturated solution of silvers ethanedioate

(i) silver ions.

(ii) ethanedioate ions.

c) Calculate the mass of silver nitrate that should be added to the saturated solution in (b) in order to reduce the concentration of ethanedioate ions to a third of its original values.

20. Propanone reacts with iodine in the presence of an acid catalyst according to the equation.

$$CH_3COCH_{3\,(aq)} + I_{2\,(aq)} \longrightarrow CH_3COCH_2I_{(aq)} + HI_{(aq)}$$

The reaction is first order with respect to propanone and independent of the concentration of iodine.

(i) Explain the term order of reaction

(ii) Write an expression for the rate law of the reaction.

(iii) Describe briefly how the order of the reaction with respect to iodine can be determined.

21. The equations for some redox reactions are shown below.

$2H^{+}_{(aq)} + 2Fe^{2+}_{(aq)} \rightleftharpoons H_{2(g)} + 2Fe^{3+}_{(aq)}$

$3Zn_{(s)} + 6OH^{-}_{(aq)} + BrO_3^{-}{}_{(aq)} + 3H_2O_{(l)} \rightleftharpoons 3Zn(OH)_4^{2-}{}_{(aq)} + Br^{-}_{(aq)}$

(a) For each reaction, write the half-cell reactions taking place at;

(i) the anode

(ii) the cathode

(b) (i) For each reaction, write the cell notation of the cell made by combining the electrodes in each half-cell.

(ii)state what each symbol used in b(i) stands for.

22.(a) Define the following terms.

(i) Solubility product

(ii) Common ion effect

(b) The solubility product of copper(II) iodate is given by the expression.

$$Ksp = [Cu^{2+}][IO_3^-]^2$$

Describe an experiment that can be carried out to determine the solubility product of copper(II) iodate.

(c) A saturated solution of copper(II) iodate has a concentration of 0.00833moles of copper(II) iodate per litre at 25^0C. Calculate the solubility product of copper(II) iodate at 25^0C and indicate its units.

(d) Determine the solubility of copper(II) iodate in a 0.02M copper(II) sulphate solution. State any assumptions you have made.

(e) Explain how the solubility of copper(II) iodate would be affected if few drops of;

(i) Concentrated ammonia solution is added

(ii) Potassium Iodate solution was added

23.(a) Define the term standard electrode potential.

(b) With the aid of a diagram, briefly describe how the standard electrode potential of copper can be determined. (7 marks)

(c) The standard electrode potentials of copper and zinc are given below;

$Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)} \quad E^\theta = +0.34V$

$Zn^{2+}_{(aq)} + 2e \longrightarrow Zn_{(s)} \quad E^\theta = -0.76V$

Write the cell notation for zinc/copper cell and calculate the e.m.f of the cell.

(d) State two ways in which an electrolytic cell differs from an e.m.f cell.

(e) A current of 2A was passed for 30 minutes through a cell containing dilute sulphuric acid and the hydrogen produced at the cathode collected. Calculate the volume of the hydrogen in cm^3 that was produced at 23^0C and 100kPa.

(f) State two applications of standard electrode potentials.

24.Electrode potentials for some half cells are given below.

Half cell	E^θ/V
$Fe^{2+}_{(aq)}, Fe^{3+}_{(aq)}/Pt_{(s)}$	-0.77
$Cr^{3+}_{(aq)}, Cr_2O^{2-}_{7(aq)}, H^+_{(aq)}/Pt_{(s)}$	-1.33

(a) Write the cell notation for the cell formed when the two half cells are connected.

(b) Write;

(i) Equations for the half cell and reactions at the anode and cathode.

(ii) Equations for the overall cell reaction.

(c) (i) Calculate the e.m.f of the cell

(ii) State whether the reaction is feasible or not. Give a reason for your answer.

25.(a) When a mixture of water and nitric acid is distilled, a constant boiling point mixture containing 68% nitric acid is obtained at 120^0C. (The boiling points of pure water and nitric acid are 100^0C and 83^0C respectively)

(i) Define the term Constant boiling mixture (azeotropic mixture).

(ii) Draw a boiling point-composition diagram for the mixture of nitric acid and water.

(iii) Explain the shape of your diagram.

(iv) Describe what would happen if a mixture containing less than 60% nitric acid was fractionally distilled.

(b) A constant boiling mixture of nitric acid and water has density of 1.42gcm^{-3}. Calculate the volume of the acid needed to prepare one litre of 2M nitric acid solution.

26.(a)Describe the spectrum of hydrogen. (use a diagram to illustrate)

(b) Explain how the spectrum of hydrogen;

(i) is formed.

