BE TRUE

TRINITY COLLEGE NABBINGO

A'LEVEL CHEMISTRY SEMINAR

SATURDAY 28TH SEPTEMBER 2024

1. Beryllium, calcium and barium are some of the elements that belong to group (II) of the periodic table
   a) (i) Write the electronic configuration of beryllium ions and barium ions in +2 oxidation state.

   (ii) Explain why beryllium chloride is more soluble in ethanol than water while barium chloride is more soluble in water than ethanol.

   b) Describe the reactions of beryllium and barium with;
   (i) Oxygen
   (ii) Dilute sulphuric acid
   c) Briefly explain the reactions that take place during the manufacture of cement.
   d) Potassium chromate (VI) solution was added to barium nitrate solution followed by dilute nitric acid. Explain what was observed.

(ST MARK'S COLLEGE, NAMAGOMA)

2. (a) The first and the third ionization energies of element R are 845 and 7780KJmol^{-1} respectively.
   i) Define the term first ionization energy.
   ii) The frequency of element R at the point of second ionization is 3.58 x 10^{15} Hz. Calculate the value of the second ionization energy of element R (Planck's constant = 6.626 x10^{-34}Js and Avogadro's number NA= 6.02x10^{23})
   iii) State the group in the periodic table to which R belongs and give a reason for your answer.

   (b) The mass spectrum of bromine shows peaks at mass to charge ratios of 158, 160 and 162and bromine has two isotopes, Br-79 and bromine-81.

   i) Briefly describe how the mass spectrum of bromine can be obtained.
   ii) Write the formulae of the ions corresponding to the peaks.
   iii) Calculate the percentage abundance of each isotope of bromine and hence sketch the mass spectrum of bromine. (The relative atomic mass of bromine is 79.91)

(CRANE HIGH SCHOOL, BWERENGA)

3. In the extraction of zinc from zinc blende, the ore is first concentrated and then extraction follows.
   a) Name the;
   i) Method by which the ore of zinc is concentrated
   ii) Two main impurities present in the ore of zinc named above.

Emphasize the word 'insoluble' on salts & ppts

   b) Describe how zinc is extracted from the concentrated ore.
   c) Explain the reactions of zinc and the following substances.
   i) Potassium hydroxide
   ii) Concentrated sulphuric acid
   d) Zinc ethanoate dissolves in water to form a colourless solution and decomposes on heating to give a gas which forms a yellow precipitate with 2,4-dinitro phenyl hydrazine solution. Explain;
   i) What is observed when sodium hydrogen carbonate solution is added to the colourless solution.
   ii) What happened when zinc ethanoate is heated and the gas passed through 2,4-dinitro phenyl hydrazine solution.

4. (a)State the difference between soap and a non-soapy detergent.

   (i) Write equations to show how a non-soapy detergent can be prepared from benzene and but-1-ene.

   (ii) Explain the cleansing action of the non-soapy detergent formed in b(i) above.

   (iii) State two advantages of using non-soapy detergents over soap
   b) Distinguish between addition and condensation polymerization.
   c) Write equations to show how each of the following polymers is formed.
   i) Perspex
   ii) Nylon-6, 10
   d) Polytetrafluoroethene is formed by addition polymerization. In an experiment, the osmotic pressure of a 3.0% solution of polytetrafluoroethene in toluene was found to be 46.77mmHg at 27°C. determine the number of monomer units in the polymer. (R=8.31, C=12, F=19)

$\{F_2C=CF_2\}$

Toulene

(TRINITY COLLEGE NABBINGO)

5. (a) (i) Write the electronic configuration of chromium (Atomic number of chromium= 24)

   ii) State the most common oxidation states of chromium +3 and +6

   b) Describe the reactions of chromium with;

   i) Water

   ii) Sulphuric acid

   c) Explain what happens when each of the following solutions is added to a solution of chrome alum $K_2SO_4.Cr_2(SO_4)_3.24H_2O$. In each case state what is observed and write equations for the reactions that take place

