MASAKA UACE CHEMISTRY SEMINAR QUESTIONS

PHYSICAL CHEMISTRY

1 (a) (i) Define the term distribution coefficient

(ii) State the conditions under which it is valid

(b) Describe an experiment to determine the distribution coefficient of iodine between carbon tetrachloride and water

(c) A solution containing 6g of Q in $50cm^3$ of an aqueous is in equilibrium at room temperature with 108g of Q in $100cm^3$ of ether. Calculate the mass of Q that will be extracted by shaking $100cm^3$ of the aqueous solution containing 10g of Q with two successive portions of $50cm^3$ of ether

(d) Ions of a metal M reacts with excess ammonia to complex according to the following equation

$25cm^3$ of 0.2M solution of M ions were mixed with $25cm^3$ of 1M ammonia solution followed by $50cm^3$ of trichloromethane in a separating funnel and the mixture shaken until equilibrium was attained at 25. Using volumetric analysis it was found that moles of free ammonia were present in the trichloromethane layer. Given that the distribution coefficient of KD for ammonia between water and trichloromethane at room temperature is 25 determine the value of n in the complex.

(e) Explain one other application of partition confident

(f) The table below shows the results of partitioning of ammonia between a 0.1M cobalt(II) chloride and trichloromethane.

$[NH_3]$in 0.1M $CoCl_2$	6.72	6.94	1.19	1.43	1.70	1.92
$[NH_3]$ in $CHCl_3$	0.01	0.03	0.05	0.07	0.09	0.11

i) plot a graph of $[NH_3]$ in 0.1M $CoCl_2$ against $[NH_3]$in $CHCl_3$

ii) Determine the formula of the complex formed

iii) Write equation for the formation of the complex

2 (a) What is meant by the terms

(i) Common ion effect

(ii) Solubility product

(b) Describe an experiment that can be used to determine the solubility product of silver sulphate

(c) The solubility of silver suphate in 0.1M sodium sulphate at 25 is $2.0339gdm^{-3}$.calculate the solubility product of silver sulphate at 25

(d) State and explain the effect on solubility of silver sulphate when he following was added to its saturated solution

(i) Silver nitrate solution

(ii) Ammonia solution

(e) State two applications of solubility product

3.(a) Define the terms;

(i) **Relative atomic mass**

(ii) **Relative abundance**

(b) Briefly describe how the relative atomic mass of an element is determined by spectrometry with aid of a well labeled diagram.

(c) The mass spectrum of element **Y** shows four peaks of heights in ratio 2.1 : 4 : 2.2 : 1.6 with isotopic masses 10.692, 11.291, 10.928 and 12.029 a.m.u respectively. Determine the;

(i) Relative abundances of the isotopes of **Y**.

(ii) Relative atomic mass of **Y**.

4.(a) What is meant by **freezing point constant of a substance?**

(b) (i) Describe an experiment to determine the molecular mass of naphthalene by freezing point depression method. (Diagram not required)

(ii) State four limitations of the method in (b)(i) above.

(c)The freezing points of solutions of various concentrations of naphthalene at 760 mmHg are shown in the table below.

Concentration ($g(1000g)^{-1}$ of cyclohexane)	10	20	30	40	50	60
Freezing point(^oC)	4.93	3.36	1.79	0.22	-1.35	-2.92

(i) Plot a graph of freezing point against concentration.

(ii) Use your graph to determine the freezing point of pure cyclohexane.

(ii) Determine the slope of the graph and use it to determine the relative molecular mass of naphthalene.

(k_f of cyclohexane is $20.1^oCKg^{-1}mol^{-1}$)

5 (a) Explain what is meant by the term ideal solution

(b) Propanone was mixed with trichloromethane

(i) State what was observed and explain your answer

(ii) Sketch a well labeled diagram for the vapour pressure composition diagram of a mixture of propanone and trichloromethane. The boiling point of propanone is lower than that of trichloromethane

(iii) Describe what would happen if a mixture if trichloromethane and propanone was fractional distilled

(c) The boiling point of a solution containing 2.8g of a compound Z in 20g of water is 100.2 at standard temperature and pressure.

