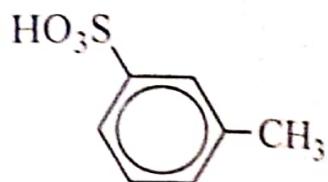
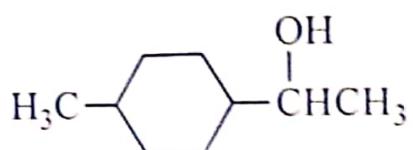
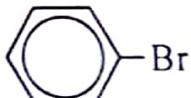
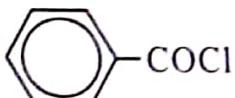
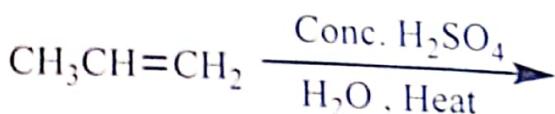
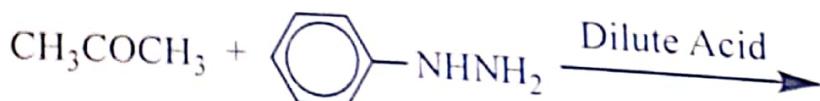
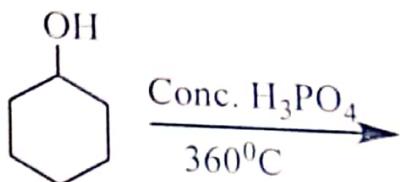
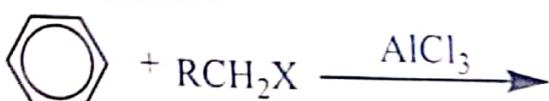


## TRIAL QUESTIONS

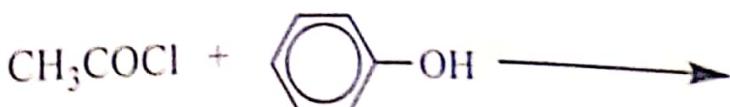
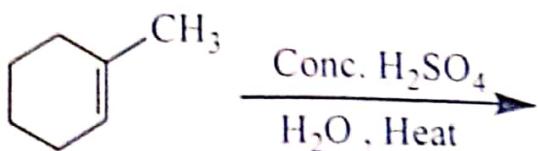
1. a). Discuss the reactions of methyl benzene with chlorine. (Include the mechanisms for the reaction that takes place.)
- b). Write equations to show how the following compounds can be synthesized from methyl benzene:

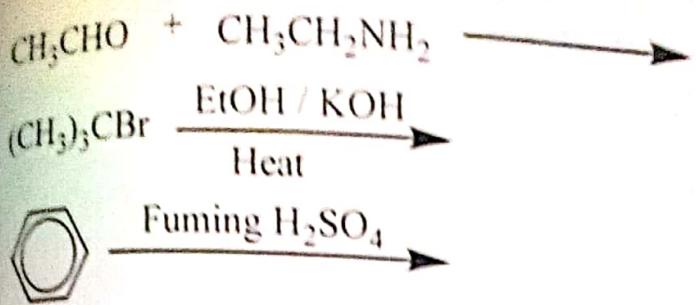


2. Copy and complete the following reactions. In each case, outline a mechanism for the reaction.

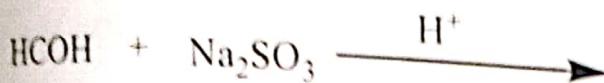


3. Complete the following equations and in each case, outline the accepted mechanism for the reaction.

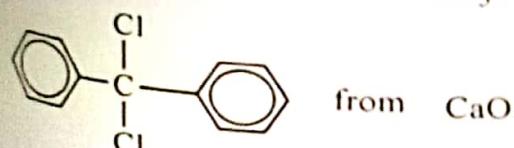
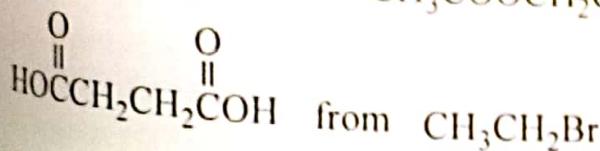
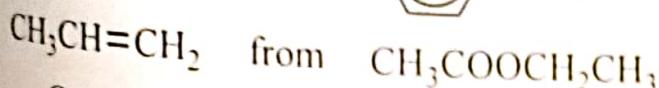
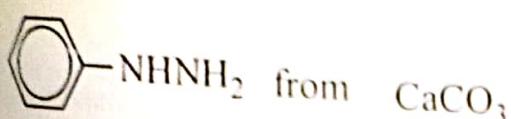
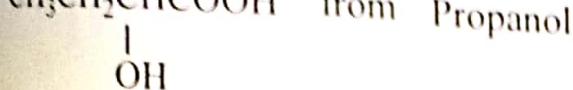




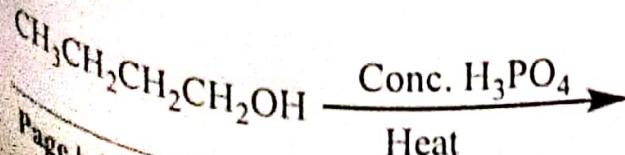
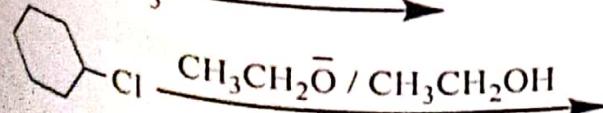
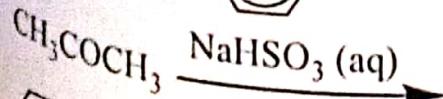
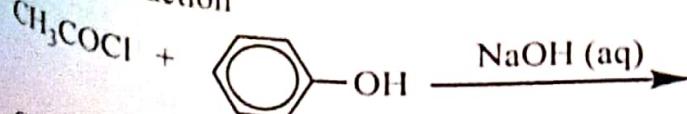
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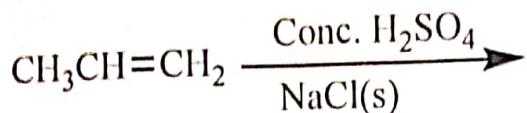


4. Write equations to show how the following conversions can be carried out



5. Complete the following equations and in each case, outline the accepted mechanism for the reaction

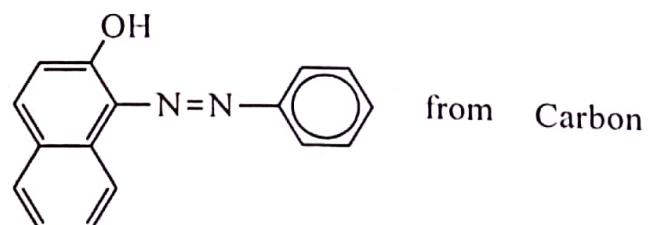
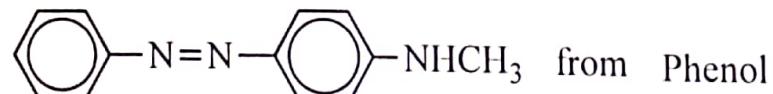
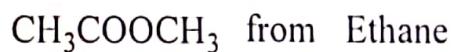
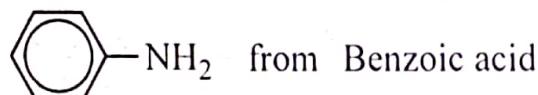




6. Propan-1-ol (b.pt 98°C) and propan-2-ol (b.pt 82°C) belong to a group of compounds called alkanols.

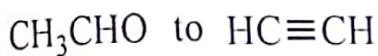
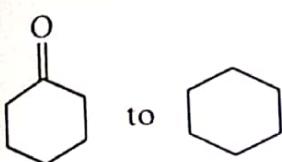
- a) i) Write down the general formula for alkanols.
- ii. State the types of isomerism exhibited by the two compounds.
- iii) Describe briefly one chemical test that can be used to confirm the functional group in alkanols.
- b). Name a reagent that can be used to distinguish between propan-1-ol and propan-2-ol and state what would be observed when the reagent is treated with each compound.
- c. Write reactions to show how the following conversions can be carried out
  - i). propan-1-ol can be converted to ethylamine.
  - ii). Propan-2-ol can be prepared from 2-phenylpropane.

