

3 Alkenes Exercise

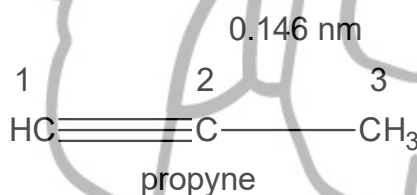
- 1 Draw the skeletal structures to show the isomers for alkenes of molecular formulae C_5H_{10} . Identify structures that can display cis-trans isomerism.
- 2 When 0.1 mol of a hydrocarbon **Y** reacts with hot acidified $KMnO_4$, 4.80 dm^3 of CO_2 is produced under room temperature and pressure.

What is the possible structural formula of **Y**?

- A $CH_3CH_2CH_2CH_3$.
- B $CH_3CH_2CH=CH_2$
- C $CH_2=CHCH_2CH_2CH=CHCH_3$
- D $CH_2=CHCH_2CH_2CH_2CH=CH_2$

- 3 The bond lengths in propyne differ from those which might be expected.

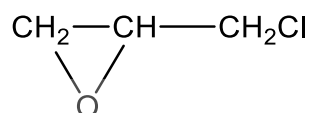
The carbon-carbon bond length in ethane is 0.154 nm and in ethyne is 0.120 nm . The single C2–C3 bond in propyne, however, is shorter than the single bond in ethane: it is 0.146 nm .



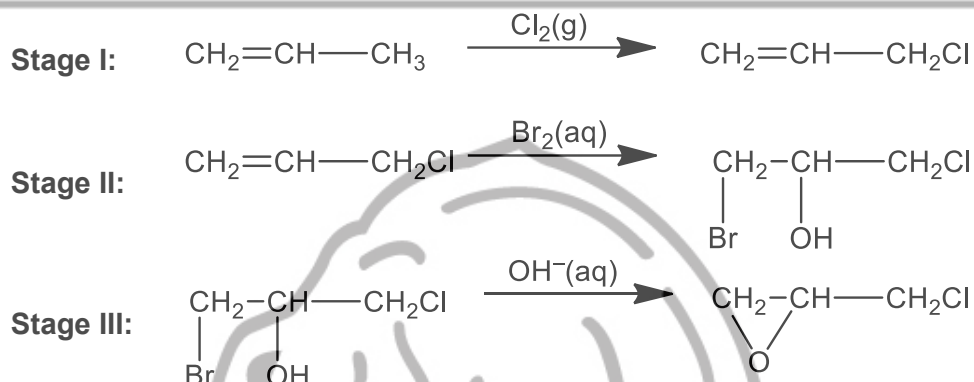
What helps to explain this C2–C3 bond length?

- A It has a partial sp^2-sp^2 character.
- B It is an $sp-sp^3$ overlap.
- C The sp^3-sp^3 bonding is pulled shorter by a p–p (π -bond) overlap.
- D The electrons in the C3 carbon atom are attracted the π -bonds towards between C1 and C2.

- 4 Epoxy resins are polymers which are used as adhesives. One monomer used in their manufacture has the following structure.

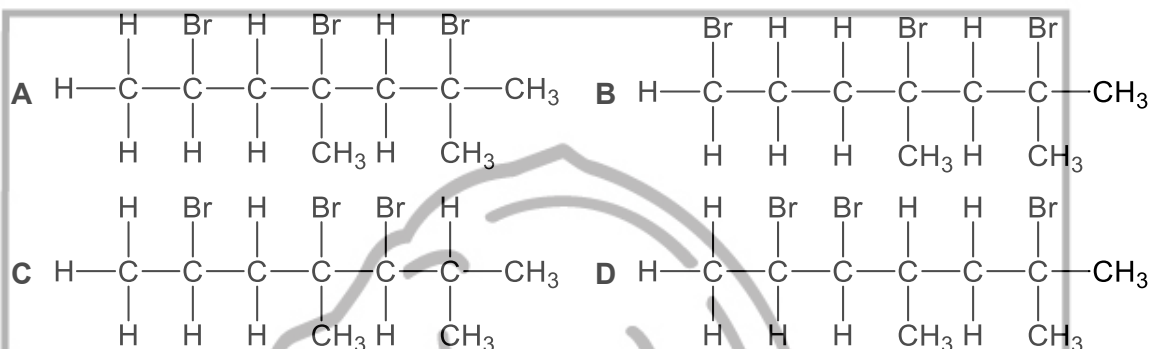
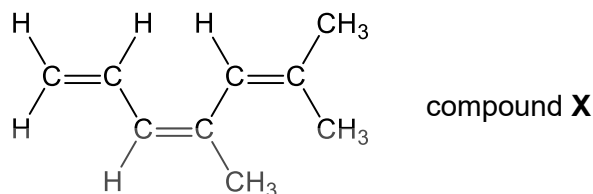


This is manufactured from propene in three stages:

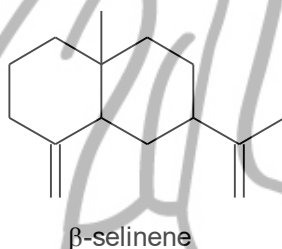


- (a) (i) What type of reaction has taken place between propene and chlorine gas in **Stage I**?
- (ii) Suggest what conditions are necessary for this reaction.
- (iii) Write out the mechanism for this reaction.
- (b) (i) What type of reaction has taken place between 3-chloroprop-1-ene and $\text{Br}_2(\text{aq})$ in **stage II**?
- (ii) Outline the mechanism for this reaction.

