

18. Carboxylic acids and derivatives

18.2 Esters

Paper 1

Question Paper

1 $C_2H_5COOCH_3$ is reacted with aqueous acid.

The products from this reaction are reacted with $LiAlH_4$ to form two molecules Y and Z.

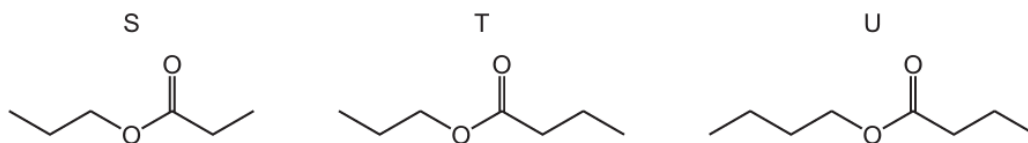
What are the identities of molecules Y and Z?

- A** both molecules are C_2H_5OH
- B** CH_3OH and $CH_3CHOHCH_3$
- C** CH_3OH and C_2H_5OH
- D** CH_3OH and $C_2H_5CH_2OH$

2 Compound Z has the molecular formula $C_4H_8O_2$.

Compound Z reacts with propan-1-ol in the presence of concentrated H_2SO_4 .

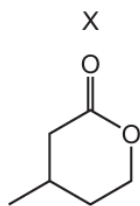
The diagram shows the skeletal formulae of three compounds, S, T and U.



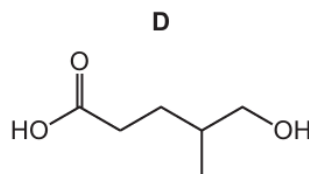
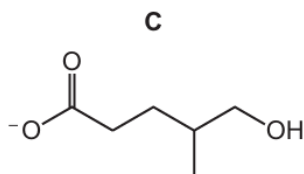
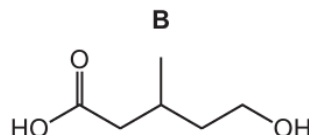
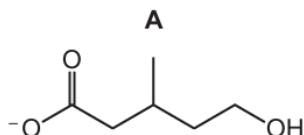
What are the possible skeletal formulae of the products of the reaction between compound Z and propan-1-ol?

- A** S and T
- B** U only
- C** S and U
- D** T only

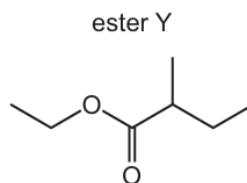
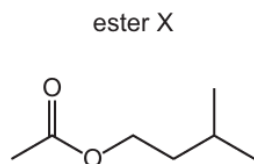
- 3 Compound X is treated with an excess of dilute aqueous potassium hydroxide.



What is the structure of the organic product?



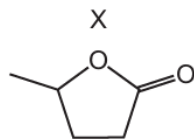
- 4 The diagrams show the structures of two esters, X and Y, that are formed in ripening apples.



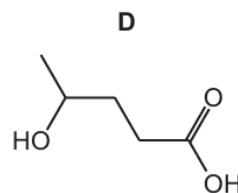
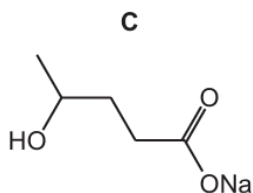
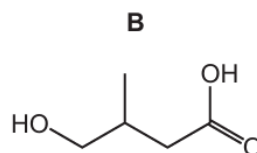
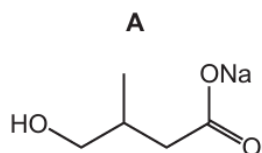
Which carboxylic acids are formed when these esters are hydrolysed by $\text{H}_2\text{SO}_4(\text{aq})$?

	ester X	ester Y
A	CH_3COOH	$\text{CH}_3\text{CH}_2\text{COOH}$
B	CH_3COOH	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{COOH}$
C	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{COOH}$
D	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{COOH}$

- 5 The structure of compound X is shown.