7. Write equations to show how each of the following compounds can be synthesized.  
In each case, indicate the reagents and conditions for the reaction

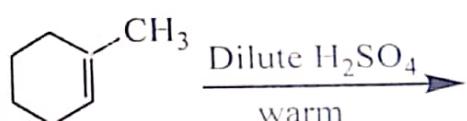
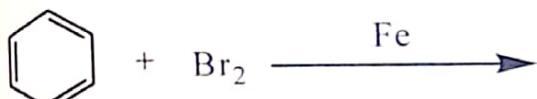


8. Write the equation to show how but-2-ene can be prepared from an alcohol.

- a. When but-2-ene was reacted with hydrogen bromide in the presence of chloride ions, a mixture of bromo and chloro compound was formed. Outline a mechanism for the reaction leading to the formation of the two products. Name the type of mechanism for the reaction
- b. Name a compound with different functional group but same type of reaction as in (a) which can be used to prepare but-2-ene.
- 9. Write equations to show how the following conversions can be carried out  
CH<sub>3</sub>COCH<sub>3</sub> to CH<sub>3</sub>CH<sub>2</sub>Br



10. Complete the following equations and in each case, outline the accepted mechanism for the reaction



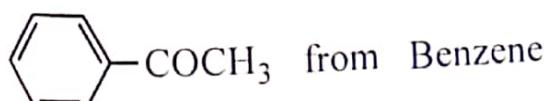
11.a) An organic compound W contains by mass 61.02% carbon, 15.25% hydrogen and the rest nitrogen. Determine the empirical formula of W.

b) When 0.26g of W was vaporized at a temperature of  $67^\circ\text{C}$  and pressure of 700mmHg, it occupied a volume of 0.000134 litres. Determine the molecular formula of W.

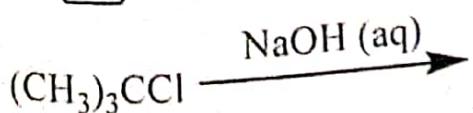
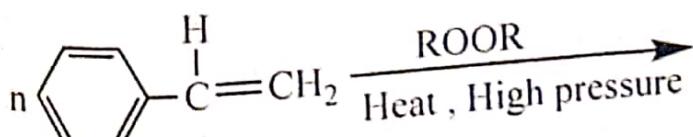
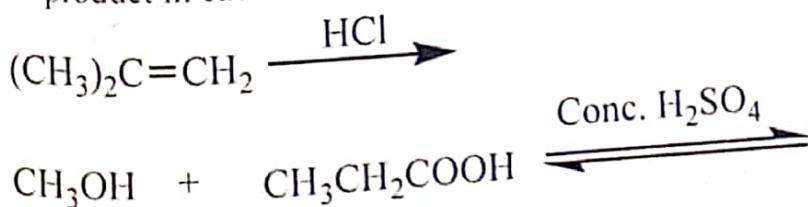
c) W reacts with cold nitrous acid forming a yellow oily solution. Write the: Structural formula and name of W and equation for the reaction that took place when W was treated with cold nitrous acid.

12. Write equations to show how the following synthesis can be carried out. In each case indicate the necessary reagents and conditions

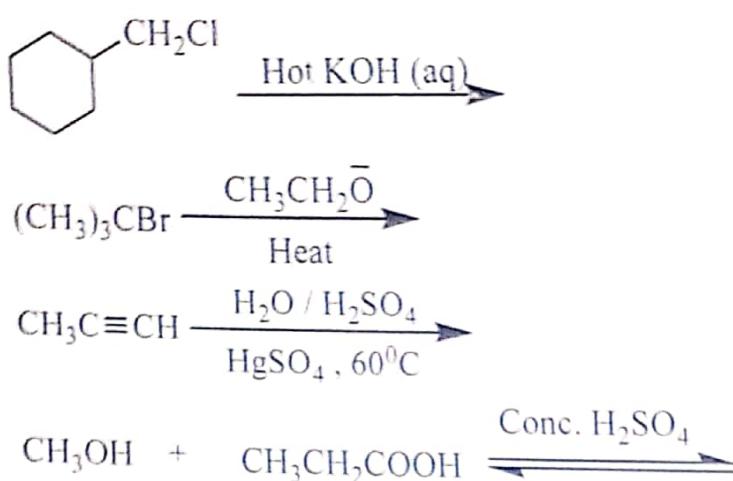
Propanamide from ethanol Propan-2-ol to propan-1-ol



13. Complete the following equations and give the IUPAC name of the main organic product in each case



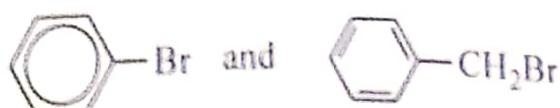
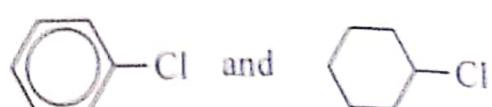
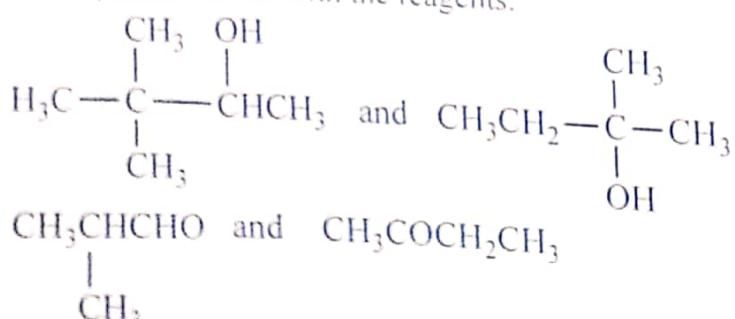
14. Complete the following equations and in each case, outline the accepted mechanism for the reaction



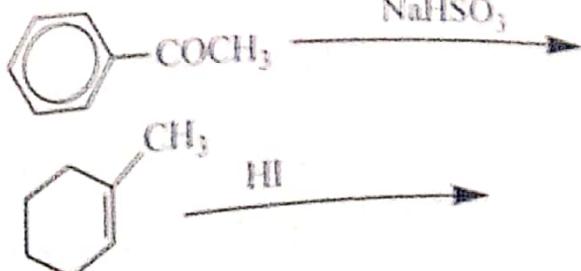
15. Write the equations to show how the following compounds can be synthesized. In each case indicate the reagents and conditions for the reactions.

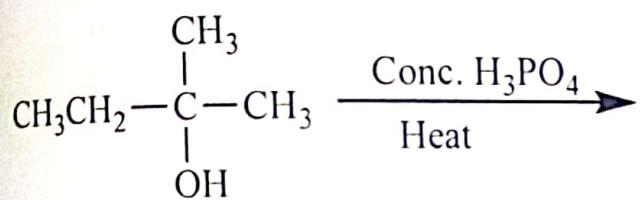
- a) Propanoic acid from ethyne
- b) Benzoic acid from benzene
- c) Ethylamine from ethanoic acid

16. Name reagents which can be used to distinguish between each of the following pairs of compounds. In each case state what would be observed if each member of the pair is treated with the reagents.



17. Complete the following equations and outline the mechanism for the reaction





18. A compound Y contains 52.2% carbon, 13.0% hydrogen and the rest oxygen.

a). determine the empirical formula of Y

b). when vaporised 0.1g of Y occupied 78.8cm<sup>3</sup> at 107°C and 654mmHg.

i. Calculate the formula mass of Y.

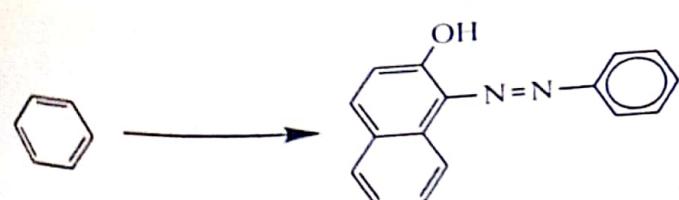
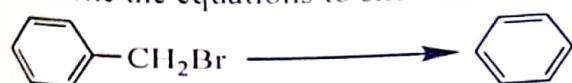
ii. Determine the molecular formula of Y.

iii. Write the structural formulae of all possible isomers of Y.

c). Y does not react with sodium. Identify Y.

ii. Write equations to show how Y can be prepared from methanol.

19. Write the equations to show how the following synthesis can be done



20. 2-bromo-2-methylpropane reacts with aqueous sodium hydroxide to form an organic compound Z.

a). write the equation and suggest a mechanism for the reaction.

b) Name one reagent that can be used to identify the functional group in Z.

c) Sodium metal was dissolved in excess ethanol. Write equation for the reaction.

d) 2-bromo-2-methylpropane was added to a solution in (b) and the mixture heated.

Write equation and indicate a mechanism for the reaction that took place.

21. The molecular formula of a compound M is C<sub>5</sub>H<sub>6</sub>O. Compound M forms a yellow precipitate with Brady's reagent.

a) Write the structural formulae and names of all possible isomers of M.

b) M reacted with iodine in aqueous solution of sodium hydroxide to form a yellow precipitate. Identify M.

c) Write equations to show how you would prepare M from an alkene.

22. State giving equations what would be observed when the following pairs of substances are mixed

$\text{CH}_3\text{CH}_2\text{CHO}$  and Ammoniacal silver nitrate solution



and Alkaline potassium manganate (VII) solution



and Bromine water

23. A gaseous hydrocarbon Q contains 90% carbon. The density of Q is  $1.785 \times 10^3 \text{ g m}^{-3}$  at STP. Determine:

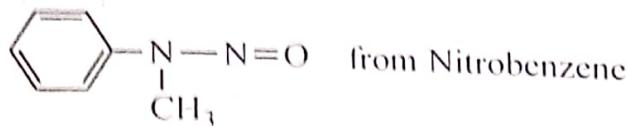
- The empirical formula of Q.
- The molecular formula of Q.

