

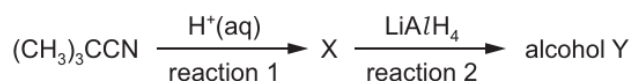
# 18. Carboxylic acids and derivatives

## 18.1 Carboxylic acids

### Paper 1

#### Question Paper

- 1  $(\text{CH}_3)_3\text{CCN}$  reacts to form alcohol Y via the reaction sequence shown.



Which row names the molecule X and the class of alcohol Y?

	name of molecule X	class of alcohol Y
<b>A</b>	2,2-dimethylbutanoic acid	primary
<b>B</b>	3,3-dimethylbutanoic acid	tertiary
<b>C</b>	dimethylpropanoic acid	primary
<b>D</b>	dimethylpropanoic acid	tertiary

- 2 The product of the reaction between propanone and hydrogen cyanide is hydrolysed under acidic conditions.

What is the formula of the final product?

- A**  $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$   
**B**  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$   
**C**  $(\text{CH}_3)_2\text{CHCONH}_2$   
**D**  $(\text{CH}_3)_2\text{C}(\text{OH})\text{COOH}$
- 3 P is a carboxylic acid with molecular formula  $\text{C}_5\text{H}_{10}\text{O}_2$ .

Carboxylic acid P reacts with an excess of  $\text{LiAlH}_4$  to form compound Q.

Which pairs of molecules could be carboxylic acid P and compound Q?

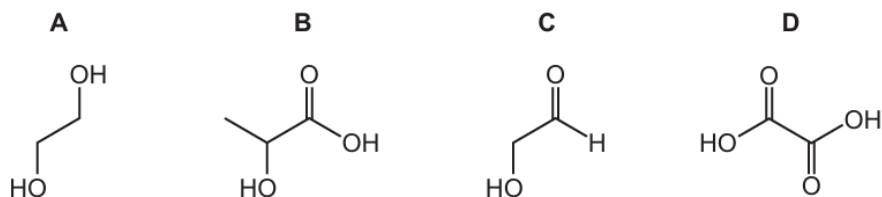
	carboxylic acid P	compound Q
1	$\text{CH}_3(\text{CH}_2)_3\text{COOH}$	$\text{CH}_3(\text{CH}_2)_3\text{OH}$
2	$\text{CH}_3(\text{CH}_2)_3\text{COOH}$	$\text{CH}_3(\text{CH}_2)_3\text{CHO}$
3	$(\text{CH}_3)_3\text{CCOOH}$	$(\text{CH}_3)_3\text{CCH}_2\text{OH}$

- A** 1 and 2      **B** 1 and 3      **C** 2 and 3      **D** 3 only

4 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?

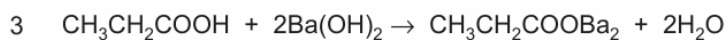
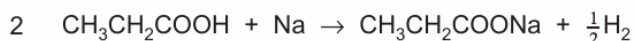
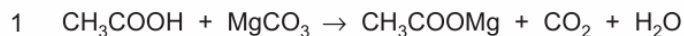


5 Propanoic acid can be made from bromoethane using a two-stage synthesis.

Which pair of reagents is most suitable?

	reagent for stage 1	reagent for stage 2
<b>A</b>	hydrogen cyanide	aqueous sodium hydroxide
<b>B</b>	aqueous sodium hydroxide	excess acidified potassium dichromate(VI)
<b>C</b>	ethanolic sodium hydroxide	acidified potassium manganate(VII)
<b>D</b>	potassium cyanide	dilute hydrochloric acid

6 Three equations are shown.

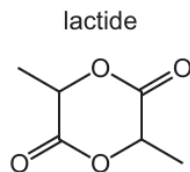


Which of the equations are correct?