(i) Explain the effect of the solute on the boiling point of water

(ii) Calculate the relative molecular mass of Z (Kf of water is $5.2mol^{-1}$ per 100g)

6 (a) (i) What is meant by the term standard electrode potential

(ii) State two factors that determine the magnitude of electrode potential of a metal

(b) (i) Describe briefly the standard hydrogen electrode (diagram not required)

(ii) Draw a well labeled diagram to show how the standard electrode potential of copper can be determined

(c) A cell was constructed as shown

(i) Write equation for the reaction that occurs at each electrode

(ii) Write the overall cell reaction equation

(d) If the electron potential of the systems and . are -0.403 and + 0.799 respectively

(i) Calculate the cell voltage

(ii) Determine Gibb's free energy for the reaction

(iii) Comment on the feasibility of the reaction

(e) A current of 20.1 A was passed through molten copper (II) bromide for 8 hours and bromine liberated reacted with 94.0g of hydroxy benzene . Calculate the number of moles of

(i) Bromine liberated

(ii) Hydroxy benzene that reacted

7 (a) Define the term eutectic mixture

(b) The table below shows the melting points of various mixtures of tin and lead

% of tin	0	20	40	70	80	100
Melting point(°C)	327	280	234	193	206	232

(i) Draw a well labeled melting point-composition diagram for tin-lead mixture

(ii) use the diagram to determine the eutectic temperature and eutectic composition

(c) Describe the phase changes that would happen when a liquid mixture containing 40% tin is gradually cooled from 400-100

(d) (i) State two similarities and two differences between a eutectic mixture and a compound

(ii) State two tests that can be carried out to distinguish a eutectic mixture and a compound.

8 (a) Distinguish between lattice and hydration energy

(b) Explain briefly how the two energy terms in (a) affect the solubility of ionic compounds

(c) Given the following data

Standard enthalpy of formation of Aluminium fluoride = -1301KjMol^{-1}

Standard enthalpy of atomization of Aluminium = +314 KjMol^{-1}

Standard enthalpy of bond dissociation of fluorine gas = +158 KjMol^{-1}

First ionization energy of Aluminium = +577 KjMol^{-1}

Second ionization energy of Aluminium = +1820KjMol^{-1}

Third ionization energy of Aluminium = +2740KjMol^{-1}
First electron affinity of fluorine = -348 KjMol^{-1}

(i) Define the term standard enthalpy of formation

(ii) Draw an energy diagram for the formation of Aluminium fluoride and use it to determine the lattice energy of Aluminium fluoride

(iii) Given that the hydration energy of Aluminium ion and fluoride ion are -4690 and -364 KjMol^{-1}respctively. Calculate the enthalpy of solution of Aluminium fluoride and hence comment on its solubility in water

(d) State and explain two factors that affect hydration energy.

9 (a) what is meant by the term Steam distillation

(b) State the

(i) Principles behind steam distillation

(ii) Conditions for steam distillation to occur

(c) Using a well labeled diagram describe an experiment for isolating amino benzene from a mixture containing non volatile impurities

(d) 50g of a mixture of 4-nitrophnol and 2-nitrophenol was steam distilled at 760mmHg and 98 . The distillate was found to weigh 35g. If the vapour pressure of water at that temperature is 653mmHg, calculate the percentage of 4-nitrophenol in the mixture.

(e) State two advantages and two disadvantage of using steam distillation to purify substances

10 (a) potassium benzoate undergoes hydrolysis when dissolved in water

(i) What is meant by the term alt hydrolysis?

(ii) The hydrolysis constant of potassium benzoate is . Calculate the PH of a solution containing 0.1M potassium benzoate and state and assumptions made in your calculation

(b) The PH readings below refer to the titration of sodium hydroxide solution against 25.0cm^3 of a 0.1M mono basic acid solution

Vol of NaOH added(cm^3)	0.0	4.0	6.0	8.0	10.0	12.0	14.0	14.6	14.8	15	15.2	15.4	16
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

(ii) from the graph, determine the volume of sodium hydroxide required to neutralize the acid

(iii) State whether the acid is strong or weak. Give a reason for your answer

(iv) Explain the shape of the graph

(v) Calculate the molar concentration of sodium hydroxide

11 (a) State Kohlrausch's law of independent migration of ions

(b) The ionic conductivities at infinite dilution of some ions are shown in the table below

Ions	Radius(nm)	Conductivity(perohmcm^{2}mol^{-1})
Li^+	0.060	38.7
Na^+	0.095	50.1
K^+	0.133	73.5

Explain the trend in the ionic conductivities

(c) The molar conductivity at infinite dilution of sodium nitrite, nitric acid and sodium bromoethanoate are 121.3, 421.0, 89.0 ohm^{-1}cm^{2}mol^{-1} respectively.

