CHEMISTRY

Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions provided on the Question Paper.
The use of an approved scientific calculator is expected, where appropriate.

The number of marks is given in brackets [ ] at the end of each question, or part question.

This document consists a total of **9** printed pages.

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1 **(a)** It is observed that there were many products formed when liquid bromine was added to 2,3-dimethylpentane in the presence of sunlight.

(i) Describe the mechanism where 2-bromo-3,4-dimethylpentane was formed. [4]

(ii) State the number of different monosubstituted 5-carbon products that can be formed from 1 stereoisomer of 2,3-dimethylpentane, including stereoisomers. [2]

(iii) State the expected ratio of products formed, assuming that the reactivity for all hydrogen atoms is the same. [2]

(iv) Explain why the reactivity of all hydrogen atoms in 2,3-dimethylpentane, in reality, is **not** the same. [1]

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(b) 2-bromo-3,4-dimethylpentane can also be formed from an appropriate alkene under suitable reaction conditions.

(i) Draw the structure of all alkenes, including stereoisomers, such that when reacted with HBr, will form 2-bromo-3,4-dimethylpentane. [2]

(ii) Describe the mechanism of the reaction where one of your structures in **(i)** leads to 2-bromo-3,4-dimethylpentane being formed. [3]

(iii) Explain why this reaction can be conducted in the absence of sunlight, while the reaction in **(a)** must be conducted under sunlight. [2]

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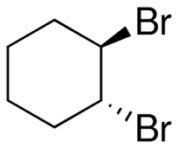
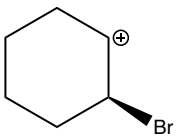
(c) When cyclohexene is reacted with Br_2, only 1 product, **A**, is formed, shown below.



A

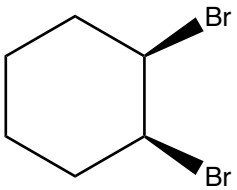
(i) Suggest why the proposed structure below **cannot** be the intermediate in the reaction. [1]



(ii) Suggest how it would have been possible to tell that

- there is only **1** product formed; and
- **A**, <u>not</u> **B**, is the product. [3]

You can assume that the product formed has the molecular formula $C_6H_8Br_2$.



B

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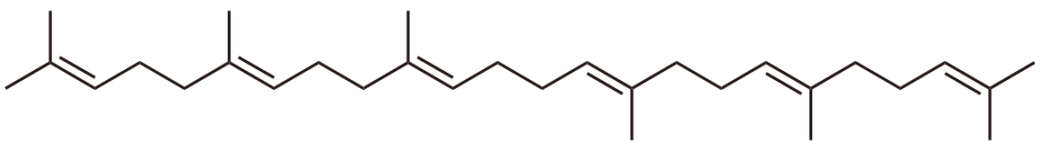
[Total: 20]

2 (a) Squalene is an unsaturated hydrocarbon found in shark liver oil.



Squalene

(i) Write a balanced chemical equation when squalene undergoes oxidative cleavage. State the reactants and conditions for oxidative cleavage. [3]

You may use [O] to represent the oxidising agent.

(ii) To determine the degree of unsaturation of squalene, a titration of squalene against an electrophilic reagent is conducted.

One such reagent is IC*l*.

Explain why IC*l* reacts faster with squalene compared to Cl_2. [1]

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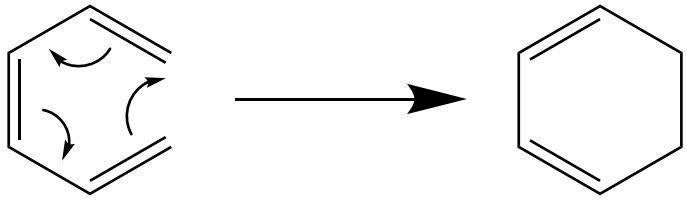
(b) A class of reactions that can occur between alkenes is the electrocyclic reaction.

A new ring is formed after a conjugated system of double bonds undergo an electrocyclic reaction.



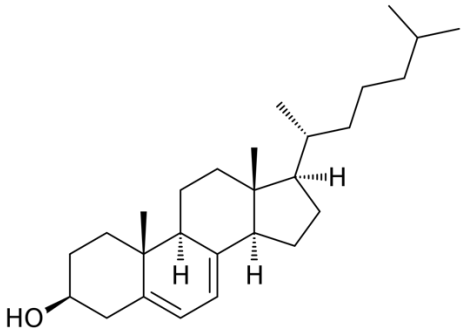
The above shows a 6-pi electron electrocyclic reaction.

In this part, you should ignore stereochemistry.

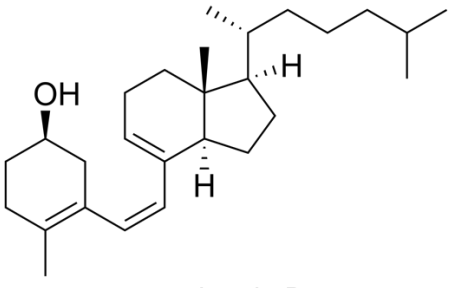
(i) Draw curly arrows to show how 2-methylbuta-1,3-diene forms a cyclobutene. [1]

(ii) Electrocyclic reactions are reversible.

Show how 7-dehydrocholestrol forms pre-vitamin D_3 via an electrocyclic reaction using curly arrows to represent electron movement. [1]

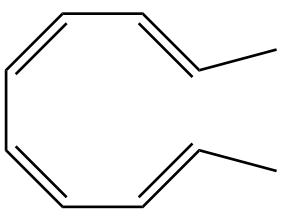


7-dehydrocholestrol

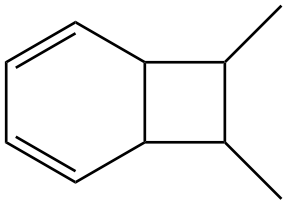


pre-vitamin D_3

(iii) **B** is formed from **A** through 2 electrocyclic reactions. Draw curly arrows, and the intermediate, to show how **B** is formed from **A**. [3]

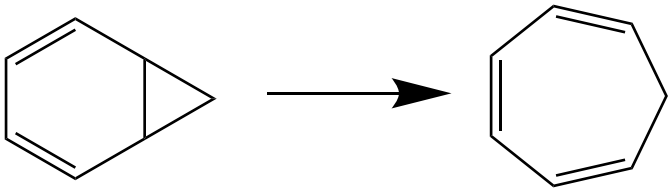


A



B

(iv) Suggest why this electrocyclic reaction takes place so readily, even at extremely low temperatures. [1]



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