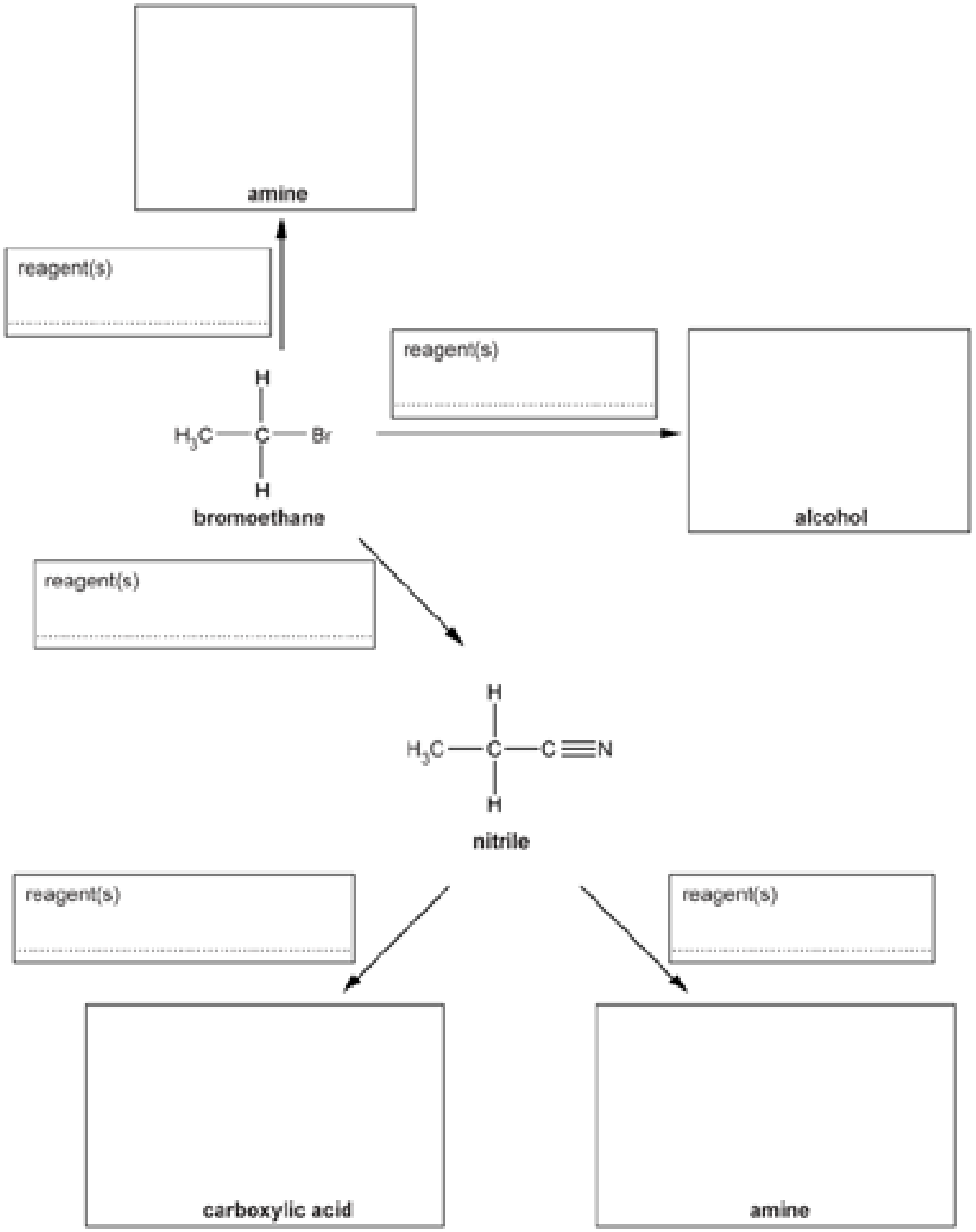
1. Complete the flowchart by filling in each box.



[9]

2. Ethylbenzene, $C_6H_5CH_2CH_3$, can be prepared by reacting benzene with chloroethane, CH_3CH_2Cl, in the presence of $AlCl_3$. The $AlCl_3$ acts as a halogen carrier.

