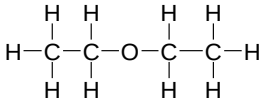
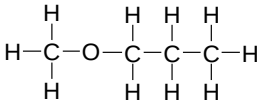
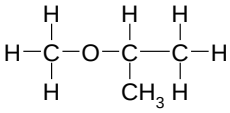
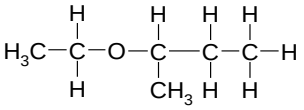
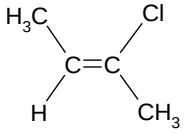
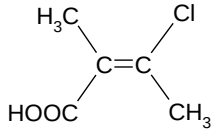
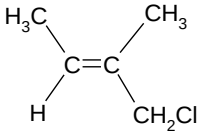
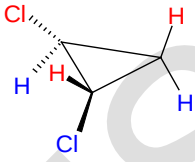
IB HL New Organic Material - mostly new to 2016 syllabus

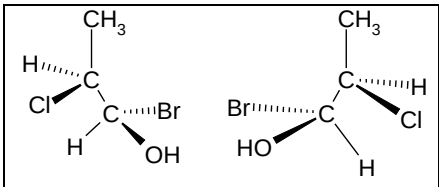
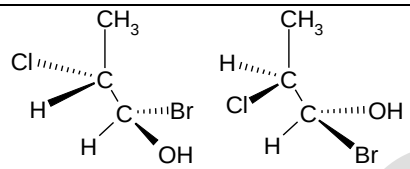
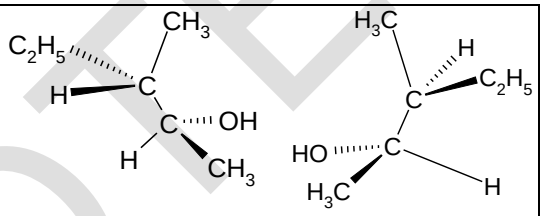
1 Name the following compounds:

			
ethoxyethane	1-methoxypropane	2-methoxypropane	2-ethoxybutane

2 Classify the following as *E* or *Z* isomers

			
Z	*E*	*E*	*E*

3 Classify each of the following pairs as enantiomers or diastereomers:

		
enantiomers (mirror images)	enantiomers (mirror images)	diastereomers (not mirror images)

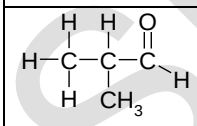
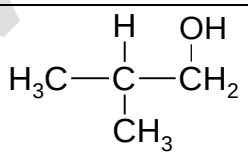
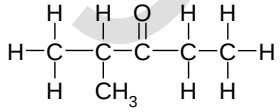
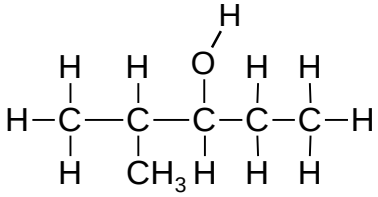
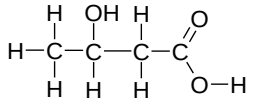
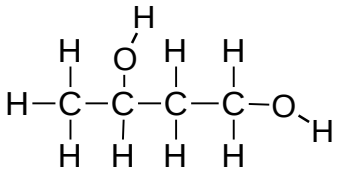
4 (a) State the reagents and conditions for reduction of an aldehyde or ketone [2]

$NaBH_4$(sodium borohydride) in methanol solvent

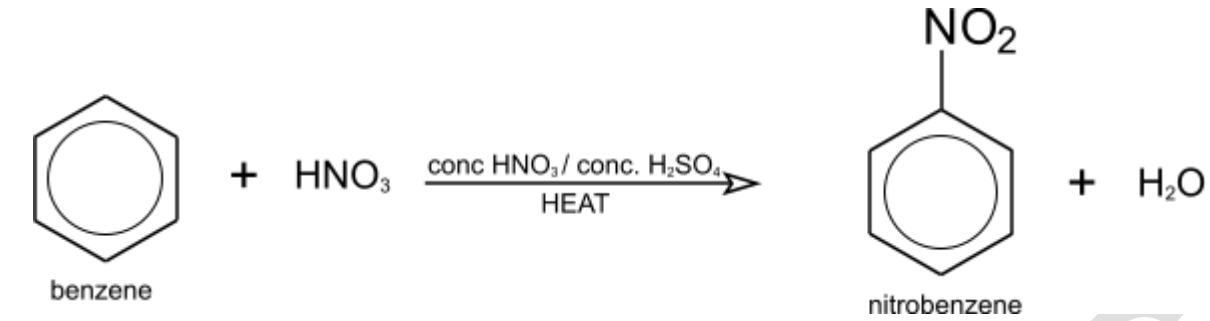
(b) State the reagents and conditions for reduction of a carboxylic acid [2]

