

Cambridge AS & A Level

CHEMISTRY

Paper 1

Topical Past Paper Questions
+ Answer Scheme

2015 - 2021



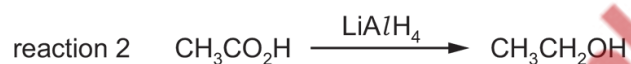
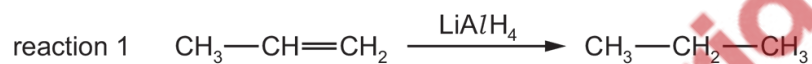
Chapter 18

Carboxylic acids and derivatives

18.1 Carboxylic acids

1084. 9701_m22_qp_12 Q: 34

A student suggests two uses of LiAlH_4 .

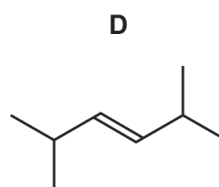
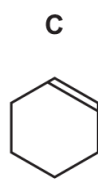
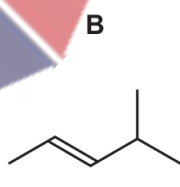
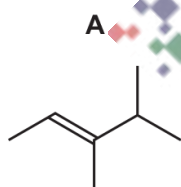


Which reactions would give the product shown?

- A both reactions
- B reaction 1 only
- C reaction 2 only
- D neither reaction

1085. 9701_s21_qp_11 Q: 21

Which compound would produce two different carboxylic acids when treated with hot, concentrated, acidified manganate(VII) ions?



1086. 9701_s21_qp_13 Q: 28

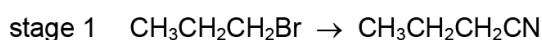
Compound Y is treated with a single reagent under suitable conditions. 2-methylbutanoic acid is produced.

What could compound Y be?

- A pentan-2-one
- B 2-methylbutan-2-ol
- C 2-methylbutanenitrile
- D methylpropanenitrile

1087. 9701_w21_qp_12 Q: 24

Butanoic acid can be made from 1-bromopropane in two stages.



Which types of reaction are stage 1 and stage 2?

	stage 1	stage 2
A	electrophilic addition	hydrolysis
B	electrophilic addition	oxidation
C	nucleophilic substitution	hydrolysis
D	nucleophilic substitution	oxidation

1088. 9701_w21_qp_12 Q: 29

Organic compound Z has an alcohol group and a carboxylic acid group.

Compound Z reacts with magnesium carbonate to make a salt with a relative formula mass of 230.3.

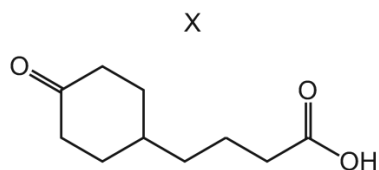
Compound Z does not react with acidified potassium manganate(VII).

What could be the identity of compound Z?

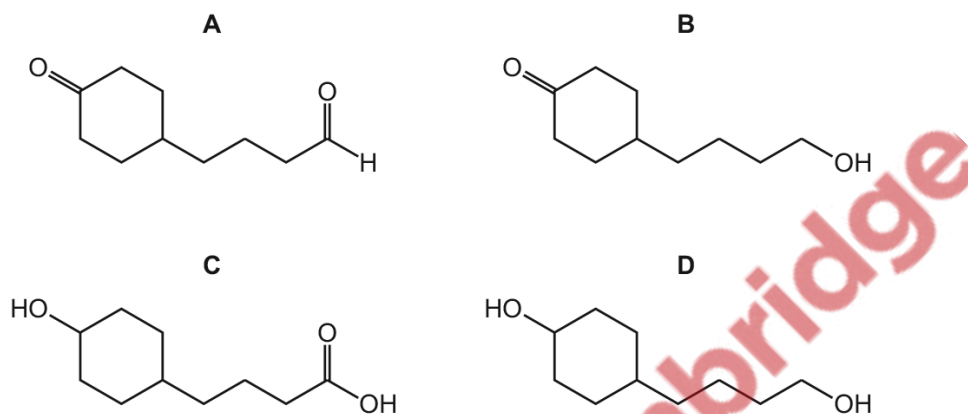
- A 2-hydroxy-2-methylbutanoic acid
- B 2-hydroxy-2-methylpropanoic acid
- C 3-hydroxy-2-methylbutanoic acid
- D 3-hydroxy-2-methylpropanoic acid

1089. 9701_m20_qp_12 Q: 28

Compound X is treated with an excess of lithium aluminium hydride. The reaction is allowed to go to completion.



What is the structure of the organic product?



1090. 9701_s20_qp_11 Q: 30

Which reaction produces an organic anion with a good yield?

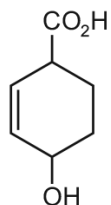
- A** heating ethanenitrile under reflux with dilute sodium hydroxide
- B** heating ethanenitrile under reflux with dilute sulfuric acid
- C** heating ethane with sodium metal
- D** heating ethanol under reflux with dilute sodium hydroxide



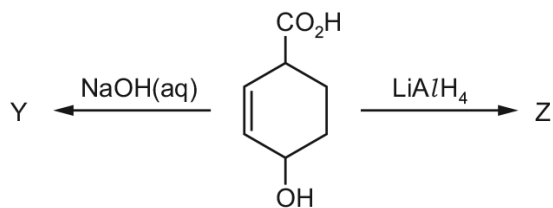
1091. 9701_s20_qp_12 Q: 20

Compound X is shown.

compound X



X is treated separately with NaOH(aq) and LiAlH₄ to give Y and Z.



What are Y and Z?

	Y	Z
A		
B		
C		
D		

1092. 9701_s20_qp_13 Q: 23

Butanoic acid can be produced from 1-bromopropane in two steps using reagents V and W as shown.



What could be reagents V and W?

	V	W
A	KCN in ethanol	HCl(aq)
B	KCN in ethanol	NaOH(aq)
C	NH ₃ in ethanol	HCl(aq)
D	NaOH(aq)	H ⁺ / Cr ₂ O ₇ ²⁻ (aq)

1093. 9701_s20_qp_13 Q: 26

Which reagent reacts with **both** of the –OH groups in lactic acid, CH₃CH(OH)CO₂H?

- A** acidified potassium dichromate(VI)
- B** ethanol
- C** sodium
- D** sodium hydroxide

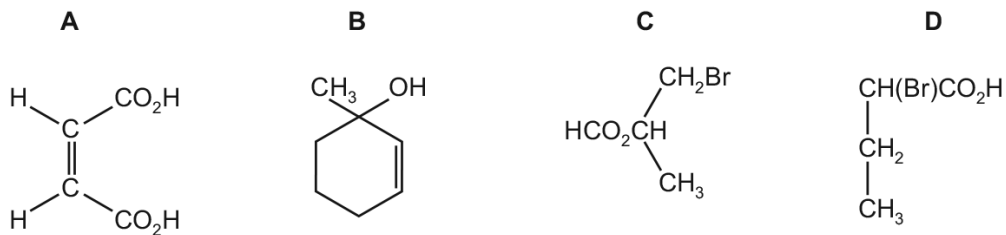
1094. 9701_w20_qp_11 Q: 24

A student converts 1-iodopropane, C₃H₇I, into butanoic acid, C₃H₇CO₂H, by a two-stage chemical synthesis.

In the **first** of the two stages, which reagent is reacted with 1-iodopropane?

- A** aqueous sodium hydroxide
- B** ethanolic ammonia
- C** ethanolic potassium cyanide
- D** ethanolic sodium hydroxide


1095. 9701_w20_qp_11 Q: 29

Which compound is chiral and reacts with Na_2CO_3 to give CO_2 ?

