OLD KAMPALA SSS

A'LEVEL CHEMISTRY SEMINAR QUESTIONS 2022

(1ST OCTOBER 2022 AT 8:00AM)

1. (a) Explain what is meant by the terms;

(i) Lattice energy (2 marks)

(ii) Hydration energy (2 marks)

(iii) Enthalpy of solution (2 marks)

(b) The enthalpy of solution and lattice energy of Potassium Iodide are +21 and -642kJmol^{-1} respectively.

(i) Draw an energy diagram to show how the energy terms are related.(2 marks)

(ii) Calculate the hydration energy of Potassium Iodide. (2 marks)

(b) With the aid of a diagram, describe an experiment that can be carried out to determine the enthalpy of solution of ammonium chloride, write an expression to show how the enthalpy of solution of ammonium chloride can be calculated from the results of the experiment. (10 marks)

(KAJJANSI PROGRESSIVE SCHOOL)

2. (a) Write equation for the reaction between water and;

(i) Sodium hydride

(ii) Calcium hydride

(iii) Silicon hydride

(iv) Sulphur hydride

(b) (i) Silicon tetrachloride

(ii) Tin tetrachloride

(iii) Lead(IV) chloride

(iv) Tin(II) chloride

(v) Chromium(III) chloride

(ST.NOA GIRLS)

3. (a) Define the terms:

(i) eutectic point (1 mark)

(ii) eutectic mixture (1 mark)

(b) The table below shows the melting points of various mixtures for Lead and Tin

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

(i) Draw a fully labeled diagram of tin-lead system (5 marks)

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

(iii) Describe the phase changes which would take place if a liquid mixture containing 30% tin is cooled from 400^0C to 100^0C. (5 marks)

(iv) 200g of the liquid mixture of composition 5% Tin was cooled to 200^0C. Determine the composition of the remaining liquid mixture at 200^0C and calculate the mass of lead in the remaining liquid mixture at this temperature . (5 marks)

(c) State three differences between a eutectic mixture and a pure compound. (3 marks)

(AGGREY MEMORIAL)

4. (a)Define the term buffer solution (1 mark)

(b) (i) Describe how an acidic buffer solution of pH 3.5 can be prepared using methanoic acid of pKa value 3.75 ($4^1/_2$marks)

(ii) Explain how an acidic buffer solution works. (6 marks)

(c) Ethanoic acid ionizes in water according to the following equation.

$$CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$$

(i) Write an expression for the ionization constant, Ka for ethanoinc acid.

(ii) Using the expression in (c) (i) , calculate the ratio of the concentration of ethanoate ions to the concentration of ethanoic acid in a solution of pH 4 and also in a solution of pH 6. (Ka for ethanioic acid is $1.8x10^{-5}$ $moldm^{-3}$) (1 mark)

(iii) At which of the two pH values would better buffering occur? Give a reason for your answer. (2 marks)

(d) State one Biological and one industrial application of buffer solutions. (2 marks)

(OLD KAMPALA S.S.S)

5. (a) State the distribution law. (2 marks)

(b) Describe how the distribution coefficient of butane-1,4-dioic acid (succinic acid) between water and ethoxyethane can be determined. (5 marks)

(c) 100cm^3 of a solution contains 30g of substance Z. Calculate the mass of Z extracted by shaking the solution with:

(i) 100cm^3 of ethoxyethane (3 marks)

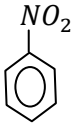
(ii) two 50cm^3 portions (5 marks)

(The distribution coefficient of Z between ethoxyethane and water is 5)

(d) Briefly describe how the distribution coefficient can be used to determine the formula of then complex formed between copper(II) ions and ammonia. (5 marks)

(BISHOPS S.S MUKONO)

6. Complete the following equations and in each case suggest a mechanism for the reaction

(a)  $\xrightarrow[AlCl_3]{CH_3COCl}$

(b)  $\xrightarrow[conc.\ H_2SO_4,\ 60^0C]{conc.\ HNO_3}$

(c) $CH_3CH_2CHO \xrightarrow{H^+/H_2NCONH_2}$

(d) $CH_3CHO \xrightarrow{dil.\ NaOH}$

(e) $CH_3COCl \xrightarrow{CH_3CH_2NH_2}$

(f) $CH_3COCH_3 \xrightarrow{KCN/H^+_{(aq)}}$

(STANDARD HIGH SCHOOL ZANA)

