

Isopentyl Bromide

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

When isopentyl bromide (**F**), $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{Br}$, reacts with hot aqueous ethanolic KOH , two products are formed: compound **G**, $\text{C}_5\text{H}_{12}\text{O}$, and compound **H**, $\text{C}_7\text{H}_{16}\text{O}$.

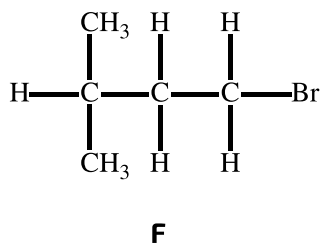


Figure 1: Isopentyl bromide (**F**)

Part A

Hydroxide with ethanol

The hydroxide ion and ethanol can take part in an acid-base reaction. Write an equation to represent this. State symbols are not required.

Part B

Compound G

What is compound **G**?

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part C

Compound H

What is compound **H**?

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part D

Type of reaction

State the type of reaction undergone by compound **F**

Part E

F with ammonia

Draw the structure of the product derived from compound **F** by reaction with concentrated aqueous ammonia.

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string.
Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part F

Reaction with potassium cyanide

Draw the structure of the product derived from compound **F** by reaction with ethanolic potassium cyanide.

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string.
Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Mechanism Types

Subject & topics: Chemistry | Organic | Reactions Stage & difficulty: A Level P1

Part A

Perspex intermediate

The following reaction is an intermediate stage in the manufacture of the important polymer known as *Perspex*.

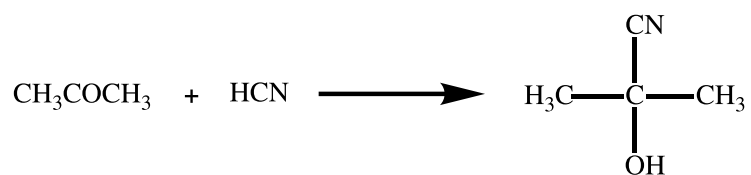


Figure 1: Intermediate in manufacture of *Perspex*

What type of mechanism is involved in this reaction?

- ☐ electrophilic addition
- ☐ nucleophilic substitution
- ☐ nucleophilic addition
- ☐ electrophilic substitution
- ☐ free radical substitution

Part B

Reaction with chlorine

A non-polar organic compound undergoes a reaction with chlorine [$A_r(\text{Cl}) = 35.5$] when light is shone upon the reaction mixture. The relative molecular mass of the product is 34.5 greater than that of the original compound.

The reaction is most likely to be:

- ☐ nucleophilic addition
- ☐ free radical substitution
- ☐ electrophilic addition
- ☐ nucleophilic substitution
- ☐ electrophilic substitution

Part A adapted with permission from UCLES, A-Level Chemistry, November 1991, Paper 1, Question 23 ;

Part B adapted with permission from OCSEB, A-Level Chemistry, June 1994, Paper 1, Question 21

Question deck:

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Organic Reaction Intermediates

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Part A

Hydrobromic acid with ethene

Hydrogen bromide reacts with ethene to form bromoethane. Which of the following is the best description of the organic intermediate?

- ☐ Its structure is planar
- ☐ It has a negative charge
- ☐ It is an electrophile
- ☐ It is a free radical
- ☐ It contains carbon, hydrogen and bromine

Part B

Carbocation intermediate

In which of the following reactions is a cation an intermediate?

- ☐ $\text{CH}_2=\text{CH}_2 + \text{Br}_2 \longrightarrow \text{CH}_2\text{BrCH}_2\text{Br}$
- ☐ $\text{CH}_3\text{CHO} + \text{HCN} \xrightarrow{\text{CN}^-} \text{CH}_3\text{CH}(\text{OH})\text{CN}$
- ☐ $\text{CH}_3\text{CH}_3 + \text{Cl}_2 \longrightarrow \text{CH}_3\text{CH}_2\text{Cl} + \text{HCl}$
- ☐ $\text{CH}_3\text{CH}_2\text{Cl} + 2 \text{NH}_3 \longrightarrow \text{CH}_3\text{CH}_2\text{NH}_2 + \text{NH}_4\text{Cl}$
- ☐ $\text{CH}_3\text{CH}_2\text{Br} + \text{NaOH} \xrightarrow{\text{H}_2\text{O}} \text{CH}_3\text{CH}_2\text{OH} + \text{NaBr}$