(ii) provides evidence for the existence of energy levels.

(c) The frequency of hydrogen at the point of ionization is 3.28x10^{15} Hz. Calculate the ionization energy of hydrogen. (Plank's constant = 6.6x10^{-34} Js)

27.(a) Sodium hydroxide solution was added to 25cm^3 of 0.1M ethanoic acid and the PH of the solution was measured at intervals. The results are given in the table below.

Volume of NaOH(cm^3)	0	4	8	12	16	20	22	22.5	23	24	28
pH of mixture	2.8	3.5	4	4.5	5.1	5.8	7	9	10.5	11.4	12.3

i) Plot a graph of PH against volume of Sodium hydroxide.

ii) Explain the shape of the graph.

iii) Determine the PH at the end point.

iv) Calculate the molar concentration of sodium hydroxide.

(b) i) Calculate the molarity of sodium ethanoate at the end point.

ii) Determine the hydrolysis constant for sodium ethanoate.

28.(a) Define the term relative atomic mass.

(b) Explain how the relative atomic mass can be determined can be determined by a mass spectrometer.

(c) The mass spectrum of an element A contained four lines at mass/charge of 204, 206, 207 and 208 with detector currents (mA) of 0.16, 2.72, 2.50 and 5.92 respectively. Calculate;

i) the relative abundance of the different isotopes in the sample of element A.

ii) the relative atomic mass of A.

29.(a) State what is meant by the following terms "order of reaction" and "half life of a reaction".

(b) A compound B shows the concentration of B at various times.

Time (minutes)	2.0	4.0	7.0	10.0	14.0	20.0
concentration of B (moll^{-1}) [B]	0.820	0.67	0.49	0.372	0.24	0.141

Draw a graph of $\log_{10}$[B] against time.

(c) Using the graph, determine the;

i) Order of the reaction

ii) Rate constant for the reaction

iii) Half-life for the reaction.

30.(a) What is meant by steam distillation.

(b) (i) State three properties of a substance that enable it to be purified by steam distillation.

(ii) Explain how the properties you have stated in b(i) enable the substance to be purified by steam distillation.

(iii) State two advantages of isolating substances by steam distillation.

(c) The vapour pressure of water VP_{H2O} and that of substance A (VP_A) at different temperatures are given in the table below.

Temperature (^0C)	20	40	60	80	100
VP_{H2O} (atm)	0.22	0.26	0.30	0.35	0.39
VP_A(atm)	0.35	0.42	0.49	0.56	0.63

i) On the same axes, plot graphs of vapour pressure against temperature for water and substance A.

ii) When substance A was distilled in steam at 1atm pressure the temperature of distillation was 97^0C and the distillate obtained contained 4.3g of substance A and 1.1g of water using your graph in c(i). Calculate the relative molecular mass of substance A.

31. (a) The molar conductivity of sodium hydroxide solutions of different concentrations are shown in the table below.

Concentration/ $moldm^{-3}$	0.01	0.04	0.09	0.16	0.25	0.36
Molar conductivity, Λ $\Omega^{-1}\,cm^2\,mol^{-1}$	238	230	224	217	210	202

i) Draw a graph of molar conductivity against square root of concentration.

ii) Explain the shape of the graph.

iii) Determine the value of molar conductivity at infinite dilution of sodium hydroxide and indicate its units.

Using the same conductivity cell, the resistance of a 0.1M Potassium Chloride solution and 0.1M bromoethanoic acid solution were found to be 24.96 and 66.50 Ohms respectively at 25^0C when determined using the same conductivity cell. [The Conductivity of Potassium Chloride at 25^0C is 0.01164 $\Omega^{-1}cm^2\ mol^{-1}$ and the molar conductivity of bromoethanoic acid at infinite dilution is 389 $\Omega^{-1}cm^2mol^{-1}$]

i) Calculate the cell constant.

ii) Calculate the molar conductivity of the 0.1M bromoethanoic acid.

iii) Determine the pH of 0.1M bromoethanoic acid.

32. (a) The table below shows the result of partitioning aminoethane between trichloromethane and 0.1M Copper(II) Sulphate solution.

$[CH_3NH_2$ (0.1M $CuSO_4)]$	0.87	1.10	1.33	1.57	1.80
$[CH_3NH_2$ $(CHCL_3)]$	0.02	0.03	0.04	0.05	0.06

i) Plot a graph of $[CH_3NH_2(0.1M\ CuSO_4)]$ versus $[CH_3NH_2(CHCL_3)]$

ii) Determine the number of moles of aminoethane that has formed a complex with copper(II) ion.