7. (a) Write the name and formula of one of the ores from which zinc is extracted and describe how zinc is extracted from the ore. (8 marks)

(b) Describe using equations the reactions of zinc with;

(i) air

(ii) water

(iii) sodium hydroxide (10 marks)

(c) (i). Explain why zinc is not considered a typical transition metal. (2marks)

(ii) State three ways in which the chemistry of zinc is similar to that of magnesium. (3 marks)

(d) (i). state what is observed when dilute aqueous ammonia is added dropwise to a solution containing zinc ions. (1 marks)

(ii) Write equation(s) for the reactions that take place in d(i). (2 marks)

(OLD KAMPALA S.S.S)

8. (a) Explain what is meant by an ideal solution (2 marks)

(b) The vapour pressures of benzene and methyl benzene are 75.2mmHg and 57.0mmHg respectively at 20^0C. Calculate;

(i) the vapour pressure of a mixture containing 15.6g of benzene and 73.6g of methyl benzene at 20^0C. (Assume that the two liquids form an ideal solution) (4 marks)

(ii) the composition of the vapour above the mixture. (2 marks)

(c) Compound A (boiling point 372^0C) and compound B (boiling point 399^0C) form an ideal solution.

(i) Sketch a labeled boiling point/composition diagram. (3 marks)

(ii) Using the diagram, describe and explain how pure B can be obtained from a mixture containing 50% B.

(STANDARD HIGH SCHOOL ZANA)

9. 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.

(OLD KAMPALA S.S.S, MBALALA SCH)

10. (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;

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

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

Write the cell notation for zinc/copper cell and calculate the e.m.f of the cell. (3 marks)

(d) State two ways in which an electrolytic cell differs from an e.m.f cell. (2 marks)

(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. (6 marks)

(f) State two applications of standard electrode potentials. (2 marks)

(ST NOA GIRLS S.S)

11. 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. (1 mark)

(b) Write;

(i) Equations for the half cell and reactions at the anode and cathode. (2 marks)

(ii) Equations for the overall cell reaction. (1 mark)

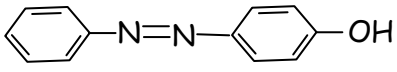
(c) (i) Calculate the e.m.f of the cell

(ii) State whether the reaction is feasible or not. Give a reason for your answer. (1mark)

(KASUBI S.S)

12. 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 $CH_3C \equiv CCH_2CH_3$

(SEROMA CHRISTIAN HIGH SCHOOL)

13. (a) Describe one general method for the preparing the halogens (excluding fluorine) in the laboratory. ($3^1/_2$marks)

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

(i) Water (6 marks)

(ii) Aqueous sodium hydroxide solution ($10^1/_2$marks)

(KOLOLO HIGH SCHOOL)

14. 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 (5 marks)

(b) Giving reasons, suggest the trend in the acid strength of the hydrides. (4 marks)

(c) Using equations where possible explain what happens when concentrated sulphuric acid is mixed with each of the hydrides. (6 marks)

(d) (i) Arrange the following compounds in their order of increasing acid strength $HClO_3, HClO_2, HClO$ (1 mark)

(ii) Explain your answer in d(i) (4 marks)

(SEROMA CHRISTIAN HIGH SCHOOL)

15. (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. (5 marks)

(iii) Explain the shape of your diagram. (4 marks)

(iv) Describe what would happen if a mixture containing less than 60% nitric acid was fractionally distilled. (3 marks)

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

(STANDARD HIGH SCHOOL ZANA, KASUBI S.S)

16. (a)Describe the spectrum of hydrogen. (use a diagram to illustrate)(7 marks)

(b) Explain how the spectrum of hydrogen;

(i) is formed. (4 marks)

(ii) provides evidence for the existence of energy levels (7 marks)

(a) 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)

(OLD KAMPALA S.S.S, AGGREY MEMORIAL)

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

(a) Water (4 marks)

(b) Concentrated acids (6 marks)

(c) Sodium hydroxide (6 marks)

(d) Dilute acids (4 marks)

(BISHOPS S.S MUKONO)

26. 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.