Q forms a white precipitate with ammoniacal silver nitrate solution.

- Identify Q.
- Using equations only, show how Q can be synthesized from propanoic acid.

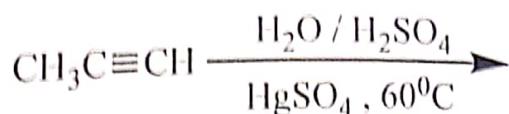
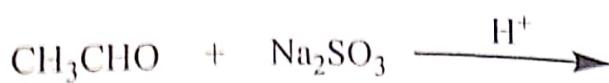
24. Write equations to show how the following compounds can be synthesized. Indicate the conditions for the reactions

$\text{CH}_3\text{CH}_2\text{NH}_2$  from Ethanoic acid



$\text{CH}_3\text{CH}_2\text{COOH}$  from bromoethane

25. Complete the following reaction equations and write the accepted mechanism



26. Name the reagents that can be used to distinguish between the following pairs of compounds. In each case state what is observed if each member of the pair is separately treated with the reagent

$\text{CH}_3\text{COOH}$  and  $\text{HCOOH}$

$\text{CH}_3\text{CHO}$  and  $\text{CH}_3\text{CH}_2\text{CHO}$

27. A calcium salt Y contains 31.25% carbon, 3.75% hydrogen and 40% oxygen the rest being calcium. Calculate the:

i. Empirical formula of Y

ii. Molecular formula of Y (molar mass of Y = 158)

iii. Y decomposes on heating to a white solid Z and liquid W. Y reacts with iodine and excess sodium hydroxide solution forming a yellow precipitate but does not

react with acidified potassium dichromate solution. Identify Z, W and the yellow precipitate.

iv. Write equation for the reaction that takes place between W and iodine solution in aqueous sodium hydroxide.

v. Write a mechanism for the reaction between W and hydrazine.

28. State what was observed when the following mixtures are heated and, in each case, write the equation for the reaction that would take place.

a) Benzoic acid and neutral iron (III) chloride solution.

b) Methanol and propanoic acid in the presence of concentrated sulphuric acid.

c) Methanoic acid and ammoniacal silver nitrate solution

d) Ethanol and iodine in aqueous sodium hydroxide solution.

29. (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<sup>3</sup>. 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

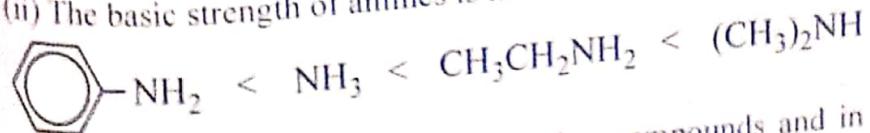
(ii) Write the equation between Q and sodium carbonate

(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



30. Write equations between the following compounds and in each case outline mechanism leading 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) Ethanal and 2,4-dinitrophenylhydrazine in presence of an acid catalyst

(f) Phenol and ethanoyl chloride in alkaline solution

31. Write short notes about the following reactions

- (a) Electrophilic addition reactions
- (b) Elimination reactions
- (c) Electrophilic substitution reactions
- (d) Nucleophilic addition reactions
- (e) Free radical substitution reactions

32. Write equations to show how the following conversions can be done 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) Polyphenylethene (polystyrene) from phenylethanone

33. 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 but-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

34. (a) An organic compound Z contains 80% carbon, 6.7% hydrogen and the rest being oxygen. When Z was steam distilled at 97 and 760mm Hg, the distillate contained 25.44% of Z by mass. The vapour pressure of water at 97 is 723mm Hg. 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 ammoniacal silver nitrate solution.

- (i) Identify Z
- (ii) Write equation for the reaction between Z and sodium hydrogen sulphite and outline the mechanism for the reaction
- (iii) Using equations while stating reagents and conditions state how Z can be prepared from \_\_\_\_\_ (ii) Phenyl ethane (iii) benzoic acid

35. (a) (i) Name one 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,  $C_1H_2(OCOR)_n$ , 1.108g of Z was heated with 10.0cm<sup>3</sup> of 1.0M sodium hydroxide solution for some time then cooled. The unreacted alkali required 4.0cm<sup>3</sup> of 0.1M hydrochloric acid for complete neutralization. Determine the relative formula mass of Z

(iv) 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

36. a) Explain what is meant by each of the following terms

(i) A polymer

(iii) A copolymer

(ii) Condensation polymerization

(iv) 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 (i) 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) A synthetic polymer has the structure below:

9.110.2 Moles of the polymer were formed when 350g of the monomer was polymerized.

Calculate the value of n and hence deduce the molecular mass of the polymer.

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

37. Define structural isomerism.

i) Discuss the three types of structural isomerism giving suitable examples in each case.

ii) A compound has the following formula  $C_5H_8Cl_2$ . Write down the three possible isomers of the compound

iii) Write a mechanism for the reaction of one of the isomers of  $C_5H_8Cl_2$  with sodium hydroxide

38. An organic compound Q contains 54.55% carbon, 9.09% hydrogen and the rest being oxygen. The density of Q at 50°C and 2.0 atm pressure is 3.3185 gdm<sup>-3</sup>. Calculate the:

- Empirical formula of Q.
  - Molecular formula of Q.
- b) Q forms a yellow precipitate with a solution of 2, 4-dinitrophenylhydrazine in ethanol and concentrated sulphuric acid.
- Identify Q by its structural formula and IUPAC name.
  - State what would be observed when Q is added to ammoniacal silver nitrate solution and the mixture is warmed.
  - Write an equation for the reaction that occurs in b (ii) above.
  - Suggest a possible mechanism for the reaction between Q and acidified hydroxylamine ( $\text{H}_2\text{NOH}$ ).

39. Use equations to show how each of the following compounds can be synthesized.

- Ethoxy cyclohexane from nitrobenzene
- Ethanol from propanoic acid
- Propan-2-ol from propanone Phenylhydrazine.
- Phenylethanone from chlorobenzene
- 2-Methylpropan-2-ol from Propan-2-ol
- But-1-ene from ethyne
- Propanamide from ethanol
- Propanal from propan-2-ol
- Hexane from propene

40. The following reagents can be used to distinguish between members in a class of organic acid. Name the class of organic compounds and in each case state what would be observed if the reagent is separately treated with a member of each of the class you have named. Write an equation for the positive observation made

- Reagent: Neutral iron (III) chloride
- Reagent: Sodium nitrite in presence of cold concentrated hydrochloric acid.
- Reagent: Anhydrous zinc chloride and concentrated hydrochloric acid
- Reagent: Sodium hydroxide solution and iodine solution
- Reagent: Sodium carbonate solution

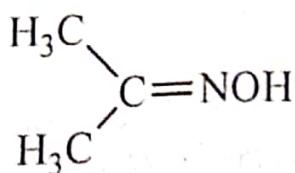
41. a) A compound P of vapour density 79 contains 31.25% carbon, 4.15% hydrogen, 40% oxygen and the rest calcium. Determine the molecular formula of P.

b). When compound P was strongly heated, a white solid X and another compound R which gives a yellow precipitate with iodine solution in presence of aqueous sodium hydroxide solution but has no effect on acidified potassium dichromate solution were produced.

- i) Identify P, R and the yellow precipitate.
- ii) Write the equation for the reaction when P is heated.
- c). Write the equation and outline a suitable mechanism for the reaction between R and:
- i) iodine solution in presence of aqueous sodium hydroxide
  - ii) Phenylhydrazine in acidic medium
- d). State the reagent that can be used to distinguish between the following compound and in each case state what is observed:
- i) P and  $(\text{HCOO})_2\text{Ca}$
  - ii) R and  $\text{H}_2\text{CO}$
42. A compound Y  $\text{C}_4\text{H}_{10}$  forms two layers after about 5 minutes when reacted with concentrated hydrochloric acid in presence of anhydrous zinc chloride.
- a) Write the structural formula and IUPAC name of Y.
  - b) Write;
  - i) Equation for the reaction between Y and hot acidified potassium dichromate (VI) solution
  - ii) Equations to show how Y can be prepared using an alkene as one of the starting materials. Indicate the conditions and reagents where necessary.
43. (a) X, Y and Z are structural isomers of  $\text{C}_4\text{H}_{10}\text{O}$ . the isomers react with sodium metal liberating hydrogen gas
- i) Name the functional group in the isomers of  $\text{C}_4\text{H}_{10}\text{O}$
  - ii) Write down the general equation for the reaction that occurs between  $\text{C}_4\text{H}_{10}\text{O}$  and sodium metal
- b) Isomer X reacts with concentrated sulphuric acid but gives no observable change on addition of warm acidified potassium dichromate.
- i) Identify X
  - ii) Suggest a suitable mechanism for the reaction between X and hot concentrated sulphuric acid
44. Alkanols, phenols and alkanoic acids are compounds that contain a hydroxyl group bonded to a carbon atom
- a) Name the reagents that you would use in the laboratory to distinguish between each of the following pairs of compounds. in each case state what would be observed when each member of a pair is treated with the reagent you have named and write an equation in each case to explain the observation made
- i) Alkanols and phenols
  - ii) phenols and alkanoic acid
- b) Pentan-1-ol and phenol are found to be acidic, phenol being stronger
- i) for each compound write an equation for the reaction which shows that it is an acid