- A** 1, 2 and 3      **B** 1 and 2 only      **C** 2 only      **D** 3 only

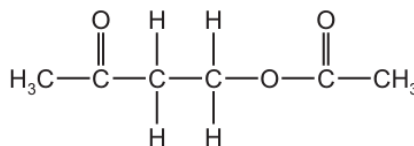
- 7 Which method could produce butanoic acid?
- A an acid–base reaction involving  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{Na}$
  - B the hydrolysis of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$
  - C the acidic hydrolysis of  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_3$
  - D the oxidation of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- 8 Compound X,  $\text{C}_5\text{H}_{10}\text{O}_3$ , has one chiral carbon atom per molecule. Compound X produces bubbles with Na but **not** with  $\text{Na}_2\text{CO}_3$ .
- Which formula could represent compound X?
- A  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CO}_2\text{CH}_3$
  - B  $\text{HOCH}_2\text{CH}(\text{CH}_3)\text{CO}_2\text{CH}_3$
  - C  $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)(\text{OH})\text{CO}_2\text{H}$
  - D  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{CH}_3)\text{CO}_2\text{H}$
- 9 Which reaction will form propanoic acid?
- A acidic hydrolysis of propyl ethanoate
  - B alkaline hydrolysis of ethyl propanoate
  - C acidic hydrolysis of propanenitrile
  - D acidic hydrolysis of ethanenitrile

- 10** Lactide is an intermediate in the manufacture of a synthetic fibre.



Which compound, on heating with an acid catalyst, can produce lactide?

- A** hydroxyethanoic acid  
**B** 2-hydroxybutanoic acid  
**C** 2-hydroxypropanoic acid  
**D** 3-hydroxypropanoic acid
- 11** Compound X reacts with ethanoic acid in the presence of an  $\text{H}^+$  catalyst to produce the compound shown.



What is the molecular formula of compound X?

- A**  $\text{C}_2\text{H}_4\text{O}$       **B**  $\text{C}_2\text{H}_6\text{O}_2$       **C**  $\text{C}_4\text{H}_8\text{O}$       **D**  $\text{C}_4\text{H}_8\text{O}_2$
- 12** Two 1g samples of Y are reacted separately and completely with sodium and with sodium carbonate. The volumes of the gases produced are collected and measured.

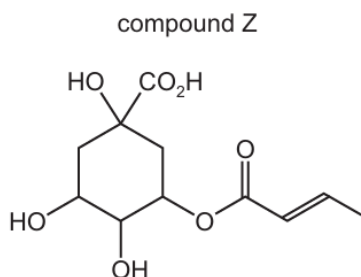
	relative volumes of gases	
	with Na	with $\text{Na}_2\text{CO}_3$
Y	2	1

What could Y be?

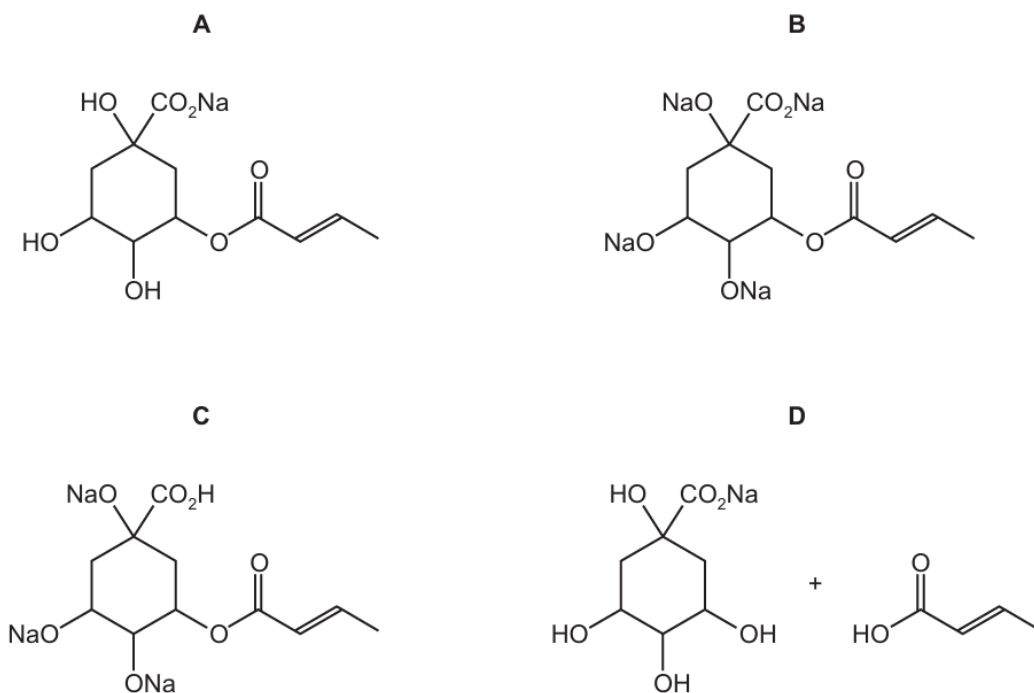
- A**  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{OH}$   
**B**  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$   
**C**  $\text{CH}_3\text{COCH}_2\text{OH}$   
**D**  $\text{CH}_3\text{COCO}_2\text{H}$