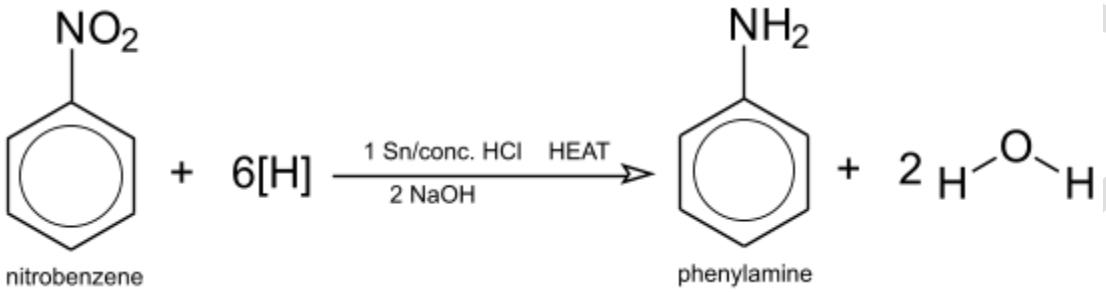
stage 1 – $LiAlH_4$ (lithium aluminium hydride)in dry ethoxyethane solvent
stage 2 – H^+(aq)

(c) Give the structural formulae of the organic products formed when the following compounds undergo reduction under appropriate conditions. [3]

	product
	
	
	

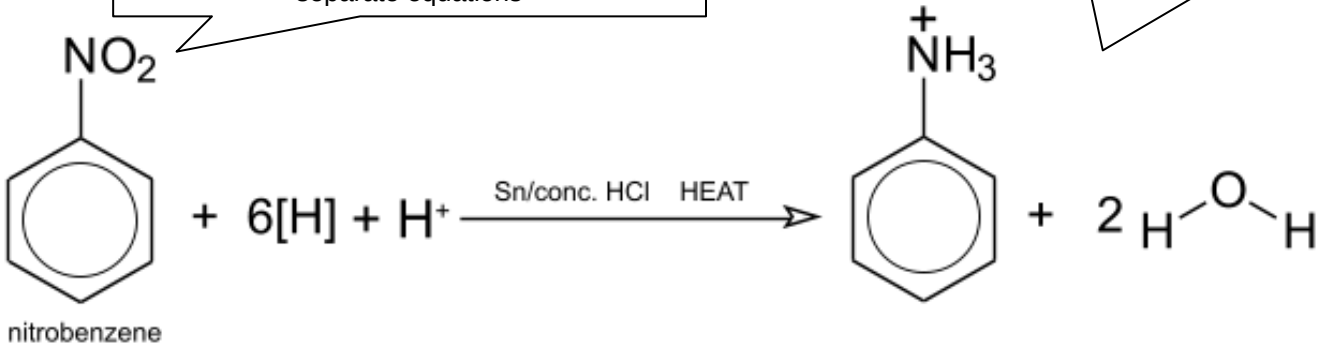
5 Describe using chemical equations and giving essential conditions how nitrobenzene can be converted to phenylamine. [4]