- ii) explain why phenol is a stronger acid than pentan-1-ol
- c) Alkanols can be oxidized to corresponding carbonyl compounds using acidified potassium dichromate solution.
- i) write an equation for the oxidation of propan-2-ol to the corresponding carbonyl compound
  - ii) how can you confirm that the carbonyl compound has been formed
  - iii) write the equation of reaction that takes place during confirmation
- d) Write the structural formula and IUPAC name of an alkanol that may not react with acidified potassium dichromate.
45. a compound Z contains only carbon, hydrogen and oxygen.
- a) Elemental analysis gave 54.5% carbon and 9.09% hydrogen. Determine the empirical formula of Z
  - b) 0.534g of Z occupies  $148\text{cm}^3$  at  $20^\circ\text{C}$  and  $740\text{mmHg}$ .
    - i) Determine the molecular mass of Z
    - ii) Determine the molecular formula of Z
    - c) Z dissolves in sodium hydrogen carbonate solution liberating carbon dioxide.  
What this conclude
    - d) suggest one possible structural formula of Z
46. a) 0.208g of an organic compound Y containing Carbon, hydrogen and oxygen on complete combustion gave 0.609g of carbon dioxide and 0.125g of water. calculate
- b) The molar mass of Y is 120.5g. Determine the molecular formula of Y
  - c) Y burns with a sooty flame, gives a yellow precipitate with Brady's reagent but does not form silver deposits with Tollen's reagent. Identify Y.
  - d) Write equations to show how
- i) Y can be synthesised from a known alcohol
  - ii) Y reacts with sodium metal in the presence of ethanol
47. An organic compound A has a molecular formula of  $\text{C}_4\text{H}_9\text{Br}$ .
- a) Write the structural formula and names of all possible isomers of A
  - b) When A was reacted with sodium hydroxide, compound B was formed. B formed two layers within ten minutes when shaken with a mixture of concentrated hydrochloric acid and anhydrous zinc chloride
  - i) identify A
  - ii) write equation and state the conditions for the reaction between A and sodium hydroxide
- c) B can be reacted with chromium trioxide in presence of in the presence of concentrated sulphuric acid to give compound C, which reacts with iodine in the presence of sodium hydroxide solution. state what would be observed and write equations for

- i) the oxidation of B  
 ii) reaction between C and iodine in the presence of sodium hydroxide  
 d) One of the isomers of A undergoes unimolecular reaction when treated with aqueous sodium hydroxide.  
 i) name the isomers  
 ii) write the rate equation for the reaction and indicate what each symbol stands for  
 iii) suggest a mechanism for the reaction
- 48.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,  $C_3H_6O_2$ . B reacted with sodium with effervescence but had no effect on litmus paper.
- write the names and structural formulae of all possible isomers of B
  - Name the reagent that can be used to distinguish between the isomers in (i) and state what would be observed if the isomers are treated with the reagent.
- b) B reacted with acidified dichromate solution to give D which formed a yellow precipitate when reacted with alkaline iodine solution.
- Identify B, D and the yellow solid
  - Name one reagent that can be used to identify the functional group in D
- c) Write equations and indicate a mechanism for the reaction between B and
- Concentrated phosphoric acid on heating
  - Ethanoyl chloride
49. An organic compound X contains 60% by mass of Carbon, 13.3% by mass of hydrogen and the rest being oxygen. 0.0725g of X on vaporization occupied 396cm<sup>3</sup> at 290°C and 0.0726 atm pressure.
- a) Calculate
- empirical formula of X
  - molecular formula of X
- b) X has isomers
- write down the structural formulae of the possible isomers of X
  - Which isomer has the lowest boiling point? Give a reason for your answer
- c) When X was heated with acidified potassium dichromate solution, compound Y was formed. Y formed a yellow precipitate with iodine solution and sodium hydroxide.
- Name compounds X and Y
  - write equations to show how the compound below can be from Y. Outline the mechanism for the reaction



d) Starting with ethene, write equations to show how X can be prepared. Indicate reagents and conditions for the reactions.

50. a) Combustion analysis of 0.305g of organic compound P produced 0.88g of carbon dioxide and 0.225g of water vapour as products. determine the empirical formula of P

b) When another 0.305g of P was autoclaved at  $75^{\circ}\text{C}$  and 730mmHg the resulting vapour occupied a volume of  $74.3\text{cm}^3$ .

i) Determine the molecular formula of P

ii) Write down the structural formula and the systematic names of two isomers of P

c) i) When a sample of P was mixed with anhydrous zinc chloride dissolved in concentrated hydrochloric acid, there was visible change in the solution after 8.5 minutes. Identify P.

ii) Write down the mechanism of reaction between P and concentrated sulphuric acid at  $1500^{\circ}\text{C}$  to form compound Q.

d) Write down the mechanism of the reaction between Q and hydrogen bromide dissolved in tetrachloromethane

51. 1.86g of compound X contains carbon, hydrogen and nitrogen only. X on combustion liberated 5.28g of carbon dioxide gas and  $224\text{cm}^3$  of nitrogen gas at s.t.p.

a) Determine the empirical formula of X

b) When vaporized, 0.2g of X occupied  $81\text{cm}^3$  at  $184.1^{\circ}\text{C}$  and 101.325 KPa. Determine the molecular formula of X.

c) X burns with a sooty flame and the pH of its aqueous solution is greater than 7. Write the molecular structure of X.

d) X was reacted with sodium nitrite in the presence of hydrochloric acid at  $50^{\circ}\text{C}$  and the product treated with 2-naphthol. State what was observed and write the equation for the reaction that took place.

52. An alkyne  $\text{C}_4\text{H}_6$  can be hydrolysed to form an organic compound Y which does not react with a solution with a solution of copper (II) sulphate, silver nitrate and sodium carbonate.

a) i) state the necessary conditions for the formation of Y  
ii) what is the possible structure of Y

iii) Write the equation of reaction and mechanism of the reaction between Y and phenylhydrazine.

b) How can you synthesise Y from propene?

53. a) A hydrocarbon Q, on complete combustion in oxygen produces 67.95g of water and  $172.58\text{dm}^3$  of carbon dioxide gas. In the Victor Meyer experiment, when 3.34g of Q was volatilized, it was found to occupy a volume of  $790\text{cm}^3$  at  $27^{\circ}\text{C}$  and pressure of 760mmHg.

i. Determine the empirical formula of Q

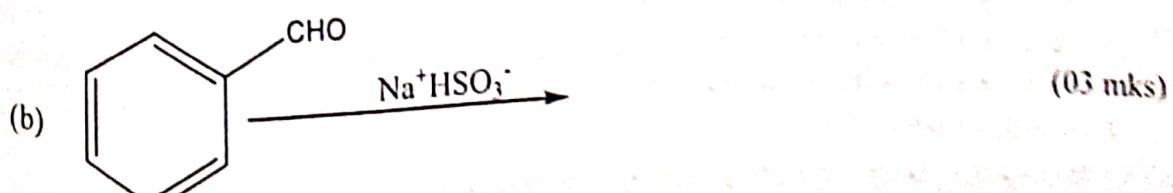
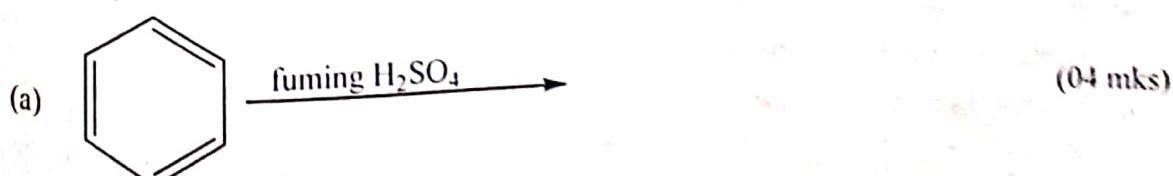
- ii. Molecular formula of Q
- b) Q instantly decolorizes a solution of bromine in tetrachloromethane. When Q is refluxed with alkaline manganate (vii) and the resultant solution acidified, a white crystalline precipitate R with molecular formula  $C_6H_6O_2$  is obtained. On heating R with a mixture of solid calcium hydroxide, compound X is formed. X has no apparent reaction with bromine until a little iron powder is added to it. Identify Q, R and X.
- c) Write equations and suggest possible mechanisms for the reactions between bromine and
- i. Q in tetra chloromethane
  - ii. X in presence of iron powder
- d) Write equations indicating equations to show how R can be obtained from X