5 Which of the following is the major product formed when compound **X** reacts with HBr?



6 β -selinene can be isolated from plant material.



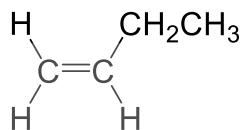
When β -selinene reacts completely with HBr, the product mixture contains different compounds, all with the same molecular formula.

Which row identifies the molecular formula of the products and the number of these products which are tertiary bromoalkanes?

	molecular formula of the products	number of products which are tertiary bromoalkanes
A	$\text{C}_{15}\text{H}_{24}\text{Br}_2$	2
B	$\text{C}_{15}\text{H}_{24}\text{Br}_2$	3
C	$\text{C}_{15}\text{H}_{26}\text{Br}_2$	2
D	$\text{C}_{15}\text{H}_{26}\text{Br}_2$	3

- 7 C_4H_8 can exist in 4 non-cyclic isomers forms, **W**, **X**, **Y** and **Z**.

W has the structure as shown:



W reacts with chlorine under two different conditions.

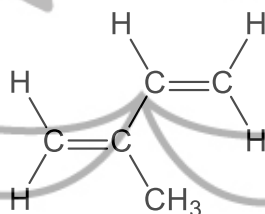
Reaction I:

In the absence of light, **W** reacts with Cl_2 dissolved in CCl_4 to give an equimolar mixture of two isomers **A** and **B**.

Reaction II:

W reacts with Cl_2 gas under ultraviolet light to give $\text{CH}_2=\text{CH}(\text{CH}_2\text{CH}_2\text{Cl})$. However, the presence of trace amount of nitrogen monoxide may decrease the rate of reaction.

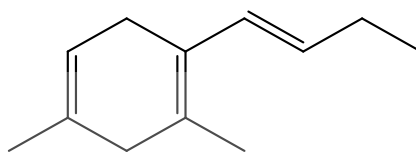
- (a) Draw the isomeric structures of **X**, **Y** and **Z** and identify the types of isomerism present.
- (b) Draw the displayed formulae of isomers **A** and **B** in reaction I.
- (c) Explain why the following step rarely occurs in reaction II.
- $$\text{CH}_2=\text{CH}(\text{CH}_2\text{CH}_3) + \text{Cl} \cdot \rightarrow \text{CH}_2=\text{CH}(\text{CH}_2\text{CH}_2\text{Cl}) + \text{H} \cdot$$
- (d) Suggest why the presence of nitrogen monoxide will slow down reaction II.
- 8 Give the structural formula of the product(s) formed when compound **X** reacts with each of the following reagents.



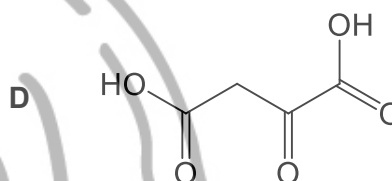
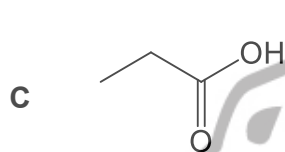
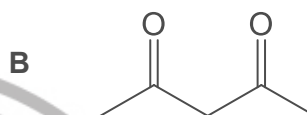
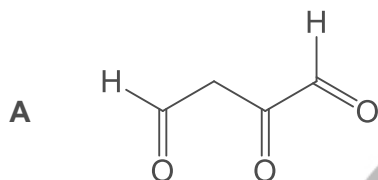
Compound **X**

- (a) Cold acidified KMnO_4
- (b) Hot alkaline KMnO_4
- (c) HBr at room temperature

- 9 Which of the following is **not** a product formed when compound Z reacts with hot acidified KMnO_4 ?

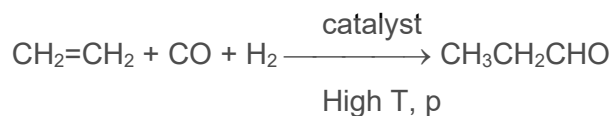


Compound Z



- 10(a) On complete combustion, 0.00754 mol of a hydrocarbon **E** gave 2.654g of CO_2 and 0.543 g of H_2O .
- Determine the molecular formula of **E**.
 - Construct an equation for the complete combustion of **E**.
- (b) **E** burns with a smoky flame. 1 mol of **E** reacts with 1 mol of bromine molecules. (Hint: a benzene ring exist)
- Draw a displayed formula of **E**.
 - Draw the displayed formula of the product formed between **E** and bromine.
- (c) (i) What organic product would you expect if **E** is heated under reflux with concentrated alkaline potassium manganate(VII)?
- Suggest what colour change might be observed.

- 11 The oxo reaction is an important industrial process in which an alkene combines directly with carbon monoxide and hydrogen under suitable conditions. The reaction with ethene is shown below:



Which of the following structural formulae correctly represents the product of the oxo reaction starting with but-2-ene?

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