1096. 9701_w20_qp_12 Q: 18

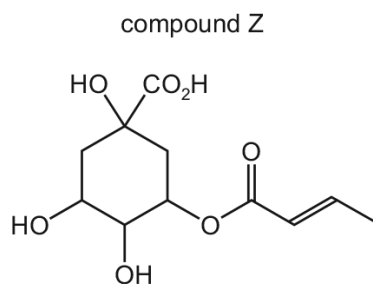
Which substance, when warmed with aqueous ammonium chloride, would produce an alkaline gas?

A $\text{CH}_3\text{CO}_2\text{H}$ **B** $\text{CH}_3\text{CH}_2\text{OH}$ **C** $\text{CH}_3\text{CO}_2\text{CH}_3$ **D** $\text{CH}_3\text{CH}_2\text{ONa}$

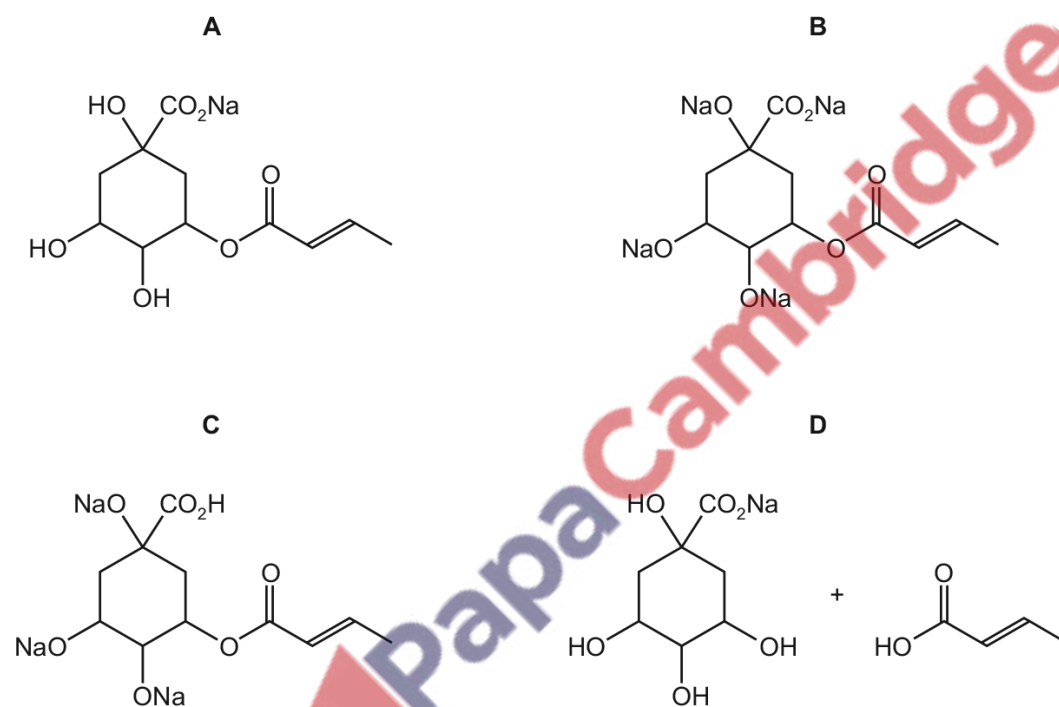

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1097. 9701_w20_qp_12 Q: 29

Compound Z is shown.



What is produced in good yield when compound Z is treated with an excess of sodium carbonate solution at room temperature?

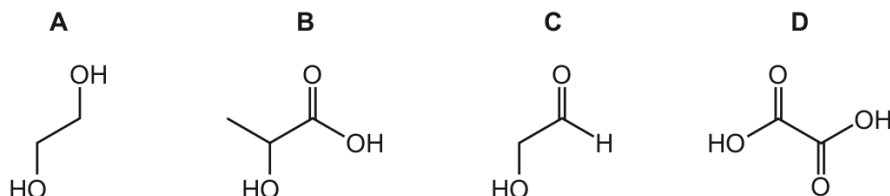


1098. 9701_m19_qp_12 Q: 29

1 mole of each of the following four compounds is reacted separately with:

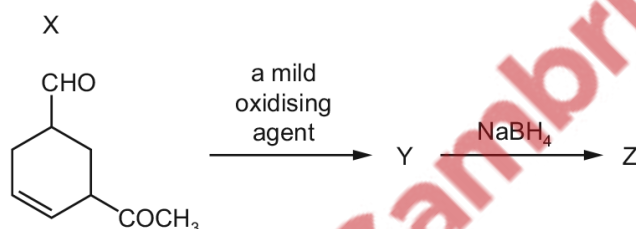
- an excess of sodium
- an excess of sodium carbonate.

Which compound produces the same volume of gas with each of the **two** reagents?

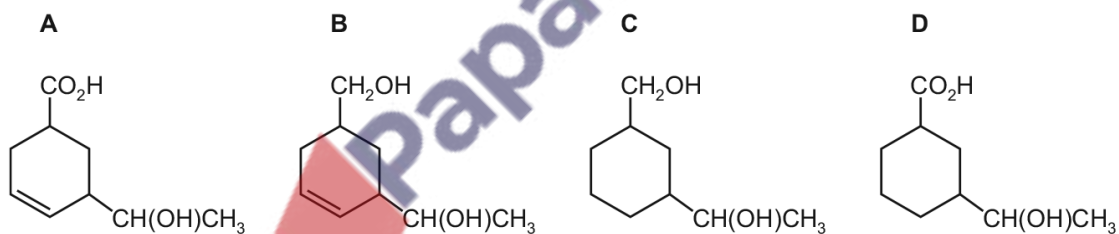


1099. 9701_s19_qp_11 Q: 28

Compound X is treated with two reagents successively, forming compound Z.

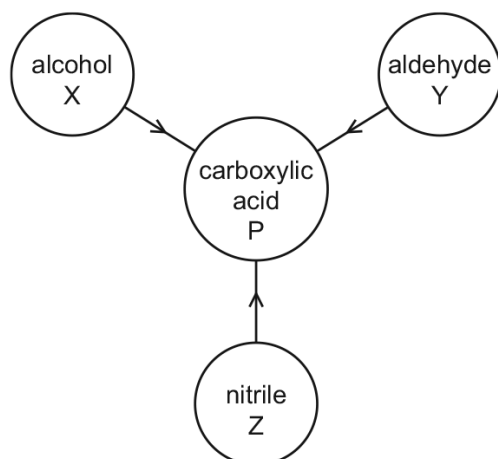


What could be Z?



1100. 9701_s19_qp_12 Q: 28

The diagram shows that a carboxylic acid P may be formed from X, Y or Z.



Which row is correct?

	alcohol X is	the change in M_r is greatest for
A	primary	Y to P
B	primary	Z to P
C	secondary	Y to P
D	secondary	Z to P

1101. 9701_w19_qp_11 Q: 28

Tartaric acid, $\text{HO}_2\text{CCH}(\text{OH})\text{CH}(\text{OH})\text{CO}_2\text{H}$, is found in many plants.

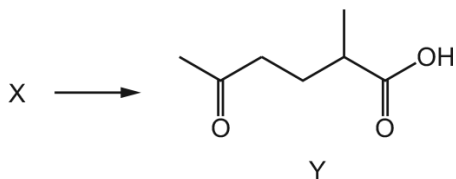
A sample of tartaric acid reacts with an excess of LiAlH_4 to form the organic product J.

What happens when $\text{NaOH}(\text{aq})$ is added to separate samples of tartaric acid and J?

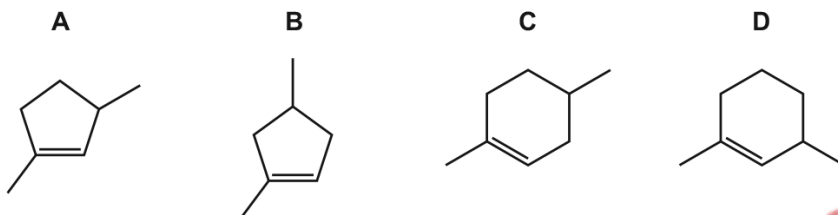
- A** Both tartaric acid and J react.
- B** Only tartaric acid reacts.
- C** Only J reacts.
- D** Neither tartaric acid nor J react.

