**1.** This question is about the analysis of organic compounds.

Compounds **F, G, H** and **I** are structural isomers.

A student carries out test-tube tests on the compounds.
The student records the observations after carrying out each test.
These are shown in **Table 5.1**.

In **Table 5.1**, 2,4-dintrophenylhydrazine has been abbreviated to 2,4−DNP.

**Table 5.1**

| Compound | Test | | | |
|---|---|---|---|---|
| | **2,4-DNP** | **Acidified dichromate(VI) reflux** | **Bromine water** | **Tollens' reagent** |
| **F** | Orange solution | Green solution | Colourless solution | Colourless solution |
| **G** | Orange solution | Green solution | Orange solution | Colourless solution |
| **H** | Orange precipitate | Orange solution | Orange solution | Colourless solution |
| **I** | Orange precipitate | Green solution | Orange solution | Silver mirror |

i. Write the formula of the species causing the colours after refluxing with acidified dichromate(VI).

Green solution _____

Orange solution _____ **[2]**

ii. The student is provided with further information about compounds **F−I**.

- They all have the molecular formula $C_5H_{10}O$.
- One of the compounds is alicyclic.
- The other compounds are unbranched.

Use this further information and the student's observations in **Table 5.1** to answer the following.

- How do the observations provide evidence for the possible functional groups in compounds **F−I**?
- Suggest a possible structure for each of the compounds **F−I**.

Show your reasoning.

_____

_____

_____

_____

Extra answer space if required.

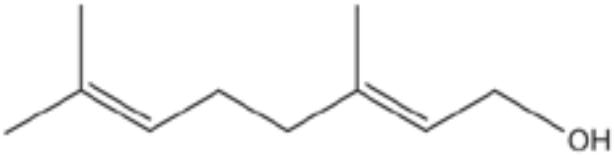
**[6]**

**2.** Alkenes and carbonyl compounds take part in addition reactions.

Describe **one** addition reaction of an alkene and **one** addition reaction of a carbonyl compound.
Include reagents and reaction mechanisms.

[6]

**3.** Geraniol, shown below, is a component in many natural oils.



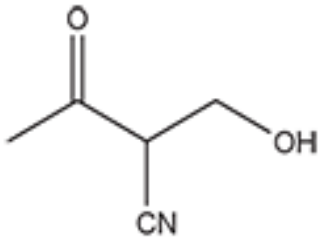

**Geraniol**

Which pair of reagents identifies both functional groups in geraniol?

**A** Acidified dichromate(VI) and 2,4-dinitrophenylhydrazine.
**B** Bromine water and 2,4-dinitrophenylhydrazine.
**C** Bromine water and acidified dichromate(VI).
**D** Tollens' reagent and aqueous silver nitrate in ethanol.

Your answer ☐ **[1]**

**4.** 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]**

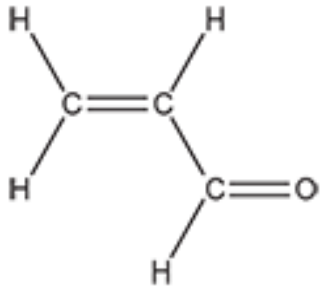
**5(a).** This question is about reactions of acrolein, $H_2C=CHCHO$.

Acrolein reacts with sodium cyanide in acidic conditions, NaCN(aq) / $H^+$(aq).

i. Outline the reaction mechanism for this reaction, showing the intermediate and the organic product.

The structure of acrolein has been provided.

Include curly arrows and relevant dipoles.



**[4]**

ii. Name this type of mechanism.