   (i) sodium carbonate solution

   (ii) sodium hydroxide solution

   d)Hydrogen peroxide was added to the solution formed in c(ii) above

   (i) State what was observed

   (ii) Write equation for the reaction that took place

chrome alum

e) A few drops of sodium hydroxide solution were added to a solution of potassium dichromate (VI)

(i) State what was observed

(ii) Write equation for the reaction that took place

(CRANE HIGH SCHOOL, ENTEBBE)

6. (a) What is meant by the term electrolytic conductivity?
   b) The table below shows the variation of conductivity with volumes of ammonia when two inert electrodes connected to a conductivity meter were immersed in a 25cm³ of 0.02M cobalt (II) sulphate solution and 2cm³ portions of 0.4M ammonia added at intervals.

Volume of ammonia solution (cm^3)	0	2	4	6	8	10	12	14	16
Conductivity of resultant solution ($\Omega^{-1}cm^{-1}$)	1.68	1.64	1.61	1.56	1.54	1.55	1.57	1.58	1.55

i) Plot a graph of conductivity of solution versus volume of ammonia.
ii) Determine the volume of ammonia that gave the least conductivity
iii) Determine the formula of the complex in the solution b(i)

c) Some half cells and their e.m.fs are given below

Half cells	e.m.f(Volts)
$I_{2(aq)}/2I^-_{(aq)}$	+0.54
$Fe^{3+}_{(aq)}/Fe^{2+}_{(aq)}$	+0.76

i) Write the cell convention for a cell made up of the half cells
ii) Write the equation for the cell reaction
iii) Calculate the standard free energy for the reaction and indicate its units

d) A current of 40.5A was passed through molten Lead (II) bromide for 4 hours and the bromine liberated treated with hydroxybenzene. Calculate the number of;
i) Bromine liberated
ii) Hydroxybenzene that reacted

(NAMILYANGO COLLEGE)

7. (a) By means of equations only show how the following synthesis can be carried out.
   (i) 1,2-Diphenylethene from benzene
   (ii) Ethyl benzoate from ethyne
   (iii) Benzene from calcium carbonate
   (iv) Benzaldehyde-2,4-dinitrophenyl hydrazone from benzene

(b) Write the Mechanism for the hydrazone last step reaction in (a) (IV).

(MITA COLLEGE, KAWEMPE)

8. A compound Q with vapour density = 30, contains 60.0% carbon, 13.3% hydrogen and the rest being oxygen
   (a) (i) Determine the empirical formula of Q
   (ii) Determine the molecular formula of Q
   (b) Write the names and structural formulae of all possible isomers of Q

(c) When Q was reacted with iodine solution and sodium hydroxide solution and the mixture warmed, a yellow precipitate was formed.
   (i) Identify Q
   (ii) Write equation for the reaction that took place
   (iii) State what would be observed when Q is heated with acidified potassium manganate (VII) solution, name the major organic product and write equation for the reaction that took place.

(d) When Q was heated with excess concentrated sulphuric acid, a gas W which turned acidified potassium manganate (VII) from purple 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) and name the product.

(ARCHBISHOP KIWANUKA S.S)

9. (a) Define the term enthalpy of displacement
   (b) Describe an experiment to determine enthalpy of displacement of copper by zinc
   (c) Excess zinc was added to 25 cm^3 of 1M copper (II) sulphate solution in a well lagged calorimeter and the temperature of the solution recorded at some time intervals. The data below was obtained.

Time (minutes)	0.0	2.5	3.0	3.5	5.0	6.0
Temperature (°C)	27.2	66.0	69.5	68.5	65.0	62.0

(i) Plot a graph of temperature against time
(ii) Use the graph to determine the molar enthalpy of displacement of copper by zinc

(d) 50 cm^3 of 1M copper(II) chloride solution is added to a polystyrene cup and the initial temperature of the solution was 28 °C. 4g of zinc dust was added to the solution and the mixture stirred. The highest temperature of the mixture was 69 °C. Calculate the heat of displacement of copper by zinc.