1102. 9701_m18_qp_12 Q: 22

Compound X can be converted into compound Y in a single step.



What could be the identity of X?



1103. 9701_s18_qp_11 Q: 28

Which reagent could be used to carry out the following reaction?



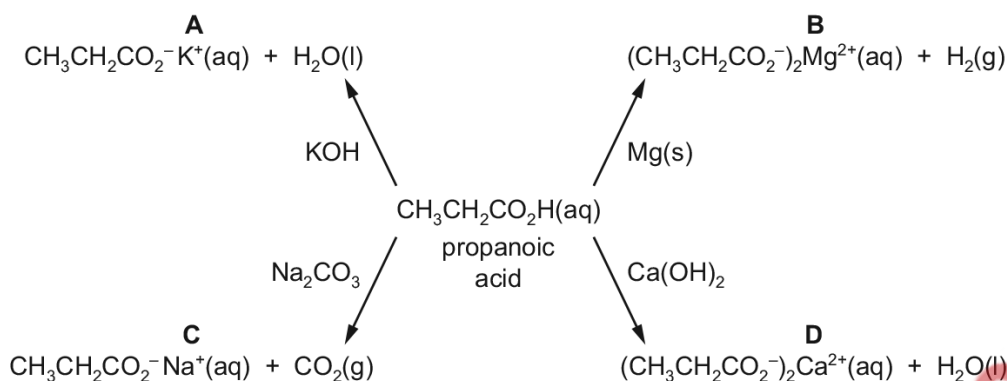
- A** a solution containing acidified dichromate(VI) ions
- B** a solution containing dilute, acidified manganate(VII) ions
- C** a solution containing hot, concentrated, acidified manganate(VII) ions
- D** concentrated sulfuric acid



1104. 9701_s18_qp_11 Q: 29

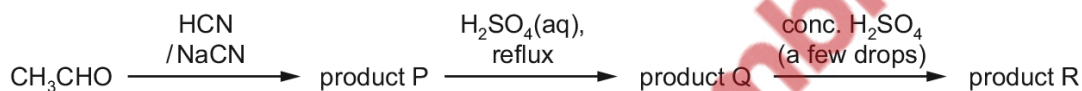
Four reactions of propanoic acid to form salts and other products are shown.

Which reaction does **not** show the formulae of **all** the correct products?



1105. 9701_s18_qp_12 Q: 28

Ethanal, CH_3CHO , is used to make product R in a three-stage synthesis.



Two molecules of Q react to give one molecule of R plus two molecules of water.

R has two ester functional groups in each molecule. R does not react with sodium.

What is the empirical formula of R?

- A** CHO **B** $\text{C}_3\text{H}_4\text{O}_2$ **C** $\text{C}_3\text{H}_5\text{O}_2$ **D** $\text{C}_6\text{H}_{10}\text{O}_5$

1106. 9701_s18_qp_13 Q: 28

A student carried out a **two-stage** synthesis in which $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ was converted into $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$.

Which compound could have been formed by the first stage of this synthesis?

- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
C $\text{CH}_3\text{CH}_2\text{CN}$
D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$

1107. 9701_w18_qp_11 Q: 26

Sodium reacts with 1 mol of compound Y to produce 1 mol of $\text{H}_2(\text{g})$.

Which compound could Y be?

- A $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- B $(\text{CH}_3)_3\text{COH}$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- D $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$

1108. 9701_w18_qp_11 Q: 28

Ethanedioic acid, $\text{HO}_2\text{CCO}_2\text{H}$, is reduced using an excess of lithium aluminium hydride, LiAlH_4 .

What is the organic product of the reaction?

- A ethanol
- B ethane-1,2-diol
- C ethanedial, OHCCHO
- D methane

1109. 9701_w18_qp_12 Q: 29

Which compound can be used to make propanoic acid by treatment with a single reagent?

- A $\text{CH}_2=\text{CHCH}_2\text{CH}_3$
- B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$
- C $\text{CH}_3\text{CH}(\text{OH})\text{CN}$
- D $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$

1110. 9701_s17_qp_11 Q: 27

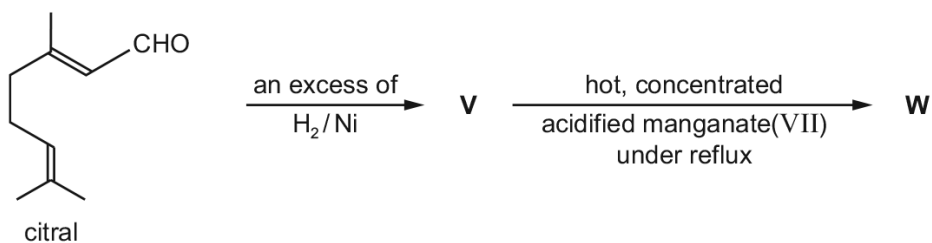
Q is a compound with the molecular formula $\text{C}_4\text{H}_{10}\text{O}$. **Q** can be oxidised with acidified potassium dichromate(VI). **Q cannot** be made by reducing a carboxylic acid with LiAlH_4 .

What is the structure of **Q**?

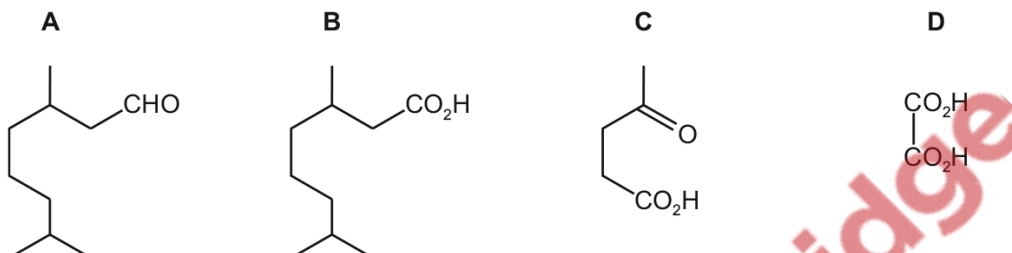
- A $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
- B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- C $(\text{CH}_3)_3\text{COH}$
- D $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$

1111. 9701_s17_qp_11 Q: 30

Citral is found in lemongrass oil. It can react to give compound **W**.



What could compound **W** be?



1112. 9701_s17_qp_13 Q: 23

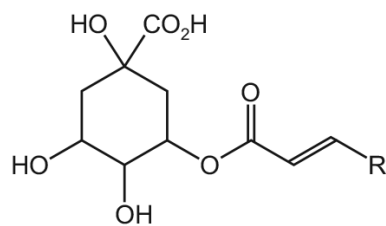
Carboxylic acids may be prepared by several different methods.

In which reaction would propanoic acid be formed?

- A** adding ammonium propanoate to dilute sulfuric acid
- B** heating ethyl propanoate with aqueous sodium hydroxide
- C** heating propan-2-ol with acidified potassium manganate(VII) under reflux
- D** heating propyl ethanoate with dilute sulfuric acid

1113. 9701_s17_qp_13 Q: 28

Chlorogenic acid is found in green coffee beans and is used in treatments for weight loss.

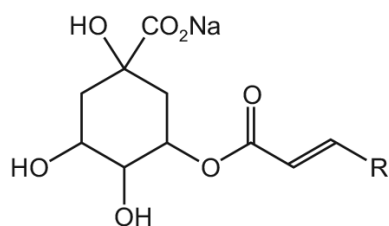


R = C₆H₅O₂ and takes no part in the reaction with sodium carbonate.

