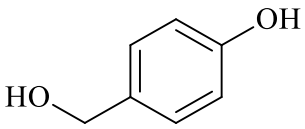
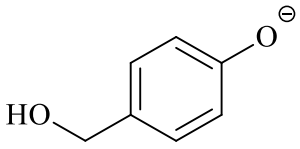
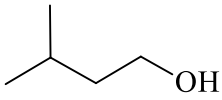
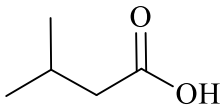
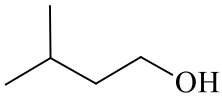
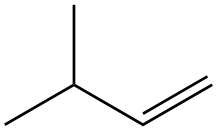
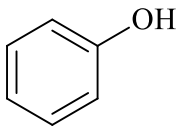
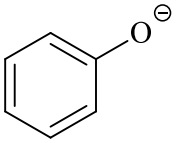
Marks 3

- Complete the following table. Make sure you give the name of the starting material where indicated.

STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	**NaOH(aq)**	
	**$Cr_2O_7^{2-}$ / H^+**	
	concentrated H_2SO_4	

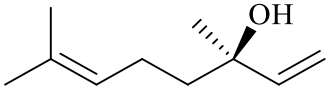
Marks 1

- Complete the following table. Make sure you give the name of the starting material where indicated.

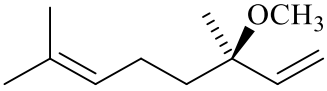
STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	NaOH	

Marks 2

- The structure of (–)-linalool, a commonly occurring natural product, is shown below.

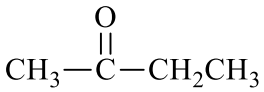


Give the constitutional formula of the organic product formed from (–)-linalool in each of the following reactions. NB: If there is no reaction, write "no reaction".

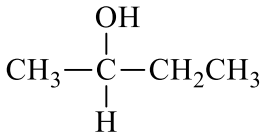
Reagents / Conditions	Constitutional Formula of Product
$Na_2Cr_2O_7$ in aqueous acid	**no reaction**
Na, then CH_3Br	

Marks 4

- Butanone is treated first with lithium aluminium hydride, $LiAlH_4$, in dry ether and then with aqueous acid to yield the alcohol, **A**.

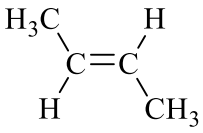
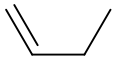


butanone



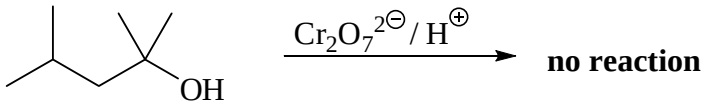
A

A is treated with concentrated sulfuric acid to give mainly the alkene **B** and two other alkenes **C** and **D**. Alkenes **B** and **C** are diastereomers, **B** and **D** (and **C** and **D**) are constitutional isomers. Give the structures for **C** and **D** and give systematic names for **B**, **C** and **D**.

B	**C**	**D**
		
Name: **(*E*)-2-butene**	Name: **(*Z*)-2-butene**	Name: **1-butene**

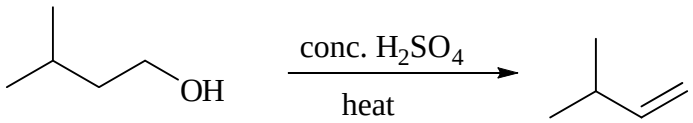
Marks 3

- Give the name of the starting material where indicated and the constitutional formula(s) of the major organic product(s) formed in each of the following reactions. NB: if there is no reaction, write "no reaction".



