Topic 20: Organic chemistry (10 hours)

20.1 Introduction

1 hour

	Assessment statement	Obj	Teacher's notes
20.1.1	Deduce structural formulas for compounds containing up to six carbon atoms with one of the following functional groups: amine, amide, ester and nitrile.	3	Condensed structural formulas can use NH_2, $CONH_2$, –COOC– and CN for these groups.
20.1.2	Apply IUPAC rules for naming compounds containing up to six carbon atoms with one of the following functional groups: amine, amide, ester and nitrile.	2	

20.2 Nucleophilic substitution reactions

2 hours

	Assessment statement	Obj	Teacher's notes
20.2.1	Explain why the hydroxide ion is a better nucleophile than water.	3	
20.2.2	Describe and explain how the rate of nucleophilic substitution in halogenoalkanes by the hydroxide ion depends on the identity of the halogen.	3	
20.2.3	Describe and explain how the rate of nucleophilic substitution in halogenoalkanes by the hydroxide ion depends on whether the halogenoalkane is primary, secondary or tertiary.	3	
20.2.4	Describe, using equations, the substitution reactions of halogenoalkanes with ammonia and potassium cyanide.	2	
20.2.5	Explain the reactions of primary halogenoalkanes with ammonia and potassium cyanide in terms of the S_N2 mechanism.	3	
20.2.6	Describe, using equations, the	2	

	reduction of nitriles using hydrogen and a nickel catalyst.		

20.3 Elimination reactions

1 hour

	Assessment statement	Obj	Teacher's notes
20.3.1	Describe, using equations, the elimination of HBr from bromoalkanes.	2	
20.3.2	Describe and explain the mechanism for the elimination of HBr from bromoalkanes.	3	

20.4 Condensation reactions

2 hours

	Assessment statement	Obj	Teacher's notes
20.4.1	Describe, using equations, the reactions of alcohols with carboxylic acids to form esters, and state the uses of esters.	2	Mechanisms will not be assessed.
20.4.2	Describe, using equations, the reactions of amines with carboxylic acids.	2	Mechanisms will not be assessed.
20.4.3	Deduce the structures of the polymers formed in the reactions of alcohols with carboxylic acids.	3	Emphasize the need for two functional groups on each monomer. Include the polyester formed from ethane-1,2-diol and benzene-1,4-dicarboxylic acid. Include the identification of the repeating unit.
20.4.4	Deduce the structures of the polymers formed in the reactions of amines with carboxylic acids.	3	Emphasize the need for two functional groups on each monomer. Include the polyamide formed from 1,6-diaminohexane and hexanedioic acid. Include the identification of the repeating unit.
20.4.5	Outline the economic importance of condensation reactions.	2	**Aim 8**

20.5 Reaction pathways

1 hour

	Assessment statement	Obj	Teacher's notes
20.5.1	Deduce reaction pathways given the starting materials and the product.	3	Conversions with more than two stages will not be assessed. Reagents, conditions and equations should be included. For example, the conversion of 1-bromopropane to 1-butylamine can be done in two stages: 1-bromopropane can be reacted with potassium cyanide to form propanenitrile, which can then be reduced by heating with hydrogen and a nickel catalyst.

20.6 Stereoisomerism

3 hours

	Assessment statement	Obj	Teacher's notes
20.6.1	Describe stereoisomers as compounds with the same structural formula but with different arrangements of atoms in space.	2	
20.6.2	Describe and explain geometrical isomerism in non-cyclic alkenes.	3	Include the prefixes *cis*- and *trans*- and the term restricted rotation.
20.6.3	Describe and explain geometrical isomerism in C_3 and C_4 cycloalkanes.	3	Include the dichloro derivatives of cyclopropane and cyclobutane.
20.6.4	Explain the difference in the physical and chemical properties of geometrical isomers.	3	Include *cis*- and *trans*-1,2-dichloroethene as examples with different boiling points, and *cis*- and *trans*-but-2-ene-1,4-dioic acid as examples that react differently when heated.
20.6.5	Describe and explain optical isomerism in simple organic molecules.	3	Include examples such as butan-2-ol and 2-bromobutane. The term asymmetric can be used to describe a carbon atom joined to four different atoms or groups. The term chiral can be used to describe a carbon atom joined to four different atoms or groups, and also as a description of the molecule itself. Include the meanings of the terms enantiomer and racemic mixture. **TOK:** The existence of optical isomers provided indirect evidence of a tetrahedrally bonded carbon atom. This is an example of

			the power of reasoning in allowing us access to the molecular scale. Do we know or believe those carbon atoms are tetrahedrally coordinated? The use of conventions in representing three-dimensional molecules in two dimensions could also be discussed.
20.6.6	Outline the use of a polarimeter in distinguishing between optical isomers.	2	Include the meaning of the term plane-polarized light.
20.6.7	Compare the physical and chemical properties of enantiomers.	3	

The compound and reaction types in this topic are summarized in the following scheme.