

1. The functional group in an organic compound, **W**, was identified by carrying out two chemical tests. The results of the tests are shown below.

Heating with acidified sodium dichromate(VI)(aq)	Addition of 2,4-dinitrophenylhydrazine(aq)
orange solution turns green	yellow/orange precipitate formed

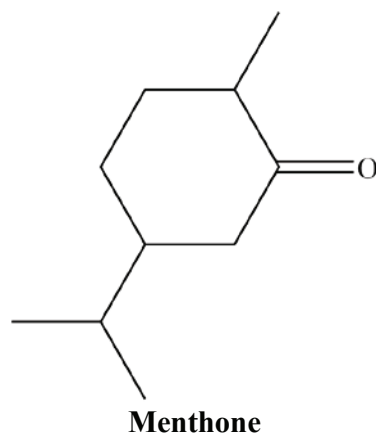
Which compound could be **W**?

- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
B CH_3COCH_3
C $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
D $\text{CH}_3\text{CH}_2\text{CHO}$

Your answer

[1]

2. Carbonyl compounds have distinctive smells.
Menthone smells of peppermint.



Menthone is reacted in a two-step synthesis shown below.

Step 1: A sample of menthone is added to hot acidified aqueous dichromate(VI) ions.

Step 2: The resulting mixture from **Step 1** is added to NaBH_4 in water.

What happens to the smell of the reaction mixture during the process?

	Step 1	Step 2
A	Smell of peppermint remains	Smell of peppermint is lost
B	Smell of peppermint is lost	Smell of peppermint returns
C	Smell of peppermint remains	Smell of peppermint remains
D	Smell of peppermint is lost	Smell of peppermint does not return

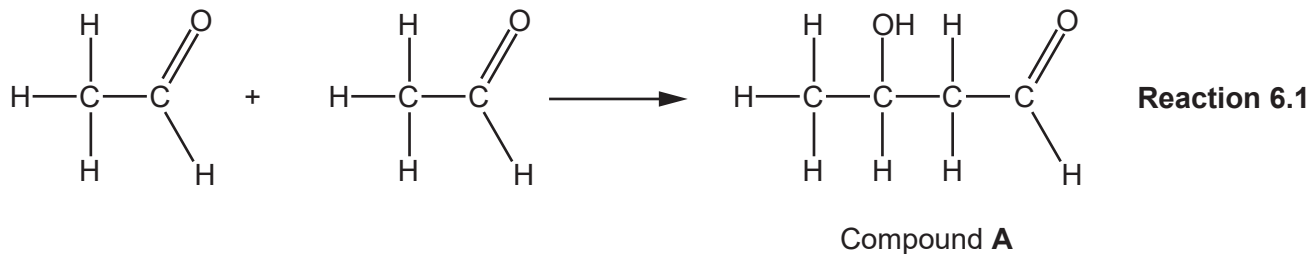
Your answer

[1]

3. This question is about organic reactions.

(a) Compound **A** is formed when ethanal is mixed with OH^- (aq) ions, which act as a catalyst.

The balanced equation is shown in **reaction 6.1** below.



(i) Give the systematic name for compound **A**.

..... [1]

(ii) What type of reaction has taken place?

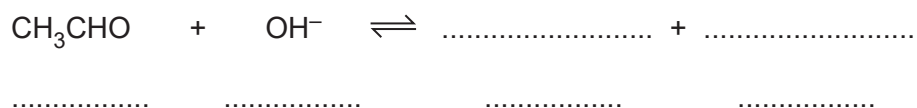
..... [1]

(iii) **Reaction 6.1** takes place in two steps. OH^- ions act as a catalyst.

In **step 1**, ethanal reacts with OH^- ions to set up an acid–base equilibrium.

In **step 2**, compound **A** is formed.

- Complete the equilibrium for **step 1** and label the conjugate acid–base pairs as: **A1**, **B1** and **A2**, **B2**.



- Suggest the equation for **step 2**.

[3]

(iv) A similar reaction takes place when propanone, $(\text{CH}_3)_2\text{CO}$, is mixed with OH^- (aq) ions.

Draw the structure of the organic product of this reaction.

[1]

4. A carbonyl compound is reacted with NaBH_4 .

Which compound(s) could be formed?

- 1 2-Methylpentan-2-ol
- 2 2-Methylpentan-1-ol
- 3 3-Methylpentan-2-ol

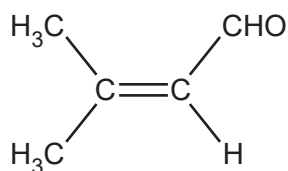
- A** 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer

[1]

5. This question is about unsaturated aldehydes and alcohols.

(a) 3-Methylbut-2-enal, shown below, is used as a food flavouring.



3-methylbut-2-enal

3-Methylbut-2-enal is reacted with hydrogen bromide, forming a mixture of two organic products.

One of the organic products forms in a much greater quantity than the other organic product.

(i) Outline the reaction mechanism for the formation of **one** of the organic products.

Include curly arrows and relevant dipoles.

[4]

(ii) Explain why one of the organic products forms in a much greater quantity than the other organic product.