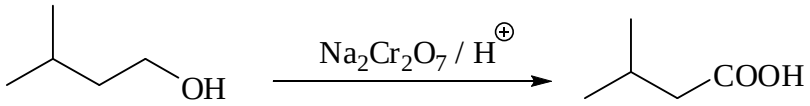
no reaction

Name: 2,4-dimethylpentan-2-ol

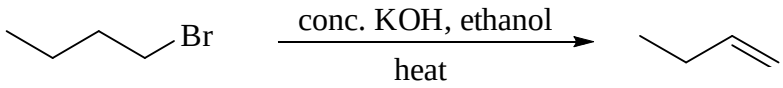


Marks 5

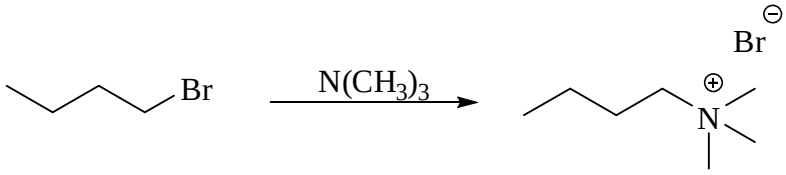
- Give the name of the starting material where indicated and the constitutional formula of the major organic product formed in each of the following reactions.



Name: 3-methyl-1-butanol

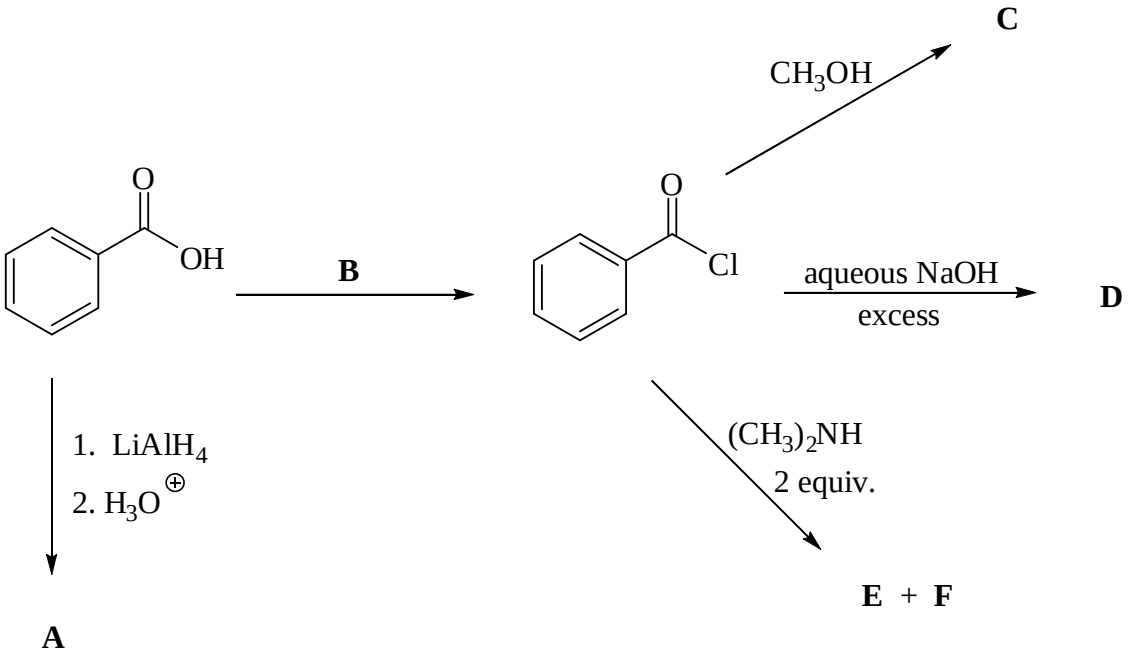


Name: 1-bromobutane

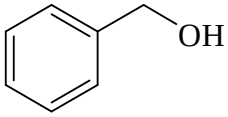
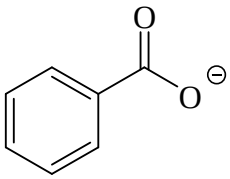
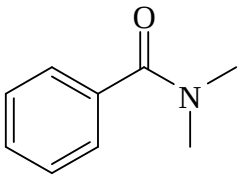
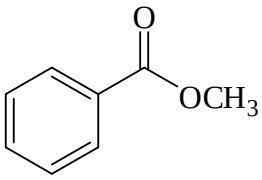
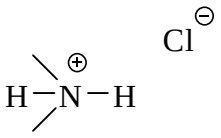


Marks 6

- Consider the following reaction sequence.