- 13** Which reaction is a redox reaction?
- A** ethanenitrile heated under reflux with dilute hydrochloric acid
  - B** ethanoic acid reacted with aqueous sodium hydroxide
  - C** ethanoic acid reacted with sodium
  - D** ethyl ethanoate heated under reflux with dilute hydrochloric acid
- 14** 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
- 15** 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**  $\text{CH}_3\text{CH}_2\text{ONa}$

- 16 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?

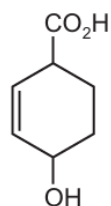


- 17 Which reaction produces an organic anion with a good yield?

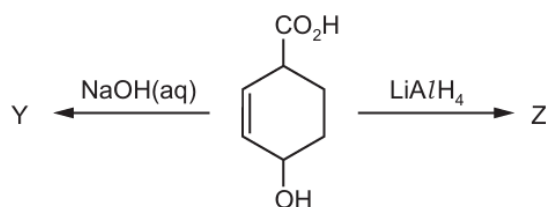
- A** heating ethanenitrile under reflux with dilute sodium hydroxide  
**B** heating ethanenitrile under reflux with dilute sulfuric acid  
**C** heating ethane with sodium metal  
**D** heating ethanol under reflux with dilute sodium hydroxide

18 Compound X is shown.

compound X



X is treated separately with NaOH(aq) and LiAlH<sub>4</sub> to give Y and Z.



What are Y and Z?

	Y	Z
<b>A</b>		
<b>B</b>		
<b>C</b>		
<b>D</b>		

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

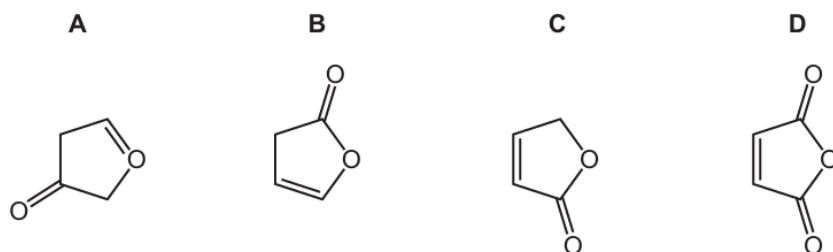
A sample of tartaric acid reacts with an excess of  $\text{LiAlH}_4$  to form the organic product J.

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.

**20** When  $\text{CH}_2(\text{OH})\text{CH}=\text{CHCO}_2\text{H}$  is warmed with a little concentrated sulfuric acid, a cyclic compound is formed.

What is the skeletal formula of the cyclic compound?



**21** Ethanedioic acid,  $\text{HO}_2\text{CCO}_2\text{H}$ , is reduced using an excess of lithium aluminium hydride,  $\text{LiAlH}_4$ .

What is the organic product of the reaction?

- A** ethanol
- B** ethane-1,2-diol
- C** ethanedial,  $\text{OHCCHO}$
- D** methane

22 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?