(i) Explain why the molar conductivity of nitric acid is very high

(ii) Calculate the acid dissociation constant of 0.1M bromoethanoic acid placed in a cell of resistance 40 ohms and cell constant $1.2x10^{-3}$ cm^{-1}

(d) State two other applications of conductivity measurements

12 (a) Define the following terms as applied to chemical kinetics

(i) Order of reaction

(ii) Molecularity

(iii) Rate constant

(b) Hydrogen peroxide decomposes according to the equation

The table below shows the results obtained when various 20cm3 samples of hydrogen peroxide solution were titrated with potassium manganate (VII) solution at various times from the start of th reaction.

Time (minutes)	0	5	10	15	20	25	30
Volume of (cm3)	24.0	18.7	14.6	11.3	8.8	6.9	5.4

(i) Write the equation for the reaction between hydrogen peroxide and potassium manganate (VII) solution

(ii) Plot a graph of against time

(iii) State the order of reaction with respect to hydrogen peroxide, giving a reason for your answer

(iv) Write the rate equation for the reaction

(V) Using the graph to determine the rate constant for the reaction

(c) Explain how each of the following factors affect the rate of a chemical reaction

(i) Concentration

(ii) Temperature

(iv) Catalyst

13. (a) Define the terms:

(i) Order of reaction

(ii) Molecularity of a reaction

(iii) Rate constant (iv) Rate equation

(v) Rate law

(vi) Activation energy

(b) Describe an experiment that can be carried out to show that the reaction between hydrochloric acid and sodium thiosulphate is first order with respect to sodium thiosulphate.

(c) The rate of reaction between ***A*** and ***B*** is Rate=$[A][B]^2[C]$.

The table below show the kinetics data for the reaction between reactant A and B

Experiment number	[A]($moldm^{-3}$)	[B]($moldm^{-3}$)	Initial rate($moldm^{-3}s^{-1}$)
1	0.02	0.02	$1.2x10^{-4}$
2	0.04	0.04	*u*
3	*S*	0.04	2.4×10^{-4}
4	0.06	0.02	*v*
5	0.04	*t*	7.2×10^{-4}

Determine the values of ***s,t,u*** and ***v***. Give reason(s) for your answers.

(d) Propanone reacts with iodine according to the equation:

$$CH_3COCH_3 + I_2 \longrightarrow CH_2ICOCH_3 + HI$$

The reaction is first order with respect to propanone and zero order with respect to iodine.

Describe an experiment to determine the rate of the reaction.

(e)The table below shows the concentration of bromine at various intervals of time for the reaction;

$$Br_2(aq) + HCOOH(aq) \longrightarrow 2HBr(aq) + CO_2(aq)$$

Time (S)	0	30	60	90	120	180	240	360	480	600
$[Br_2]x10^{-3}$ ($moldm^{-3}$)	10	9	8.1	7.3	6.6	5.3	4.4	2.8	2.0	1.3

(i) Plot a graph of concentration of bromine against time

(ii) Use the graph to find the order of reaction. Explain your answer.

(iii) Calculate the rate constant.

(f)The table below shows the results for the hydrolysis of a bromoalkane(C_4H_9Br) with sodium hydroxide solution. The enthalpy for the reaction is 160Kjmol^{-1} .

Experiment	$[C_4H_9Br]$ $(moldm^{-3})$	$[OH^-]$ $(moldm^{-3})$	Initial rate $(moldm^{-3}s^{-1})$
1	0.05	0.10	$1.0x10^{-5}$
2	0.20	0.10	$4.0x10^{-5}$
3	0.20	0.05	$4.0x10^{-5}$

(i) Determine the order of the reaction with reasons to explain your answer.

(ii) Write the structural formula and name of the alkylhalide

(iii) Draw a well labelled energy diagram for the reaction.

ORGANIC CHEMISTRY

1 (a) 1.22g of an organic compound Q on complete combustion gave 3.08g of carbon dioxide and 0.54g of water. Determine the empirical formula of Q

(b) When 3.05g of Q were vaporized at 25°C and 760mmHg occupied $610cm^3$. Determine the molecular formula of Q

(c) A solution of Q turns blue litmus paper red and forms bubbles with sodium carbonate solution but has no effect on bromine water

(i) Draw the structure and write the name of Q if it burns with a sooty flame

(ii) Write the equation between Q and sodium carbonate

(iii) Using equations while indicating conditions clearly show how Q is obtained from propan-1-ol

(d) Explain the following observations

(i) 2-nitro hydroxyl benzene has a lower boiling point than 4-nitrohydroxy benzene though both have same molecular mass

(ii) The basic strength of amines is in the order

$< NH_3 < CH_3NH_2 < (CH_3)_2NH$

2 Write equations between the following compounds and in each case outline the mechanism lading to the formation of the major product