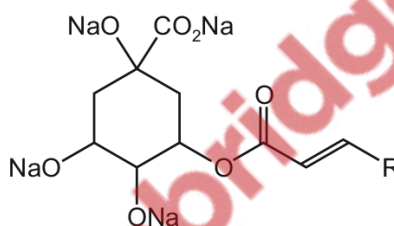
chlorogenic acid

What is produced in good yield when chlorogenic acid is treated with an excess of sodium carbonate solution at room temperature?

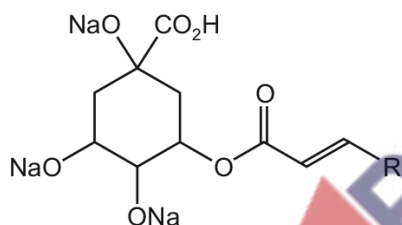
A



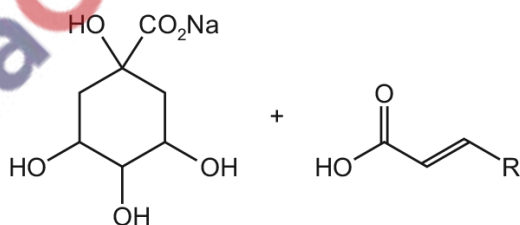
B



C



D



1114. 9701_s17_qp_13 Q: 29

Butanoic acid can be produced from 1-bromopropane using reagents X and Y as shown.

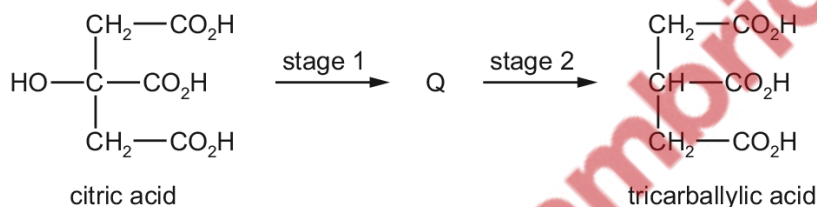


What could be reagents X and Y?

	X	Y
A	KCN in ethanol	HCl(aq)
B	KCN in ethanol	NaOH(aq)
C	NH ₃ in ethanol	HCl(aq)
D	NaOH(aq)	H ⁺ /Cr ₂ O ₇ ²⁻ (aq)

1115. 9701_w17_qp_11 Q: 25

Citric acid can be converted into tricarballic acid in two stages. An intermediate, Q, is formed.



Which reagents are needed for each stage?

	stage 1	stage 2
A	concentrated H ₂ SO ₄	H ₂ (g) and Ni
B	concentrated H ₂ SO ₄	LiAlH ₄
C	LiAlH ₄	H ₂ SO ₄ (aq)
D	NaOH(aq)	H ₂ (g) and Ni

1116. 9701_w17_qp_11 Q: 27

3-methylbutanone is treated with alkaline aqueous iodine. The mixture of products is then acidified.

Which compound is present in the final mixture of products?

- A** 3-methylbutanoic acid
- B** butanoic acid
- C** methylpropanoic acid
- D** propanoic acid

1117. 9701_w17_qp_11 Q: 28

At room temperature, propanoic acid was reacted to produce sodium propanoate. No gas was produced during the reaction.

What could the propanoic acid have reacted with?

- A** $\text{NaHCO}_3(\text{aq})$ **B** $\text{NaOH}(\text{aq})$ **C** $\text{Na}_2\text{CO}_3(\text{aq})$ **D** $\text{Na}_2\text{SO}_4(\text{aq})$

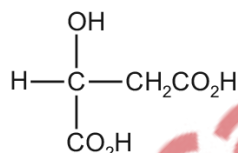
1118. 9701_s16_qp_11 Q: 22

Which pair of reagents will take part in a redox reaction?

- A** $\text{CH}_3\text{CHCH}_2 + \text{Br}_2$
B $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{concentrated H}_3\text{PO}_4$
C $\text{CH}_3\text{COCH}_3 + \text{HCN}$
D $\text{HCO}_2\text{C}_2\text{H}_5 + \text{dilute H}_2\text{SO}_4$

1119. 9701_s16_qp_11 Q: 26

Malic acid is found in apples.



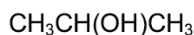
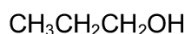
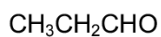
malic acid

Which reagent will react with all three $-\text{OH}$ groups present in the malic acid molecule?

- A** ethanol in the presence of concentrated sulfuric acid
B potassium hydroxide
C sodium
D sodium carbonate

1120. 9701_s16_qp_12 Q: 28

How many of the following compounds produce a carboxylic acid on heating under reflux with an excess of hot acidified $\text{K}_2\text{Cr}_2\text{O}_7$?



- A** 1 **B** 2 **C** 3 **D** 4

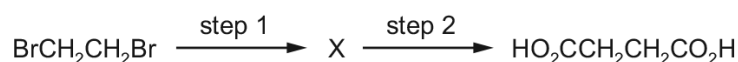
1121. 9701_w16_qp_11 Q: 28

Which reaction would **not** give ethanoic acid?

- A heating ethanenitrile under reflux with dilute sodium hydroxide
- B heating ethanenitrile under reflux with dilute sulfuric acid
- C heating ethanal under reflux with acidified sodium dichromate(VI)
- D heating ethanol under reflux with acidified sodium dichromate(VI)

1122. 9701_s15_qp_12 Q: 23

Butanedioic acid may be synthesised in two steps from 1,2-dibromoethane.



Which reagents could be used for this synthesis?

	step 1	step 2
A	HCN(g)	HCl(aq)
B	HCO ₂ Na(aq)	HCl(aq)
C	KCN(alcoholic)	H ₂ SO ₄ (aq)
D	NaOH(aq)	K ₂ Cr ₂ O ₇ /H ₂ SO ₄ (aq)

1123. 9701_s15_qp_13 Q: 25

Compound **X**, C₅H₁₂O, is oxidised by acidified sodium dichromate(VI) to compound **Y**.

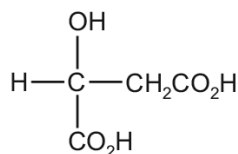
Compound **Y** reacts with butan-2-ol in the presence of a little concentrated sulfuric acid to give liquid **Z**.

What could be the formula of **Z**?

- A CH₃(CH₂)₃CO₂CH(CH₃)CH₂CH₃
- B CH₃(CH₂)₃CO₂(CH₂)₃CH₃
- C CH₃(CH₂)₂CO₂CH(CH₃)CH₂CH₃
- D (CH₃)₂CHCH₂CO₂C(CH₃)₃

1124. 9701_s15_qp_13 Q: 30

Malic acid occurs in apples.



malic acid

Under suitable conditions, which substance will react with only one of the –OH groups in the malic acid molecule?

- A $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+(\text{aq})$
- B Na(s)
- C NaOH(aq)
- D $\text{PCl}_5(\text{s})$

1125. 9701_w15_qp_11 Q: 25

If the starting material is iodoethane, which sequence of reactions will produce propanoic acid as the main final product in good yield?

- A add NaOH(aq), isolate the organic product, add acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and boil under reflux
- B add NaOH(aq), isolate the organic product, add $\text{H}_2\text{SO}_4(\text{aq})$ and boil under reflux
- C heat with HCN in ethanol, isolate the organic product, add $\text{H}_2\text{SO}_4(\text{aq})$ and boil under reflux
- D heat with KCN in ethanol, isolate the organic product, add $\text{H}_2\text{SO}_4(\text{aq})$ and boil under reflux

18.2 Esters

1126. 9701_m22_qp_12 Q: 27

Which compound will decolourise $\text{Br}_2(\text{aq})$?

- A $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
- C $\text{CH}_3\text{CHCHCH}_2\text{CH}_2\text{CH}_2\text{OH}$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_3$

1127. 9701_m22_qp_12 Q: 35

Compound X contains a single ester group.