Give the reagent **B** and draw the constitutional formulas of the major organic products, **A**, **C**, **D**, **E** and **F**, formed in these reactions.

A 	**D** 
B **$SOCl_2$**	**E** 
C 	**F** 

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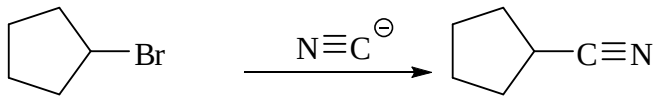
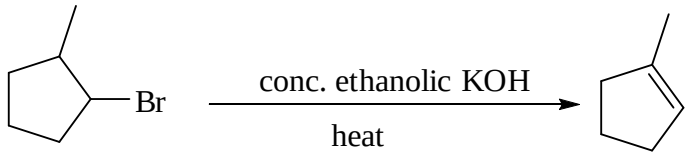
Marks 3

- Give the name of the starting material where indicated and the constitutional formula of the major organic product formed in each of the following reactions.



Name: bromocyclopentane

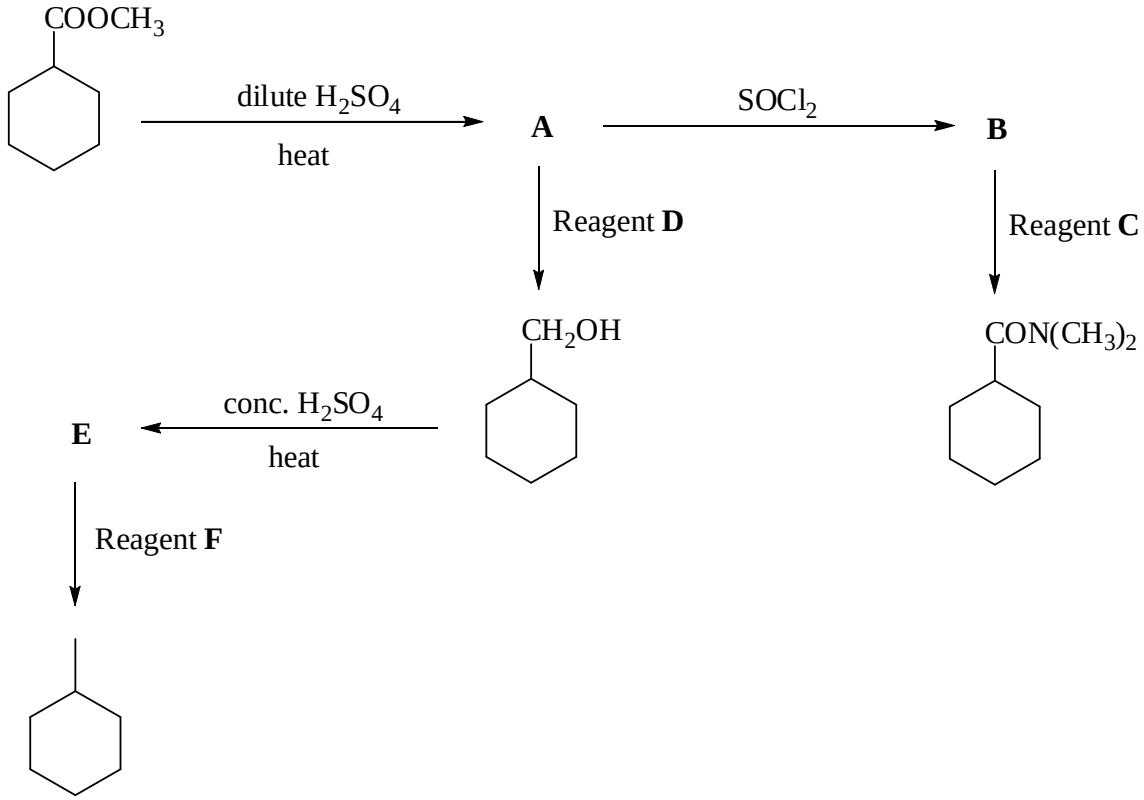
(Nucleophilic substitution by Br^- by CN^-)