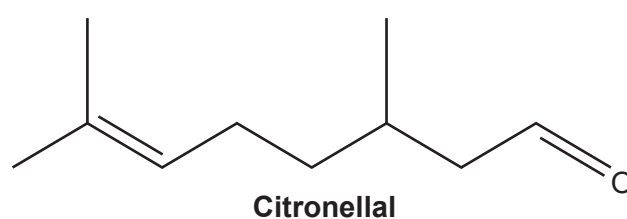
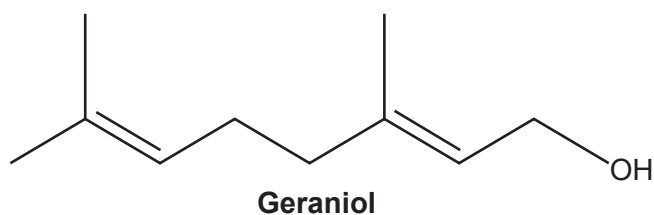
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..... [2]

- (b) Geraniol and citronellal, shown below, are isomers present in 'citronella oil', used as an insect repellent.



- Geraniol and citronellal are structural isomers of each other.
- They also show stereoisomerism.

- (i) Describe how the observations from a chemical test would distinguish between geraniol and citronellal.

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..... [2]

- (ii) What is the molecular formula of geraniol?

..... [1]

- (iii) Explain why geraniol and citronellal are structural isomers of each other.

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..... [1]

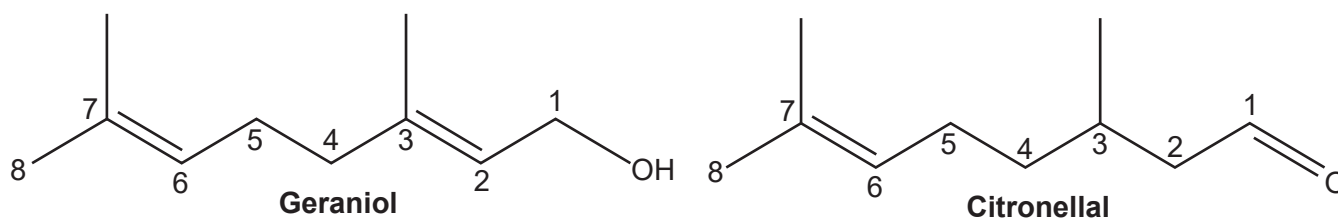
- (iv) Explain the term **stereoisomerism**.

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..... [1]

- (v) The structures of geraniol and citronellal are repeated below with the carbon atoms numbered.



Explain the types of stereoisomerism shown by geraniol and citronellal.

In your answer,

- refer to the numbered carbon atoms in the structures above
- draw diagrams clearly showing any stereoisomers.

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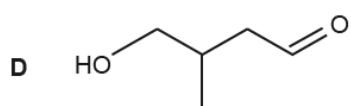
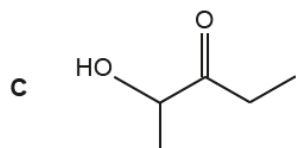
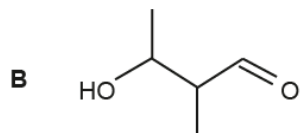
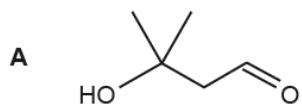
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Geraniol stereoisomers

Citronellal stereoisomers

[4]

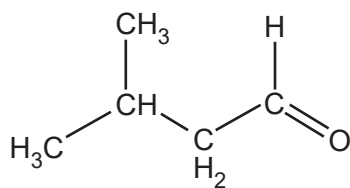
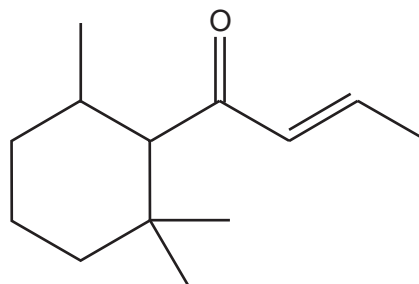
6. Which compound can be refluxed with acidified potassium dichromate(VI) to form an organic product with molecular formula $C_5H_8O_2$?



Your answer

[1]

7. The carbonyl compounds, **F** and **G**, shown below, contribute to the flavour of coffee.

**F****G**

(a) Compound **F** is a member of a homologous series.

(i) Explain the term homologous series.

.....

 [2]

(ii) Predict the molecular formula for the member of this homologous series containing 24 carbon atoms.

..... [1]

(b) Describe suitable chemical tests, with observations, that would confirm the presence of the functional groups in **F** and **G**.

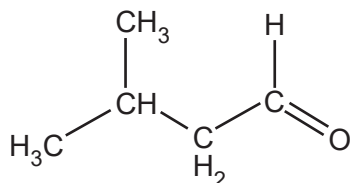
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 [4]

(c) Compound **F** reacts with HCN using NaCN(aq) and H⁺(aq).

(i) Outline the mechanism for the reaction of **F** with NaCN(aq) and H⁺(aq) and state the name of the mechanism. The structure of **F** has been provided.

Include relevant dipoles, lone pairs and the structure of the organic product.



Name of mechanism: [5]

(ii) Explain why the mechanism in (c)(i) involves heterolytic fission.

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 [2]