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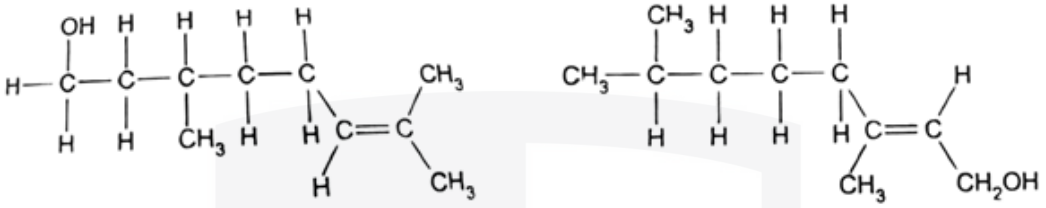
CHEMISTRY
ORGANIC CHEMISTRY

Level & Board	CIE (A-LEVEL)
TOPIC:	INTRODUCTORY TOPICS
PAPER TYPE:	QUESTION PAPER - 1
TOTAL QUESTIONS	04
TOTAL MARKS	29

Introductory topics - 1

1)

Some perfumes and scents of flowers and fruit contain compounds which are structural isomers. Two such examples are citronellol and geraniol.



citronellol geraniol

(a) Confirm that citronellol and geraniol are isomers by calculating their molecular formula and their relative molecular mass, M_r.

(i) Molecular formula,

(ii) M_r. **[2]**

(b) Name two functional groups present in both molecules. **[3]**

Citronellol and geraniol also show stereo isomerism.

(c) On the diagram of the structure of citronellol above, draw a circle around a chiral carbon atom. **[1]**

(d) (i) Draw the other *cis-trans* isomer of geraniol. [in parts (d) and (f) use R – to represent a part of the molecule]

(ii) Explain why geraniol has no optical isomers. **[2]**

(e) State what you would expect to see if citronellol was reacted with aqueous bromine. **[1]**

2)

(a) Use the concept of activation energy, together with an appropriate sketch of the Boltzmann distribution, to explain why the addition of a suitable catalyst speeds up a chemical reaction. **[4]**

(d) Use appropriate bond energy values from the Data Booklet to suggest which of the following three reactions has the lowest activation energy and which has the highest activation energy. Explain your reasoning.

$$CH_4 \longrightarrow {}^{\cdot}CH_3 + H^{\cdot} \qquad \textbf{I}$$

$${}^{\cdot}CH_3 + Cl^{\cdot} \longrightarrow CH_3Cl \qquad \textbf{II}$$

$$Cl_2 \longrightarrow 2Cl^{\cdot} \qquad \textbf{III}$$

[3]

(c) The decomposition of solutions of hydrogen peroxide is catalyzed by certain transition element ions.

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

The relevant half - equations are

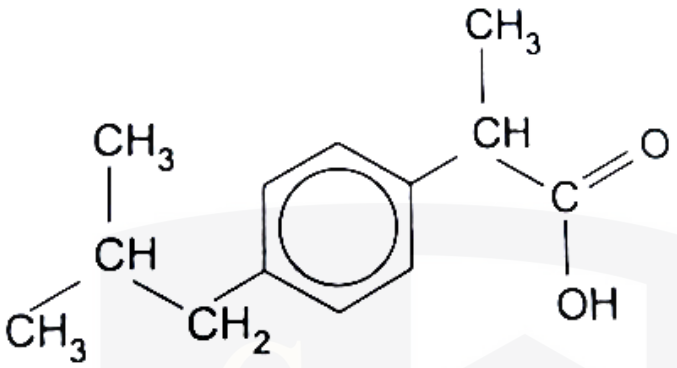
$$H_2O_2 \longrightarrow O_2 + 2H^- + 2e^-$$

$$H_2O_2 + 2H^+ + 2e^- \longrightarrow 2H_2O$$

Referring to relevant $E^{\ominus}$ data from the Data Booklet, suggest a mechanism for the catalyst of this reaction by Fe^{2+} ions. **[3]**

3)

Ibuprofen is one of the most commonly used non – steroidal ant – inflammatory drugs, used to treat chronic arthritic pain cased by inflammation of the joints.



Ibuprofen

(a) (i) Draw a circle around any chiral centre(s) in the above structure.

(ii) Write down the molecular formula of ibuprofen.

(iii) Calculate the Mr of ibuprofen and use it to calculate how many grams are needed to make 100cm^3 of a 0.15mol dm^{-3} solution.

4)

An organic ester, **B**, has the empirical formula C_2H_4O. an experiment by a student in a college gave a value of 87.5 for M_r of **B**.

(a) What is the molecular formula of **B**? **[1]**

(b) In the boxes below, draw the structural formulae of four isomers of **B** that are esters.

W	X
Y	Z

[4]

The student hydrolysed his sample of **B** by heating with aqueous mineral acid and then separating the alcohol, **C**, that was formed. He heated the alcohol **C** under reflux with acidified dichromate(VI) ions and collected the product **D**.

A sample of **D** gave an orange precipitate with 2,4 dinitrophenythydrazine reagent

A second sample of **D** gave no reaction with Tollens' reagent.

(c) (i) What group does the reaction with 2,4 – dinitrophenylhydrazine reagent show to be present in **D**?

(ii) What does the result of the test with Tollens' reagent show about **D**?

(iii) What is the structural formula of the alcohol **C**?

(iv) Which of your esters, **W**, **X**, **Y**, or **Z** has the same structure as that of the ester **B**? **[4]**

(d) Which, if any of your esters, **W**, **X**, **Y**, or **Z** is chiral? Explain your answer.

[1]

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