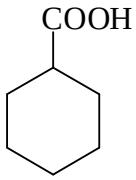
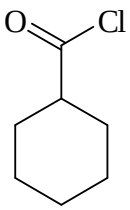
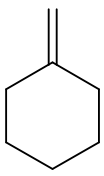
(Base catalysed elimination of H-Br to form a C=C, following Zeitsev's rule).

Marks 6

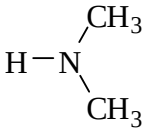
- Consider the following reaction sequence.



Give the reagents **C**, **D** and **F** and draw the structures of the major organic products, **A**, **B** and **E**, formed in these reactions.

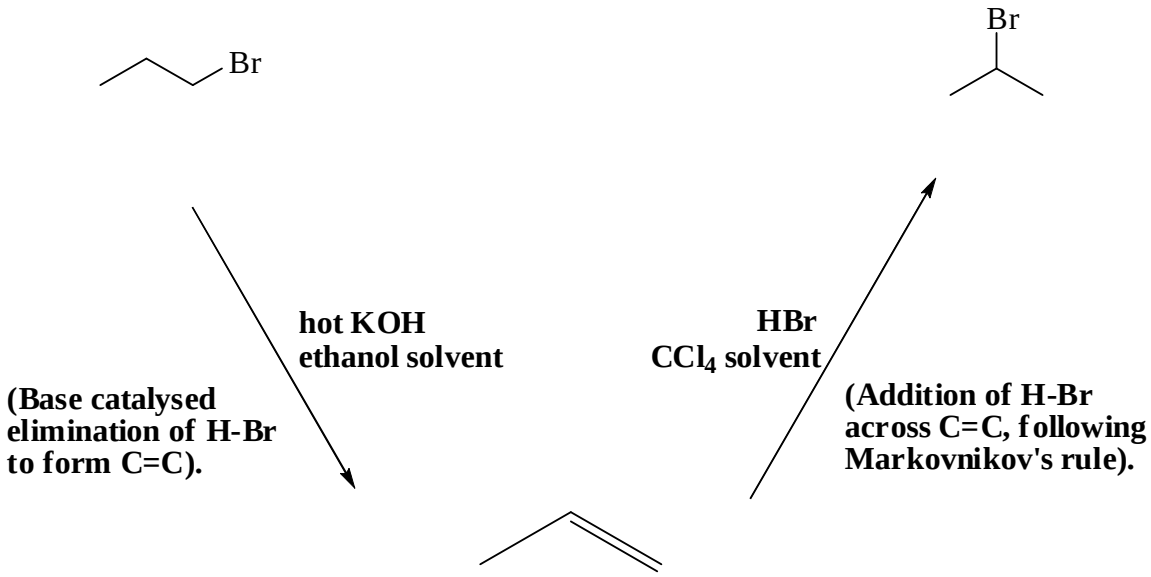
A  **(Hydrolysis of an ester to a carboxylic acid).**	**D** **(1). $LiAlH_4$ / dry ether** **(2). H^+ / H_2O** **(Reduction of carboxylic acid to primary alcohol).**
B  **(Formation of an acid chloride from a carboxylic acid).**	**E**  **(Acid catalysed elimination of H-OH ("dehydration") to form C=C).**

ANSWER CONTINUES ON THE NEXT PAGE

C	**F**
 **(Formation of amide from acid chloride).**	**H_2 / Pd/C** **(Reduction of alkene to alkane).**

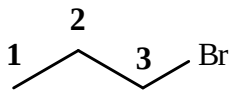
Marks 5

- Show clearly the reagents you would use to carry out the following chemical conversion. Two steps are required. Give the structure of the intermediate compound.

