



Physics. *You work it out.*

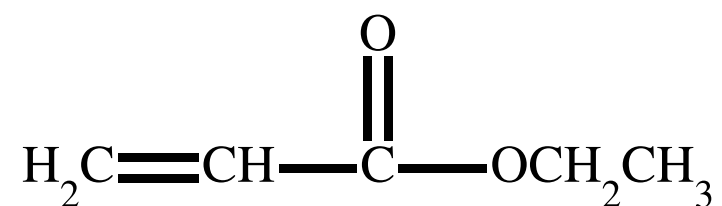
[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Organic Reactions](#) [Unsaturated Compounds](#)

Unsaturated Compounds

A Level


Part A Poly(acrylate)

The sticky substance of adhesive tape can be a poly(acrylate) made from an 'acrylic ester' such as that shown.



What is the structure of the poly(acrylate) made from this monomer?

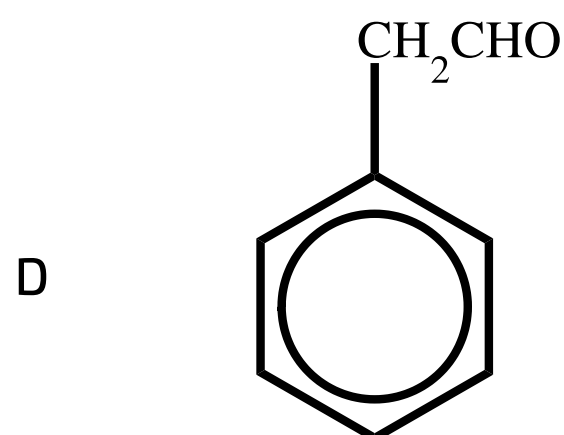
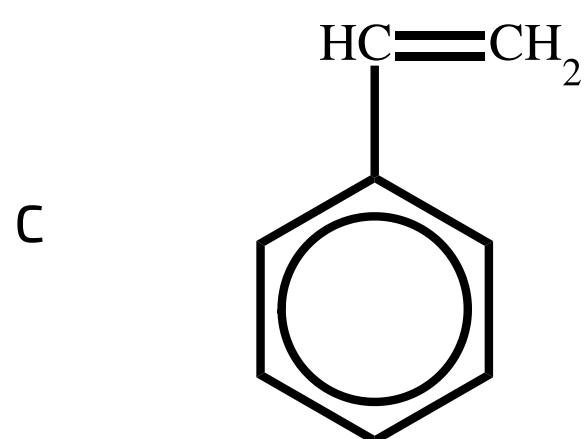
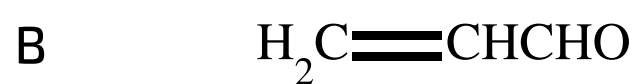
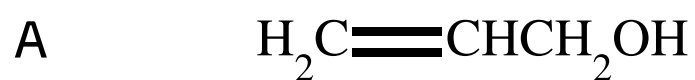
- A $\left[\text{CH}=\text{CH}-\overset{\overset{\text{O}}{\parallel}}{\text{C}} \right]_n$
- B $\left[\text{CH}=\text{CH}-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{O} \right]_n$
- C $\left[\text{CH}_2-\text{CH}=\underset{\underset{\text{OCH}_2\text{CH}_3}{|}}{\text{C}}-\text{O} \right]_n$
- D $\left[\text{CH}_2-\underset{\underset{\begin{array}{c} \text{C}-\text{OCH}_2\text{CH}_3 \\ \parallel \\ \text{O} \end{array}}{|}}{\text{CH}} \right]_n$

- ☐ A
- ☐ B
- ☐ C
- ☐ D

Part B **Smoke**

Smoke from a bonfire contains a compound that causes irritation to the eyes. This compound readily decolourises aqueous bromine and produces a precipitate of silver when bubbled into Tollens' reagent.

What is a possible structure of the compound?



-
- ☐ A
- ☐ B
- ☐ C
- ☐ D
-



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[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Isomerism](#) [Isomers of C₂H₂Cl₂](#)

Isomers of C₂H₂Cl₂



Part A Isomers of C₂H₂Cl₂

Give suitable diagrams showing the full structure of every isomer, of whatever type, with molecular formula C₂H₂Cl₂.

Draw the structures using the [structure editor](#) and give your answer as SMILES strings in the format "A, B etc." (space after comma).

Part B Type of isomerism

What types of isomerism are shown in this case?

- ☐ Stereoisomerism - Optical
- ☐ Structural Isomerism - Position
- ☐ Structural Isomerism - Functional
- ☐ Stereoisomerism - Geometric
- ☐ Structural Isomerism - Chain

Adapted with permission from OCSEB A Level Structured Science Scheme, January 1997, Unit C3: Essential Organic Chemistry, Question 2.