Ethylbenzene

Ethylbenzene

In the mechanism, chloroethane reacts with the halogen carrier to form a carbocation, which acts as the electrophile.

i. What is meant by the term **electrophile**?

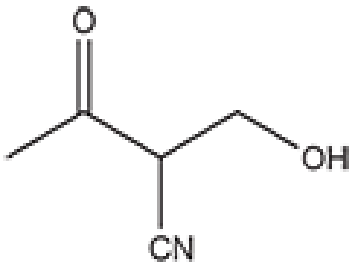
---

[1]

ii. Outline the mechanism for this reaction, including the role of $AlCl_3$ as a halogen carrier.

[5]

3. A chemist is investigating compound **A**, shown below, as a potential organic intermediate.



Compound A

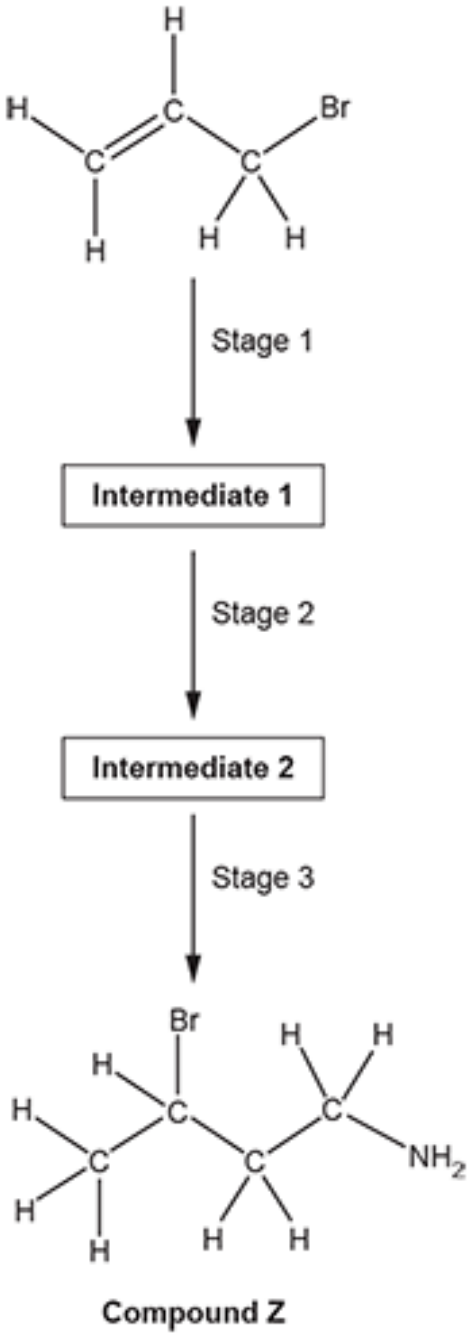
Describe the type of stereoisomerism shown by compound **A** and suggest three reactions of compound **A**, one for each of the **three** functional groups using reagents of your choice.

In your answer, show stereoisomers of compound **A**, your chosen reactants and conditions, and the structures for the organic products produced.

Mechanisms and equations are **not** required.

[6]

4. A student intends to synthesise compound **Z**, as shown in the flowchart below.



Compound Z

Plan this synthesis showing reagents, the structures of **intermediate 1** and **intermediate 2**, and equations.

[6]

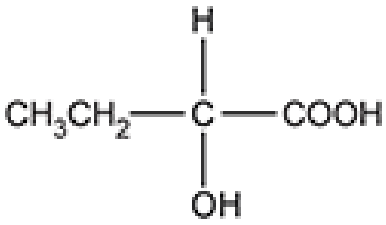
5. Which compound(s) is/are hydrolysed by HC*l* (aq) to produce butanoic acid?