(a) Benzene and warm fuming sulphuric acid

(b) 2-chloro-2-methylpropane and warm sodium hydroxide

(c) propan-2-ol and ethanoic acid in presence of sulphuric acid and heat

(d) Benzene and concentrated nitric acid in presence of concentrated sulphuric acid at 60°C

(e) Ethanol and 2,4 -dinitrophnyl hydrazine in presence of an acid catalyst

(f) Phenol and ethanoyl chloride in alkaline solution

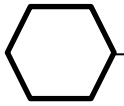
3 Write mechanisms for the following reactions

(a) Methylbenzene is heated with aqueous sodium hydroxide solution

(b) Methylbenzene is reacted with chlorine in presence of ultraviolet light.

(c) Coversion of propanal to propanaloxime
(d) Ethanoyl chloride is reacted with propylamine
(e) Warm fuming sulphuric acid and benzene
(f) Propanone is reacted with a saturated solution of sodium hydrogensulphite.
(g) Conversion of benzene to nitrobenzene
(h) Propan-2-ol and ethanoylchloride
(i) 2-methylpropene and chlorine water
(j) 2-chloro-2-methylbutane is heated with sodium ethoxide solution in ethanol
(k) Conversion of 1-chloropropane to propylmethylamine

4. Without using equations, briefly describe how the following conversions can be effected
   (a) Propyne from propan-2-ol
   (b) Phenol from benzene
   (c) Ethanoylchloride from ethane
   (d) Methylphenylamine from benzene
   (e) Methylpropanoate from bromoethane
5. Write equations to show how the following conversions can be effected.

(a)  —CHO from benzenediazonium salt

(b) Aminoethane from propanoic acid
(c) Phenol to cyclohexane-1,2-diol
(d) Butane-1,4-dioic acid from ethene
(e) Propene from ethanal
(f) Ethoxyethane from but-2-ene
(g) Propyne to 2-methylpropanoic acid
(h) Benzoylchloride from ethyne
(i) Ethoxybenzene from methylbenzene

6. A hydrocarbon, ***G***, on complete combustion forms 67.95g of water and 172.58 dm^3 of carbon dioxide gas. When 3.34g of ***G*** was vapourised, it was found to occupy a volume of 790cm^3 at 27^0C at a pressure of 760mmHg.

(a) Determine the;

(i) empirical formula of ***G***

(ii) molecular formula of ***G***.

(b) ***G*** instantly decolourises a solution of bromine in tetrachloromethane. When ***G*** is refluxed with alkaline manganate(VII) solution and the resultant solution acidified, a white crystalline solid **Q** was formed, which when heated with a mixture of solid sodium hydroxide and calcium hydroxide, a compound **R** was formed. **R** gives no apparent reaction with bromine until a little iron powder is added to it.

Identify ***G***, **Q** and **R**.

(c) Write equations and outline possible mechanisms for the reaction between bromine and;

(i) ***G*** in tetrachloromethane

(ii) **R** and a little iron powder.

(d) Write equations to show how **Q** can be obtained from **R**

7. (a) A compound **Q** contains 60.0% carbon, 13.3 % hydrogen and the rest being oxygen. Calculate the simplest formula of **Q**.

(b) when 0.698g of **Q** was dissolved in 100g of a solvent, there was 0.19 ^oC depression in freezing point of the solution. (Kf of the solvent = 1.63^0C) Calculate;

(i) the molecular formula of **Q**.

(ii) the molecular formula of **Q**.

(c)Write the names and structural formulae of all possible isomers of **Q**.

(d) When **Q** was reacted with iodine in aqueous sodium hydroxide, a yellow precipitate was formed.

(i) Identify **Q**

(ii) Write equation for the reaction between **Q** and iodine in aqueous sodium hydroxide.

(iii) State what would be observed when Q is reacted with acidified potassium dichromate(VI) solution and name the major organic product.

(e)When **Q** was heated with excess concentrated sulphuric acid, a gas ***W*** which turned the purple solution of acidified manganate(VII) to colourless was evolved. Write equation for the reaction between:

(i) **Q** and sulphuric acid and suggest a mechanism for the reaction

.

(ii) ***W*** and acidified manganate(VII) ions and name the product. Suggest a plausible mechanism for the reaction between ***W*** and hydrogen iodide.

8. (a) 1.781g of a bromoalkane, **D**, was heated with excess sodium hydroxide solution. The resulting mixture was cooled and acidified with dilute nitric acid and the solution diluted to 100cm^3. 10cm^3 of this solution required 13.0cm^3 Of 0.1M silver nitrate solution for complete precipitation of bromide ions as silver bromide.