What is produced when X is heated with NaOH(aq)?



- 6 How many esters with the molecular formula $C_5H_{10}O_2$ can be made by reacting a primary alcohol with a carboxylic acid?

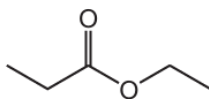
A 4

B 5

C 6

D 8

- 7 The diagram shows an ester. It is heated under reflux with an excess of NaOH(aq).



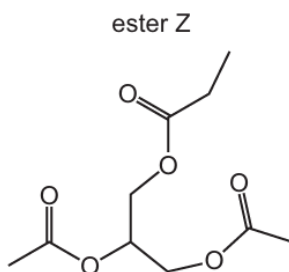
Which row shows the 2 products of the reaction?

	product 1	product 2
A		
B		
C		
D		

- 8 Which ester may be hydrolysed to produce two products, one of which may be reduced to the other?

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

- 9 Two compounds, X and Y, are mixed and a little concentrated H_2SO_4 is added. Ester Z is found in the resulting mixture of products.

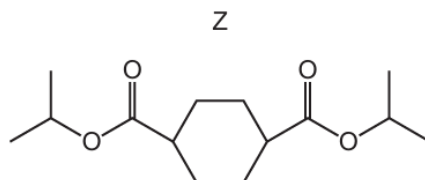


Which two compounds could be X and Y?

	X	Y
A	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}(\text{CO}_2\text{H})_3$
B	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OCOCH}_2\text{CH}_3$
C	$\text{CH}_3\text{CO}_2\text{H}$	$\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$
D	$\text{CH}_3\text{CO}_2\text{H}$	$\text{CH}_2(\text{OH})\text{CH}(\text{OH})\text{CH}_2(\text{OH})$

- 10 An alcohol, X, reacts with a dicarboxylic acid, Y, to form a double ester, Z.

The diagram shows the structure of the ester.



Which row about the reactants forming ester Z is correct?

	the class of alcohol X	the shape of the ring in Y
A	secondary	non-planar
B	secondary	planar
C	tertiary	non-planar
D	tertiary	planar

- 11** A carboxylic acid, P, has no chain isomers. It reacts with an alcohol, Q, that has only one positional isomer.

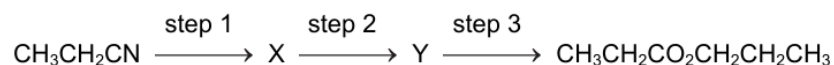
What could be the ester formed from a reaction between P and Q?

- A** butyl propanoate
B ethyl butanoate
C pentyl ethanoate
D propyl pentanoate
- 12** Propyl propanoate can be synthesised in three steps using propanenitrile as the only organic starting material.

In step 1, the nitrile is converted into compound X.

In step 2, compound X is converted into compound Y.

In step 3, compound Y is reacted with more of compound X to give propyl propanoate.



Which reagents are suitable for carrying out step 1 and step 2?

	step 1	step 2
A	HCl(aq)	conc. H ₂ SO ₄
B	HCl(aq)	LiAlH ₄
C	NaOH(aq)	conc. H ₂ SO ₄
D	NaOH(aq)	NaBH ₄

- 13** The ester CH₃CH₂CO₂CH₃ 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
- 14** How many esters have the molecular formula C₄H₈O₂?

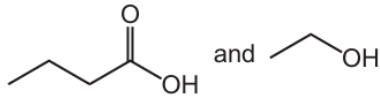
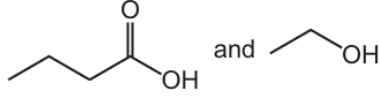
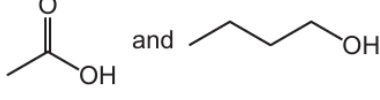
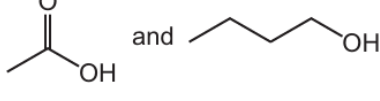
- A** 2 **B** 3 **C** 4 **D** 5