1 $CH_3CH_2CH_2COOCH_3$
2 $CH_3CH_2CH_2CH_2CN$
3 $CH_3CH_2CH_2CH_2Cl$
A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐ **[1]**

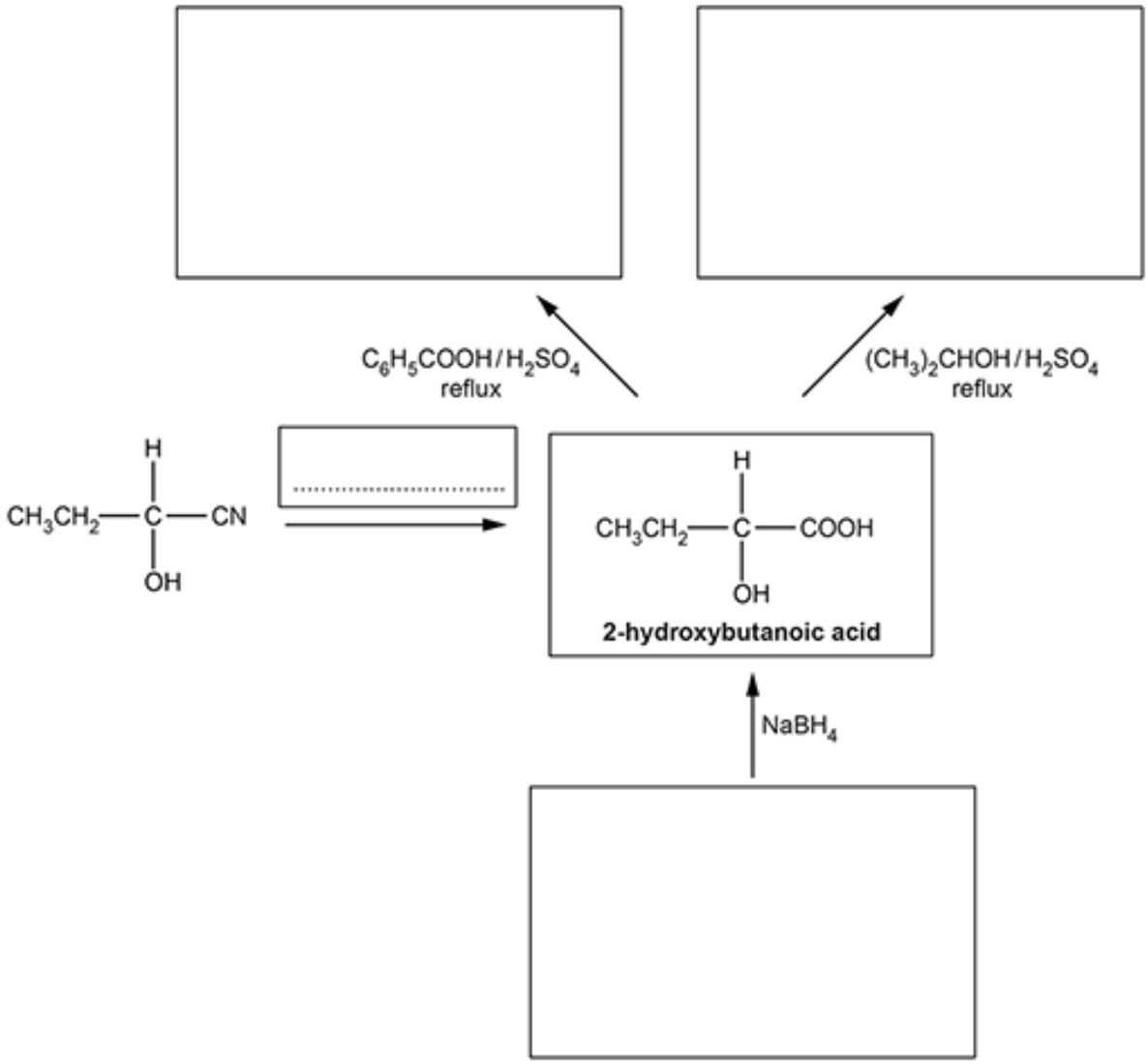
6. This question is about compounds that contain the carboxylic acid functional group.

The structure of 2-hydroxybutanoic acid is shown below.



2-hydroxybutanoic acid

Fill in the flowchart for reactions involving 2-hydroxybutanoic acid.



[4]

7. * Carbon-carbon bond formation is used in synthesis to increase the length of a carbon chain.

Describe the formation of carbon−carbon bonds in aliphatic compounds by **two** different mechanisms.

Your answer should include mechanisms for each aliphatic compound.

Additional answer space if required.

[6]

END OF QUESTION PAPER