(e) 25 cm^3 of 0.5M sodium chloride solution was added to 25 cm^3 of 0.5M silver nitrate solution and the temperature of the mixture rose from 26 °C to 29 °C. Calculate the enthalpy of precipitation of silver chloride.

(ST JOSEPH'S GIRLS S.S.S, NSAMBYA)

10. (a) Explain why a 0.2M barium chloride solution has the same freezing point as a 0.6M solution of glucose
    (b) (i) Describe an experiment that can be carried out in the laboratory to determine the formula mass of sulphur in naphthalene by the freezing point depression method.

(ii) 3.5g of sulphur in 100gof naphthalene lowered the melting point of the latter by 0.87 °C, while iodine in 100g of the same solvent lowered the melting point by 0.8 °C. Calculate the freezing point constant for naphthalene and hence determine the molecular formula of sulphur in naphthalene.

(c) The table below shows the freezing points of different concentrations of solute T in water.

Concentration of T (gdm^{-3})	0	30	60	90	120	150
Freezing point (°C)	0	-0.16	-0.32	-0.49	-0.65	-0.81

(ii) Composition of the vapour

(c) At 101.325KPa pressure, hydrochloric acid and water form an azeotropic mixture having a boiling point of 121°C and composition of 20% by mass of hydrochloric acid.

(i) Define the term azeotropic mixture

(ii) Sketch a boiling point composition diagram for hydrochloric acid and water system (The boiling points of water and hydrochloric acid are 100°C and 85°C respectively)

(iii) Describe what happens when a liquid mixture of the above system containing 60% of the hydrochloric acid is fractionally distilled.s
(d)State two methods that can be used to separate azeotropic mixtures

(KOLOLO S.S)

Mock

15. (a) State what is meant by the following terms:
(i) **Freezing point.**
(ii) **Freezing point constant** of a substance.
(b) Describe an experiment that can be used to determine the molecular mass of a sulphur in naphthalene using the method of depression of freezing point. (*Diagram not required*)

(c) Explain why the method you have described in (b) is not suitable for determining the molecular mass of starch in aqueous solution.
(d) The table below shows the freezing points of different concentrations of solute T in water.

Concentration of T ($g\ dm^{-3}$)	0	30	60	90	120	150
Freezing point (°C)	0.00	−0.16	−0.32	−0.49	−0.65	−0.81

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

(ii) Use the graph in (d)(i) to determine the relative molecular mass of T. (The Cryoscopic constant for water is 1.86°C per 1000g per mole).

state the formula

(TRINITY COLLEGE NABBINGO)

Mock question

16. (a) An organic compound T contains 40.00% carbon, 6.67% hydrogen and the rest being oxygen. The density of T is $2.679\times 10^{-3} gcm^{-3}$ at s.t.p.
Determine the
(i) empirical formula of T. CH_2O
(ii) molecular formula of T. RAM = 60, $C_2H_4O_2$
(b) Write the structural formulae of the all the possible isomers of T.
(c) T reacts with sodium carbonate to give effervescence.
Write the name and structural formula of T. ethanoic acid
(d) Write equation and outline a mechanism
(i) for the reaction that occurs when T is heated with propan-1-ol in presence of dry hydrogen chloride gas. an ester formed
(ii) to show how T can be obtained from ethylethanoate.
(e) Name **one** reagent that can be used to distinguish between T and each of the following compounds. In each case, state what would be observed if each member in the pair is treated with the reagent you have named.

(i) Methanoic acid.
(ii) Butenedioic acid.

(SAVIOUR S.S, KIBOGA)

17. (a) (i) Write the formula of and name of one ore of copper.
(ii) Describe how pure copper can be obtained from the ore you have named in (a)(i).
(*Your answers should include relevant equations for the reactions that take*)

(b) State the conditions and write equations for the reaction between nitric acid and copper.