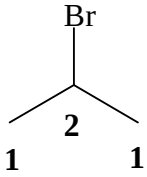


How could you distinguish between the starting material and the product by ^{13}C NMR spectroscopy?

The starting material has 3 different carbon environments so will give 3 resonances in the ^{13}C NMR.



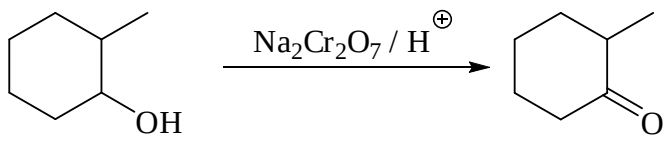
The produt has 2 different carbon environments so will give 2 resonances in the ^{13}C NMR.



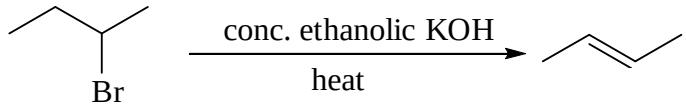
The two carbon atoms labelled as '1' are equivalent.

Marks 5

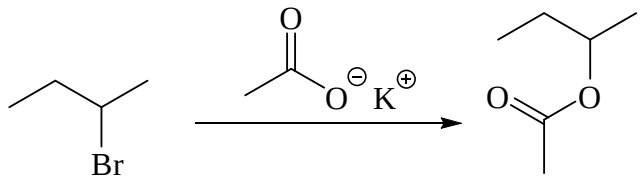
- Give the name of the starting material where indicated and the constitutional formula of the major organic product formed in each of the following reactions.