(b) Write the equation for the reaction between copper(II) ions and aminoethane.

33.a) Describe how the solubility product of Magnesium hydroxide in water can be determined.

b) (i) A saturated solution of magnesium hydroxide in water contains $1.44x10^{-4}$ mol of magnesium hydroxide per litre of sodium at 25^0C. Calculate the value of solubility product Ksp of Magnesium hydroxide at 25^0C.

(ii) Solid Magnesium hydroxide was shaken with a O.1M solution of Magnesium hydroxide until equilibrium was attained at 25^0C.

Calculate the amount of magnesium hydroxide in grams per litre that was precipitated.

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34. Beryllium , magnesium , calcium , strontium and barium are the elements of group(II) of the Periodic Table.

(a) Describe how the electropositivity of the elements varies down the group.

(b) Discuss the reaction of the elements with

(i) dry air (ii) nitric acid

(c) Describe how beryllium carbide and calcium carbide react with dilute hydrochloric acid

(d) Describe how cement is manufactured.

35. The atomic numbers and melting points of the oxides of elements of periodic (iii) of the periodic table are shown in the table below,

Element	*Na*	*Mg*	*Al*	*Si*	*P*	*S*	*Cl*
Atomic No.	11	12	13	14	15	16	17
Oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3	Cl_2O_7
Mpt	1275	2827	2007	1607	560	30	-91

(a) (i) Plot a graph of melting points of the oxides against the atomic numbers of the elements.

(ii) Explain the shape of the graph you have drawn in a(i) above.

(b) State the condition(s) and write equation to show the reactions between

(i) Water and

-Na_2O -MgO -Cl_2O_7

(ii) Sodium hydroxide and

$-Al_2O_3$ $-SiO_2$ $-P_4O_{10}$

36. The boiling points of some chlorides of period 3 elements of the periodic table are shown below.

Formula of chlorides	$NaCl$	$MgCl_2$	Al_2Cl_6	$SiCl_4$
Boiling point (°C)	1465	1418	423	57

(a) State the trend in the boiling points of chlorides.

(b) Explain your answer in (a) above.

37. State what would be observed and write equation(s) for the reaction(s) that will take place when to the solution of cobalt(II) chloride is added;

(a) Concentrated ammonia solution.

(b) Concentrated hydrochloric acid.

(c) Aqueous sodium hydroxide dropwise until in excess.

38. Chromium , manganese , copper and zinc are d – block elements in the Periodic Table.

(a) (i) What is meant by the term **d- block element**?

(ii) Write the electronic configuration of the elements. (Atomic numbers of chromium , manganese, copper and zinc are 24, 25, 29 and 30 respectively).

(b) Zinc is a d- block element but it is **not** a typical transition element.

State **two** properties in which zinc shows

(i) similarity to the rest of d- block elements

(ii) differences from the rest of the d- block elements.

(c) Describe how zinc is extracted from zinc blende.

(d) Explain the following observations

(i) when zinc metal was added to concentrated sodium hydroxide solution , silver solid dissolves with effervescence of a colourless gas and a colourless solution is formed.

(ii) when few drops of concentrated sodium carbonate solution were added to aqueous chromium(III) sulphate solution, grey green precipitate was formed and bubbled of a colourless gas were produced.

(iii) When a hydrogen peroxide solution was added to a mixture of acidified solution potassium dichromate and pentan-1-ol, a deep blue solution was formed in the organic layer.

(d) State what would be observed and write equation for the reaction when

(i) barium chloride solution was added to potassium chromate solution.

(ii) dilute sulphuric acid was added to potassium manganate(VI) solution.

39. (a) Describe one general method for the preparing the halogens (excluding fluorine) in the laboratory.

(b) Discuss the reactivity of fluorine, chlorine, bromine and iodine with;

(i) Water

(ii) Aqueous sodium hydroxide solution

40.(a) State four properties in which fluorine differs from other elements of group(VII) of the periodic table.

(b) State three reasons why fluorine is more reactive than the other elements in the periodic table

(c) Write equation for the reaction between hydrofluoric acid and silicon dioxide.

41. The boiling points of hydrides of group(VII) elements are given in the table below.

Compound	HF	HCl	HBr	HI
Boiling point (^0C)	+19.9	-85.0	-66.7	-35.4

(a) Explain the trend in the boiling points of the hydrides

(b) Giving reasons, suggest the trend in the acid strength of the hydrides.

(c) Using equations where possible explain what happens when concentrated sulphuric acid is mixed with each of the hydrides.