Part A adapted with permission from UCLES, A-Level Chemistry, 1988, Paper 3, Question 23;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1992, Paper 4, Question 22

Question deck:

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Compounds from Haloalkanes

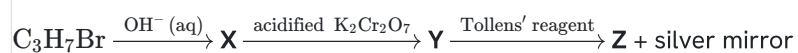
Subject & topics: Chemistry | Organic | Reactions

Stage & difficulty: A Level P1

Part A

Compounds from C_3H_7Br

The compound C_3H_7Br undergoes a sequence of reactions as follows:



What could be the formulae for **X**, **Y** and **Z**?

	X	Y	Z
A	$CH_3CH_2CH_2OH$	CH_3CH_2COOH	CH_3CH_2CHO
B	$CH_3CH_2CH_2OH$	$CH_3CH(OH)CH_2OH$	CH_3COOH
C	$CH_3CH_2CH_2OH$	CH_3CH_2CHO	CH_3CH_2COOH
D	$CH_3CH(OH)CH_3$	CH_3COCH_3	CH_3COOH

- ☐ **A**
☐ **B**
☐ **C**
☐ **D**

Part B

Compounds from chloroethane

Chloroethane is converted into a carboxylic acid containing one more carbon atom through a two-stage process.

Which of the following compounds could be the intermediate in the synthesis of the carboxylic acid?

- ☐ $\text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$
- ☐ $\text{CH}_3\text{CH}_2\text{CN}$
- ☐ $\text{CH}_3\text{CH}_2\text{OH}$
- ☐ $\text{CH}_3\text{CH}_2\text{COOCH}_3$
- ☐ $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

Part A adapted with permission from UCLES, A-Level Chemistry, November 1994, Paper 4, Question 26;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1993, Paper 3, Question 25

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Compounds from But-2-ene

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Complete the reaction scheme shown below which starts with but-2-ene. In each of the boxes **A** to **D** give the principal organic product or intermediate compound.

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

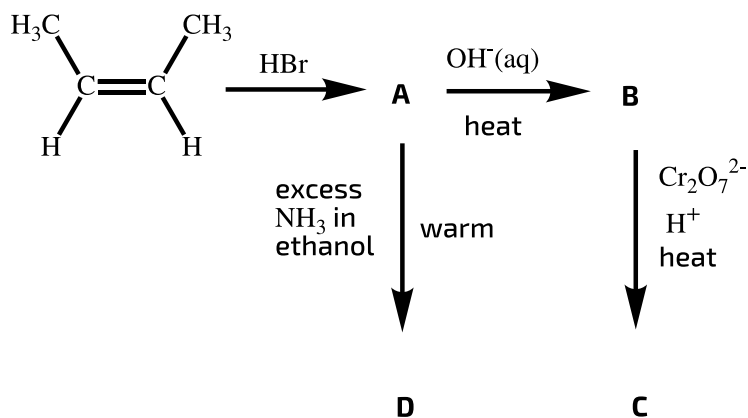


Figure 1: Compounds from but-2-ene

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

Using the structure editor

Part A

A

A is:

Part B

B

B is:

Part C

C

C is:

Part D

D

D is:

Adapted with permission from UCLES, A-Level Chemistry, June 1996, Chains and Rings, Question 1

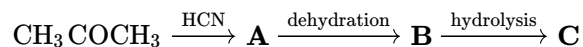
Question deck:

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Ketones with HCN Further

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

The initial product of the reaction between HCN and propanone gives **A** which is then subjected to a dehydration reaction to produce **B**.



Part A

Propanone with HCN

What is **A**?

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part B

Dehydration

What is **B**?

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part C

Hydrolysis

The product of the dehydration reaction **B** is hydrolysed under acidic conditions to give **C**.

What is **C**?

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

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string.
Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part A and B adapted with permission from UCLES, A-Level Chemistry, June 1992, Paper 4, Question 28;

Part C created for isaacphysics.org by R. Less

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More Nitriles

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Part A

Reaction with cyanide ions

Which of the following compounds could be the product of a reaction involving a nucleophilic attack by cyanide ions in aqueous ethanolic solution?

