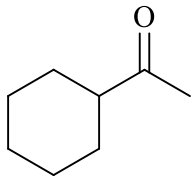
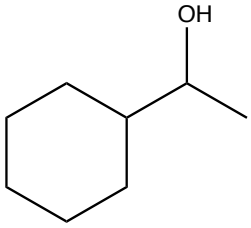
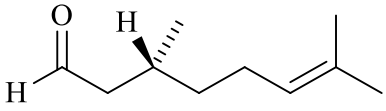
Marks 1

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

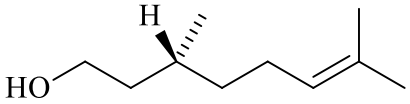
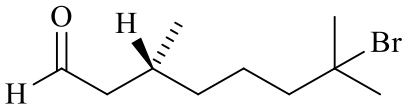
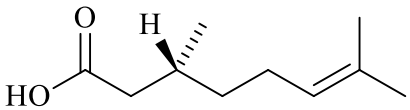
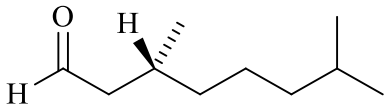
STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	1. $LiAlH_4$ 2. $H^{\oplus}$ / H_2O	

Marks 4

- The structure of (+)-citronellal, a widely occurring natural product, is shown below.

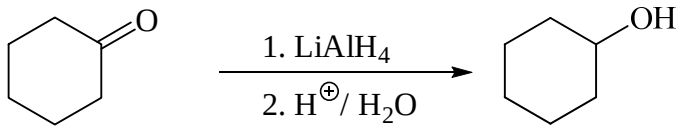


Give the constitutional formula of the organic product formed from (+)-citronellal in each of the following reactions.

Reagents / Conditions	Constitutional Formula of Product
1. $LiAlH_4$ in dry ether (solvent) 2. H^+ / H_2O	
HBr in CCl_4 (solvent)	
$Na_2Cr_2O_7$ in aqueous acid	
H_2 / Pd-C catalyst	

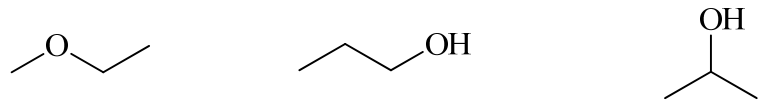
Marks
9

- 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".

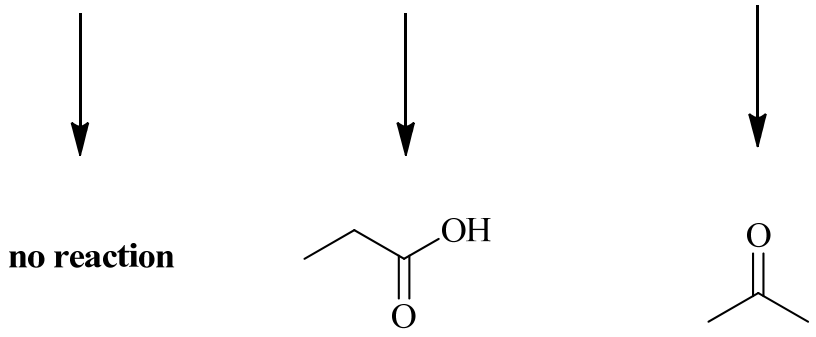


Marks 5

- Compound **X** is known to have the molecular formula C_3H_8O. Draw the constitutional formulas of the three possible isomers that could be compound **X**.



Compound **X** reacts with acidified potassium dichromate solution to give compound **Y**. Give the possible structure(s) of compound **Y**.



propionic acid (or propanoic acid)