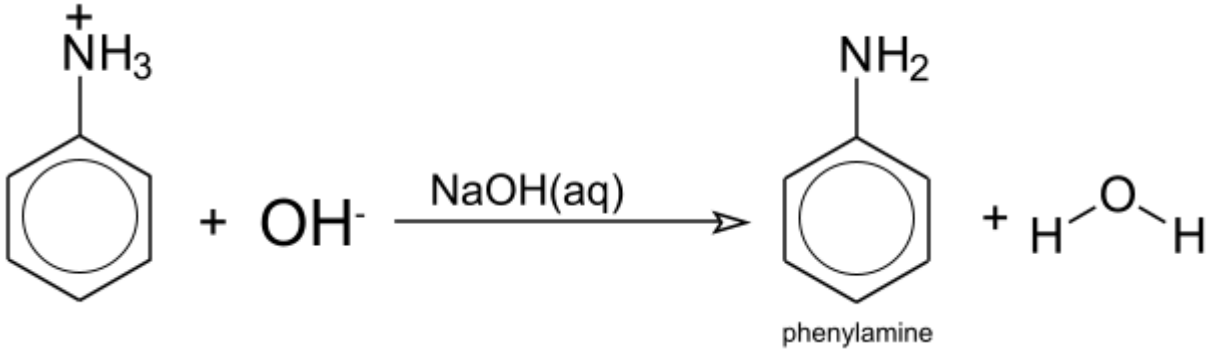




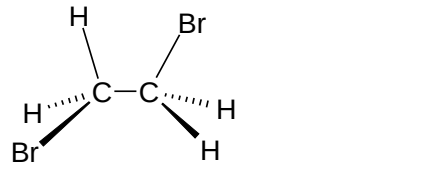
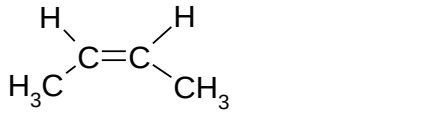
The above equation can be written as two separate equations

The actual equation for this reaction is significantly more complicated than this

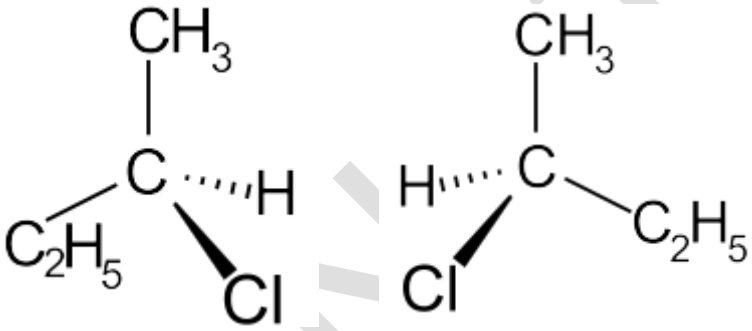




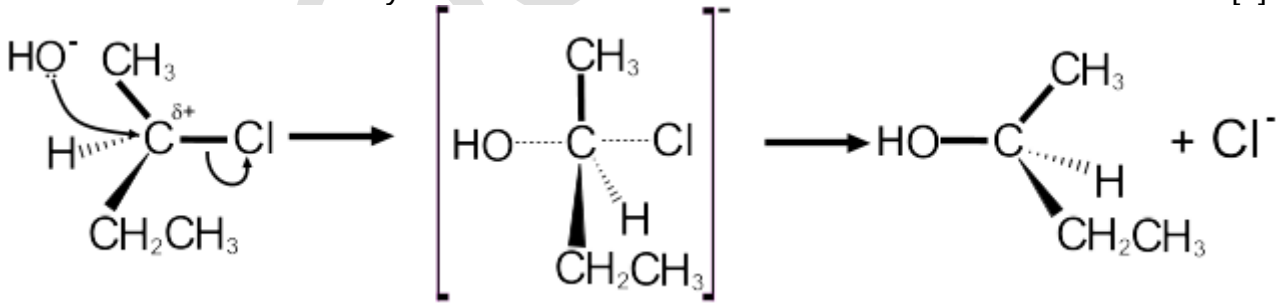
6 Classify each of the following pairs as conformational or configurational isomers:

	conformational (can interconvert by rotating about σ bond)
	conformational (can interconvert by rotating about σ bond)
	configurational - (interconversion would require breaking a bond)

7 (a) Draw clear diagrams showing the enantiomers of 2-chlorobutane. [2]



(b) Using one of the enantiomers from part a describe the S_N2 mechanism of 2-chlorobutane with sodium hydroxide solution. Clearly show the stereochemistry of the molecules. [4]



(c) 2-chlorobutane can also undergo an S_N1 reaction with sodium hydroxide solution. Explain why this reaction is described as *non-stereospecific*. [2]

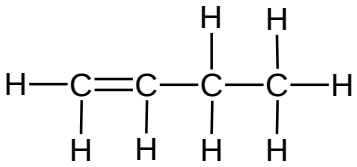
Starting with 1 enantiomer will result in formation of both enantiomers of the product
In equal amounts/a racemic mixture