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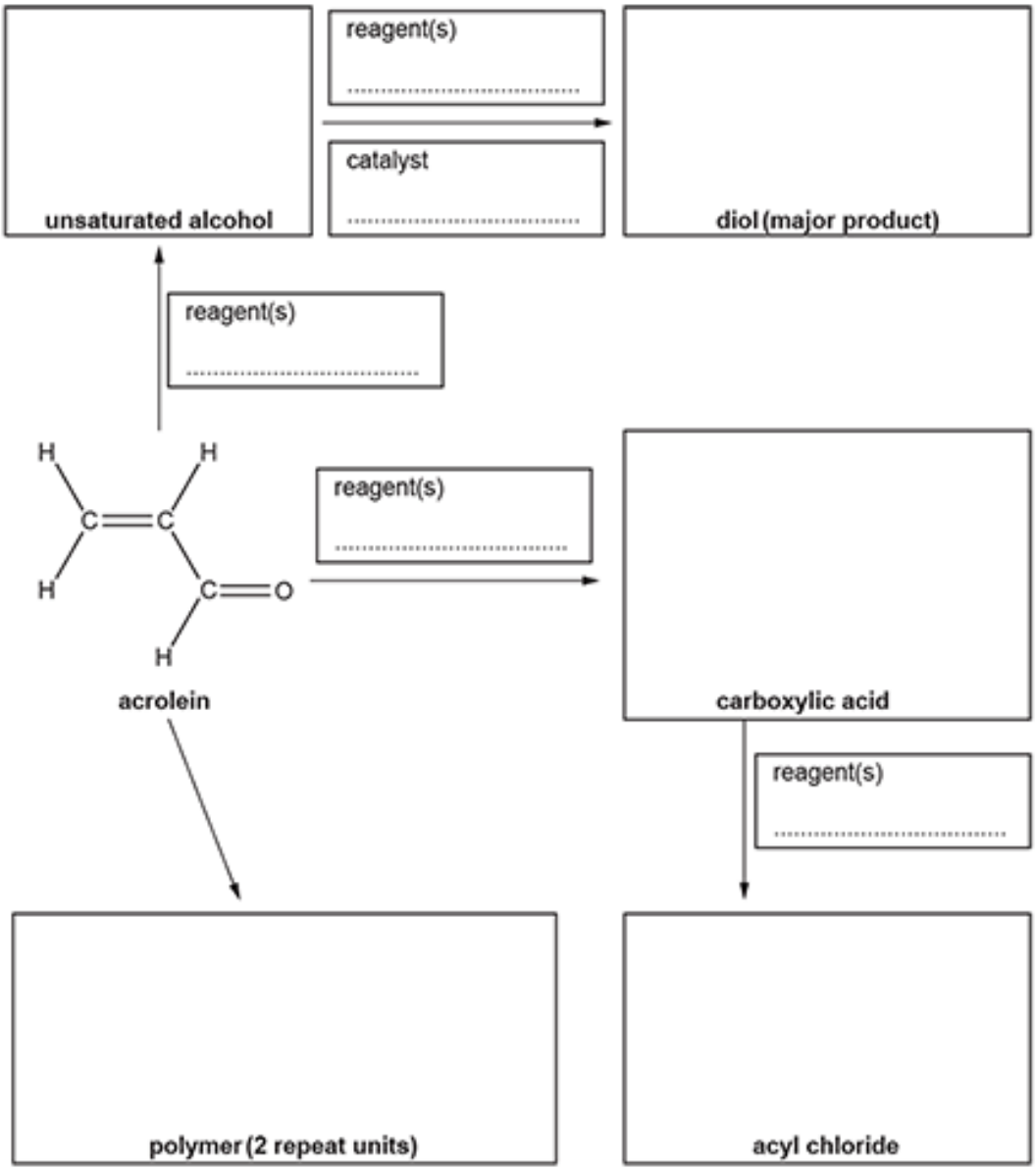
**[1]**

**(b).** Complete the flowchart by filling in each box.




**[9]**

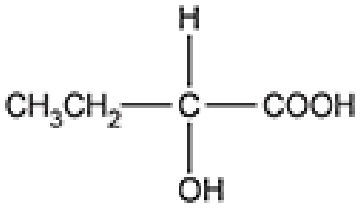
**6.** Which compound reacts with 2,4-dinitrophenylhydrazine but does **not** react with Tollens' reagent?