(i) Calculate formula mass of **D**

(ii) Deduce the molecular formula of **D**

(iii) Write the structural formulae and names of all possible isomers of **D**

(b) When **D** was reacted with sodium hydroxide, compound ***E*** was formed. ***E*** formed two layers within 10 minutes when shaken with a mixture of concentrated hydrochloric acid and anhydrous zinc chloride.

(i) Identify **D**

(ii) Write the equation and state the conditions for the reaction between **D** and sodium hydroxide.

(c) ***E*** can be oxidized by chromium trioxide in the presence of concentrated sulphuric acid to give compound ***G***, which reacts with iodine in the presence of sodium hydroxide solution. State what would be observed and write the equation for the:

(i) oxidation of ***E***

(ii) reaction between ***G*** and iodine in the presence of sodium hydroxide.

(d) One of the isomers of ***D*** undergoes a unimolecular reaction when treated with aqueous sodium hydroxide. (i) Name the isomer

(ii) Write an equation for the reaction in (d) and outline a mechanism for the reaction.

9. (a) Briefly describe how;

(i) a sample of soap can be prepared

(ii) a soapless detergent can be prepared

(ii) Write equation(s) for the reaction leading to the formation of soap

(b) Explain why soap cannot be used effectively in:

(i) hard water

(ii) strongly acidic solution

(c) Write equations to show how alkylbenzenesulphonate can be prepared from octadecan-1-ol, $CH_3(CH_2)_{16}CH_2OH$.

(d) Explain why the following compound are added to soapless detergents:

(i) polyphosphates

(ii) disodium sulphate

10 Write short notes about the following reactions

(a) Electrophiliic addition reactions

(b) Elimination reactions

(c) Electrophiliic substitution reactions

(d) Nucleophilic addition reactions

(e) Free radical substitution reactions

11 Write equations to show how the following conversions can be effected while indicating reagents and conditions clearly.

(a) Amino ethane from propan-1-ol

(b) Propene from Ethanol

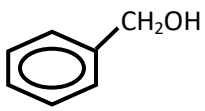
(c) Ethoxy ethane from But-2-ene

(d) Cyclohexan-1,2-diol from Benzene sulphonic acid

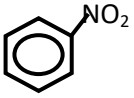
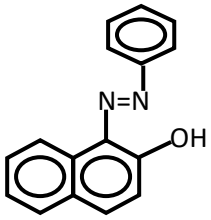
(e) Poly phenyl ethene (polystyrene) from phenyl ethanone

12 Write equations to show how the following conversions can be effected while indicating reagents and conditions clearly.

(a) CH_3CH_2Cl to CH_3CH_2COOH

b)  to 

(c) $(CH_3)_2CHBr$ to $(CH_3)_2C{=}NOH$

(d)  to 

(e) $CH_3CH_2CH_2OH$ to $(CH_3)_3COH$

13 State the reagent(s) that can be used to distinguish between each of the following pair of organic compounds and in each case state what is observed and write equation(s) for the reaction(s) that occur when each member of a pair is treated with the reagent stated

(a) but-1-yne and bute-2-yne
(b) Propanone and propanal
(c) Ethanoic acid and methanoic acid
(d) Ethanol and methanol
(e) Iodo benzene and Iodo cyclohexane
(f) Phenylethanal and phenylmethanal

14 (a) An organic compound Z contains 80% carbon, 6.7% hydrogen and the rest being oxygen. When Z was steam distilled at 97 and 760mmHg, the distillate contained 25.44% of Z by mass. The vapour pressure of water at 97 is 723mmHg. Determine;

(i) Empirical formula of Z
(ii) Relative molecular mass of Z
(iii) Molecular formula of z

(b) Z burns with a sooty flame and reacts with aqueous sodium hydrogen sulphite but does not react with ammonia cal sliver nitrate solution.