- ☐ $(\text{CH}_3)_2\text{CHCN}$
- ☐ CH_3CONH_2
- ☐ $\text{CH}_2=\text{CHCN}$
- ☐ $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

Part B

Hydrolysis of CS

CS has the structure shown below, is an active component of 'tear gas' and is readily hydrolysed.

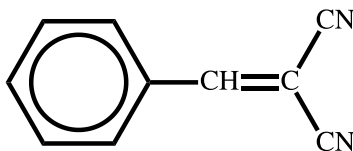


Figure 1: Structure of CS

Which of the following is a possible hydrolysis product of CS?

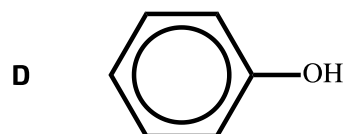
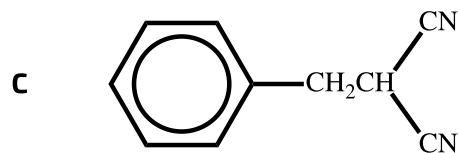
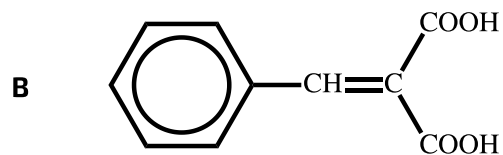
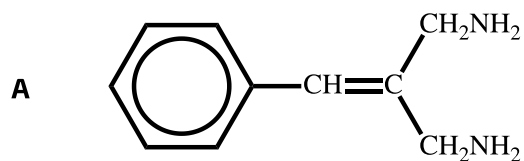


Figure 2: Possible hydrolysis products of CS

- ☐ A
- ☐ B
- ☐ C

☐ D

Part A adapted with permission from UCLES, A-Level Chemistry, November 1994, Paper 4, Question 23;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1995, Paper 4, Question 25

Question deck:

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Role of Reagent

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Part A

Bradosol

Bradosol is a compound used for the relief of sore throats. It is produced in the following reaction.

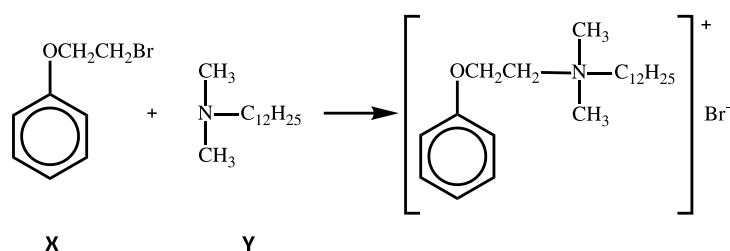


Figure 1: *Bradosol* synthesis

What is the role of compound **Y** in this reaction?

- ☐ a ligand
- ☐ an electrophile
- ☐ a nucleophile
- ☐ a reducing agent

Part B

Inorganic reagent

In which reaction does the inorganic reagent act as a nucleophile?

- ☐ $\text{CH}_3\text{CH}_2\text{Br} + \text{NaOH} \longrightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{NaBr}$
- ☐ $\text{CH}_3\text{CH}=\text{CH}_2 + \text{Br}_2 \longrightarrow \text{CH}_3\text{CHBrCH}_2\text{Br}$
- ☐ $\text{CH}_3\text{CH}_2\text{NH}_2 + \text{HCl} \longrightarrow [\text{CH}_3\text{CH}_2\text{NH}_3]^+\text{Cl}^-$
- ☐ $\text{CH}_3\text{CH}_3 + \text{Cl}_2 \xrightarrow{h\nu \text{ (light)}} \text{CH}_3\text{CH}_2\text{Cl} + \text{HCl}$

Part A adapted with permission from UCLES, A-Level Chemistry, June 1998, Paper 3, Question 19;

Part B adapted with permission from UCLES, A-Level Chemistry, November 1998, Paper 3, Question 20

Question deck:

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Reaction Types

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level C1

Part A

Sunburn ointment

Many sunburn ointments contain benzocaine which relieves the pain caused by sunburn. It can be made in the laboratory by using the following reaction scheme.