Name: 2-methylcyclohexanol

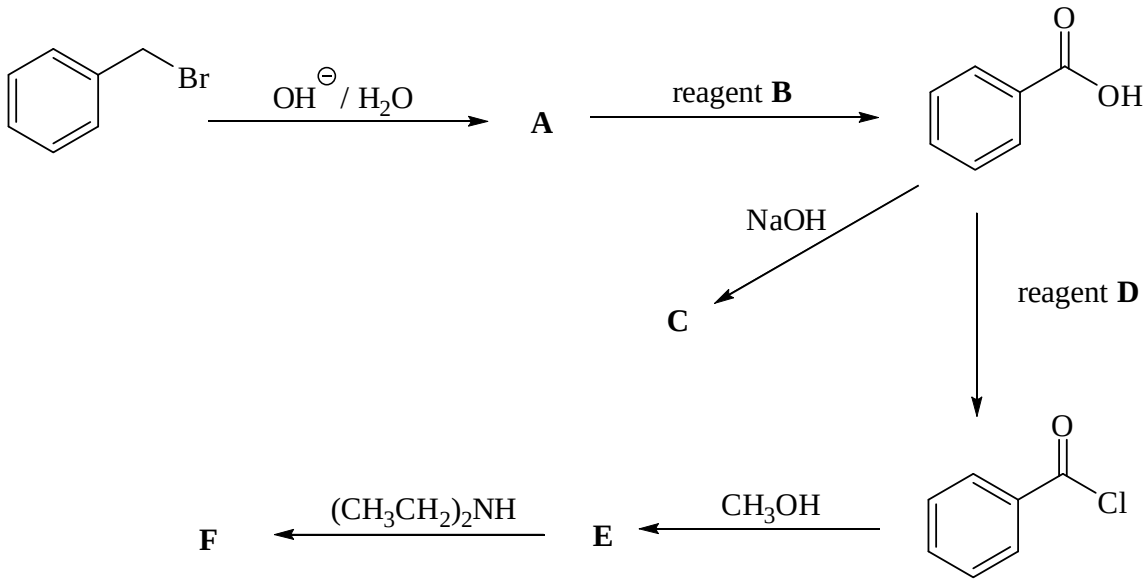


Name: 2-bromobutane

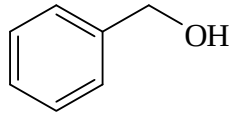
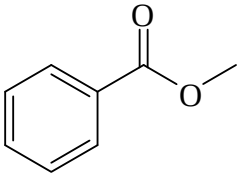
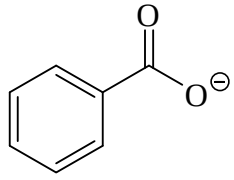
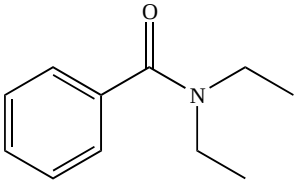


Marks 6

- Consider the following reaction sequence.

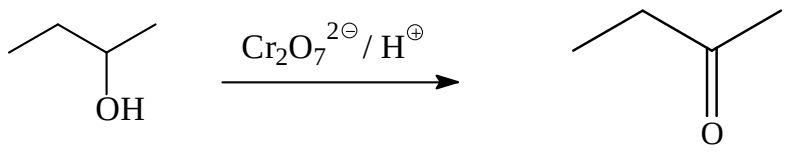


Give the reagents **B** and **D** and draw the structures of the major organic products, **A**, **C**, **E** and **F**, formed in these reactions.

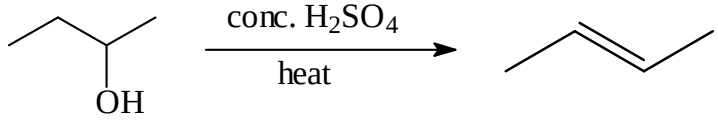
A 	**D** **$SOCl_2$ / heat**
B **$Cr_2O_7^{2-}$ / H^+**	**E** 
C 	**F**  CH_3OH

Marks 5

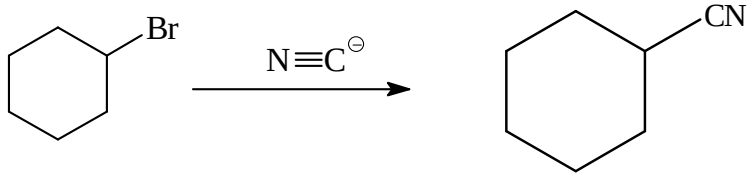
- Give the name of the starting material where indicated and the constitutional formula of the major organic product formed in each of the following reactions.



Name: 2-butanol



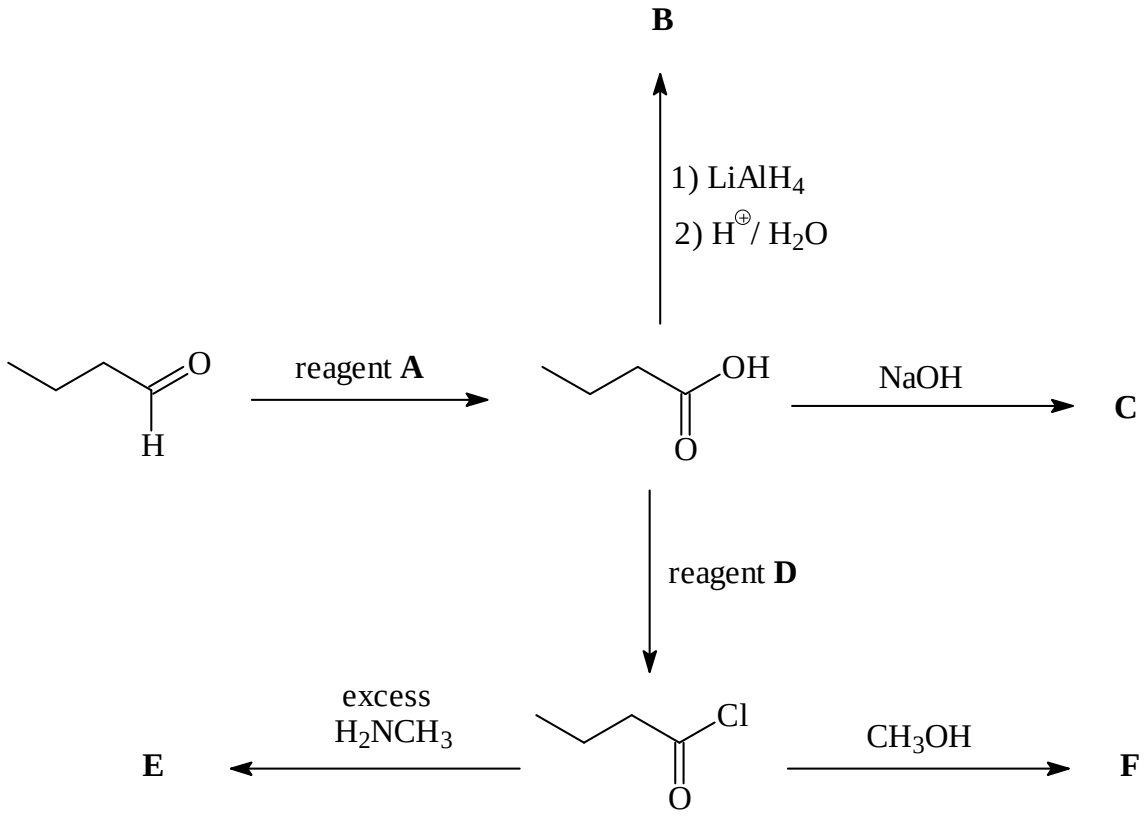
(Dehydration leading to more substituted double bond: Zeitsev's rule)