(d) Classify each of the following solvents as protic/aprotic polar or non-polar. [5]

water	methanol	propanone	tetrachloromethane	$(CH_3)_2SO$
protic polar	protic polar	aprotic polar	non-polar	aprotic polar

8 But-1-ene undergoes an addition reaction with hydrogen chloride

(a) (i) draw the full structural formula of but-1-ene. [1]

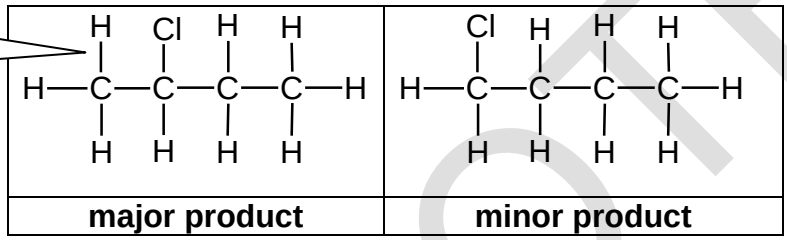


(ii) explain whether but-1-ene can form *cis-trans* isomers. [1]

No, because there are two H atoms (two groups the same) on one of the C atoms of the C=C

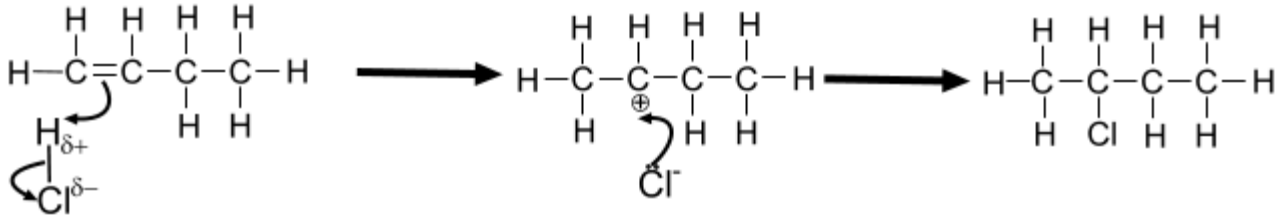
(b) (i) Deduce the **full** structural formula of the two isomers formed when but-1-ene reacts with hydrogen chloride and predict which will be the major product [2]

H attached to the C which originally had more Hs attached



major product	minor product

(ii) Draw the mechanism of the reaction of but-1-ene with hydrogen chloride to form the major product, using curly arrows to represent the movement of electron pairs. [3]

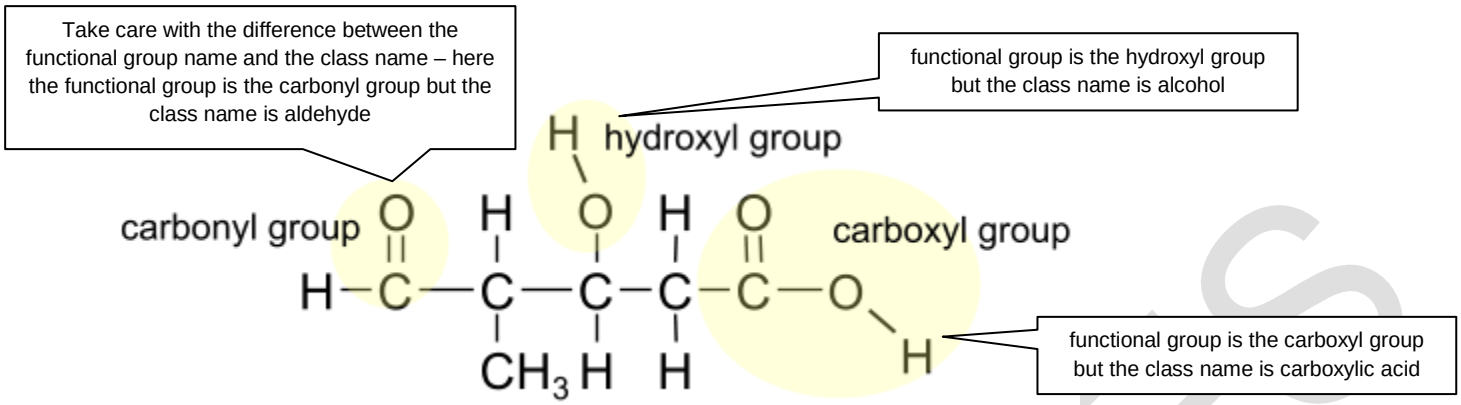


(iii) Explain the formation of a major and a minor product in the reaction.[3]