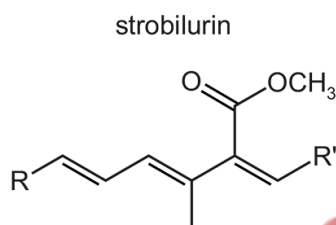
X contains 27.6% by mass of oxygen.

Which pair of products could be produced by the hydrolysis of X?

- A butan-1-ol and ethanoic acid
- B ethanol and propanoic acid
- C methanol and methanoic acid
- D propan-2-ol and butanoic acid

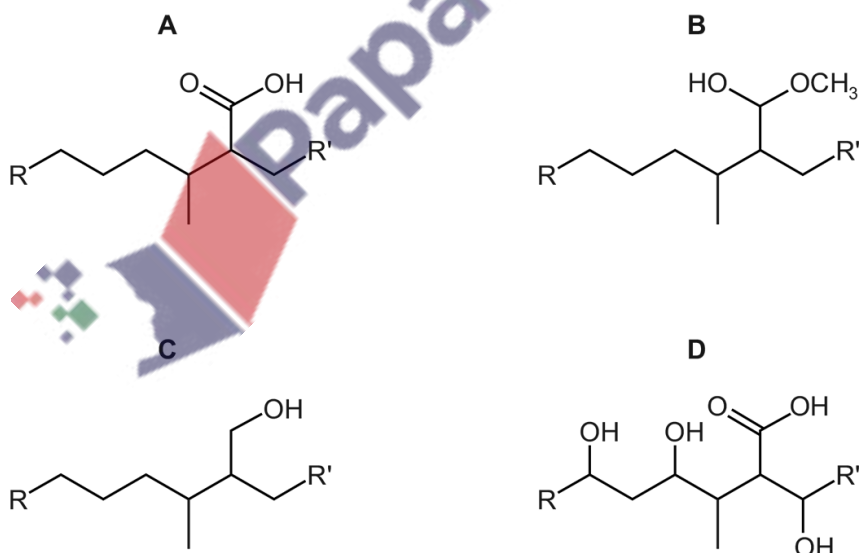
1128. 9701_m21_qp_12 Q: 23

Part of the structure of strobilurin is shown. R and R' are inert groups.



Strobilurin is warmed with aqueous sulfuric acid producing compound X. Compound X is then treated with hydrogen in the presence of a nickel catalyst producing compound Y.

What could be the structure of compound Y?



1129. 9701_m21_qp_12 Q: 28

Ethanedioic acid has the formula $\text{HO}_2\text{CCO}_2\text{H}$.

What is the formula of aluminium ethanedioate?

- A** AlC_2O_4 **B** $\text{Al}(\text{C}_2\text{O}_4)_3$ **C** $\text{Al}_2\text{C}_2\text{O}_4$ **D** $\text{Al}_2(\text{C}_2\text{O}_4)_3$

1130. 9701_m21_qp_12 Q: 29

Which reaction gives butanoic acid as one of its products?

- A** acid hydrolysis of butyl ethanoate
B alkaline hydrolysis of butyl ethanoate
C acid hydrolysis of ethyl butanoate
D alkaline hydrolysis of ethyl butanoate

1131. 9701_s21_qp_11 Q: 24

The compound cetyl palmitate, $\text{C}_{15}\text{H}_{31}\text{CO}_2\text{C}_{16}\text{H}_{33}$, is a waxy solid.

Cetyl palmitate is heated under reflux with an excess of aqueous sodium hydroxide.

Which products will be formed?

- A** $\text{C}_{15}\text{H}_{31}\text{ONa}$ and $\text{C}_{16}\text{H}_{33}\text{CO}_2\text{Na}$
B $\text{C}_{15}\text{H}_{31}\text{CO}_2\text{Na}$ and $\text{C}_{16}\text{H}_{33}\text{ONa}$
C $\text{C}_{15}\text{H}_{31}\text{OH}$ and $\text{C}_{16}\text{H}_{33}\text{CO}_2\text{Na}$
D $\text{C}_{15}\text{H}_{31}\text{CO}_2\text{Na}$ and $\text{C}_{16}\text{H}_{33}\text{OH}$

1132. 9701_s21_qp_13 Q: 29

To which classes of alcohol do P and Q belong?

	P	Q
A	primary	primary
B	primary	secondary
C	secondary	primary
D	secondary	secondary

1133. 9701_w21_qp_11 Q: 29

The structural formula of an ester is $(\text{CH}_3)_2\text{CHOCO}(\text{CH}_2)_2\text{CH}_3$.

This ester is boiled with aqueous hydrochloric acid.

Which two products are formed?

- A propan-1-ol and butanoic acid
- B propan-2-ol and butanoic acid
- C propan-1-ol and propanoic acid
- D propan-2-ol and propanoic acid

1134. 9701_w21_qp_13 Q: 29

The structural formula of an ester is $(\text{CH}_3)_2\text{CHOCO}(\text{CH}_2)_2\text{CH}_3$.

This ester is boiled with aqueous hydrochloric acid.

Which two products are formed?

- A propan-1-ol and butanoic acid
- B propan-2-ol and butanoic acid
- C propan-1-ol and propanoic acid
- D propan-2-ol and propanoic acid

1135. 9701_m20_qp_12 Q: 27

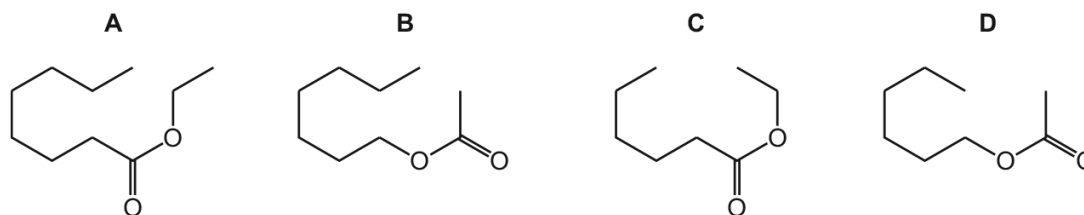
Which reaction would produce propanoic acid as one of its products?

- A heating $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{CH}_3$ with concentrated, acidified KMnO_4
- B heating $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_2\text{CH}_3$ with $\text{NaOH}(\text{aq})$
- C heating $\text{CH}_3\text{CH}_2\text{OH}$ with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ under reflux
- D reacting CH_3CHO with HCN then heating the organic product with $\text{H}_2\text{SO}_4(\text{aq})$

1136. 9701_s20_qp_11 Q: 26

When compound X is heated under reflux with aqueous sodium hydroxide solution two products are formed: sodium ethanoate and hexan-1-ol.

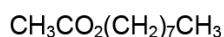
What is compound X?



1137. 9701_s20_qp_12 Q: 23

Ester X is shown.

ester X



Ester X is hydrolysed using aqueous sodium hydroxide.

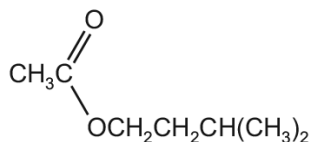
What is the molecular formula of one of the products?

- A** $\text{C}_2\text{H}_4\text{O}_2$ **B** $\text{C}_2\text{H}_3\text{O}_2\text{Na}$ **C** $\text{C}_8\text{H}_{16}\text{O}$ **D** $\text{C}_8\text{H}_{17}\text{O}_2\text{Na}$

1138. 9701_s20_qp_13 Q: 21

Ester P has the following structural formula.

ester P



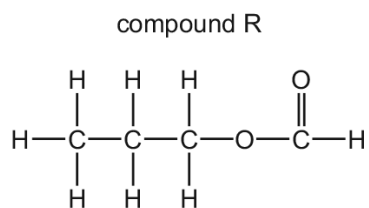
Which compounds are produced when P is hydrolysed using dilute hydrochloric acid?