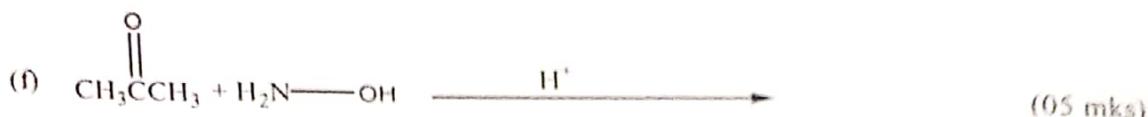
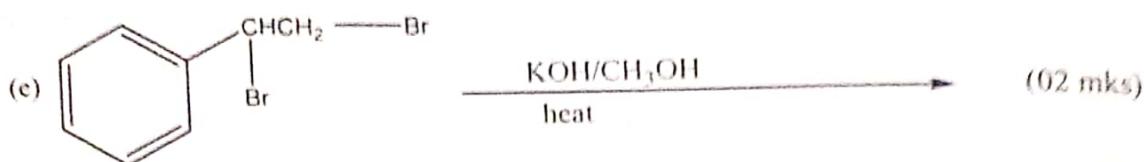
54. Explain the following

- a) bromine water reacts with propene to form 1 bromopropan-2-ol as a major product rather than 1,2-dibromopropane
- b) When 2-Methylpropene is reacted with hydrogen bromide, the major product is 2-bromo-2-methylpropane rather than 1-bromo-2-methylpropane
- c) Methanoic acid reacts with ammoniacal silver nitrate solution well as ethanoic acid does not.

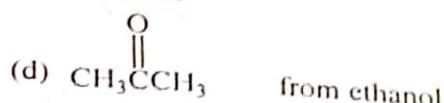
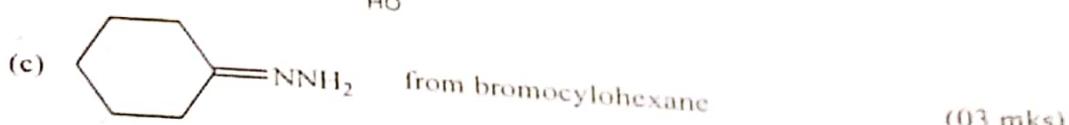
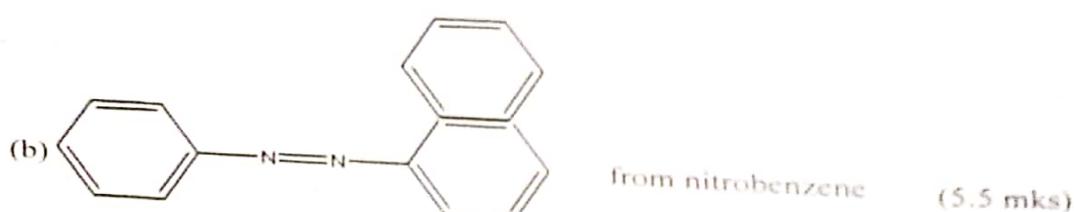
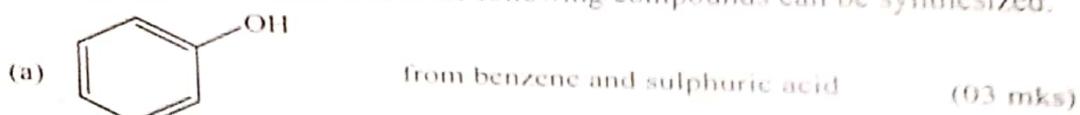
2- Nitro phenol is less soluble in water than 4- Nitro phenol

55. Complete the following equations and outline a possible mechanism for the reaction.





56. Write equations to show how the following compounds can be synthesized.



56. The complete combustion of 2.7g of a hydrocarbon A gave 2.7g of water. It takes a given volume of nitrogen 10.16 seconds to effuse through a narrow opening while the same volume of A under the same conditions takes 14.11 seconds.

(a). Determine the

(i). Empirical formula of A.

(ii). Molecular formula of A.

(b). When A is reacted with mercury (II) sulphate in the presence of dilute sulphuric acid at 60°C, it forms a compound B which forms a yellow precipitate with Brady's reagent.

(i). Name the functional group in A.

(ii). Name a reagent that can be used to identify the functional group in A, state what would be observed and write equation for the reaction that would take place.

(iii). Write the structural formulae and names of all the possible isomers of A.

(c). Name a reagent that can be used to distinguish between the isomers of A in (b) and

in each state what would be observed and write equation for the reaction that would take place if each isomer is treated with the reagent named.

- (d). A reacts with sodium in the presence of liquid ammonia.  
(i). Identify A.  
(ii). Write equation and outline a mechanism for the reaction between A and hydrogen bromide.  
(e). Write equations to show how B can be converted to 2,3-dibromobutane.

57.a). The boiling point of 2-chlorobutane and 2-iodobutane are  $68^{\circ}\text{C}$  and  $119^{\circ}\text{C}$  respectively. When treated separately with sodium hydroxide followed by acidified silver nitrate solution, 2-chlorobutane forms a white precipitate after 15 minutes while 2-iodobutane forms a yellow precipitate almost immediately. Explain why;

- i) The boiling point of 2-chlorobutane is lower than that of 2-iodobutane.  
ii) The formation of the precipitate in 2-chlorobutane takes a longer time than in 2-iodobutane.

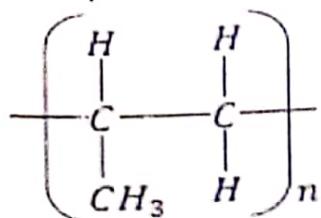
- (b) Write  
i) Equation for the reaction of 1-chlorobutane with aqueous sodium hydroxide.  
ii) The mechanism for the reaction in (b) (i).  
(c) The reaction in (b) (i) is exothermic. Sketch a labelled potential energy versus reaction coordinate diagram for the reaction.  
(d) Write equation for the reaction showing the conversion of benzene to chlorobenzene. Outline a mechanism for the reaction.  
(e) Write equations to show how 2-bromobutane can be converted to butanone. Indicate the conditions for the reactions.  
(f) (i) Name one reagent that can be used to confirm for the formation of butanone.  
(ii). State what would be observed if butanone was present.  
(iii). Write equation for the reaction of butanone and the reagent you have named in (f) (i).  
(iv). A solution containing iodine and sodium hydroxide was added to butanone. State what was observed.

58. A hydrocarbon D contains 92.31% carbon. When vaporised at  $72^{\circ}\text{C}$  and  $786\text{mmHg}$ , 1.17g of D occupies  $410.57\text{cm}^3$ .

- a) Determine the  
(i) Empirical formula of D  
(ii) Molecular formula of D  
(b) D burns with a yellow sooty flame. Identify D  
(c). Write equations, indicating the conditions for the reactions to show how D reacts with each of the following. Write the IUPAC name for the major organic product.

- (i). Propene  
(ii). Ethanoyl chloride  
(iii) Bromoethane.
- (d) Write mechanisms for each reaction taking place in (c) above.
- (e) Would you expect D to undergo electrophilic addition or electrophilic substitution reaction? Explain your answer.
- (f) Write equations to show how D can be made from 1,1-dichloroethane.
59. (a) A compound Q contains 64.9% carbon, 13.5% hydrogen and the rest being oxygen. 1.85g of Q in the vapour form occupied 969.8cm<sup>3</sup> at 200°C.  
(i) Calculate the empirical formula of Q.  
(ii) Determine the molecular formula of Q.  
(The molar gas constant, R = 8.31JK<sup>-1</sup>mol<sup>-1</sup>)  
(b). Q reacts with sodium with effervescence but has no effect on sodium carbonate. Write the names and the structures of all possible isomers of Q.  
(c) When treated with anhydrous zinc chloride in the presence of concentrated hydrochloric acid, Q formed two layers after about 8 minutes. Identity Q.  
(d). Q reacted with acidified chromium trioxide to give a compound R. Write equation for the reaction:  
(i). leading to the formation of R.  
(ii). between R and acidified 2,4-dinitrophenylhydrazine and outline a mechanism for the reaction.  
(iii). Write equation to show how Q can be prepared from an alkene and outline a mechanism for the reaction.
- 60.(a).Benzene undergoes electrophilic substitution reactions while cyclohexene undergoes electrophilic addition reactions.  
(i). Distinguish between electrophilic substitution and electrophilic addition reaction.  
(02 marks)  
(ii).Explain why benzene undergoes electrophilic substitution while cyclohexene undergoes electrophilic addition reactions  
(b). Describe the reactions of bromine with  
(i). Benzene. (ii). Cyclohexene.  
(Your answers should include equations and mechanisms for the reaction where applicable)  
(c). Write equations to show how benzene can be converted to cyclohexene.
61. (a) (i). Write equation for the reaction in which 2-chloropropane can be obtained from propene  
(ii). Outline a mechanism for the reaction leading to the formation of 2-chloropropane in (a) (i) above.