15 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 $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

16 Ethyl butanoate is a flavouring, with a fruity flavour.

Which row is correct?

	alcohol and acid that react to form ethyl butanoate	the mass of water formed when 2.32 g of ester is formed
A		0.36 g
B		0.40 g
C		0.36 g
D		0.40 g

17 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

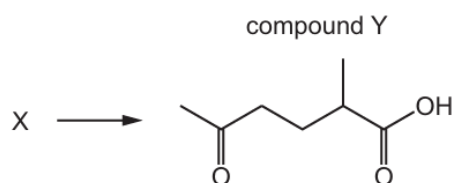
18 The compound cetyl palmitate, $C_{15}H_{31}CO_2C_{16}H_{33}$, is a waxy solid.

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

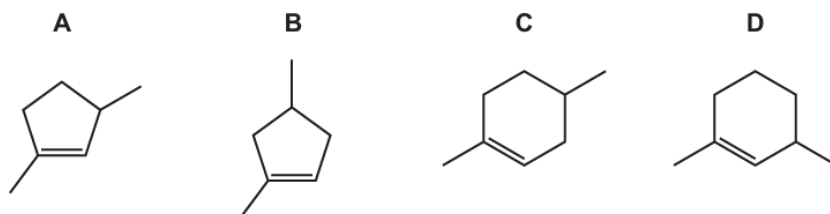
Which products will be formed?

- A** $C_{15}H_{31}ONa$ and $C_{16}H_{33}CO_2Na$
- B** $C_{15}H_{31}CO_2Na$ and $C_{16}H_{33}ONa$
- C** $C_{15}H_{31}OH$ and $C_{16}H_{33}CO_2Na$
- D** $C_{15}H_{31}CO_2Na$ and $C_{16}H_{33}OH$

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

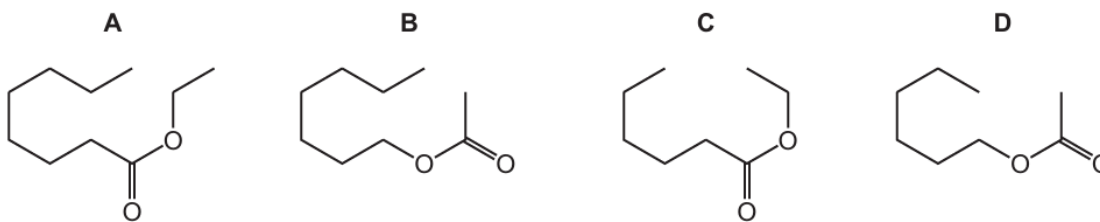


What could be the identity of X?



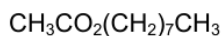
- 20 When compound X is heated under reflux with aqueous sodium hydroxide solution two products are formed: sodium ethanoate and hexan-1-ol.

What is compound X?



- 21 Ester X is shown.

ester X



Ester X is hydrolysed using aqueous sodium hydroxide.

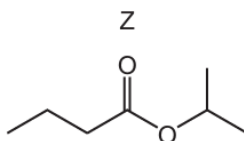
What is the molecular formula of one of the products?

- 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 $\text{C}_8\text{H}_{17}\text{O}_2\text{Na}$
- 22 How many isomeric esters have the molecular formula $\text{C}_4\text{H}_8\text{O}_2$?

- A 2 B 3 C 4 D 5

- 23 Esters can be prepared by the reaction of a carboxylic acid with an alcohol in the presence of concentrated sulfuric acid.

Which row gives the correct names of the reagents that would be suitable to prepare ester Z?

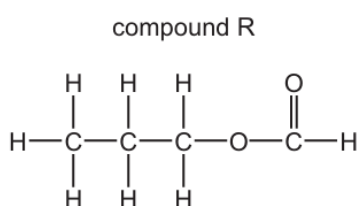


	alcohol	carboxylic acid
A	butan-1-ol	methyl propanoic acid
B	propan-1-ol	butanoic acid
C	propan-2-ol	butanoic acid
D	propan-2-ol	propanoic acid

- 24 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?

