Structure & naming of organic compounds

the carbon atom with reference to valence number, bond strength, stability of carbon bonds with other elements and the formation of isomers (structural and stereoisomers) to explain carbon compound diversity, including identification of chiral centres in optical isomers of simple organic compounds and distinction between cis- and trans-isomers in simple geometric isomers

1. Explain the similarities and differences between structural, stereoisomers and geometric isomers. (p281)

2. Why is it necessary to separate and isolate the enantiomers of a chiral molecule in the production of pharmaceuticals? (p284)

3. Give examples of a pair of stereoisomers and a pair of geometric isomers. (p281, 285)

structures including molecular, structural and semi-structural formulas of alkanes (including cyclohexane), alkenes, alkynes, benzene, haloalkanes, primary amines, primary amides, alcohols (primary, secondary, tertiary), aldehydes, ketones, carboxylic acids and non-branched esters

4. Write the semi-structural formula of cyclohexane, benzene and glycerol. (p292, 295 and data book)

IUPAC systematic naming of organic compounds up to C8 with no more than two functional groups for a molecule, limited to non-cyclic hydrocarbons, haloalkanes, primary amines, alcohols (primary, secondary, tertiary), carboxylic acids and non-branched esters

5. When naming an organic molecule with more than two functional groups, it is important to know which functional group has the highest priority. Order the following functional groups from highest to lowest priority – halo, alkyne, carboxyl, amino, alkene, hydroxyl. (p313)

6. What functional groups are present in the following families: amines, carboxylic acids, alcohols, esters, haloalkanes, benzene, ketones and aldehydes?

the pathways used to synthesise primary haloalkanes, primary alcohols, primary amines, carboxylic acids and esters, including calculations of atom economy and percentage yield of single-step or overall pathway reactions

7. Explain the difference between atom economy and percentage yield (p361-363).

8. Is it more efficient to have a three step pathway reaction with each step having an 80% efficiency or a one-step pathway with a 60% efficiency? (p362)

Categories, properties and reactions of organic compounds

an explanation of trends in physical properties (boiling point, viscosity) and flashpoint with reference to structure and bonding

9. Explain the difference in boiling point of ethanol (78.4°C) compared to ethanoic acid (b.p 118°C). (p324)

10. Provide an explanation for why using mobile phones and smoking is prohibited when refilling a car at a fuel station. (p333)

11. Explain why the solubility of a primary alcohol can decrease by 10-fold when the carbon chain increases by two carbons. (p327)

12. Explain the difference in boiling point of propanol (97°C) and propanal (48°C). (p328)

13. Define viscosity and explain why vegetable oil is less viscous than honey, but more viscous than water.

organic reactions, including appropriate equations and reagents, for the oxidation of primary and secondary alcohols, substitution reactions of haloalkanes, addition reactions of alkenes, hydrolysis reactions of esters, the condensation reaction between an amine and a carboxylic acid, and the esterification reaction between an alcohol and a carboxylic acid.

14. Explain why it is not possible to oxidise a tertiary alcohol. (p347)

15. Describe a chemical test that can be used to identify the presence of a primary or a secondary alcohol. (p347)

16. Explain, with the use of a chemical equation, why the formation of a triglyceride with the fatty acid, oleic acid as one of the reactants, is an esterification reaction between an alcohol and a carboxylic acid.

17. Show how the formation of biodiesel involves both a hydrolysis and a condensation reaction. (p26)

Analysis of organic compounds

the principles and applications of mass spectroscopy (excluding features of instrumentation and operation) and interpretation of qualitative and quantitative data, including identification of molecular ion peak, determination of molecular mass and identification of simple fragments

18. Why do fragment ions in a mass spectrum always have a positive charge? (p395)

19. Identify the peaks in the mass spectra of pentan-3-one.(p395)

m/z	Ion identity
86	
57	
29	

the principles and applications of infrared spectroscopy (IR) (excluding features of instrumentation and operation) and interpretation of qualitative and quantitative data including use of characteristic absorption bands to identify bonds

20. Explain the difference between interpreting qualitative data and quantitative data for infrared spectroscopy.

the principles (including spin energy levels) and applications of proton and carbon-13 nuclear magnetic resonance spectroscopy (NMR) (excluding features of instrumentation and operation); analysis of carbon-13 NMR spectra and use of chemical shifts to determine number and nature of different carbon environments in a simple organic compound; and analysis of high resolution proton NMR spectra to determine the structure of a simple organic compound using chemical shifts, areas under peak and peak splitting patterns (excluding coupling constants) and application of the n+1 rule

21. Complete the table below for high resolution H^1NMR.

Aspect (High resolution ^{1}HNMR)	What it tells us about the chemical structure
Number of peaks	
Chemical Shift	
Peak Splitting	
Peak Area	

22. Determine the structure of a molecule with the formula C_2H_6O using the data from high resolution 1HNMR spectra.

Chemical shift	3.83	2.82	1.25
Ratio of area under peak	2	1	3
Splitting	Quartet	Singlet	triplet

determination of the structures of simple organic compounds using a combination of mass spectrometry (MS), infrared spectroscopy (IR) and proton and carbon-13 nuclear magnetic resonance spectroscopy (NMR) (limited to data analysis) – completed in questions

the principles of chromatography including use of high performance liquid chromatography (HPLC) and construction and use of a calibration curve to determine the concentration of an organic compound in a solution

23. Explain why non-polar compounds take longer to move through a non-polar column than polar compounds in reversed-phase HPLC.

24. What is the effect of increasing chain length on the retention time of organic molecules passing through a HPLC column.

determination of the concentration of an organic compound by volumetric analysis, including the principles of direct acid-base and redox titrations

25. Explain why the redox titration between potassium permanganate and oxalic acid (HOOCCOOH) does not require an indicator. (p447)

26. What is the most suitable indicator for the acid base titration between benzoic acid and sodium hydroxide? Explain your answer (p439)

Unit 4 AOS1 summary

CHEM TopUp Tools

Organic Pathways

Outline an organic pathway that can be used to produce methyl ethanoate from ethene and chloromethane.

Organic Pathways

Illustrate how propanal, propanone and propanoic acid can be produced from 1-propanol and 2-propanol. (p346)

Adele Hudson, Feb 2020