acetone

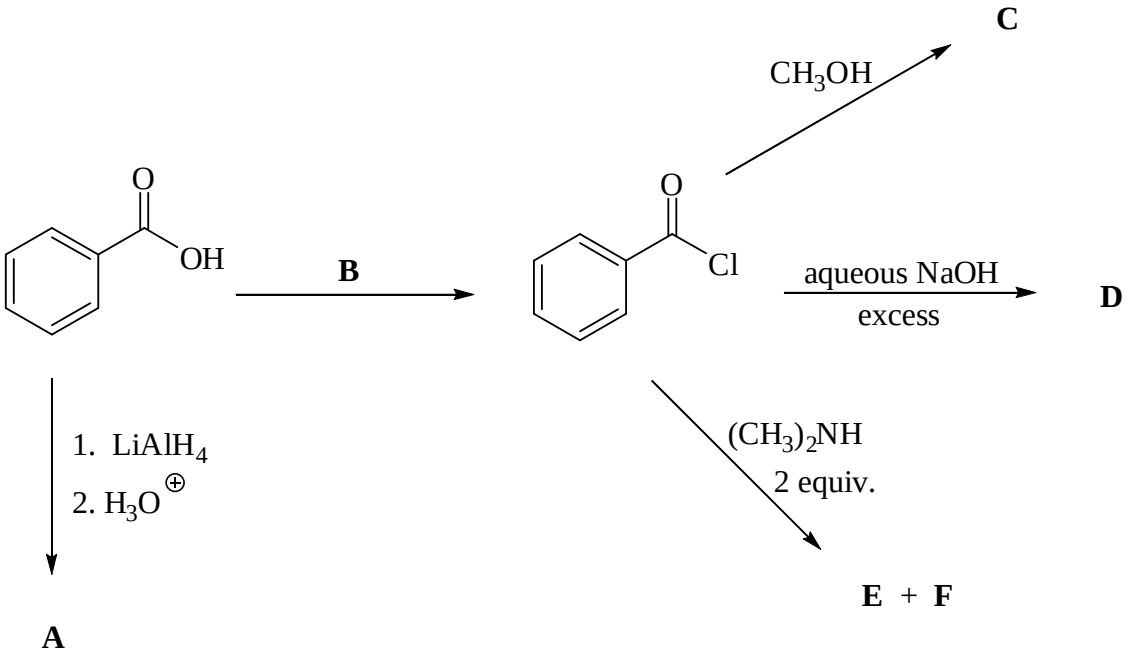
Describe a simple **chemical test** that could be used to identify compound **Y**. Give the reagent(s) used and any expected observation(s).

Propionic acid is an acid and acetone is not. Any reaction that detects the presence of an acid – such as simple addition of universal indicator – would be able to identify whether propionic acid or acetone is present.

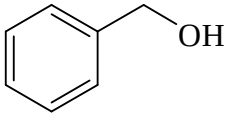
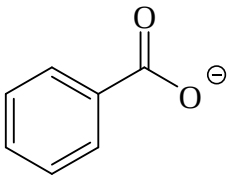
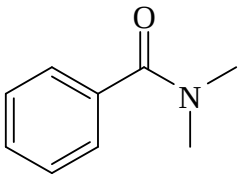
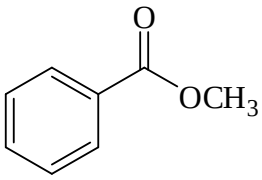
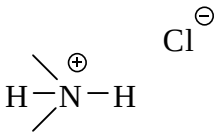
An alternative is addition of $NaHCO_3$(aq). The propionic acid will react to produce bubbles of CO_2. Acetone will not react.