- A** $\text{CH}_3\text{COC}l$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
B $\text{CH}_3\text{CH}_2\text{OH}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CO}_2\text{H}$
C $\text{CH}_3\text{CO}_2\text{H}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CO}_2\text{H}$
D $\text{CH}_3\text{CO}_2\text{H}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$



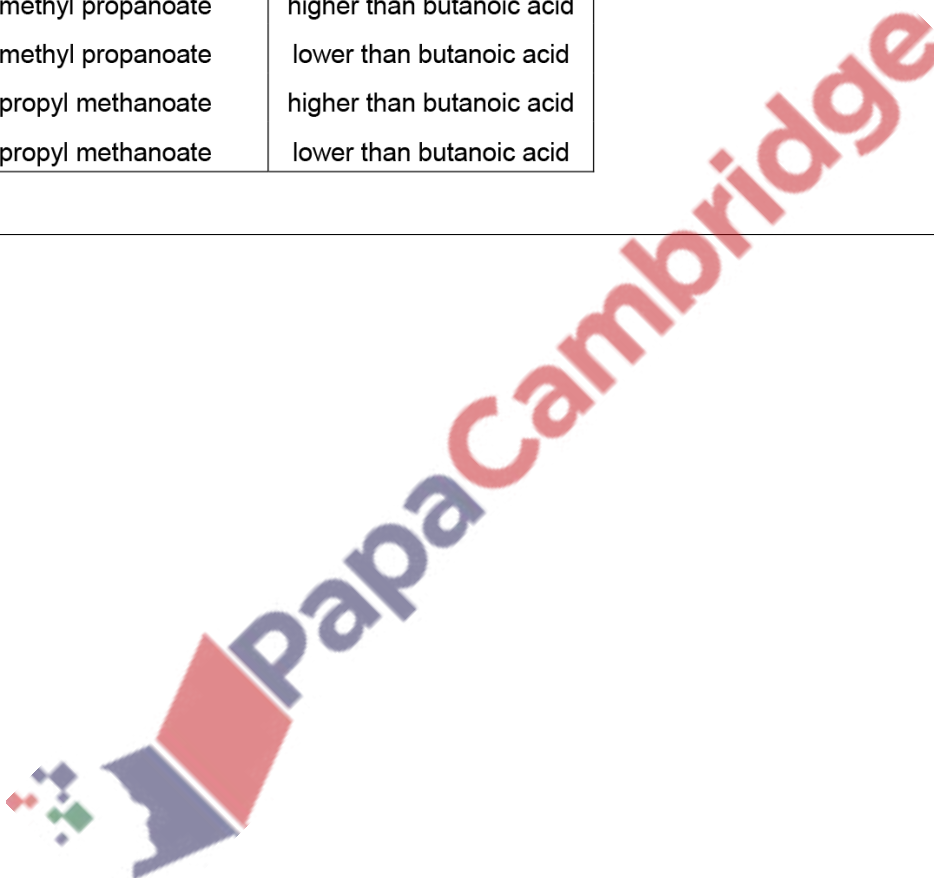
1139. 9701_s19_qp_12 Q: 29

One molecule of compound R is shown.



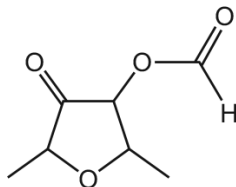
What is the name of compound R and how does its boiling point compare with that of butanoic acid?

	name of R	boiling point of R
A	methyl propanoate	higher than butanoic acid
B	methyl propanoate	lower than butanoic acid
C	propyl methanoate	higher than butanoic acid
D	propyl methanoate	lower than butanoic acid

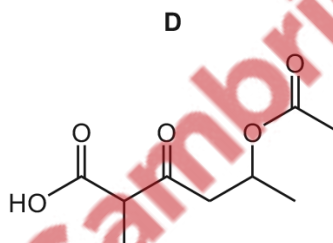
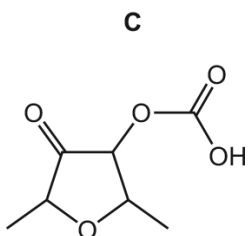
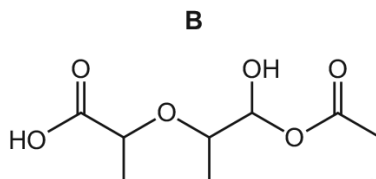
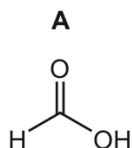


1140. 9701_s19_qp_13 Q: 30

An ester is shown.



What is the structure of the carboxylic acid that would be obtained by acid hydrolysis of the ester linkage?



1141. 9701_w19_qp_12 Q: 29

Compound Q can be hydrolysed by $\text{HCl}(\text{aq})$. The two products of this hydrolysis have the same empirical formula.

What could Q be?

- A** $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{OH}$
- B** $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- C** $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- D** $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$

1142. 9701_s18_qp_11 Q: 11

Hydrogen ions catalyse the hydrolysis of esters.

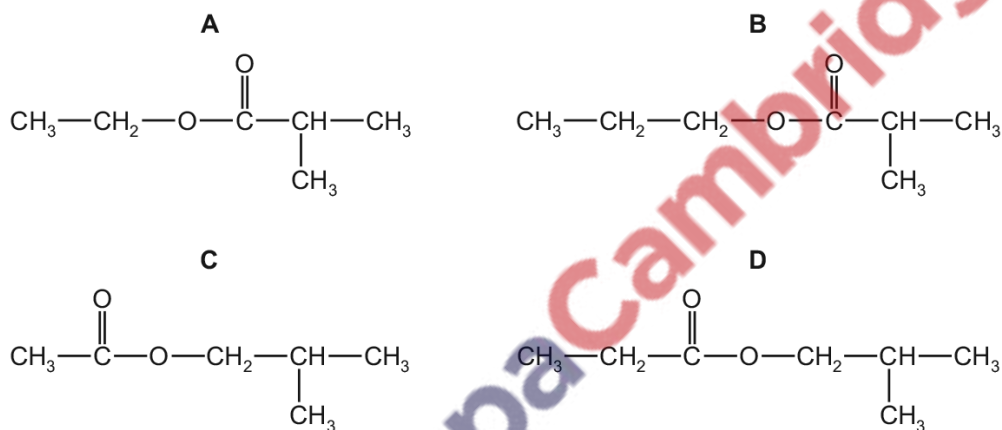
Which statement is correct?

- A The hydrogen ions act as a heterogeneous catalyst.
- B The hydrogen ions are in the same phase as the reactants.
- C The hydrogen ions are used up in the reaction.
- D The hydrogen ions have no effect on the activation energy of the reaction.

1143. 9701_s18_qp_11 Q: 27

Ethyl propanoate is refluxed with aqueous sodium hydroxide. The alcohol produced is then reacted with methyl propanoic acid to make a second ester.

What is the structural formula of this second ester?



1144. 9701_s18_qp_12 Q: 29

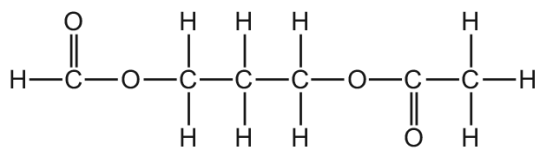
The ester ethyl butanoate can be hydrolysed using an excess of dilute sodium hydroxide solution.

Which substance is a product of this reaction?