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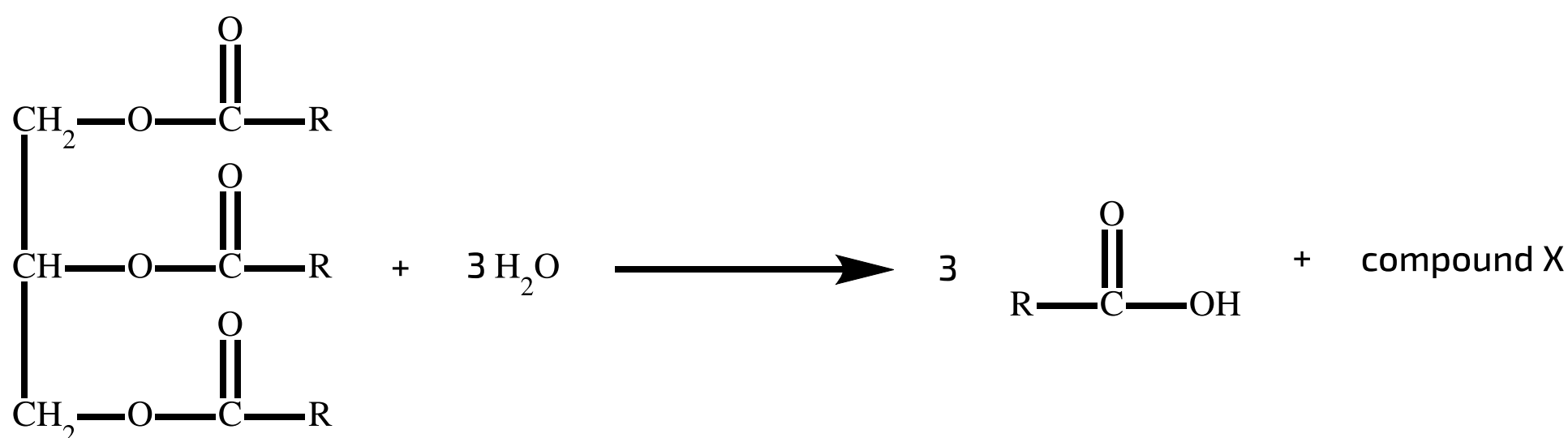


Fatty Acids

A Level



Fatty acids are long-chain carboxylic acids which can be obtained by hydrolysing an oil or fat:



oil or fat

(where R represents a hydrocarbon chain)

Fatty acids vary in the length and structure of their hydrocarbon chains. For example stearic acid $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ is found in solid animal fats whereas oleic acid, $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$, is found in vegetable oils such as olive oil.

Part A Functional group

Name the functional group which is being hydrolysed.

Part B Reaction conditions

Give the correct conditions for carrying out the hydrolysis reaction.

- ☐ Aqueous
 - ☐ Concentrated
 - ☐ Acid
 - ☐ Base
 - ☐ Cooling
 - ☐ Reflux
 - ☐ Bromine
 - ☐ Hydrogen gas
 - ☐ Potassium dichromate (VI)
 - ☐ Potassium manganate (VII)
-

Part C Compound X

Draw the full structural formula for the compound **X**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part D Unsaturation

Unsaturated fats react with iodine and the 'iodine value' of a fat is used to measure the degree of unsaturation. Food scientists measure this value in 'grams of iodine which will react with 100 grams of fat'.

Which of the following are correct statements about *unsaturated fats*?

- ☐ They contain single bonds.
 - ☐ They contain double bonds.
 - ☐ They contain more hydrogens than the corresponding *saturated fats*.
 - ☐ They contain the same number of hydrogens as the corresponding *saturated fats*.
 - ☐ They contain fewer hydrogens than the corresponding *saturated fats*.
-

Part E Oleic acid with iodine

Draw the structural formula of the compound formed when iodine reacts with oleic acid, $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$.

Use the [structure editor](#) to generate a SMILES string as your answer.

Part F Iodine value

Calculate the iodine value for oleic acid. (M_r for oleic acid is 282; A_r for I is 127).

Give your answer to 3 sf.