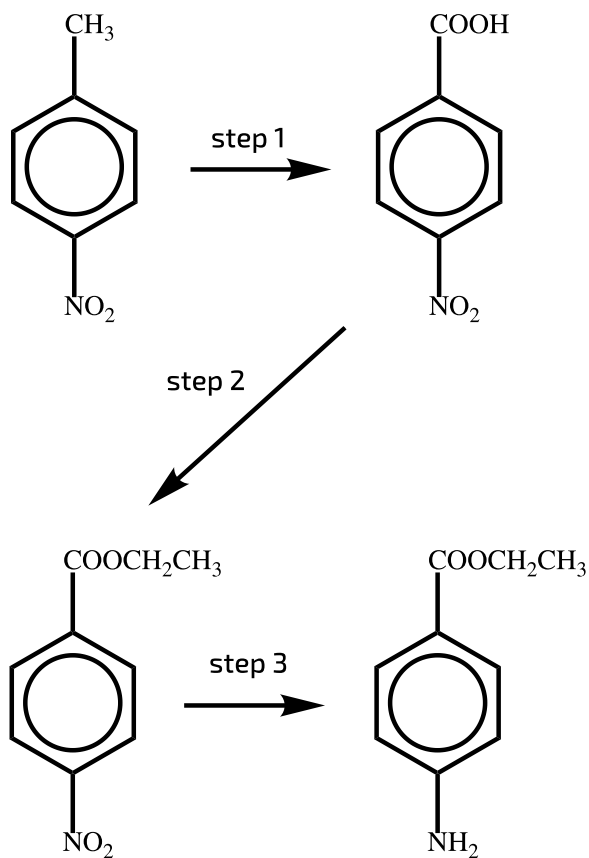


Figure 1: Preparation of benzocaine

Which of the following statements about this reaction scheme are correct?

1 Step 1 is an oxidation.

2 Step 2 is an esterification.

3 Step 3 is a reduction.

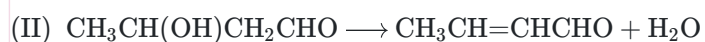
- ☐ 1, 2 and 3 are correct
- ☐ 1 and 2 only are correct
- ☐ 1 and 3 only are correct
- ☐ 2 and 3 only are correct
- ☐ 1 only is correct
- ☐ 2 only is correct

☐ 3 only is correct

Part B

Aldol

The Russian composer Borodin was also a research chemist who discovered a reaction in which two ethanal molecules combine to form a compound commonly known as aldol (reaction I). Aldol forms another compound on heating (reaction II).



Which of the following best describes reactions I and II?

	I	II
A	addition	elimination
B	addition	reduction
C	elimination	reduction
D	substitution	elimination

☐ A

☐ B

☐ C

☐ D

Part A adapted with permission from UCLES, A-Level Chemistry, November 1993, Paper 4, Question 36;

Part B adapted with permission from UCLES, A-Level Chemistry, November 1994, Paper 4, Question 21

Question deck:

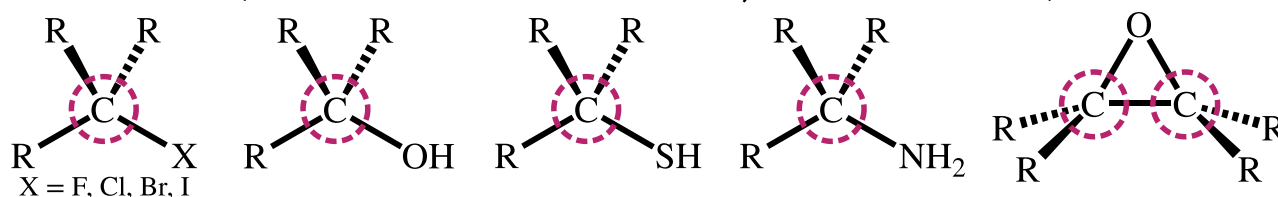
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Classifying Organic Reactions 1