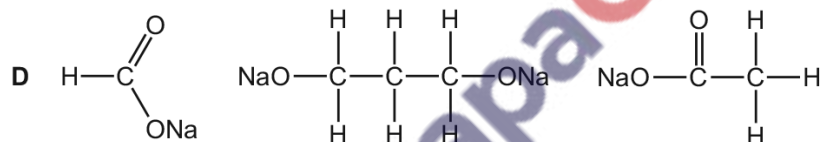
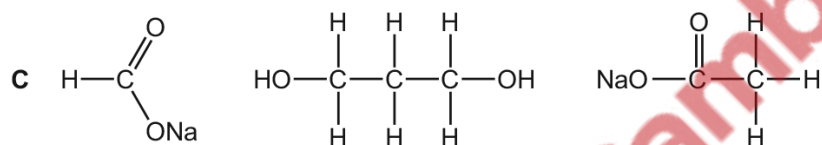
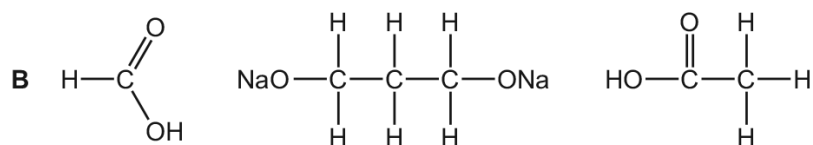
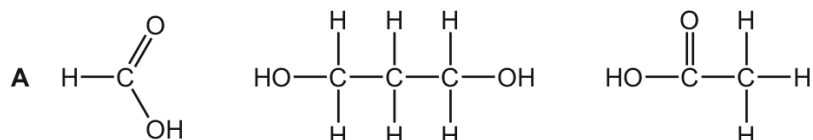
- A CH₃CH₂CH₂CO₂Na
- B CH₃CO₂Na
- C CH₃CH₂ONa
- D H₂O

1145. 9701_w18_qp_11 Q: 29

The diester shown can be hydrolysed by heating with an excess of aqueous sodium hydroxide.



What would the products of this reaction be?



1146. 9701_w18_qp_12 Q: 28

Compound **Y** gives methanol and sodium ethanoate on treatment with aqueous sodium hydroxide.

What is the structure of **Y**?

- A** $\text{CH}_3\text{CO}_2\text{CH}_3$
- B** $\text{HCO}_2\text{C}_2\text{H}_5$
- C** $\text{HO}_2\text{CCH}_2\text{CHO}$
- D** $\text{HOCH}_2\text{CH}_2\text{COOH}$

1147. 9701_s17_qp_12 Q: 30

Which compound, when hydrolysed, gives propanoic acid and propan-2-ol?

- A** $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_3$
B $(\text{CH}_3)_2\text{CHCO}_2\text{CH}_2\text{CH}_3$
C $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_3$
D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_3$

1148. 9701_w17_qp_11 Q: 30

 A sample of the ester $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_3$ is hydrolysed. The product mixture is then treated with hot, acidified KMnO_4 .

What are the final carbon-containing products?

- A** $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ only
B $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{CH}_2\text{CO}_2\text{H}$
C $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
D $\text{CH}_3\text{CH}_2\text{OH} + \text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$


1149. 9701_m16_qp_12 Q: 28

Which mixture could be used to produce propyl methanoate?

- A** $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and CH_3OH
B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ and HCO_2H
C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and HCO_2H
D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ and CH_3OH

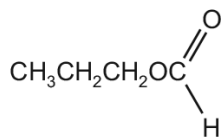
1150. 9701_m16_qp_12 Q: 30

Which row of the table is correct?

	 increasing number of carbon atoms \longrightarrow			
A	ethyl methanoate	methyl propanoate	pentyl pentanoate	propyl butanoate
B	ethyl methanoate	methyl propanoate	propyl butanoate	pentyl pentanoate
C	methyl propanoate	propyl butanoate	ethyl methanoate	pentyl pentanoate
D	propyl butanoate	ethyl methanoate	pentyl pentanoate	methyl propanoate

1151. 9701_s16_qp_11 Q: 21

The structural formula of compound **X** is shown below.



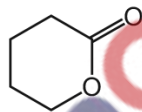
compound **X**

What is the name of compound **X** and how does its boiling point compare with that of butanoic acid?

	name of X	boiling point of X
A	methyl propanoate	higher than butanoic acid
B	methyl propanoate	lower than butanoic acid
C	propyl methanoate	higher than butanoic acid
D	propyl methanoate	lower than butanoic acid

1152. 9701_s16_qp_11 Q: 27

Cyclic esters are also known as lactones. *Delta* lactone is used as a solvent and in the manufacture of polyesters.



delta lactone

From which compound could *delta* lactone be made by a single reaction?

- A** HOCH₂CH₂CH₂CH₂CHO
- B** HOCH₂CH₂CH₂CH₂CO₂H
- C** HOCH₂CH₂CH₂CH₂CH₂OH
- D** HOCH₂CH₂CH₂CH₂CH₂CO₂H

1153. 9701_s16_qp_11 Q: 29

The ester CH₃CH₂CH₂CO₂CH₂CH(CH₃)₂ was hydrolysed under acidic conditions.

What are the organic products of this hydrolysis?

- A** butanoic acid and 2-methylpropan-1-ol
- B** butanoic acid and 2-methylpropan-2-ol
- C** butan-1-ol and 2-methylpropanoic acid
- D** propanoic acid and 2-methylpropan-1-ol

1154. 9701_s16_qp_12 Q: 30

Compound X, $C_4H_8O_2$, has an unbranched carbon chain. An aqueous solution of X has an approximate pH of 3.

Compound Y, C_3H_8O , is a secondary alcohol.

X and Y are reacted together in the presence of a little concentrated sulfuric acid to form Z as the major organic product.

What is the structural formula of Z?

- A $(CH_3)_2CHCO_2CH_2CH_2CH_3$
- B $CH_3(CH_2)_2CO_2CH(CH_3)_2$
- C $CH_3(CH_2)_2CO_2(CH_2)_2CH_3$
- D $(CH_3)_2CHCO_2CH(CH_3)_2$

1155. 9701_s16_qp_13 Q: 29

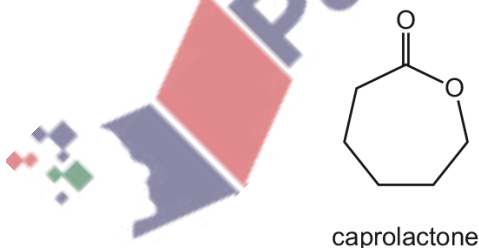
The ester, $CH_3CH_2CO_2CH_3$, is hydrolysed by boiling with aqueous sodium hydroxide.

Which compound is one of the products?

- A ethanol
- B propan-1-ol
- C sodium methanoate
- D sodium propanoate

1156. 9701_s16_qp_13 Q: 30

Caprolactone is a cyclic ester. It is being used increasingly for the manufacture of specialist polymers.

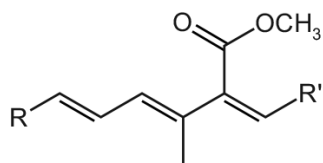


From which compound could caprolactone be made by a single reaction?

- A $OHCCH_2CH_2CH_2CH_2CHO$
- B $HOCH_2CH_2CH_2CH_2CH_2CH_2OH$
- C $HOCH_2CH_2CH_2CH_2CH_2CO_2H$
- D $HO_2CCH_2CH_2CH_2CH_2CO_2H$

1157. 9701_w16_qp_11 Q: 23

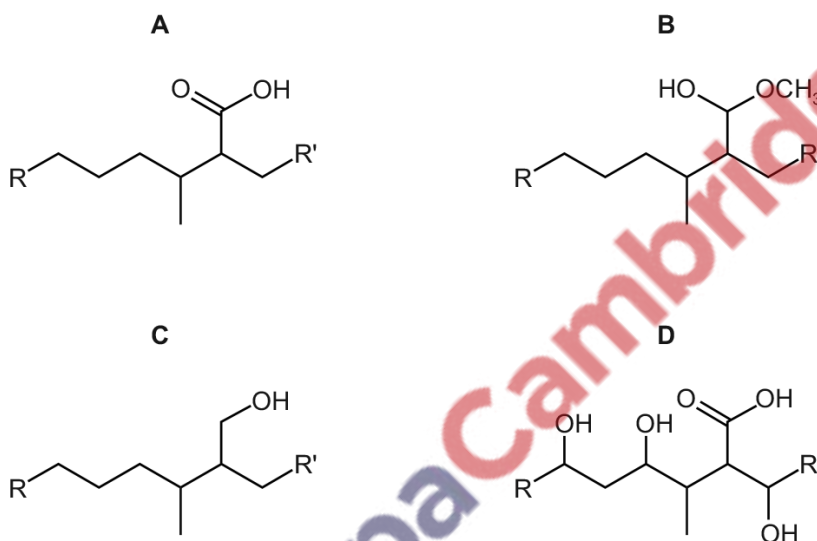
Part of the structure of a fungicide, strobilurin, is shown. R and R' are inert groups.