(c) 2.10 g of a sample of copper ore was dilute sulphuric acid with heating and the resultant solution made up to 250cm³ with distilled water. To 30.0 cm³ of the dilute solution was added 10% potassium iodide solution and the resultant mixture required 45 cm³ of a 0.05 M sodium thiosulphate solution for complete reaction using starch indicator.
The reactions that take place are:

$$2Cu^{2+}(aq) + 4I^{-}(aq) \longrightarrow Cu_2I_2(aq) + I_2(aq)$$
$$2S_2O_3^{2-}(aq) + I_2(aq) \longrightarrow S_4O_6^{2-}(aq) + 2I^{-}(aq)$$

Calculate the percentage by mass of copper in the ore. (Cu=63.5).
(d) State what be observed and write equations for the reaction between that would take place if to an aqueous copper(II) sulphate solution is added
(i) potassium hexacyanoferrate(II) solution.
(ii) excess concentrated hydrochloric acid.

18. Explain each of the following observations. Illustrate your answers with equations where applicable.
(a) The boiling point of propanoic acid is 141°C, whereas methyl ethanoate with the same formula mass boils at 57°C.
(b) Lead(II) chloride is more soluble in concentrated hydrochloride than in dilute hydrochloric acid.
(c) When iodocyclohexane was treated with aqueous sodium hydroxide solution and resultant solution neutralised with dilute nitric acid and then, tested with silver nitrate solution, a yellow precipitate was observed. Iodobenzene on similar treatment gave no precipitate.
(d) At 25°C, the dissociation constants of bromoethanoic acid and ethanoic are $1.3\times 10^{-3} mol\ dm^{-3}$ and $1.7\times 10^{-5} mol\ dm^{-3}$respectively.
(e) A mixture of benzene (b.pt 80.1°C) and water (b.pt 100°C) boils at a temperature less than the boiling point of benzene.

19. (a) State
(i) **Hess's law.**
(ii) what is meant by the term; **enthalpy of solution.**
(b) Describe an experiment that can be carried out to determine the enthalpy of solution of an ionic salt.
(Diagram **not** required)
(c) Some thermochemical data are shown below:
Enthalpy of atomisation of fluorine $= +79\ kJ\ mol^{-1}$
First ionisation energy of calcium $= +590\ kJ\ mol^{-1}$

(i) Plot a graph of freezing point depression against concentration of T
(ii) Use the graph you have drawn to determine the relative molecular mass of T (The Cryoscopic constant for water is 1.86 °C per 1000g per mole)

(MENGO S.S)

11 (a) Define

i) Order of reaction
ii) Molecularity

b) The following data was obtained for the reaction

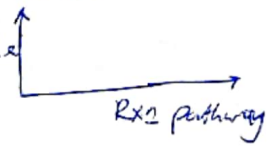
$$A + 2B \rightleftharpoons 2C + D \qquad \Delta H^{\theta} = -50KJmol^{-1}$$

Activation energy for the forward reaction is 150KJmol^{-1}

EXP No.	[A] (mol^{-1})	[B] (mol^{-1})	Initial rate (mol l^{-1} min^{-1})
I	4.0×10^{-2}	4.0×10^{-2}	6.40×10^{-3}
II	4.0×10^{-2}	8.0×10^{-2}	1.28×10^{-4}
III	8.0×10^{-2}	4.0×10^{-2}	2.56×10^{-4}
IV	8.0×10^{-2}	8.0×10^{-2}	5.12×10^{-4}

i) Determine the order of reaction. Explain your working w.r.t A = 2 w.r.t B =
ii) Write the rate equation for the reaction
iii) Calculate the rate constant

c) i) Draw a labeled energy diagram for the reaction in B above



ii) Calculate the activation energy for the backward reaction

d)Explain the effect of increasing temperature on the
i) rate of reaction
ii) equilibrium constant for the reaction

e) Draw a sketch graph to show the change in the concentration of B with time ...two temperatures T1 and T2 where T2>T1

(KITANTE HIGH SCHOOL)

12. (a) Define the term eutectic mixture

(b) The table below shows how the melting of mixtures of tin and lead vary with compositions