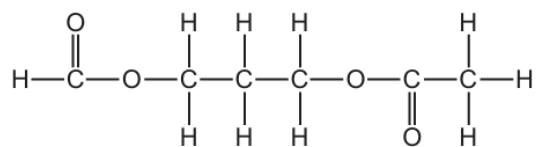
- A $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{OH}$
 B $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
 C $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 D $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
- 25 One molecule of compound R is shown.



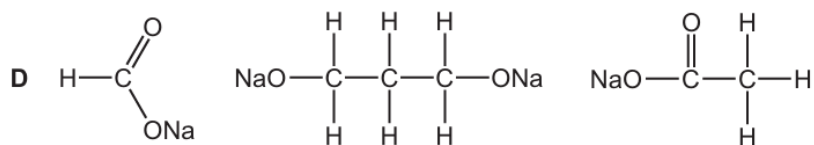
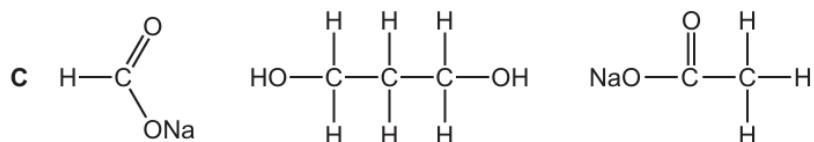
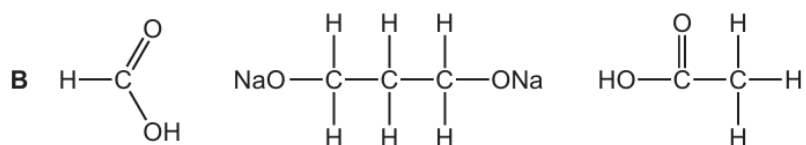
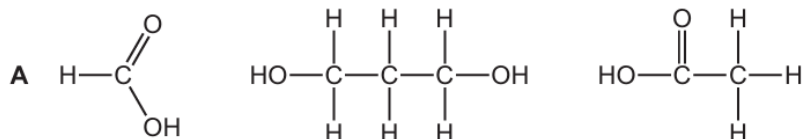
What is the name of compound R and how does its boiling point compare with that of butanoic acid?

	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

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



What would the products of this reaction be?



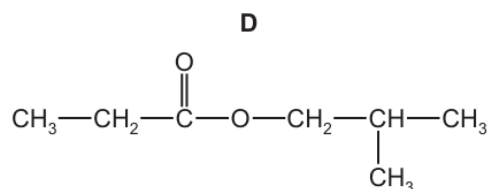
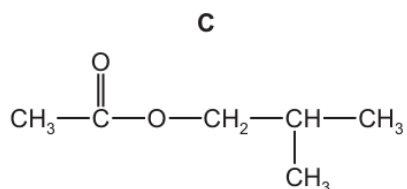
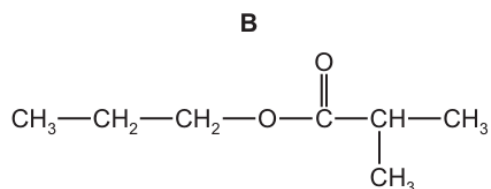
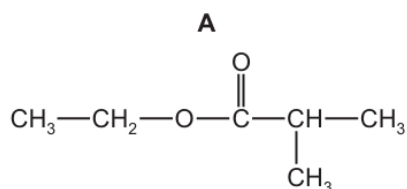
- 27** Compound **Y** gives methanol and sodium ethanoate on treatment with aqueous sodium hydroxide.

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 $\text{HOCH}_2\text{CH}_2\text{COOH}$

- 28** 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?



- 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** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{Na}$
- B** $\text{CH}_3\text{CO}_2\text{Na}$
- C** $\text{CH}_3\text{CH}_2\text{ONa}$
- D** H_2O