(i) Identify Z
(ii) Write equation for the reaction between Z and sodium hydrogen sulphite and outline the mechanism for the reaction

(c) Using equations while stating reagents and conditions state how Z can be prepared from

(i) Benzene
(ii) Phenyl ethane
(iii) benzoic acid

15 (a) (i) Name on source of vegetable oil
(ii) Briefly explain how soap can be prepared from the vegetable oil you named in a (i) above
(iii) During the preparation of soap from Z 1.108g of Z was heated with 10.0cm^3 of 1.0M sodium hydroxide solution for some time then cooled. The unreached alkali required 4.0cm^3 of 0.1M hydrochloric acid for complete neutralization. Determine the relative formula mass of Z
(ii) Explain why soap cannot be effectively used in acidic medium

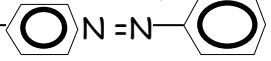
(d) Soap and detergents are surfactants
(i) Explain the term surfactant
(ii) Name two active ingredients in detergents and state their role
(iii) Using equations while stating conditions clearly, outline steps followed to synthesize a detergent starting with

16 (a) Explain what is meant by each of the following terms
(i) A polymer
(iii) A copolymer
(ii) Condensation polymerization
(ii) Addition polymerization

(b) Natural rubber is a natural polymer while Nylon 6,10 is an artificial polymer
(i) Distinguish between a natural and an artificial polymer
(ii) Write the structural formulae of the polymers named in (b) above
(iii) Suggest the structure and IUPAC names of the monomer(s) of the polymers in (ii) above.
(iv) State the type of polymerization by which each of the polymers named in ((b) is formed

(c) (i) Briefly explain how natural rubber can be made stronger and elastic
(ii) State two uses of the product in c(i)

(d) Giving examples in each case distinguish between a thermal setting and a thermal softening plastic

17. Using words only, without equations, show how the following compounds can be synthesized.
(a) Methyphenylamine from benzene.
(b) Methylamine from ethanoic acid.
(c) $(CH_3)_2C$ =NNHCONH$_2$ from ethane.
(d) Propylamine from bromoethane.
(e) Methyl benzoate from phenol.
(f) $(CH_3)_2N$  from benzene
(g) Pent – 1 – yne from ethyne.

INORGANIC CHEMISTRY

1 (a) (i) What is meant by the term an ore?

(ii) Write the formula and name of one ore from which copper can be extracted

(b) Describe how

(i) The ore named in (ii) above can be concentrated

(ii) Pure copper can be extracted from the concentrated ore

(c) Discuss the reaction of copper with

(i) Hydrochloric acid

(ii) Sulphuric acid

(d) Hydrated copper (II) sulphate was dissolved in distilled water and the resultant solution divided into two parts. To the first part was added excess concentrated hydrochloric acid and to the second a few drops of hexacyanoferrate (II) solution were added.

(i) State what was observed in each case

(ii) Write the equation for the reaction that

(e) 6.53g of impure copper was dissolved in excess dilute nitric acid and the resultant solution made up to the 250cm^3 with distilled water. To 25cm^3 of this solution was added excess potassium iodide solution and the iodine liberated required 40cm^3 of 0.25M sodium thiosulphate solution. Calculate the percentage by mass of copper

2 (a) Briefly describe the individual manufacture of each of the following chemical substances (**answers should include relevant equations and conditions, diagrams not required**)

(i) Nitric acid

(ii) Sulphuric acid

(iii) Sodium hydroxide

(iv) Single super phosphate fertilizer

3 (a) Describe how zinc can be extracted from zinc sulphide

(b) Explain the following observations

(i) Zinc is a d-block element but not a transition element

(ii) Zinc chloride dissolves in water to form a solution whose PH is less than seven

(c) Describe the reactions of zinc with

(i) Water

(ii) Sodium hydroxide

(d) 7.5g of zinc ore was dissolve in excess concentrated ammonia and the solution made up to one litre. The resultant solution was shaken with chloroform and left to settle. 50cm^3 of the organic layer need 25cm^3 of 0.05M hydrochloric acid for

neutralization. 25cm^3 of the aqueous layer was neutralized by 40cm^3 of 0.5M hydrochloric acid. Determine the percentage of zinc in the ore. (KD of ammonia between water and chloroform is 25)

4 (a) Distinguish between a d-block element and a transition element

(b) Describe the properties of chromium as a transition element

(c) Explain the reactions that occur when a solution of sodium hydroxide is added to a solution of chromium (III) sulphate drop wise until in excess followed by hydrogen peroxide and heat

(d) (i) Write a half reaction for the reduction of dichromate ions to chromium (III) ions in acidic medium

(ii) To a solution of acidified potassium dichromate was added potassium iodide solution. If 10cm3 of the resultant solution required 165cm^3 of 0.25M sodium thiosulphate for complete reaction using starch indicator, calculate the mass of potassium dichromate in 1dm^3 of the solution.

e) Few drops of concentrated sodium carbonate solution were added to an aqueous solution of chromium (III) sulphate

(i) State what was observed

(ii) Write equation(s) for the reaction(s) that took place

5 The elements beryllium and magnesium belong to group (II) of the periodic table

(a) Describe the reaction of the elements with'

(i) Water

(ii) Sodium hydroxide

(iii) Air

(b) State and explain the trend in solubility down the group of their

(i) Hydroxides

(ii) Sulphates

(c) Name one reagent that can be used to distinguish between magnesium, and barium ions in solution and in each case state what is observed.