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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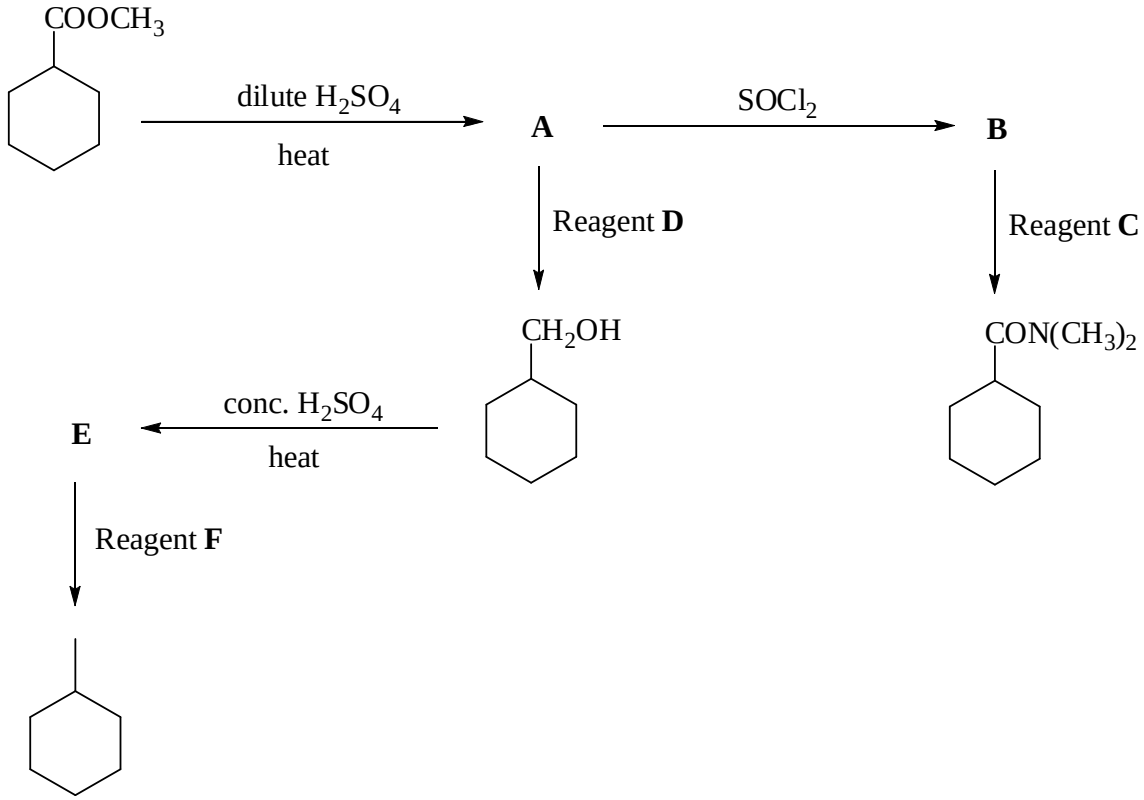
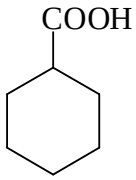
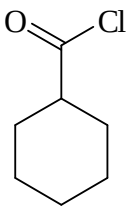
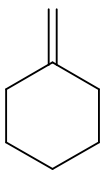
Marks 6

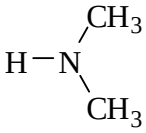
- Consider the following reaction sequence.



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

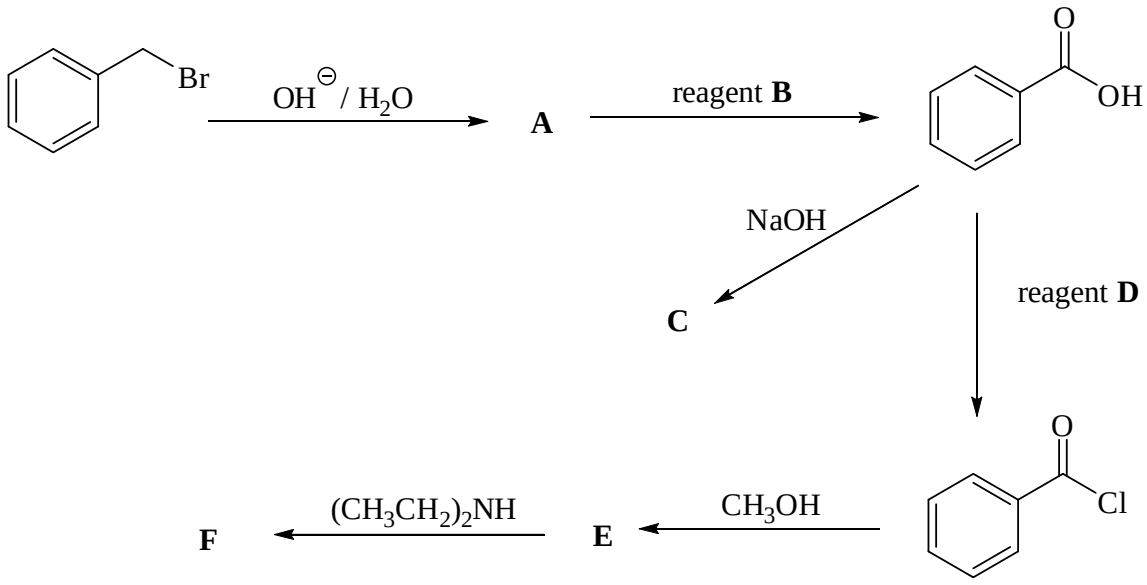
A  **(Hydrolysis of an ester to a carboxylic acid).**	**D** **(1). $LiAlH_4$ / dry ether** **(2). H^+ / H_2O** **(Reduction of carboxylic acid to primary alcohol).**
B  **(Formation of an acid chloride from a carboxylic acid).**	**E**  **(Acid catalysed elimination of H-OH ("dehydration") to form C=C).**