Percentage of tin in the mixture	0.0	20	40	70	80	100
Melting point (°C)	327	280	234	193	206	232

(i) Plot a fully labeled melting point-composition for the tin-lead system
(ii) Determine the eutectic temperature and the composition of the eutectic mixture

(c) Describe the changes that would take place when a liquid mixture of the above system containing 80% by mass of tin is cooled from 280°C to 100°C

(d) The partition coefficient of substance Q between hexane and water is 8.0 at 25°C. Calculate the mass of Q that would be extracted from an aqueous solution containing 60.0g per litre when shaken with:

(i) 125cm^3 of hexane at once

(ii) two successive portions of 62.5cm^3 of hexane

(a) State one application of partitions of solutions

(KINAAWA HIGH SCHOOL, MUGONGO)

13. Manganese is one of the transition elements.

(a) State
(i) what is meant by the term **transition element?**
(ii) **three** properties in which manganese differs from magnesium.

(b) Describe the reactions of manganese with each of the following substances.
(i) Oxygen.
(ii) Sulphuric acid.

[*Your answer should include relevant equations for the reactions*]

(c) State what would be observed and write equations for the reactions that would take place when to aqueous manganese(II) chloride is added
(i) dilute ammonia solution dropwise until in excess and mixture allowed to stand.
(ii) concentrated nitric acid followed by little solid sodium bismuthate(V).

(d) Potassium manganate(VII) is commonly used in volumetric analysis even when it is not a primary standard.
State
(i) **two** reasons why potassium manganate(VII) is commonly used in volumetric analysis.
(ii) **one** reason why potassium manganate(VII) is not a primary standard.

(e) Name **one** substance that can be used to standardised potassium manganate(VII).

(f) Write equation for the reaction between acidified potassium manganate(VII) and hydrogen peroxide.

(BULOBA HIGH SCHOOL)

14. (a) State Raoult's law

(b) The vapour pressures of methanol and ethanol at 20°C are 12.530 and 5.866KPa respectively. If 20g of methanol give an ideal solution when mixed with 100g of ethanol,

Calculate the;

(i) Total vapour pressure above the mixture (C=12, O=16, H=1)

Second ionisation energy of calcium $= +1145\ kJ\ mol^{-1}$
Enthalpy of atomisation of calcium $= +178.2\ kJ\ mol^{-1}$
Enthalpy of formation of calcium fluoride $= -1293\ kJ\ mol^{-1}$
First electron affinity of fluorine $= -348\ kJ\ mol^{-1}$

(i) Draw an energy level diagram for the formation of calcium fluoride and use it to calculate the lattice energy of calcium fluoride.

(ii) Calculate the enthalpy of solution of calcium fluoride.
(The hydration energies of calcium and fluoride ions are $-1562\ kJ\ mol^{-1}$ and $-506\ kJ\ mol^{-1}$ respectively).

(iii) Comment on the solubility of calcium fluoride.

20. (a) State:

(i) ***Raoult's law.***

(ii) *what is meant by the term* ***ideal solution?***

(b) Liquids **P** and **Q** form liquid mixture that obeys Raoult's law. A mixture of **P** and **Q** boils at 100°C and 760 mmHg pressure. *The vapour pressures of pure* **Q** *and pure* **P** *at 100°C are 1450 mmHg and 550 mmHg respectively.*

Calculate the:

(i) composition of the mixture.

(ii) composition of the vapour above the mixture.

(c) Nitric acid and water form a non-ideal mixture that deviates negatively from Raoult's law. When the mixture was distilled, a constant boiling point mixture containing 68% nitric acid was obtained at 120°C. The constant boiling point mixture has a density of 1.42 gdm^{-3}. (The boiling point of pure water and nitric acid are 100°C and 83°C)

(i) Explain why the mixture shows a negative deviation from Raoult's law.

(ii) Using a well labelled diagram, explain what would happen when a mixture containing 50% of water is fractionally distilled.

(iii) Calculate the volume of acid needed to prepare 250 cm^3 of a 0.05 M nitric acid.