6 Write the general electron configuration of the outer most energy level of group (IV) elements.

(b) Describe the reaction of group (IV) elements with

(i) Water

(ii) Sodium hydroxide

(b) Write equation for the reaction between water and

(i) Lead (Iv) chloride

(ii) Tin (II) chloride

(iii) Silicon (IV) hydride

(d) Sodium hydroxide was added to lead (II) nitrate solution drop wise until in excess. State what was observed and write the equation(s) for th reaction(s) that took place

(e) Dilute nitric acid was added to the resultant mixture in (d) above drop wise in excess. State what was observed and writhe the equation(s) for th (s) if any that take place

7 fluorine is In group (VII) of the periodic table but has properties that are different from those of other members of group (VII)

(a) (i) state tree reasons why fluorine behaves anomalously

(ii) Describe three chemical properties of fluorine that are different from the rest of the group members (illustrate your answers using equations)

(b) The boiling points of the hydrides of group (VII) are given in the table below

Compound	HF	HCl	HBr	HI
Boiling point(	+19.9	-85.0	-66.7	-35.4

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

(ii) Giving reasons suggest the trend in acid strength of the hydrides

(c) Using equations where possible explain what happens when concentrated sulphuric acid is mixed with each hydride

8 (a) what is meant by the term first ionization energy

(b) Briefly explain the factors that affect the value of first ionization energy

(c) Explain the trend in the first ionization energy of elements in period (III) of the periodic table

(d) The following are successive ionization energies of elements A, B, C D and E

Elements	Ionization energy in $KJMol^{-1}$			
	First	second	Third	Fourth
A	44166	4962	6630	7283
B	1036	2675	3367	4063
C	463	1866	2902	3762
D	8867	9120	9650	13200
E	568	2096	3125	3995

(i) Explain the general trend in successive ionization energy

(ii) Determine the group to which each element belongs

(e) Write balanced equation for the reaction between C and

(i) Water

(ii) Chlorine

9 The atomic number and melting points of the oxides of period 3 elements ar given in the table below

Atomic number of element	11	12	13	14	15	16	17
Formula of oxide							
Melting point ()	1193	3075	2300	1708	563	40	-91

(a) Plot a graph of melting point of the oxides against atomic number of the period 3 element
(b) Explain the trend in melting points of the oxides using the graph in (a) above
(c) Describe the reactions of the oxides with;
  (i) Water
  (ii) Sodium hydroxide
  (v) Sulphuric acid

10 Explain the following observations
(a) The boiling points of the hydrides of oxygen, sulphur, selenium and tellurium are in the order
(b) When dilutee sulphuric acid is added to a solution of potassium manganate (VI) the colour of the solution changes from green to purple and a black solid is formed
(c) Sodium hydroxide solution for use in volumetric analysis is prepared using freshly distilled water
(d) Titrations with sodium thiosulphate are not carried out in acidic medium
(e) The PH of a solution of chromium (III) chloride is less than seven while that of ammonium carbonate is greater than seven
(f) Iodine is a solid at while chlorine is a gas at room temperature
(g) The Pka of chloroethanoic acid is lower than that of ethanoic acid
(h) Phosphorous (V) chloride exists but nitrogen (V) chloride does not
(i) Lead (IV) chloride exists while lead (IV) iodide does not
(j) Anhydrous copper (II) sulphate dissolves with rise in temperature of solution while hydrated copper(II) sulphate dissolves with fall in temperature of the solution

11. The elements carbon, silicon, tin and lead are found in group (IV) of the periodic table. Carbon differs in some properties from other members of the group.
(a) (i) Give reasons why carbon differs from other group members.
(ii) State three (3) properties in which carbon is different from other members of the group.
(b) Describe the reactions of the oxides of these elements with sodium hydroxide.
(c) Describe the reactions of the chlorides of the above elements with water.
(d) Write equations to show how you would prepare,

i) Lead (ii)oxide

ii) Lead (iv) oxide

(e) Describe the reaction of Lead (iv) oxide with hydrochloride acid and Sulphuric acid.

12. Explain the following observations,

(g) An aqueous solution of sodium thiosulphate forms a pale yellow precipitate when exposed to air for some time.

(h) 2-methylpropene reacts with bromine water to form 1-bromo-2-methylpropan-2-ol instead of 1, 2 – dibromo - 2 -methyl propane.