ANSWER CONTINUES ON THE NEXT PAGE

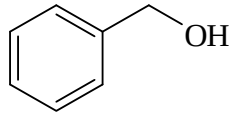
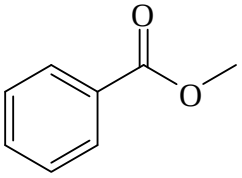
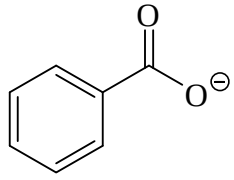
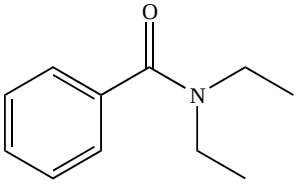
C	**F**
 **(Formation of amide from acid chloride).**	**H_2 / Pd/C** **(Reduction of alkene to alkane).**

Marks 6

- Consider the following reaction sequence.

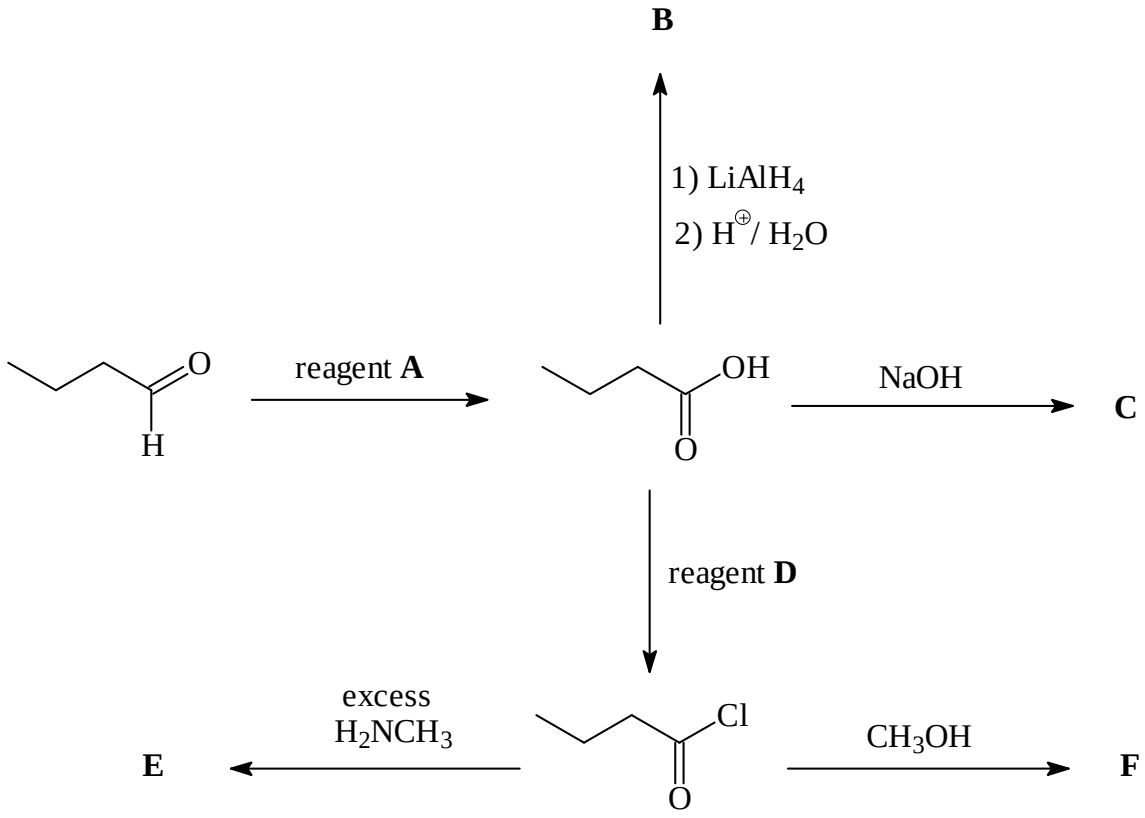


Give the reagents **B** and **D** and draw the structures of the major organic products, **A**, **C**, **E** and **F**, formed in these reactions.