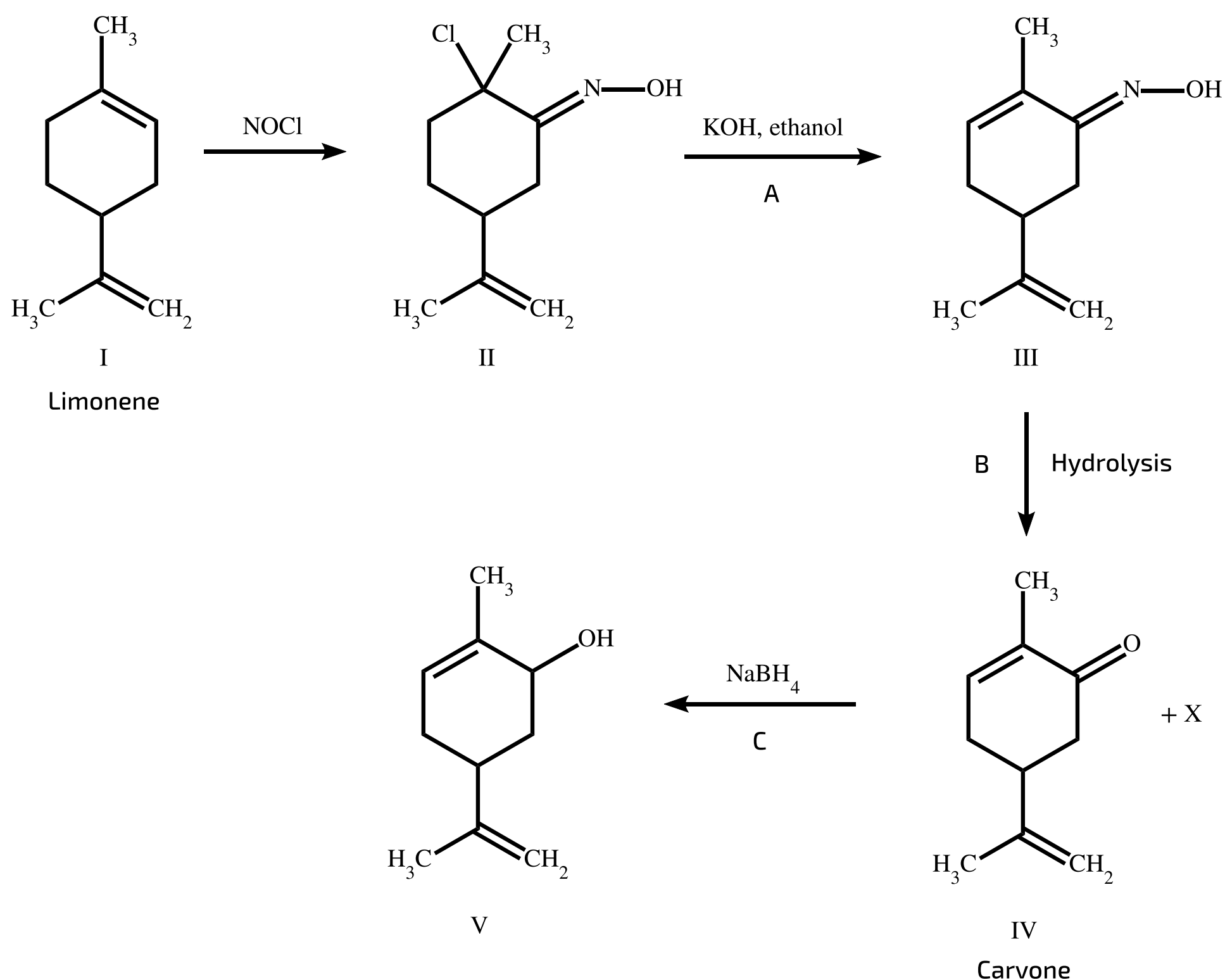
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Limonene

Limonene, I, is the substance providing the natural odour of lemons. As part of work to relate its structure to that of another important natural product, carvone, IV, and to establish the position of the double bonds in both of these compounds, the following sequence of reactions was carried out. Examine this sequence of reactions carefully and answer the questions which follow it.



Part A Reaction A

What type of reaction is reaction **A**?

Part B Functional groups in IV

Identify the functional groups in compound **IV**.

Give your answer in the format "A, B..." (space after comma).

Part C Product X

Suggest the identity of the unspecified product, X, of reaction **B**.

Part D Reaction C

What type of reaction is transformation **C**?

Part E V with ethanoyl chloride

Give the structure of the product from reaction of **V** with ethanoyl chloride. There is no need to indicate stereochemistry.

Use the [structure editor](#) to generate a SMILES string.

Part F **V with bromine**

Give the structure of the product from reaction of **V** with excess bromine. There is no need to indicate stereochemistry.

Use the [structure editor](#) to generate a SMILES string.

Adapted with permission from OCSEB Structured Science Scheme, June 1996, Unit C6: Further Organic Chemistry, Question 3.

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[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Organic Reactions](#) [Apples](#)

Apples

A Level



Compound **B**, a diacid that occurs in apples and other fruit, has the following composition by mass:

C : 35.8 % H : 4.5 % O : 59.7 %

B reacts with ethanol in the presence of concentrated sulfuric acid under reflux to give **C**, $C_8H_{14}O_5$. Compound **C** evolves hydrogen gas when treated with sodium metal and reacts with acidified potassium dichromate(VI) to give compound **D**. Compound **D** produces an orange precipitate with 2,4-dinitrophenolhydrazine* but has no reaction with Fehling's or Tollens' reagent.

* 2,4-dinitrophenolhydrazine gives an orange precipitate in the presence of aldehydes and ketones.

Part A Empirical formula

Calculate the empirical formula of **B**.

Part B Compound B

Suggest a structure for compound **B**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part C Compound C

Suggest a structure for compound **C**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part D **B \longrightarrow C reaction**

What kind of reaction is the transformation **B \longrightarrow C**?

Part E **Compound D**

Suggest a structure for compound **D**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part F **C \longrightarrow D reaction**

What kind of reaction is the transformation **C \longrightarrow D**?

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