21. Write equations to show how the following compounds can be synthesized.
(a) Propan-2-ol from ethanol.
(b) Iodobenzene from benzene.
(c) Propanoic acid from ethene.
(d) Benzaldehyde hydrazone from bromobenzene.
(e) Sodium benzenesulphonate from ethyne.
(f) Methylbenzene from methylbenzaote
(g) Butanoyl chloride from propan-1-ol

22. Elements X and Y form an ionic compound XY the lattice energy of which is 755KJmol^{-1}. X is a metal and its first ionization energy is 492KJmol^{-1}. The heat of atomization of X is

110KJmol^{-1}. Element Y is a diatomic gas. The bond dissociation energy of Y is 20KJmol^{-1} and its electron affinity is 365KJmol^{-1}. The heats of hydration of X and Y ions are 300 and 375KJmol^{-1} respectively.

(a) By means of a diagram, show how the energy changes involved in the formation of solid XY are related.
(b) Calculate;
(i) The heat of formation of solid XY
(ii) The heat of hydration of solid XY
(c) (i) if the second ionization energy of X is 2300KJmol^{-1} and the lattice energy of XY_2 is 1900KJmol^{-1}, calculate the heat of formation of solid XY_2.
(iii) From your answer to c(i), what do you deduce about the stability of solid XY_2?

23. Differentiate between;
(a) A nucleophilic and electrophilic reactions
(b) Addition and substitution reactions
(c) Molecular and empirical formulae
(d) Chain and position isomers

24. Compound Q, C_3H_6O forms a yellow precipitate with 2,4-dinitrophenylhydrazine (Brady's reagent). Q does not react with a solution of silver nitrate in ammonia.
(a) Write the structural formula of Q
(b) Write an equation for the reaction between Q and Brady's reagent. Suggest a mechanism for the reaction
(c) Write an equation to show how Q could be prepared in the laboratory

25. Given below are some bond dissociation energies in KJmol-1.

C-H	416
C-C	336
H-H	437

Enthalpy of atomization of C is 721KJmol^{-1}.
(a) Calculate the enthalpy of formation of cyclohexane
(b) The enthalpy changes for the dehydrogenation of cyclohexene and that for the dehydrogenation of cyclohexane to benzene are +120KJmol^{-1} and +209KJmol^{-1} respectively.
(i) Write an equation for the dehydrogenation of cyclohexane to cyclohexatriene
(ii) Calculate the enthalpy change for the dehydrogenation of cyclohexane to cyclohexatriene
(iii) State the more stable product of the dehydrogenation of cyclohexane. Give reasons for your answer.

26. (a) Describe briefly an experiment to show that graphite and diamond are allotropes of carbon.

(b) Some properties of graphite and diamond are shown below

Allotrope	Density (gcm^{-3})	Heat of combustion at 298K ($KJmol^{-1}$)
Graphite	2.25	-393.5
Diamond	3.51	-395.4

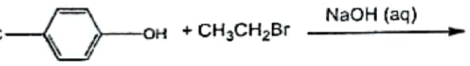
(i) Calculate the heat of conversion of graphite to diamond and state the allotrope which is more stable at room temperature (298K). Give a reason for your answer.
(ii) State what would happen to the total volume of the system if a given mass of diamond is converted completely into graphite. Explain your answer
(iii) Suggest with a reason, one condition required for converting graphite to diamond
(iv) Calculate the change in volume when one gram of graphite is converted completely into diamond.

27. Explain the following observations.
(a) Standard electrode potential of lithium is greater than that of potassium although potassium reacts more vigorously with water than lithium.
(b) When a solution of sodium thiosulphate is exposed to air, a yellow precipitate is formed after sometime.
(c) Beryllium chloride is more soluble in ethanol than in water whereas magnesium chloride is more soluble in water than in ethanol.
(d) Phenol is more acidic than phenylmethanol.