(d) (i) Arrange the following compounds in their order of increasing acid strength $HClO_3, HClO_2, HClO$

(ii) Explain your answer in d(i)

42.Discuss the reactivity of group(IV) elements (Carbon, silicon, Germanium, Tin and lead) of the periodic table with

(a) Water

(b) Concentrated acids.

(c) Sodium hydroxide

(d) Dilute acids

43.Berryllium, Magnesium, Calcium and Barium are some of the elements that belong to group (II) of the periodic table.

a) Describe giving conditions for the reactions of the elements with:

i) water

ii) sulphuric acid [illustrate your answers with the equations]

(b) Giving reasons, state how the solubilities of;

(i) hydroxides (ii) sulphates , vary down the group.

MIXED QUESTIONS

44.Explain the following observations

(a) Propene undergoes electrophilic addition where propanone undergoes nucleophilic addition.

(b) Hydrogen bromide **can not** be prepared in the laboratory using potassium bromide and concentrated sulphuric acid however hydrogen chloride can efficiently be prepared using potassium chloride and concentrated sulphuric acid.

(c) Iodobenzene is more reactive than chlorobenzene towards nucleophiles but much less reactive than iodoethane.

(d) When potassium iodide solution was added to lead(II) nitrate solution drop-wise until in excess, a yellow precipitate is formed that dissolves to form a yellow solution. However

when the same reagent is trewated with copper(II) nitrate solution, a white precipitate in a brown solution was formed.

45. Explain the following observations

(a) Phenylamine is a weaker base than ethylamine

(b) Phenol is a stronger acid than Phenylmethanol

(c) Copper(I) oxide reacts with dilute sulphuric acid to give a pale blue solution and a brown solid is deposited.

(d) when hydrogen sulphide gas is bubbled through aqueous solution of lead(II) nitrate, a black precipitate is formed but no precipitate is formed when the same gas is bubbled through acidified lead(II) nitrate solution.

(e) Aluminium fluoride is more soluble in water than in ethanol whereas aluminium bromide is more soluble in ethanol than in water.

(f) Water boils at 100^0C and methyl benzene boils at 111^0C at 101.3kPa. The boiling point of a mixture of water and methyl benzene is 96^0C.

CHEMISTRY PRACTICAL

QUESTION ONE

You are provided with following;

FA1, which is a solution containing 13.44gdm^{-3} of thiosulphate ions.

FA2, which is a solution of manganate (VII) ions of unknown concentration.

SOLID T, which is a metal sulphite,

10% potassium iodide solution

2.0M sulphuric acid solution

You are required to determine the;

(i) Concentration of manganate(VII) ions in FA2 in moldm^{-3}

(ii) Percentage purity of metal sulphite

Theory

Acidic manganate (VII) ions oxidize iodide ions to liberate iodine according to the following equation.

$2MnO_4^-(aq) + 16H^+(aq) + 10I^-(aq) \longrightarrow 2Mn^{2+}(aq) + 5I_2(aq) + 8H_2O(l)$

The liberated iodine reacts with thiosulphate ions according to the following equation

$I_2(aq) + 2S_2O_3^{2-}(aq) \longrightarrow S_4O_6^{2-}(aq) + 2I^-(aq)$

Manganate (VII) ions also react with sulphite ions in acid medium according to the following equations

$2MnO_4^-(aq) + 5SO_3^{2-}(aq) + 6H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 5SO_4^{2-}(aq) + 3H_2O(l)$

PART I

Procedure

Using a measuring cylinder transfer 65cm^3 of **FA2** into a clean 250cm^3 **glass beaker**, followed by 35cm^3 distilled water, label the resultant solution **FA3**

Pipette 25.0cm^3 (or 20.0cm^3) of **FA3** into a conical flask. Add 15cm^3 of 2M sulphuric acid followed by 15cm^3 of 10% potassium iodide solution.

Titrate the iodine liberated with **FA1** from the burette until the solution is pale-yellow.

Add 4 – 5 drops of starch indictor and continue the titration until the end point.

Repeat the titration until you obtain consistent results.

Record your results in table I below.

Results

Volume of pipette used = ……cm^3

Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of **FA1** used (cm^3)			

(a)(i)State the volumes of **FA1**used for calculating average.

(ii)Calculate the average volume of **FA1**

Questions

(b)Calculate the number of moles of;;

(i) Iodine that reacted with thiosulphate ions in FA1 **(S = 32, O = 16)**

(ii)Manganate (VII) ions in 100cm^3 of **FA2**

(b)Determine the concentration of manganate(VII)ions in **FA2** in $moldm^{-3}$

PART II

Procedure

Weigh accurately 1.20g of M into a beaker. Add a little water and shake to dissolve. Transfer the resultant solution into a 250cm^3 volumetric flask and top up with distilled water up to the mark. Label this solution FA4.