(i) When a concentrated solution of sodium hydrogen carbonate is added to aqueous potassium iron(iii) sulphate [$K_2SO_4.Fe_2(SO_4)_3.24H_2O$], a brown precipitate is formed with effervescence of a colourless gas.

(j) Phosphorus (v) chloride exost but nitrogen (v) chloride does not.

(k) When 1- chloropropane is heated with sodium hydroxide solution in a mixture, the product acidified with dilute nitric acid followed by silver nitrate solution a white precipitate is formed.

When chlorobenzene is treated in the same way, there is no precipitate formed.

13. a) Describe the large scale manufacture of sulphuric acid.

b) Describe the reaction of sulphuric acid with,

i) Hydrogen iodide

ii) Magnesium

iii) Aluminium

c) Sulphur dioxide is oxidized to Sulphur trioxide according to the equation

$$2SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3\,(g)} \quad \triangle H = -95 \text{ KJ/mole.}$$

Describe giving reasons the effect on the position of equilibrium and KC value of

i) increasing temperature

ii) Adding a reagent that reacts with Sulphur trioxide.

d) 3 moles of Sulphur dioxide and 1.5 moles were put in a sealed vessel at 650°c, At equilibrium and a total pressure of 20 atmosphere and the equilibrium mixture contained 0.3 moles of Oxygen. Calculate the,

i) Partial pressure of each equilibrium component.

ii) Equilibrium constant KP for the reaction and state its unit

e) Write equation for the reaction showing how Sulphuric acid is used to prepare super phosphate fertilizer.

15. (a) (i) State the names and formulae of the two ores from which zinc can be extracted.

(ii) Briefly describe how pure zinc is obtained from any of the ores in (a) (i) above.

(b) Describe the reactions of zinc with;

(i) air

(ii) sulphuric acid

(iii) sodium hydroxide

(c) A few drops of potassium hexacyanoferrate(III) solution were added to zinc sulphate solution.

(i) State what was observed.

(ii) Write equation for the reaction.

16. (a) Write the formula and name of the main ore of aluminium.

(b) Describe how:

(i) the ore is purified

(ii) pure aluminium is obtained from the purified ore.

(c) Describe the reaction of aluminium with:

(i) air

(ii) hydrochloric acid

(iii) sulphuric acid

(iv) sodium hydroxide

(d) State what you will observe and write equations for the reactions that take place when;

(i) sodium carbonate solution is added to an aqueous solution of aluminium sulphate.

(ii) sodium hydroxide solution is added to aqueous aluminium sulphate dropwise until in excess.

17. (a) (i) Define the term an **ore**.

(ii) Write the formula and name of the sulphide ore from which iron can be extracted.

(b) Describe how iron is extracted from the ore in (a) (ii) above.

(c) Describe the reaction of iron with:

(i) water

(ii) chlorine

(iii) sulphuric acid

18. (a) (i) Describe the industrial manufacture of nitric acid starting from nitrogen and hydrogen as raw materials.

(ii) State **two** uses of nitric acid.

(b) State the conditions and write equations for the reaction(s) of nitric acid and:

(i) Magnesium
(ii) Phosphorus
(iii) Sulphur

MIXED QUESTION

1. Explain the following observations

(a) Aluminium fluoride has a higher melting point than aluminium chloride.

(b) Boron trichloride is non-polar whereas nitrogen trichloride is polar.

(c) The bond angle in an ammonia molecule is 107° whereas that in phosphine is 94°.

(d) When anhydrous magnesium sulphate is added to water, the temperature rises and yet when hydrated magnesium sulphate is used, the temperature falls.

(e) Both 2-nitrophenol and 4-nitrophenol exhibit hydrogen bonding and yet the boiling points of the two compounds differ greatly.

(f) Carbonic acid and sulphorous acid are both weak acids but their molecules exhibit different bond angles.

(g) Aminobenzene is more reactive towards bromination that benzene.

(h) The apparent relative molecular mass of ethanoic acid obtained by elevation of boiling point of benzene is 120.

(i) When sodium hydroxide solution is added to a solution of manganese(II) sulphate , a white precipitate is formed which is insoluble in excess alkali. The precipitate turns brown on standing.

(j) The boiling point of a solution containing 0.3075g of nitrobenzene in 100g of benzene is the same as that of a solution containing 0.38g of camphor in 100g of benzene.

(k) When concentrated hydrochloric acid was added to an aqueous solution cobalt(II) chloride, the colour of the solution changed from pink to blue and back to pink on when diluted with water.

END

WISH YOU THE BEST