28. Write a mechanism to show how the following conversion can be effected.
(a) Benzene to phenylethanone
(b) Benzoic acid to 3-nitrobenzoic acid
(c) 2-iodo-2-methylpropane to 2-methylpropan-2-ol
(d) Propene to 2-bromopropane

29. Complete the following equations and outline a mechanism

(a) $(CH_3)_2CO \xrightarrow{\text{Dil. NaOH}}$

(b)  $+ CH_3CH_2Br \xrightarrow{\text{NaOH (aq)}}$

(c) $CH_3C(CH_3)=CH_2 \xrightarrow[\text{Warm}]{H^+/H_2O}$

(d) $CH_4 \xrightarrow{Cl_2/U.V}$

30. (a) With the aid of a diagram, briefly describe how the standard electrode potential of an electrode can be measured.

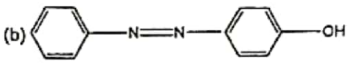
(b) The convention of a cell is given below.

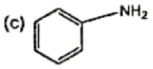
$Pt/Fe^{2+}_{(aq)}, Fe^{3+}_{(aq)} // MnO_4^-{}_{(aq)}, Mn^{2+}_{(aq)}, H^+_{(aq)} /Pt$

Write equations for the half cell reactions at each electrode.

(c) Write the overall equation for the cell reaction
(d) The electrode potential for the system $Fe^{2+}_{(aq)} /Fe^{3+}$ and $Mn^{2+}_{(aq)} /MnO_4^-{}_{(aq)}$ are +0.76 and +1.51 volts respectively. Deduce whether the reaction in (c) is feasible or not and give a reason for the answer.

31. Write equations to show how you can prepare the following
(a) CH_3CO_2H from ethene

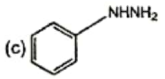
(b)  from phenylamine

(c)  from benzoic acid

(d) $CH_3CO_2CH_2CH_2CH_3$ from 1-bromopropane

32. Write equations to show how you can prepare the following
(a) $(CH_3)_3C—OH$ from propan-1-ol

(b) $(CH_3)_2C(OH)—COOH$ from Ethanol

(c)  from Benzene

(d) CH_3COCH_3 from ethanol

33. A 8.0g of copper ore was leached with dilute sulphuric acid and the resultant solution diluted to 250cm³. To 30cm³ of this solution was added excess 10% potassium iodide solution. The liberated iodine required 23.5cm³ of 0.05M sodium thiosulphate solution for complete reaction. Calculate the percentage of copper in the ore.
34. Write notes on each of the following reactions. Your answer should include a suitable example in each case and also mechanisms
(a) Nucleophilic substitution
(b) Electrophilic addition

(c) Nucleophilic addition
(d) Electrophilic substitution

35. A water soluble mineral schronite has the formula $xMgSO_4.yK_2SO_4.2H_2O$.
(a) Give one simple test you could carry out to show that schronite is a double salt rather than a complex of magnesium.
(b) An analysis of the salt schronite was carried out as follows. 8.04g of the salt was dissolved in water and the volume made up to 500cm^3. To 50cm^3 of the solution, excess barium chloride solution was added. The precipitate of barium sulphate ($BaSO_4$, Mr=233) was filtered off, washed and dried and it weighed 0.932g. Calculate the moles of barium sulphate formed hence the total moles of potassium and magnesium sulphate in 8.04g of schronite.
(c) To a second 50cm^3 of the solution, ammonium chloride solution and sodium dihydrogen phosphate were added. All the magnesium was precipitated as magnesium ammonium phosphate. This was filtered off, washed, dried and ignited to give 0.222g of magnesium pyrophosphate, $Mg_2P_2O_7$ according to the equation
$2MgNH_4PO_{4(s)} \rightarrow Mg_2P_2O_{7(s)} + 2NH_{3(g)} + H_2O_{(l)}$
Calculate;
(i) Number of moles of magnesium pyrophosphate formed
(ii) Number of moles of magnesium sulphate in 8.04g of schronite
(iii) Number of moles of potassium sulphate in 8.04g of schronite
(iv) Total mass of magnesium sulphate and potassium sulphate in 8.04g of schronite
(d) Use the results above to calculate the mass and number of moles of water in 8.04g of schronite hence write down the formula of the double salt.