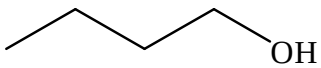
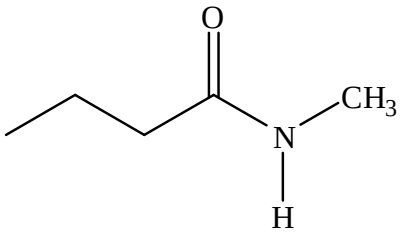
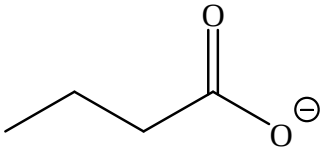
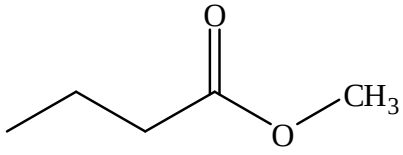
A 	**D** **$SOCl_2$ / heat**
B **$Cr_2O_7^{2-}$ / H^+**	**E** 
C 	**F**  CH_3OH

Marks 6

- Consider the following reaction sequence.

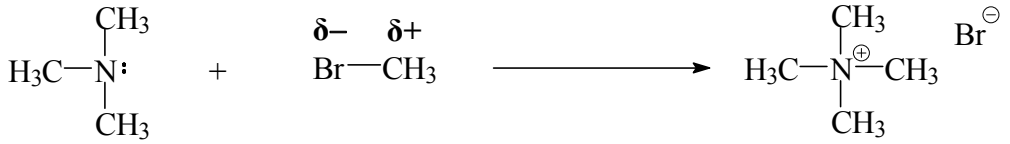


Give the reagents **A** and **D** and draw the structures of the major organic products, **B**, **C**, **E** and **F**, formed in these reactions.

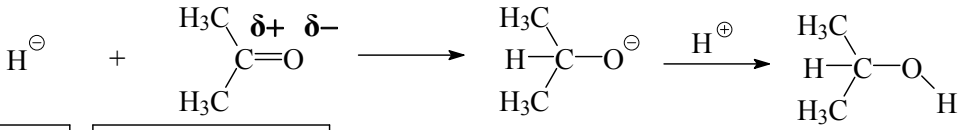
A **$Cr_2O_7^{2-}$ / H^+**	**D** **$SOCl_2$**
B 	**E** 
C 	**F** 

Marks

- 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**

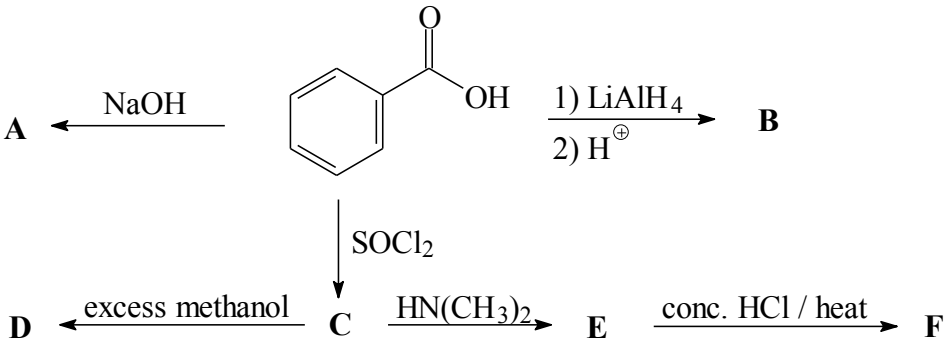


nucleophile **electrophile**



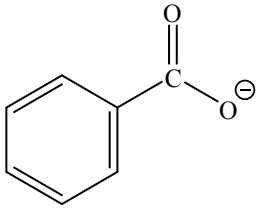
nucleophile **electrophile**

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

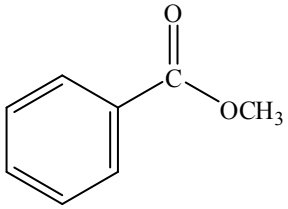


Draw the structures of the major organic products, **A-F**, formed in these reactions.

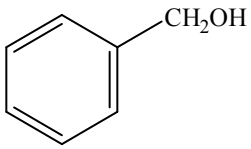
A



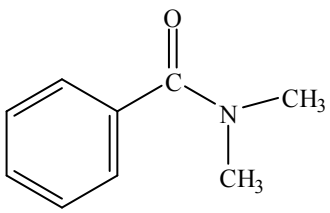
D



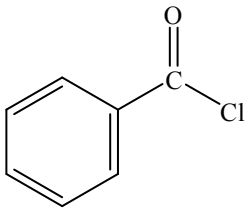
B



E



C



F