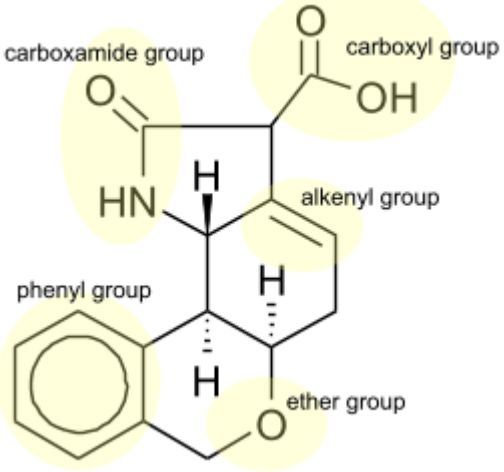
The secondary carbocation (which forms the major product) is more stable than the primary carbocation (which forms the minor product) as there are *more* electron-releasing alkyl groups around the positively-charged C

9 (a) Deduce the molecular formulae of each of the molecules shown [3]

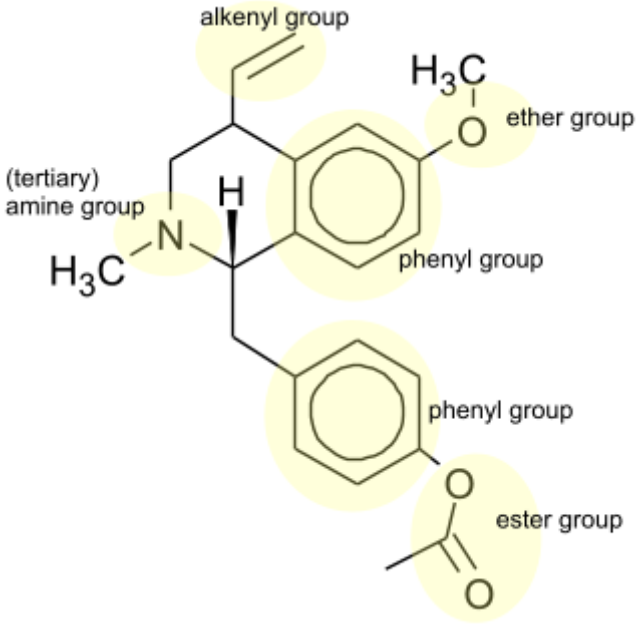
(b) Deduce the names of the functional groups present in each of the following molecules. [12]



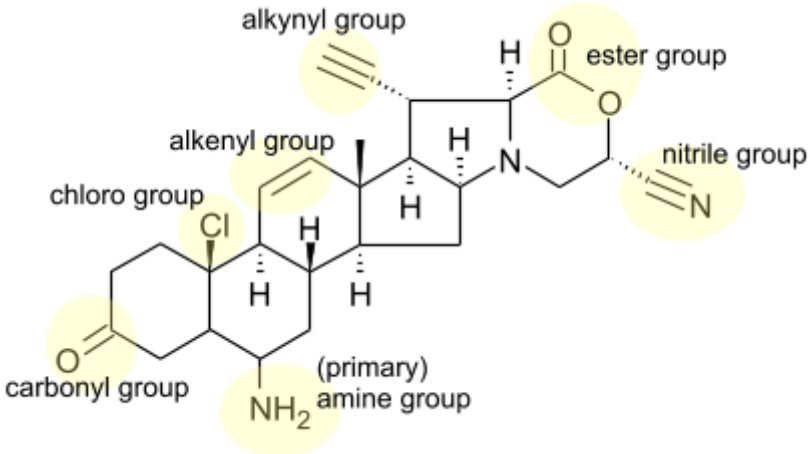
$C_6H_{10}O_4$



$C_{16}H_{15}NO_4$



$C_{22}H_{25}NO_3$



$C_{26}H_{30}ClN_3O_3$

(c) Only some H atoms are shown in these diagrams. Explain the significance of the wedge and dashed bonds to certain H atoms. [2]

A wedge indicates a bond coming out of the plane of the paper and a dashed line indicates a bond going into the plane of the paper;
Each of these H atoms is attached to a chiral carbon atom/the carbon it is attached to has 4 different groups (including the H) attached