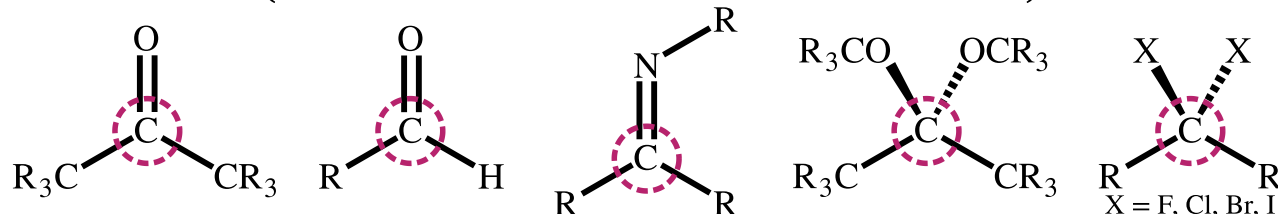
Subject & topics: Chemistry | Organic | Reactions Stage & difficulty: A Level C1

One of the reasons organic chemists use skeletal formulae is to draw attention to the functional groups a molecule contains. These contain atoms other than carbon and hydrogen, so-called heteroatoms. Many different functional groups are possible, but it is often useful to keep track of the number of bonds that a given carbon atom has to electronegative atoms, the 'level' of a particular functional group. The electronegative elements include the halogens, oxygen, nitrogen and sulfur and will be represented by the symbol E; general alkyl groups are represented by an R. Some examples are shown below, but there are many other possibilities.

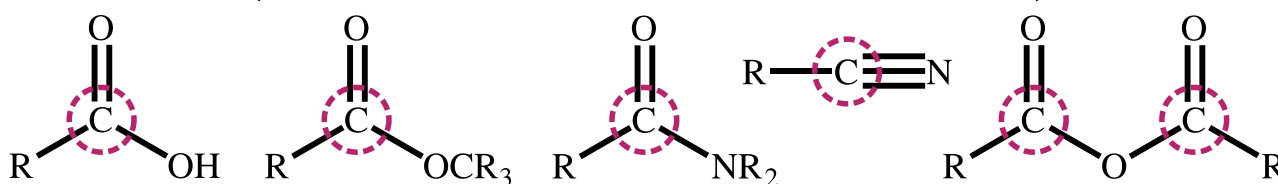
Example level **ONE** functional groups
(circled carbon atoms all have just one C–E bond)



Example level **TWO** functional groups
(circled carbon atoms all have two C–E bonds)



Example level **THREE** functional groups
(circled carbon atoms all have three C–E bonds)



Keeping track of the functional group level can be a useful way of understanding a large number of organic reactions.

In every one of the reactions in this question, no carbon-carbon bonds are broken or formed.

During **oxidation** reactions, the functional group level will be found to increase as new C–E bonds are formed at the expense of C–H bonds.

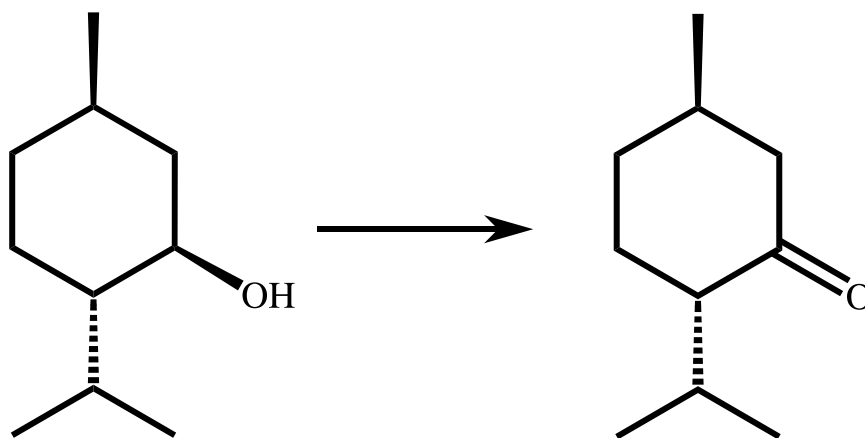
During **reduction** reactions, the functional group level is found to decrease as new C-H bonds are formed at the expense of C-E bonds.