Results

Mass of weighing bottle + M = ……g

Mass of weighing bottle alone = ……g

Mass of M= ……g

PART III

Procedure

Pipette 20.0 or 25.0cm^3 of FA4 into a conical flask. Add an equal volume of 2M sulphuric acid and titrate the mixture with FA2 from the burette. Repeat the titration two more times and record your results in table 2 below

Volume of pipette used ……cm^3

Final burette readings (cm^3)			
Initial burette readings(cm^3)			
Volume of FA2 used (cm^3)			

(a)(i)Titre values used to calculate the average volume of FA2

(ii) Calculate the average volume of FA2

Questions

(a) Calculate the;

(i) molar concentration of sulphite ion in FA4

(b)Determine the;

(i)mass of pure metal sulphite (Molar mass of metal sulphite = 125g)

(ii) Percentage purity of the metal sulphite

Question two

You are provided with substance, **Y**, which contains **two** cations and **two** anions. You are required to carry out the following tests on **L** to identify the cations and anions in it. Identify any gas(es) evolved. Record your observations and deductions in the table below.

TESTS	OBSERVATIONS	DEDUCTIONS
(a)Heat **two** spatula end-ful of **Y** in a dry test tube strongly until no further change.		
(b)To two spatula end-ful of Y add 3-4 drops of concentrated sulphuric acid and warm		
(c)To **three** spatula end-ful of **Y** in a test tube add about $10cm^3$ of distilled water shake strongly to dissolve you may warm		
(d) . To $2cm^3$ of the solution in part(c) add $2cm^3$ of ethanol and 5drops of concentrated sulphuric acid and boil		
(e) Use $2cm^3$ of the solution in part(c) to carry out a test of your own to confirm one of the anion in solution of Y **test**		
(e) To the remaining solution add dilute sodium hydroxide solution drop-wise until no further change. Filter and keep both the filtrate and residue		
(f). To the filtrate from part (e) add dilute sulphuric acid drop wise until the solution is just acidic. Divide the resultants into **five** parts.		
(i)To the first part of acidified solution add 2-3 drops of barium nitrate solution		

(ii)To the second part of acidified solution add 2-3 drops of silver nitrate solution		
(iii)To the third part of acidified solution add little bleaching powder followed by $1cm^3$ of carbon tetrachloride and shake strongly allow to stand		
(iv)To the fourth part of acidified solution add dilute ammonia solution drop-wise until in excess		
(d)(iii). Use the fifth part of acidified filtrate to carry out a test of your own choice to confirm the cation in the filtrate **Test**		
(g). Dissolve the residue from part (e) in minimum amount of sulphuric acid. Divide the resultant solution into **three** parts.		
(i). To the first part, 2-3 drops add potassium hexacyanoferrate(II) solution followed by dilute ammonia solution.		
(ii). To the second part, add dilute ammonia solution drop-wise until in excess		
(iii) Use the third part of to carry out a test of your own choice to confirm the second cations in Y **Tes**		

(h) Identify the (i) Cations in Y (ii) Anions in Y .

QUESTION THREE

You are provided with an organic substance, ***O***. You are required to determine the nature of ***O***. Carry out the following tests on ***O*** and record your observation and deductions in table below. **(20marks)**

TESTS	OBSERVATIONS	DEDUCTIONS
(a)Burn a small amount of ***O*** on a spatula end		
(b)To about $1cm^3$ of *O* add $3cm^3$ of distilled water test the mixture with litmus paper		
(c)To about $1cm^3$ of *O* add $2cm^3$ of sodium hydrogen carbonate solution		
(d)To about $1cm^3$ of *O* add 2 – 3 drops of neutral iron (III) chloride solution		
(e)To about $1cm^3$ of *O* , add 2 – 3 drops of acidified potassium manganate (VII) and **warm**		
(f)To about $1cm^3$ of *O* , add 2-3 drops of 2,4-dinitrophenylhydrazine solution		
(g)To about $1cm^3$ of *O* , add 2-3 drops of saturated solution of sodium hydrogen sulphite and shake strongly		
(h)To about $2cm^3$ of silver nitrate solution in a clean test tube add 2drops of sodium hydroxide solution followed by ammonia solution until the		

precipitate just dissolves heat the mixture to the hot mixture add about $1cm^3$ of *O* and shake		
(i)To about $1cm^3$ of *O* , add 2-3 drops Fehling solution and heat		

(j)Comment on the nature of ***O***.