strobilurin

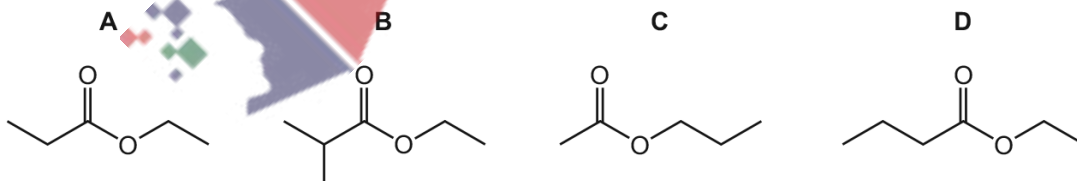
In this reaction, strobilurin is warmed with aqueous sulfuric acid producing compound X. Compound X is then treated with hydrogen in the presence of a nickel catalyst producing compound Y.

What could be the structure of compound Y?



1158. 9701_w16_qp_11 Q: 29

Which formula represents an ester that will form propanoic acid on hydrolysis with dilute sulfuric acid?



1159. 9701_w16_qp_12 Q: 26

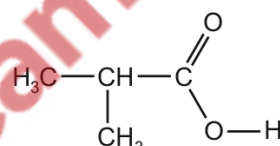
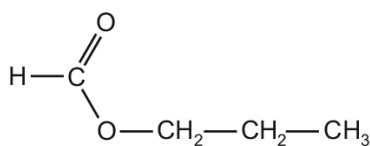
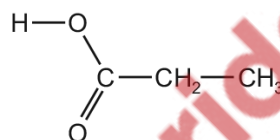
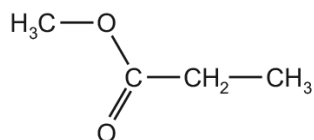
Ethane-1,2-diol, $\text{HOCH}_2\text{CH}_2\text{OH}$, reacts with an excess of ethanoic acid, $\text{CH}_3\text{CO}_2\text{H}$, in the presence of an acid catalyst. A compound is formed with the molecular formula $\text{C}_6\text{H}_{10}\text{O}_4$.

What is the structure of this compound?

- A $\text{CH}_3\text{OCOCH}_2\text{CH}_2\text{CO}_2\text{CH}_3$
- B $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}_3$
- C $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{OCOCH}_3$
- D $\text{HOCH}_2\text{CH}_2\text{COCH}_2\text{OCOCH}_3$

1160. 9701_w16_qp_12 Q: 29

How many of the compounds shown will react with aqueous sodium hydroxide to form the sodium salt of a carboxylic acid?

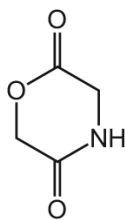


- A 1
- B 2
- C 3
- D 4



1161. 9701_s15_qp_11 Q: 21

The cyclic compound M is heated with dilute hydrochloric acid.



compound M

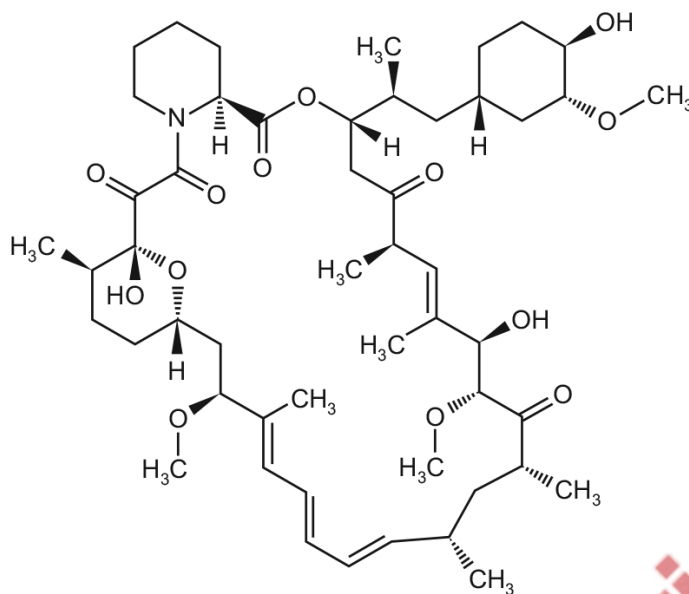
What are the products of the reaction?

- A** $\text{HOCH}_2\text{CO}_2\text{H}$ and $\text{H}_2\text{NCH}_2\text{CO}_2\text{H}$
- B** $\text{HO}_2\text{CCH}_2\text{OH}$ and $\text{HO}_2\text{CCH}_2\text{NH}_3^+$
- C** $\text{H}_2\text{NCOCH}_2\text{OH}$ and HOCH_2CHO
- D** $\text{HOCH}_2\text{CONH}_3^+$ and HOCH_2CHO

PapaCambridge

1162. 9701_s15_qp_12 Q: 30

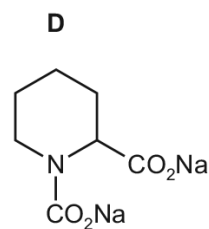
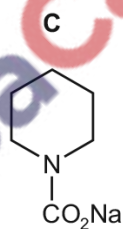
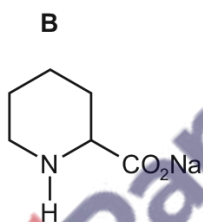
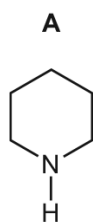
The drug *Sirolimus* is used to treat patients after kidney transplants.



Sirolimus

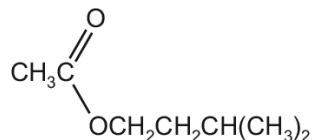
On reaction with hot aqueous sodium hydroxide, *Sirolimus* produces an equimolar mixture of two organic products.

What is the structural formula of the product with the lower relative molecular mass?



1163. 9701_s15_qp_13 Q: 23

An ester P with a fruity odour has the following structural formula.



Which compounds are produced when P is hydrolysed using hydrochloric acid?

- A $\text{CH}_3\text{COC}l$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
- B CH_3CHO and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
- C $\text{CH}_3\text{CO}_2\text{H}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CHO}$
- D $\text{CH}_3\text{CO}_2\text{H}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$

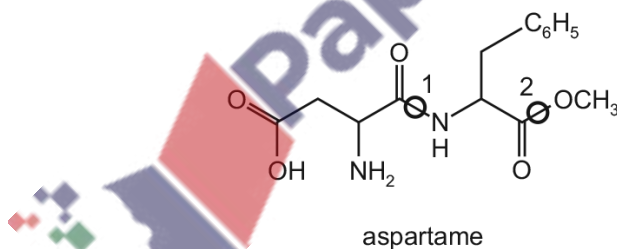
1164. 9701_w15_qp_11 Q: 30

Which compound produces butan-2-ol and ethanoic acid on hydrolysis?

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

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The structure of aspartame, which is used as an artificial sweetener, is shown.



If aspartame is warmed in aqueous alkali, which of bonds 1 and 2 will be broken?

- A both bond 1 and bond 2
- B bond 1 only
- C bond 2 only
- D neither bond 1 nor bond 2