During **hydrolysis** reactions, the functional group level of every carbon remains the same, but the addition of water (hydro) may be used to split (lyse) functional groups, and / or replace some bonds to electronegative atoms with new bonds to oxygen. Different hydrolysis reactions may require different conditions with some only taking place at a significant rate with acid or alkali present.

Each of the following ten reactions takes place with a single reagent. Classify each one as either an **oxidation**, a **reduction**, or a **hydrolysis reaction**. Simply tick the appropriate box.

Part A

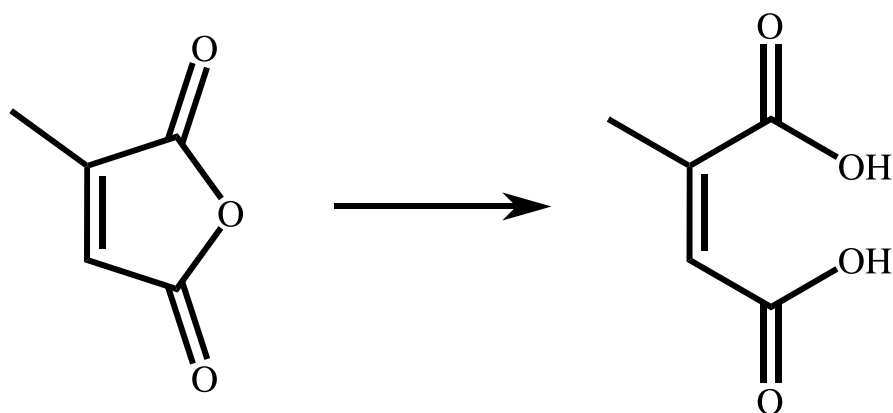
Reaction 1



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part B

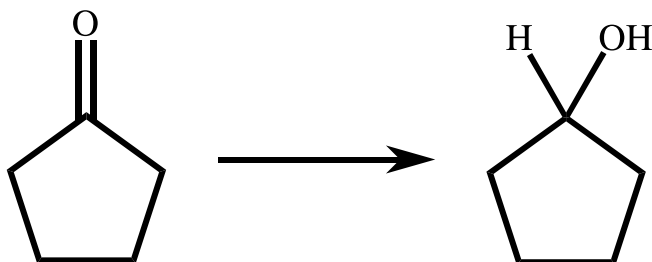
Reaction 2



-
- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part C