**A** $C_6H_5COCOOH$
**B** $C_6H_5CH(OH)CHO$
**C** $CH_3COCHO$
**D** $CH_3CH_2CH(OH)CH_3$

Your answer ☐ **[1]**

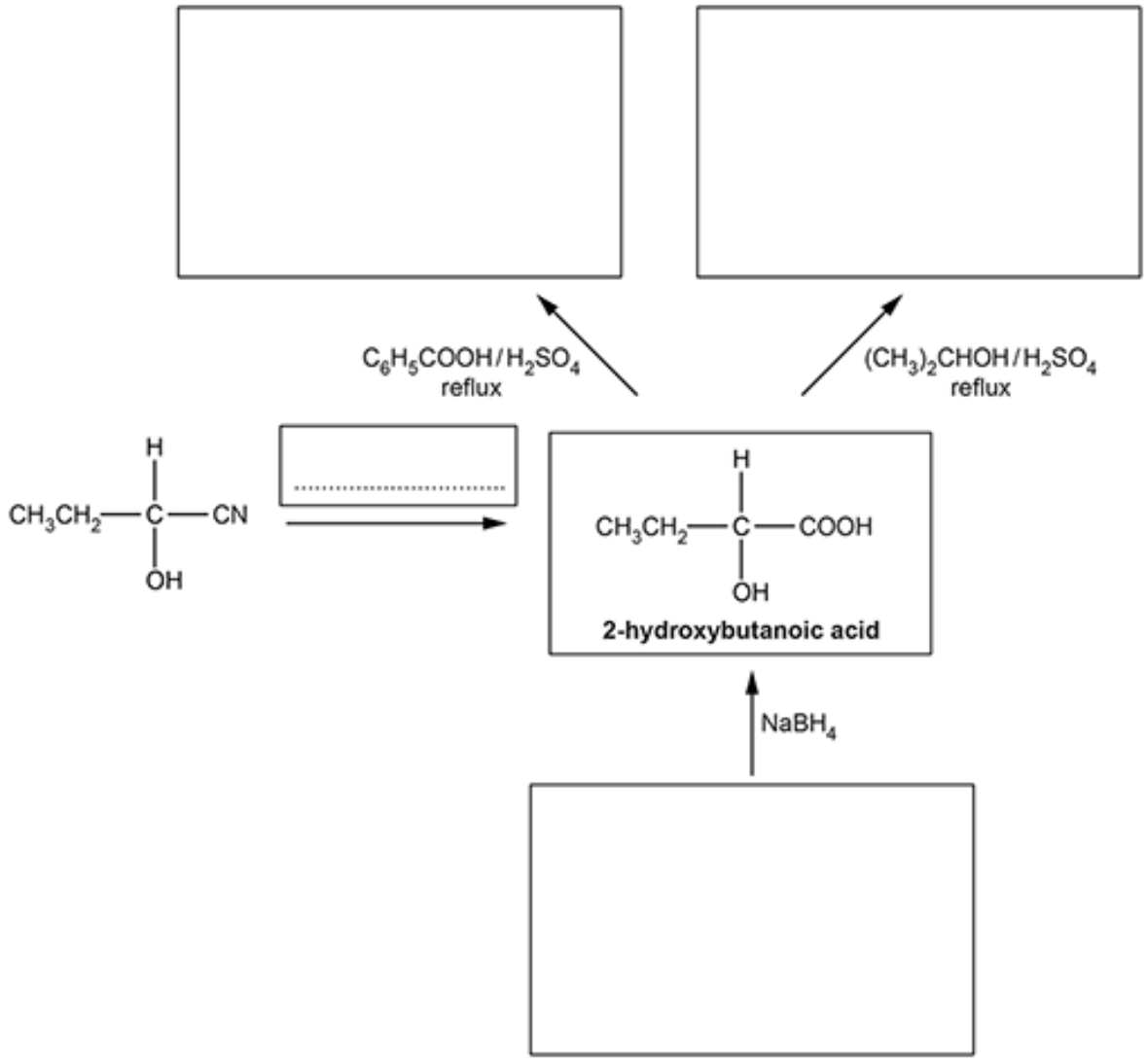
**7.** This question is about compounds that contain the carboxylic acid functional group.

The structure of 2-hydroxybutanoic acid is shown below.



**2-hydroxybutanoic acid**

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




**[4]**

**8. *** 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]**

**9.** This question is about carbonyl compounds.

i. Describe a chemical test to confirm the presence of a carbonyl group.

How could the product of this test be used to identify the carbonyl compound?

Your answer should **not** include spectroscopy.

**[3]**

ii. Describe a chemical test that would identify whether a carbonyl compound is an aldehyde.

Your answer **should** include the reagent and observations.

**[1]**

**END OF QUESTION PAPER**