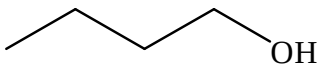
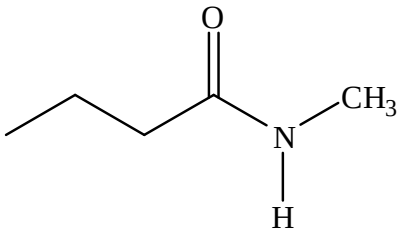
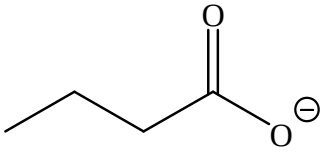
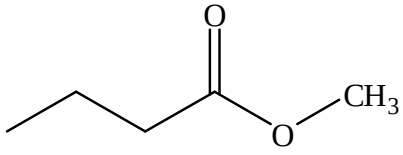
Name: bromocyclohexane

Marks 6

- Consider the following reaction sequence.

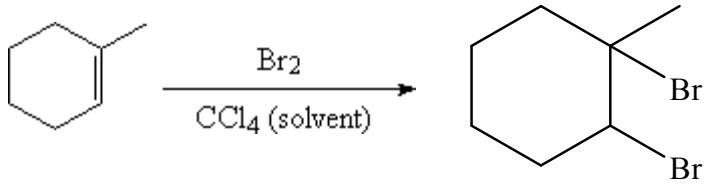


Give the reagents **A** and **D** and draw the structures of the major organic products, **B**, **C**, **E** and **F**, formed in these reactions.

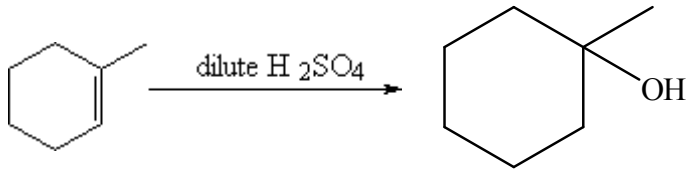
A **$Cr_2O_7^{2-}$ / H^+**	**D** **$SOCl_2$**
B 	**E** 
C 	**F** 

Marks 5

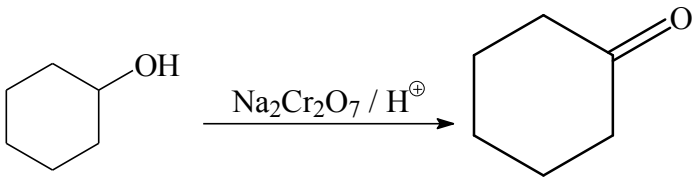
- Give the name of the starting material where indicated and the constitutional formula of the major organic product formed in each of the following reactions.