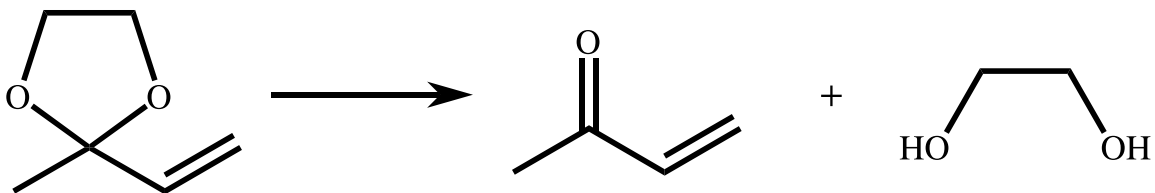
Reaction 3



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part D

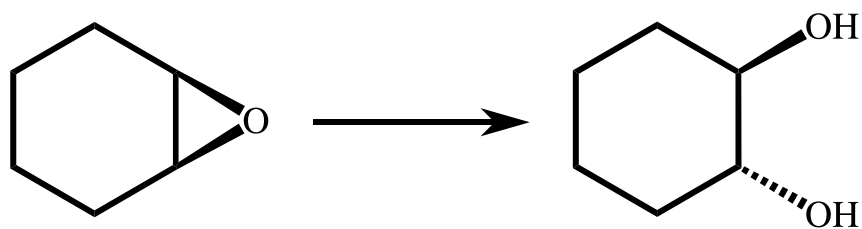
Reaction 4



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part E

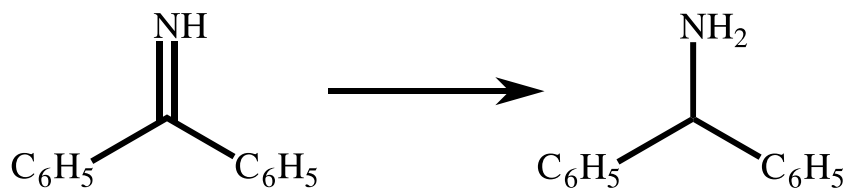
Reaction 5



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part F

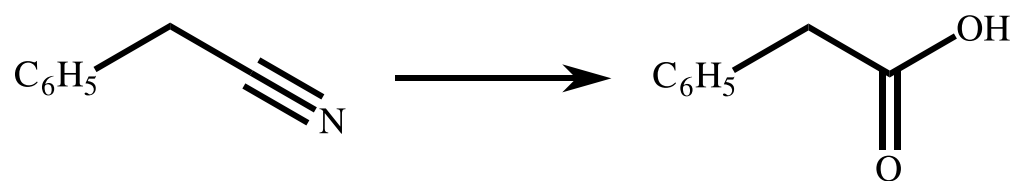
Reaction 6



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part G

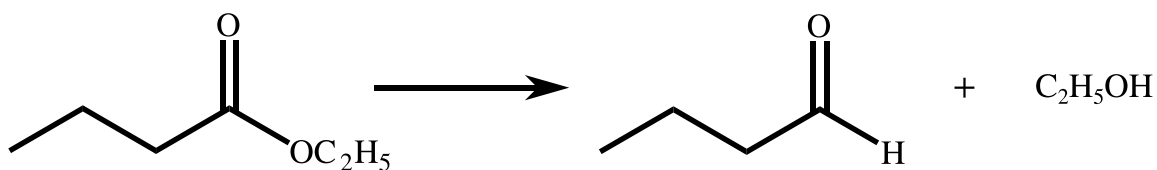
Reaction 7



- ☐ Reduction
- ☐ Oxidation
- ☐ Hydrolysis

Part H

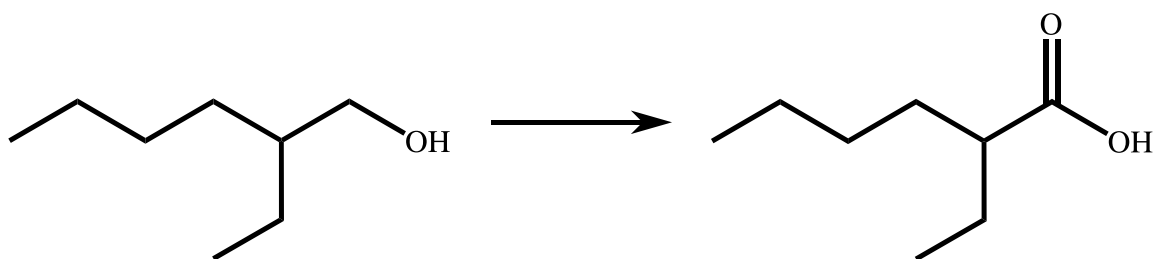
Reaction 8



- ☐ Hydrolysis
- ☐ Reduction
- ☐ Oxidation

Part I

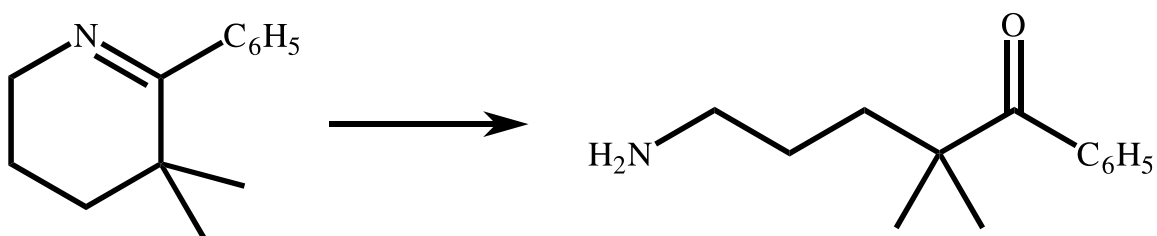
Reaction 9



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

Part J

Reaction 10



- ☐ Oxidation
- ☐ Reduction
- ☐ Hydrolysis