(KASUBI S.S)

27. (a) State four properties in which beryllium differs from other elements of group (II) of the periodic table.

(b) State four reasons why beryllium differs from the rest of the elements in group(II) of the periodic table.

(c) i) Name the reagent that can be used to distinguish between Ca^{2+} and Ba^{2+} ions.

(ii) State what would be observed and write equation(s) for the reactions that would take place if the reagent you have named in c(i) was separately treated with Ca^{2+} and Ba^{2+} ions.

(KASUBI S.S)

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.

(SEROMA CHRISTIAN HIGH SCHOOL)

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. (03 marks)

(c) Using the graph, determine the;

i) Order of the reaction
ii) Rate constant for the reaction
iii) Half-life for the reaction.

(KAJJANSI PROGRESSIVE S.S)

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.

(i) 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. (4marks)

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. (4 marks)

(STANDARD HIGH SCHOOL ZANA)

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. (4 marks)

ii) Explain the shape of the graph. (4 marks)

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 $\Omega^{-}1cm^{-2}$ and the molar conductivity of bromoethanoic acid at infinite dilution is 389 $\Omega^{-1}cm^2mol^{-1}$]

i) Calculate the cell constant. (2 marks)

ii) Calculate the molar conductivity of the 0.1M bromoethanoic acid. (3 marks)

iii) Determine the pH of 0.1M bromoethanoic acid. (4 marks)

(ST NOA GIRLS S.S)

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.

(KOLOLO HIGH SCHOOL)

33.(a) Explain what is meant by the term electronegativity.

(b) State the factors that determine the value of electronegativity of an element.

(c) Explain how the factors you stated in (b) affect the value of electronegativity.

(d) The table below of some elements and their electron affinities.

Atomic number	11	12	13	14	15	16	17
Electron affinities$KJmol^{-1}$	2.0	-6.7	3.0	13.5	6.0	20.0	36.4

i) Draw a graph of electron affinities versus atomic number.

ii) Explain the shape of the graph.

(KAJJANSI PROGRESSIVE, MBALALA SCH MUKONO)

34.Describe how these conversions can be effected. Equations are not required;

a) Propanol to ethanol ($5^1/_2$marks)

b) Ethyne to benzoic acid (4 marks)

c) Butanoic acid to butan-2-ol ($5^1/_2$marks)

d) Ethanol to propan-2-ol (5 marks)

(KASUBI S.S)

35.a) Differentiate between soap and soapless detergents. (2 marks)

b) Write equations to show how alkyl benzene sulphonate can be prepared from octadecan-1-ol, $CH_3(CH_2)_{16}CH_2OH$ (6 marks)

c) Explain why the following compounds are added to soapless detergents;

(i) polyphosphates (2 marks)

(ii) sodium sulphate (2 marks)

(BISHOPS HIGH SCHOOL MUKONO)

36.a) Write equations to show how the following compounds can be prepared.

i) Phenylamine (4 marks)

ii) Ethalymine (aminoethane)

b) Which one of phenylamine and ethylamine is a stronger base? Explain your answer. (3 marks)

(ST NOA GIRLS S.S)

37.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. (3marks)

ii) How can the reaction in b(i) be used to distinguish between phenylamine and ethylamine. (1 mark)

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

(KOLOLO HIGH SCHOOL)

38. (a) Aluminium can be extracted from bauxite, which is impure hydrated aluminium oxide. Describe how,

(i) Pure aluminium oxide is obtained from bauxite. (10 marks)

(ii) aluminium is obtained from pure aluminium oxide ($3^1/_2$marks)

(Your answer should include equations)

(b) Discusss the reactions of aluminium with hydrochloric acid, sulphuric acid and nitric acid ($3^1/_2$marks)

(c) Explain why aluminium utensils should not be washed using soap solutions. (3 marks)

(SEROMA CHRISTIAN HIGH SCHOOL)

END