- (iii). Write equation to show how 2-chloropropane can be converted to propyne.  
[your answer should include reagents and conditions].
- (b). (i) Name one reagent that can be used to differentiate between propyne and but-2-yne.  
(ii). State what would be observed if propyne and but-2-yne were separately treated with the reagent you have named in (b) (i).  
(iii). Write equation to illustrate your answer.
- (c) Write (i). Equation(s) to show how 2-methylpropanoic acid can be prepared from 2-chloropropane  
(ii). The mechanism for the reaction between 2-methylpropanoic acid with methanol in the presence of concentrated sulphuric acid.
- 62.(a). Propanone and propanal both undergo nucleophilic addition reactions.  
(i). What is a nucleophilic addition reaction?  
(ii). Explain why carbonyl compounds can undergo nucleophilic addition reactions.
- (a). Name  
(i). The functional group in propanone and propanal.  
(ii). A reagent used to identify the functional group in propanone and propanal. State what would be observed and write equation for the reaction that takes place.
- (b). Name a reagent that can be used to distinguish between propanone and propanal.  
State what is observed and write equation for the reaction.
- (c). Propanal was added to saturated solution of sodium hydrogen sulphite.  
(i). State what was observed.  
(ii). Outline an acceptable mechanism for the reaction.
- (d). Propanal can be converted to a compound Y with a structure



- (i). Name Y.  
(ii). Write equations to show how propanal can be converted to Y.  
(iii). State one use of Y
- (e). Propanone was warmed with a mixture of iodine and sodium hydroxide solution.  
(i). State what was observed. (01 mark)  
(ii). Write equation for the reaction. (01 mark)

- 63.(a). An organic compound P contains 35.04% Carbon, 6.56% hydrogen and 58.40% bromine. Calculate the empirical formula of P. ( $H = 1$ ,  $C = 12$ ;  $Br = 79.9$ ).  
(b). The vapour pressure of P was found to be 68

- (i). Determine the molecular formula of P.
- (ii). Write the names and structural formulae of all the possible isomers of P.
- (c). When P was reacted with sodium hydroxide, a compound, Q was formed. When a solution of anhydrous zinc chloride in concentrated hydrochloric acid was added to Q, it turned cloudy within 10 minutes.
- (i). Identify Q.
- (ii). State the condition(s) for the reaction to take place and write the mechanism for the reaction between P and sodium hydroxide. (03 marks)
- (d). Explain the difference in the reactivity of P and bromobenzene with sodium hydroxide.
- (e). Write equation(s) to show how P can be synthesized from butan-1-ol.
64. (a). The acids HCOOH, CH<sub>3</sub>COOH and CH<sub>3</sub>CH<sub>2</sub>COOH are organic acids.
- (i). Arrange the acids in order of increasing acid strength.
- (ii). Explain your answer in (a) above.
- (b). Describe the reaction between CH<sub>3</sub>COOH and ethanol. [Your answer should include an equation and a mechanism for the reaction].
- (c). Write equations to show how CH<sub>3</sub>CH<sub>2</sub>COOH can be converted to propyne. Include the conditions for the reactions in each case.
- (d). Name a reagent that can be used to distinguish between HCOOH and CH<sub>3</sub>COOH. State what would be observed when the reagent you have named is treated separately with the reagent you have named.
- (e). Write equation for the reaction that takes place in (d).

65. (a). Discuss the reactions of ethanol with sulphuric acid. In each case, outline a mechanism for the reaction that takes place.
- (b). Write equations to show how the following compounds can be synthesised from ethanol.
- (i). Propanone.      (ii). Ethyne.

66. (a). A gaseous hydrocarbon X consists of 11.11% by mass hydrogen and has a vapour density of 27. Calculate the
- (i). Empirical formula of X.
- (ii) Molecular formula of X.
- (iii) Write the structural formulae and the IUPAC names of all the possible isomers of X.
- (b). 1 mole X reacts completely with one mole of hydrogen gas in the presence of platinum catalyst. Identify X
- (c). When X was warmed with a dilute sulphuric acid, a substance Y was formed which was oxidized to compound Z by hot acidified potassium dichromate (VI). Outline a mechanism for the reaction between

- (i) X and warm dilute sulphuric acid.  
(ii). Z and acidified solution of hydroxylamine.  
(iii). Z and a solution of potassium cyanide in dilute sulphuric acid.
67. Explain the following observations;
- Diethylamine is a stronger base than aminobenzene.
  - Bromine water reacts with propene to form 1-bromopropan-2-ol as the major product instead of 1,2-dibromopropane.
  - Ethanoic acid is a weaker acid than dichloroethanoic acid.
  - When 2-methylpropene is reacted with hydrogen bromide, the major product is 2-bromo-2-methylpropane rather than 1-bromo-2-methylpropane.
68. Write names or structural formulae of one pair of compounds with the same functional groups that can be distinguished using the following reagents. In each case, state what would be observed if each member of a pair was separately treated with the reagent and write an equation for the reaction that would take place.
- Ammoniacal silver nitrate solution.
  - Bromine water.
  - Acidified potassium dichromate (VI).
  - Iodine solution and sodium hydroxide solution.
  - 2,4 dinitrophenylhydrazine.
69. When 0.10g of an organic compound X containing carbon, hydrogen and oxygen only was completely burnt in excess oxygen, 0.227g of carbon dioxide and 0.093g of water were produced. When 0.368g of X were vaporised at 37°C and 760mmHg, it occupied a volume of 161.4cm<sup>3</sup>. calculate
- Calculate the
    - Empirical formula of X.
    - Molecular formula of X.
  - Write the structural formulae and the IUPAC names of the possible isomers of X.
  - X does not react with ammoniacal silver nitrate solution. Identify X.
  - Write equations to show how X can be
    - Synthesised from ethanol.
    - 1-bromopropane
  - Outline a mechanism for a reaction between X and
    - A solution of hydrazine in concentrated sulphuric acid.
    - An aqueous solution of hydrogen cyanide.
70. (a). Explain why benzene undergoes electrophilic substitution whereas cyclohexene undergoes electrophilic addition reaction. In each case, write an equation to illustrate your answer.

(b). Write equation

- (i). To show how methylbenzene can be converted to benzene.
- (ii). For the reaction between methylbenzene and chlorine in the presence of sunlight.

Outline a mechanism for the reaction.

(c). Write the mechanism for the reaction between benzene and

- (i). A mixture of concentrated nitric acid and sulphuric acid.
- (ii). Propene in the presence of phosphoric acid.
- (iii). Ethanoyl chloride in the presence of iron (III) chloride.

71. Explain what is meant by each of the following terms. [your answers should include acceptable mechanism for the reaction]

- (a). Nucleophilic addition reaction.
- (b). Nucleophilic substitution unimolecular reaction.
- (c). Nucleophilic substitution bimolecular reaction.
- (d). Electrophilic substitution reaction
- (e). Electrophilic addition reaction.

72. Write names or structural formulae of one pair of compounds with the same functional groups that can be distinguished using the following reagents. In each case, state what would be observed if each member of a pair was separately treated with the reagent and write an equation for the reaction that would take place.

- (a). Sodium carbonate solution.
- (b). Neutral iron (III) chloride solution
- (c). Hot sodium hydroxide solution, dilute nitric acid and silver nitrate solution.
- (d). Sodium nitrite and concentrated hydrochloric acid at 0°C.
- (e). A solution of anhydrous zinc chloride and concentrated

73. Explain the following observations

- (a). Methanoic acid is a stronger acid than ethanoic acid.
- (b). Alkenes undergo electrophilic addition reactions while carbonyl compounds undergo nucleophilic addition reaction.
- (c). The boiling point of ethanol is much higher than that of methoxymethane although both have the same molecular mass.
- (d). The boiling point of pentane and 2,2-dimethylpropane are 36°C and 10°C respectively yet the two compounds have the same molecular mass.
- (e). Ethanamide is a weaker base than ethylamine.

74. (a). Explain the following observations.

- (i). The enthalpy of hydrogenation of cyclohexene is 121 kJ mol<sup>-1</sup> while that of benzene is

$209 \text{ kJ mol}^{-1}$ .

(ii) Although benzene has a carbon to carbon double bond, it undergoes electrophilic substitution reaction rather than electrophilic addition reactions.

(b) Describe the reactions of benzene with each of the following. [Include the condition and mechanism for the reactions]

(i) Sulphuric acid.

(ii) Chlorine.

(iii) ethanoyl bromide.

(c) Write equations to show how benzene can be

(i) Converted to benzoyl chloride

(ii) Obtained from ethanol.

75. (a) When a given mass of an aliphatic non-cyclic amine  $Z$  was burnt in excess oxygen, 2.64g of carbon dioxide and 1.62g of water were produced while 269.51cm<sup>3</sup> of nitrogen were collected at 68°C and 789mmHg. The vapour density of  $Z$  at s.t.p. is 2.634gdm<sup>-3</sup>. Calculate the

(i) Empirical formula of  $Z$ .

(ii) Molecular formula of  $Z$ .