36. Carbonates are salts of carbonic acid which is itself obtained when carbon dioxide dissolves in water.
(a) Write the structural formulae of carbon dioxide and carbonate ion. On each structure, indicate the type of bonding.
(b) The bond length of carbon-oxygen double bond are 0.143nm and 0.122nm respectively.
(i) Estimate the bond lengths in carbonate ion and in carbon dioxide. Give reasons for your answers.
(ii) Write the structural formula of carbonic acid and estimate the carbon-oxygen bond length.
(iii) Give approximate values of the OCO bond angles in the structure you gave in (ii) and explain your answer.
(c) The solubility of carbon dioxide in water is 0.51cm^{3}g^{-1} at s.t.p. Assuming the density of water is 1gcm^{-3}, calculate the solubility of carbon dioxide in moldm^{-3} at s.t.p. (1 mole of gas occupies 22.4 litres at s.t.p)

37. (a) Name one source of nitrogen and one of hydrogen used in the manufacture of ammonia

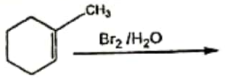
(b) Nitrogen and hydrogen react to form ammonia according to the equation

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$. $\Delta H = -92KJmol^{-1}$

State what would happen to the position of equilibrium and in each case give a reason if:

(i) The pressure of the system is increased
(ii) The temperature of the system is increased
(iii) Iron is added
(d) Stoichiometric amounts of nitrogen and hydrogen were reacted at 50atm and at equilibrium, 0.8 moles of ammonia were formed. Calculate:
(i) The amount of hydrogen at equilibrium
(ii) Value of the equilibrium constant, KP for the reaction.

38. (a) What is meant by the term "Partition law?"
(b) Briefly describe how the equilibrium constant, K_c for the reaction
$I_{2(aq)} + I^-_{(aq)} \rightleftharpoons I_3^-{}_{(aq)}$ can be determined by partition method.
(c) The following results were obtained for the partition of iodine between carbon disulphide and aqueous potassium iodide.
Initial concentration of potassium iodide =0.2 moldm^{-3}
Total concentration of iodine in aqueous layer =0.002moldm^{-3}
Concentration of iodine in carbon disulphide =0.072moldm^{-3}
(The KD of iodine between pure water and carbon disulphide is 1.63×10^{-3}).
Calculate:
(i) The concentration of free iodine in water
(ii) Concentration of fixed iodine
(iii) The equilibrium constant, K_c for the reaction.
$I_{2(aq)} + I^-_{(aq)} \rightleftharpoons I_3^-{}_{(aq)}$

39. Complete the following equations and outline the mechanisms of reaction
(a)  $\xrightarrow{Br_2/H_2O}$
(b)  $+ CH_3CH_2Cl \xrightarrow{AlCl_3}$
(c)  $\xrightarrow[Conc.H_2SO_4, warm]{Conc.HNO_3}$
(d) $(CH_3)_2C{=}O \xrightarrow{NH_2NH_2/H^+}$

40. (a) Name the pair(s) of function group(s) that can be distinguished using the following reagents. In each case, state what would be observed.
    (i) Ammoniacal silver nitrate solution
    (ii) Iron(III) chloride solution

(b) Write equations to show how the following compounds can be synthesized.

i) Propanone from ethanol

(ii) ethyne from ethanol

(iii) Propane-1,2-diol from 2-bromopropane

41. Discuss the reactions of:
    (a) Amines with nitrous acid
    (b) Ethanol with sulphuric acid
    (c) Methylbenzene with chlorine

    Your answer should include:
    (i) Suitable examples for the reactions in (a)
    (ii) Equations for the reactions in (b)
    (iii) Mechanisms for the reactions in (c)

END

"Learning is not attained by chance; it must be sought for with ardor and attended to with diligence"- Abigail Adams