

21. Organic synthesis Analysis

21.1 Organic synthesis

Paper 1

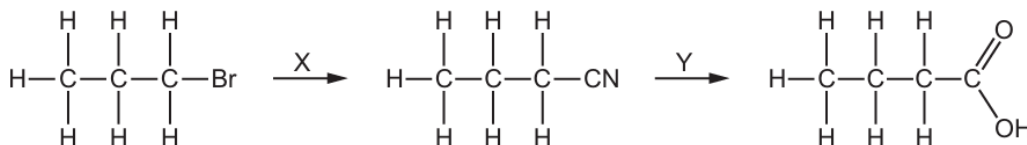
Question Paper

- 1 The diagram shows a synthetic route to produce 1-methylcyclohexanol.



What is reagent Y?

- A aqueous NaOH
 B cold dilute KMnO_4
 C ethanolic NaOH
 D hot concentrated KMnO_4
- 2 X and Y are the reagents required to convert 1-bromopropane into butanoic acid.



What are the correct identities of reagents X and Y?

| | X | Y |
|---|--|-------------------|
| A | NH_3 | HCl(aq) |
| B | KCN in $\text{C}_2\text{H}_5\text{OH}$ | NaOH(aq) |
| C | KCN in $\text{C}_2\text{H}_5\text{OH}$ | HCl(aq) |
| D | HCN | NaOH(aq) |

- 3 The table shows three sets of reagents and reaction conditions.

| | reagents | reaction conditions |
|---|--|-----------------------------------|
| 1 | $\text{CH}_2\text{C}(\text{CH}_3)\text{CH}_3$ and HCl(g) | room temperature |
| 2 | $\text{CH}_3\text{C}(\text{CH}_3)(\text{OH})\text{CH}_3$ and SOCl_2 | room temperature |
| 3 | $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3$ and Cl_2 | the presence of ultraviolet light |

Which sets of reagents and conditions can be used to produce 2-chloro-2-methylpropane as one of the organic products?

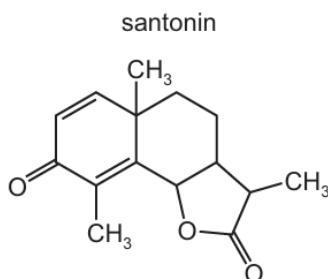
- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

- 4 Propanoic acid can be used to make propene by a two-stage synthesis.

Which row shows suitable reagents for this synthesis?

| | reagent for first stage | reagent for second stage |
|----------|-------------------------|-------------------------------|
| A | LiAlH_4 | conc. H_2SO_4 |
| B | LiAlH_4 | NaOH in ethanol |
| C | NaBH_4 | conc. H_2SO_4 |
| D | NaBH_4 | NaOH in ethanol |

- 5 The structure of santonin is shown.



Santonin is first treated with warm dilute H_2SO_4 . The product of this reaction is treated with cold dilute acidified KMnO_4 . A final product, Q, is obtained.

How many atoms of hydrogen in each molecule of product Q will react with sodium metal?

- A** 2 **B** 4 **C** 5 **D** 6
- 6 Compound R can be formed from 1-bromopropane using a nucleophilic substitution reaction followed by an oxidation reaction.

What is the identity of R?

- A** propanoic acid
B propanone
C propylamine
D propyl ethanoate

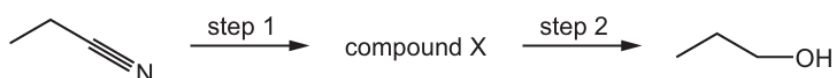
- 7 Butanoic acid is prepared from 1-bromopropane.

This synthesis requires a sequence of two reactions.

Which compound is prepared in the first stage of the synthesis?

- A 1-aminopropane
- B propan-1-ol
- C butanal
- D butanenitrile

- 8 The synthesis shown may be used for the production of propan-1-ol.



Which row gives the correct reagents for steps 1 and 2?

| | step 1 | step 2 |
|----------|----------|---------------------|
| A | HCl(aq) | H ₂ + Ni |
| B | HCl(aq) | LiAlH ₄ |
| C | NaOH(aq) | H ₂ + Ni |
| D | NaOH(aq) | NaBH ₄ |

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

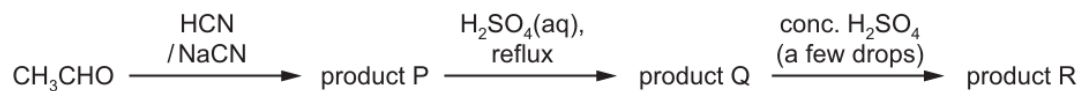
In the **first** of the two stages, which reagent is reacted with 1-iodopropane?

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

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

- A CH₂=CHCH₂CH₃
- B CH₃CH₂CH₂CN
- C CH₃CH(OH)CN
- D CH₃CH(OH)CH₃

- 11** 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** $\text{C}_6\text{H}_{10}\text{O}_5$