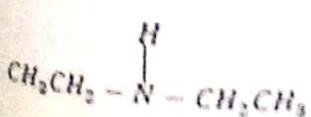
(b) Write the structural formulae and IUPAC names of the isomers of  $Z$ .

(c) Name a reagent that can be used to distinguish between the isomers in (b) and in each case, state what would be observed and write the equations for the reactions that took place.

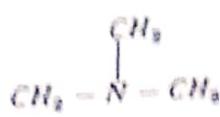
(d) Write equations to show how benzene can be converted to phenylmethylamine.

76. The structural formulae of amines X, Y and Z are shown below.

X



Y



Z



(a) (i) Describe the reaction of the amines with nitrous acid. [Your answer should include observations and equations]

(ii) The basicity of the amines is in order  $X > Y > Z$ . Explain.

(b) (i) Write equation(s) to show how  $Z$  can be prepared from nitrobenzene. [Include reagents and conditions].

(ii)  $Z$  can be used in the manufacture of azo-dyes. Describe the steps you would follow in preparing azo-dye starting from  $Z$ . [Your answer should include observations and equation].

77. (a) Describe the reactions of bromoethane with potassium hydroxide.

(b) (i) Briefly describe a test that can be carried to distinguish between bromoethane and bromobenzene.

(ii). Account for the difference in the reactivity of bromoethane and bromobenzene.

(c). write equation to show how

(i). Bromoethane can be prepared from ethanol.

(ii). Bromobenzene can be prepared from benzene.

(d). Write the mechanism for the reaction in (c) (ii).

78. For each of the following pairs of compounds

Name one reagent which;

(a). When reacted with each member of the pair will show similar observation.

(b). Can be used to distinguish between the members of each pair. In each case, state what would be observed when each member of the pair is reacted with the reagent you have named.

79.(a). 1.86g of compound X contains carbon, hydrogen, and nitrogen only. X on combustion liberated 5.28g of carbon dioxide gas and  $224\text{cm}^3$  of nitrogen at s.t.p.

(i). Determine the empirical formula of X.

(ii). When steam distilled at  $98^\circ\text{C}$  and 760 mmHg pressure, the distillate contained 25.8g of water and 7.4g of X. determine the molecular formula of X. [the vapour pressure of water at  $98^\circ\text{C}$  is 720 mmHg]

(b). X burns with a yellow sooty flame. Identify X.

(c). X was added to bromine water

(i). State what was observed.

(ii). Write the equation for the reaction.

(iii). Write the name of the major organic product formed.

(d). X was reacted with sodium nitrite and dilute hydrochloric acid at  $5^\circ\text{C}$ .

(i). Name the major organic product formed.

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

(e). State one industrial use of the product in (d).

(f). State what would be observed and write equation for the reaction that would take

place if the product in (d) was separately treated with an alkaline solution of

(i). Phenol.

(ii). 2-naphthol.

(g). Write equations to show how X can be converted to cyclohexanol. (03 marks)

80.(a). An organic compound P contains 68.85% carbon, 4.92% hydrogen and the rest being oxygen. When vaporised at 199.2kPa and  $92^\circ\text{C}$ , 1.83g of P occupied a volume of  $228.4\text{cm}^3$ . Determine the

(i). Empirical formula of P

(ii). Molecular formula of P.

(b). P burns with a yellow sooty flame. Write the structural formula and name of P.

- (c). (i) Name the functional group in P.  
(ii). Name a reagent that can be used to confirm for the presence of the functional group in P you have named.  
(iii). State what is observed when the reagent you have named in (c) (ii) is treated with P.  
(iv). Write equation for the reaction that takes place in (c) (iii) above.  
(c). Describe the reaction of P with methanol.  
(d). State what is observed and write equation for the reaction that takes place when neutral iron (III) chloride solution is added to a warm solution of P.  
(e). Write equations to show how P can be  
(i). Obtained from aniline.  
(ii). Converted to chlorocyclohexane.

- 81.(a). A compound X, vapour density 58, contains 62.07% carbon, 10.34% hydrogen and the rest being oxygen. X burns with a non-sooty flame.  
(i). Calculate the empirical formula of X.  
(ii). Determine the molecular formula of X.  
(b). Hydrolysis of X yielded compounds Y,  $C_4H_{10}O$  and Z,  $C_2H_4O_2$ . Both Y and Z react with metallic sodium. Z reacts with sodium carbonate but Y does not.  
(i). Identify Z  
(ii). Write the IUPAC names and the structural formulae of all the possible isomers of Y.  
(iii). Name a reagent that can be used to distinguish between the isomers in (b) (ii) and state what would be observed if the reagent is reacted separately with each of the isomers.  
(c). When Y was warmed with acidified potassium dichromate, there was no observable change.  
(i). Identify Y.  
(ii). Write the structural formula of X.  
(d). Write  
(i). An equation and outline a mechanism for the reaction between Y and hot concentrated phosphoric acid.  
(ii). The IUPAC name of the product in (d)(i).

82. (a). Write equations to show how the following compounds can be prepared.  
(i). Phenylamine from benzene.  
(ii). Ethylamine from ethanol.  
(b). Which one of phenylamine and ethylamine is a stronger base? Explain  
(c). State what would be observed and write equations for the reactions that take place for each of the compounds, phenylamine and ethylamine reacting with  
(i). Ethanoyl chloride.

- (ii). Acidified solution of sodium nitrite at 5°C.  
 (d). Write mechanism for the reaction of ethanoyl chloride and ethylamine  
 (e). Phenylamine can be converted to benzene diazonium chloride. Write equation for the conversions of the diazonium salt to  
 (i). Iodobenzene,  
 (ii). Benzoic acid.

83. Explain the following types of organic reactions. [include an example and a mechanism for the reaction]

- (a). Elimination unimolecular reaction,  
 (b). Elimination bimolecular reaction,  
 (c). Electrophilic substitution reaction,  
 (d). Electrophilic addition reaction,

84. Name one reagent that can be used to distinguish between each of the following pairs of compounds and in each case, state what would be observed when the reagent you have named is used.

- i)  $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$  and  $\text{HCOCH}_2\text{CH}_2\text{CH}_3$   
 ii)  $\text{C}_6\text{H}_5\text{CHO}$  and  $\text{C}_6\text{H}_5\text{CH}_2\text{COCH}_3$   
 iii)  $\text{CH}_3\text{C}\equiv\text{CCH}_3$  and  $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$   
 iv)  $\text{CH}_3\text{OH}$  and  $\text{CH}_3\text{CH}_2\text{OH}$   
 v)  $(\text{CH}_3)_3\text{C}-\text{OH}$  and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$   
 vi)  $\text{C}_6\text{H}_5\text{Cl}$  and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$   
 vii)  $\text{C}_6\text{H}_5\text{NH}_2$  and  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$

85. (a). What is meant by the term structural isomerism?  
 (b). Describe the three types of structural isomerism giving suitable examples in each case.  
 (c). A compound has structural formula  $\text{C}_3\text{H}_6\text{Cl}_2$ . Write down the structural formulae and names of the possible isomers of the compound.  
 (d). Describe the reaction of one of the isomers of  $\text{C}_3\text{H}_6\text{Cl}_2$  with sodium hydroxide and write the mechanism for the reaction.

86. Discuss the reaction of

- (a). Amines with nitrous acid,  
 (b). Ethanol with sulphuric acid,  
 (c). Methylbenzene with chlorine.

[Your answers should include equations and mechanisms for the reactions where applicable]

87.(a). Compound X has a molecular formula  $C_3H_8O$ . Write the structural formulae and IUPAC names of all the possible isomers of X.

(b). X reacted with iodine and aqueous sodium hydroxide solution to form a yellow precipitate.

(i). Identify X.

(ii). Write equation for the reaction between X and iodine in the presence of sodium hydroxide solution.

(iii). State what would be observed and write equation for the reaction that would take place when X is reacted with hot acidified potassium dichromate (VI) solution and name the main organic product.

(c). When X was heated with excess concentrated sulphuric acid, a gas Y which decolourises bromine water was evolved. Write equation for the reaction between

(i). X and sulphuric acid and suggest a mechanism for the reaction

(ii). Y and bromine water and name the product. (02 marks)

(d). Y was used to manufacture hydroxybenzene. Write equation and indicate conditions for the reaction

88.(a). Propene and propanone both undergo addition reactions.

(i). Write the structural formulae of propene and propanone.

(ii). Name one substance that forms an addition compound with Propene.

Propanone

(iii). Name the two addition compounds formed in (a) (ii).

(b). 1-bromopropane undergoes substitution reaction more readily than bromobenzene.

Explain.

(c). Benzene is nitrated using a mixture of nitric acid and sulphuric acid.

(i). State the conditions for the reaction.

(ii). What is the role of sulphuric acid?

(iii). Write a mechanism for the reaction that takes place.

(iv). Name the product of the reaction.

(d). Write equations to show how

(i). Benzene can be converted bromobenzene.

(ii). Benzene can be converted to benzoic acid.

(iii). Propene can be prepared from propanone.

89. (a). Both ethanol and phenol contain a common functional group.