Name: 1-methylcyclohex-1-ene



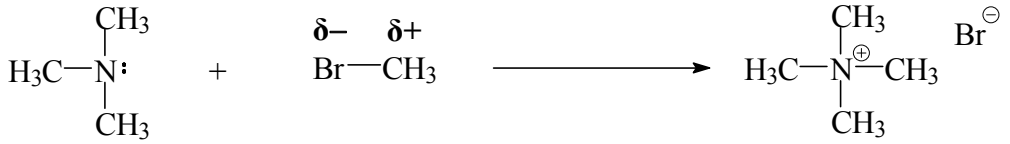
Markovnikov addition - H becomes attached to carbon with fewer alkyl groups attached.



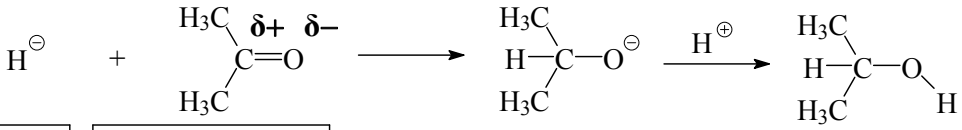
Name: cyclohexanol

Marks

- Classify the starting materials of the following reactions as nucleophile or electrophile and indicate with δ⊕ and δ⊖ the polarisation of the C–Br and C=O bonds. **4**

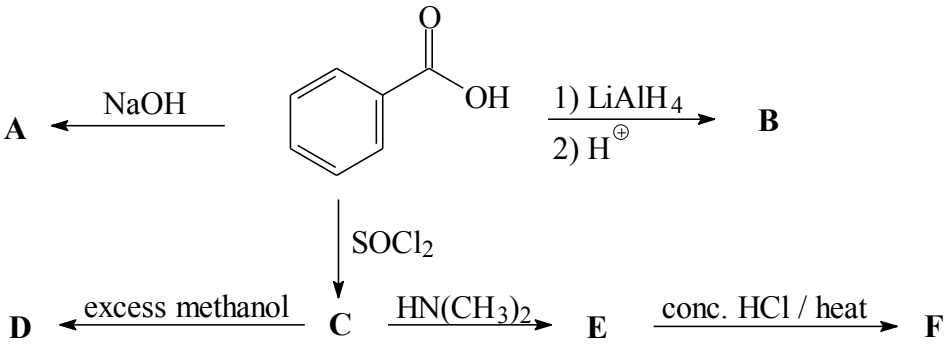


nucleophile **electrophile**



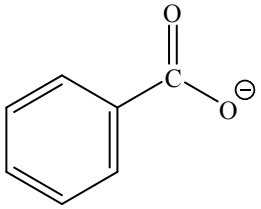
nucleophile **electrophile**

- Consider the following reaction sequence. **6**

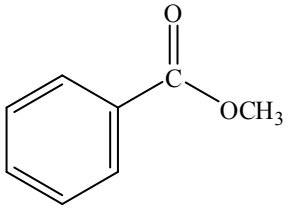


Draw the structures of the major organic products, **A-F**, formed in these reactions.

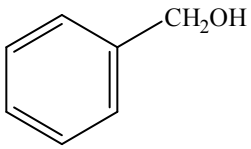
A



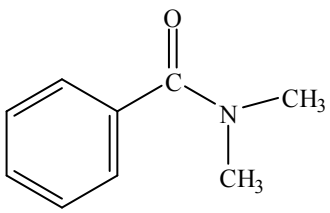
D



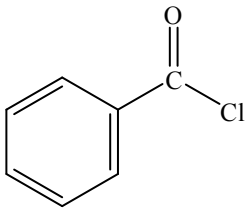
B



E



C



F