(i). Name the functional group and write its formula.

(ii). Name a reagent that can be used to identify the functional group and state what would be observed.

- (iii). Name one reagent that can be used to distinguish between the two compounds.
- (iv). State what would be observed if each of the compounds is treated with the reagent you have named.
- (b). An aqueous solution of phenol is acidic to litmus whereas that of ethanol is neutral. Explain the observation.
- (c). Phenol and ethanol can react with ethanoyl chloride.
- (i). Write equation for the reaction of each compound with ethanoyl chloride and name the organic product in each case.
- (ii). Outline the mechanism for the reaction between phenol and ethanoyl chloride.
- (d). Write equation, state the condition and indicate mechanism for a reaction in which ethanol reacts differently from phenol.
89. Phenylamine and cyclohexanamine contain the same functional group.
- (a). Name the functional group in the compounds.
- (b). (i) Name one reagent that can be used to distinguish between the compounds.
- (ii). State what would be observed when the reagent you have named is treated with each of the compounds (01 mark)
- (iii). Write equations for the reactions that take place in (b) (ii).
- (b). Which of the two compounds is a stronger base? Explain.
- (c). Write equations to show how phenylamine
- (i). Reacts with chlorine water. State what is observed and name the organic product formed. (03 marks)
- (ii). Can be converted to phenylhydrazine.
- (iii). Reacts with benzene diazonium chloride.
- (d). Outline a mechanism for the reaction between cyclohexanamine and ethanoyl bromide.
91. The molecular formula of a given compound, M, is  $C_3H_6N$ .
- (a). Write the structural formulae and the IUPAC names of any three isomers of M.
- (b). Discuss the reactions of the isomers with nitrous acid. [Your answer should include observations and equations where applicable]
- (c). Arrange the isomers in order of their increasing
- (i). Basic strength. Explain your answer.
- (ii). Boiling points. Explain your answer.
- (d). Write equations to show how benzoic acid can be converted phenylamine.

92. Benzaldehyde and ethanal contain the same functional groups. (03 marks)

(a). Name the functional group.

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- (b). Name a reagent that can be used to confirm for the presence of this functional group in the compounds.
- (c). State what is observed and write equation for the reaction that takes place when the reagent you have named is treated with each of the compounds.
- (d). Name a reagent that can be used to distinguish between the two compounds. In each case, state what would be observed and write equation for the reaction that takes place. (0.4 marks)
- (e). State what would be observed outline a mechanism for the reaction between ethanal and a saturated solution of sodium hydrogen sulphite.
- (f). Outline a mechanism for the reaction between acidified solution of hydrazine and benzaldehyde.
- (g). Write equations to show how benzaldehyde can be prepared from ethanal.

93.(a).A colourless liquid Y containing 50.00% carbon, 5.56% hydrogen and the rest being oxygen burns with a blue non-sooty flame. The vapour density of Y is  $3.0 \times 10^3$   $\text{g cm}^{-3}$  at room temperature. Determine the

- (i). Empirical formula of Y.  
(ii). Molecular formula of Y.

[1 mole of gas occupies 24  $\text{dm}^3$  at room temperature and pressure].

(b). Y decolourises cold acidified potassium manganate (VII) solution. Write the structural formula and IUPAC name of Y.

(c). Write a mechanism for the reaction between Y and each of the following substances and in each case, give the IUPAC name of the products.

- (i). Hydrogen chloride  
(ii). Methanol in the presence of concentrated sulphuric acid.

(d). Write equations to show how Y can be

- (i). Converted to ethane.  
(ii). Obtained from ethanal.

(e). Write equation and name the product for the reaction between Y and

- (i). Bromine in carbon tetrachloride  
(ii). Sodium hydrogen carbonate.

94. (a). An organic compound G contains 25.40% carbon, 3.17% hydrogen, 37.57% chlorine and the rest being oxygen. The vapour density of G is 47.25.

(i). Calculate the empirical formula of G.

(ii). Determine the molecular formula of G.

(b). Write the structural formulae and the IUPAC names of all the possible isomers of compound G.

(c).(i) Name a reagent that would react with all the isomers to give the same observation. (0.1 mark)

(ii). State what would be observed when the reagent you have named is treated with the isomers. (01 mark)

(c). G reacts with sodium hydrogen carbonate with effervescence. Write equation for the reaction.

(d). Write equation and outline the mechanism for the reaction between G and

(i). Potassium cyanide.

(ii). Silver methanoate.

(e). Write equations to show how G can be

(i). Converted to ethyne.

(ii). Obtained from methanal.

95.(a). A bromoalkene, Q, with general formula  $C_nH_{2n+1}Br$ , contains 58.39% bromine.

(i). Determine the molecular formula of Q.

(ii). Write the structural formula and the IUPAC names of the possible isomers of Q.

(b). Q was reacted with hot sodium hydroxide solution to and the resulting mixture was added a solution of anhydrous zinc chloride and concentrated hydrochloric acid and a turbid solution was formed after 8 minutes.

(i). Identify Q,

(ii). Write a mechanism for the reaction that took place between Q and hot sodium hydroxide.

(iii). Write equation for the reaction leading to the formation of the turbid solution.

(c). Write equations, indicating the conditions and outline mechanisms for the reaction between Q and

(i). Phenol.

(ii). Silver ethanoate

96. (a). 6.85g of a bromoalkane, J, was reacted with excess sodium hydroxide solution. The resulting solution was neutralised with excess nitric acid and diluted to 250cm<sup>3</sup>. 25cm<sup>3</sup> of this solution required 12.5cm<sup>3</sup> of 0.4M silver nitrate solution for complete precipitation of silver bromide. Calculate

(i). The relative formula mass of J.

(ii). The molecular formula of J.

(iii). Write the structural formulae and IUPAC names of all the possible isomers of J.

(b). J undergoes nucleophilic substitution bimolecular reaction when reacted with warm sodium hydroxide solution.

(i). Identify J.

(ii). Write the equation for the reaction between J and warm sodium hydroxide solution

(iii). Write the rate equation for the reaction between J and warm sodium hydroxide solution.

(iv). Draw a well labelled potential energy diagram for the reaction, given that the reaction is endothermic.

(c). Outline a mechanism for the reaction between J and hot sodium methoxide.

97. (a). A hydrocarbon T contains 88.89% carbon. When vaporised, 1.35g of T occupied  $672\text{cm}^3$  at  $54.6^\circ\text{C}$ .

(i). Calculate the empirical formula of T.

(ii). Determine the molecular formula of T.

[One mole of gas occupies  $22.4\text{ dm}^3$  at s.t.p.]

(b). When T was warmed with a mixture of dilute sulphuric acid mercury (II) sulphate, compound U was formed. U reacts with Brady's reagent to give a yellow precipitate.

(i). Write the structural formulae and the IUPAC names of the possible isomers of T.

(ii). Name a reagent that can be used to distinguish between the isomers you have written in (b) (i), and state what would be observed if the reagent you have named is treated with each of the isomers

(iii). Write equation for the any reaction that takes place in (b) (ii).

(c). (i) Identify U.

(ii). Write equation for the reaction between U and Brady's reagent that leads to the formation of a yellow precipitate.

(d). T reacts with sodium amide. Write equations to show how T can be

(i). Prepared from 1,2-dichloropropane.

(ii). Converted to 2,2-dibromopentane.

98. (a). An organic compound, L, contains 61.02% carbon, 15.25% hydrogen and the rest being nitrogen. The vapour density of L  $2.634\text{ g l}^{-1}$  at s.t.p.

(i). Calculate the empirical formula of L.

(ii). Deduce the molecular formula of L.

(b). L reacts with a solution of sodium nitrite and cold dilute hydrochloric acid to form bubbles of a colourless gas and compound M.

(i). Name the colourless gas.

(ii). Write the structural formulae and IUPAC names of the possible isomers of L.

(c). When a solution of anhydrous zinc chloride was added to M, a cloudy solution was formed after 9 minutes.

(i). Identify L and M

(ii). Write equation for the reaction leading to the formation of M.

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

(i). L and ethanoyl chloride

(ii). M and cold concentrated sulphuric acid.

(e). Write equations to show how L can be prepared from M.

99.(a). An organic compound V contains 66.41% carbon, 5.53% hydrogen and the rest being chlorine. When 2.53g of V were vaporised at 785mmHg and 92°C, it occupied a volume of 580cm<sup>3</sup>.

- (i). Calculate the empirical formula of V.
  - (ii). Determine the molecular formula of V.
- (b). V burns with a yellow sooty flame. Write the structural formulae of all the possible isomers of V. (04 marks)
- (c). V reacts with aqueous sodium hydroxide.
- (i). Identify the isomer.
  - (ii). Write equation and outline a mechanism for the reaction between the isomer.
  - (iii). Describe a test that can be carried out to differentiate V from the rest of the any one isomer in (b).
- (d). Write equations to show how V can be
- (i). Converted to cyclohexylethanoic acid
  - (ii). Prepared from phenylmethanal.