

10.2 Functional Group Chemistry

Question Paper

Course	DPIB Chemistry
Section	10. Organic Chemistry
Topic	10.2 Functional Group Chemistry
Difficulty	Hard

Time allowed: 50
Score: /41
Percentage: /100

Question 1a

a)
Dichloromethyl benzene reacts with chlorine to produce trichloromethyl benzene. State the name of this type of mechanism and the required condition.

[2]

[2 marks]

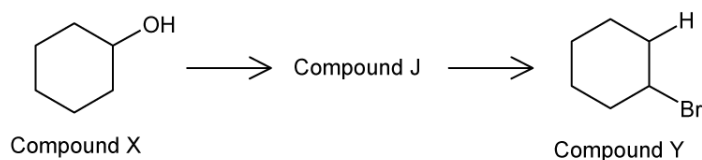
Question 1b

b)
Outline the mechanism for the reaction occurring in part a).

[4 marks]

Question 1c

c)
A reaction pathway is shown below. Compound J reacts with bromine water to form a colourless solution.



State the IUPAC name for Compound J.

[1]

[1 mark]

Question 1d

d)

Identify the reagents and conditions for the formation of Compound Y from Compound J.

[2]

[2 marks]

Question 2a

a)

Compounds **W**, **X** and **Y** are all carbohydrates with **X** and **Y** each containing five carbons. Compound **W** and a byproduct, compound **Z**, are formed from the reaction between compound **X** and **Y**. Compound **X** can be oxidised by the reaction with acidified potassium dichromate to give compound **Y**.

2.754 g of compound **Y** contains 0.027 moles.

Using the information given, state the name of compound **Y** and justify your answer.

[3]

[3 marks]

Question 2b

b)

Deduce the structural formula of compound **W** and explain how compound **Z** is formed in the reaction.

[2]

[2 marks]

Question 2c

c)

Compound **X** will oxidise to compound **Y** if allowed to fully oxidise. Explain how a student could stop the full oxidation of compound **X**.

[4]

[4 marks]

Question 2d

d)

Deduce the formula of an isomer of compound **X** that will not react with acidified potassium dichromate, $\text{H}^+ / \text{K}_2\text{Cr}_2\text{O}_7$.

[1]

[1 mark]

Question 3a

a)

Ester **A** is responsible for a raspberry scent and has the molecular formula $\text{C}_5\text{H}_{10}\text{O}_2$. Ester **A** can be produced by the reaction of an acid with a branched primary alcohol. Identify the acid and alcohol used to prepare ester **A**.

[2]

[2 marks]

Question 3b

b)

State the IUPAC name and draw the structural formula of ester **A**.

[2]

[2 marks]

Question 3c

c)

State the name of the product when the alcohol used to form ester **A** reacts with potassium permanganate, KMnO_4 (aq).

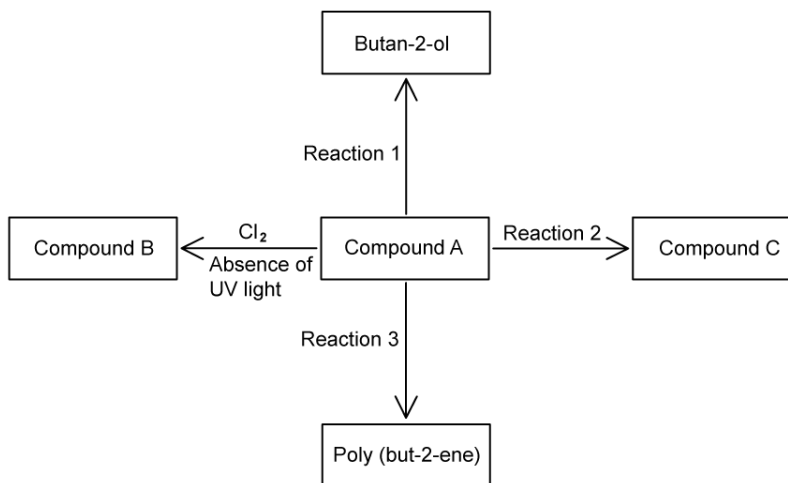
[1]

[1 mark]

Question 4a

a)

The following scheme shows reactions of Compound **A**.



i)

Deduce the structural formula of compound **A**.

[1]

ii)

Apply IUPAC rules to name compound **B**.

[1]

[2 marks]

Question 4b

b)
Reaction 1 forms an alcohol when reacted with concentrated sulfuric acid, H_2SO_4 and steam.

i)
State the conditions required for this reaction.

[1]

ii)
Deduce the structure of the intermediate in this reaction.

[1]

[2 marks]

Question 4c

c)
Butan-2-ol can also be directly formed from a halogenoalkane.

i)
State the name of the type of reaction occurring in this conversation.

[2]

ii)
State the conditions for this reaction.

[1]

[3 marks]

Question 4d

d)

Identify the structure of the repeating unit of poly(but-2-ene).

[1]

[1 mark]

Question 4e

e)

Compound A reacts with hydrogen bromide to form compound C. A student suggested a possible formula of compound C is $\text{CH}_2(\text{Br})\text{CH}_2\text{CH}_2\text{CH}_3$.

State whether the student is correct and justify your answer.

[1]

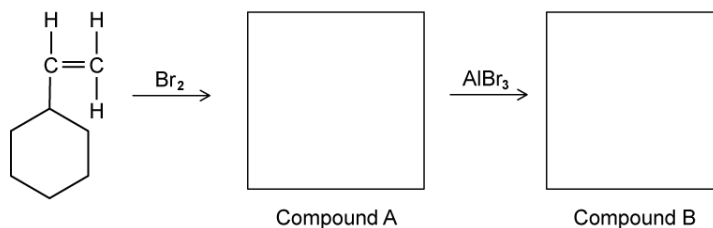
[1 mark]

Question 5a

a)

A student investigated two reactions of phenylethene, $\text{C}_6\text{H}_5\text{CHCH}_2$. First she reacted phenylethene with excess bromine at room temperature to form Compound **A**. She then added aluminium bromide, AlBr_3 to the reaction mixture to form Compound **B**.

Draw the structure of Compound **A** and identify one the isomers of $\text{C}_8\text{H}_7\text{Br}_3$ formed in the second reaction.

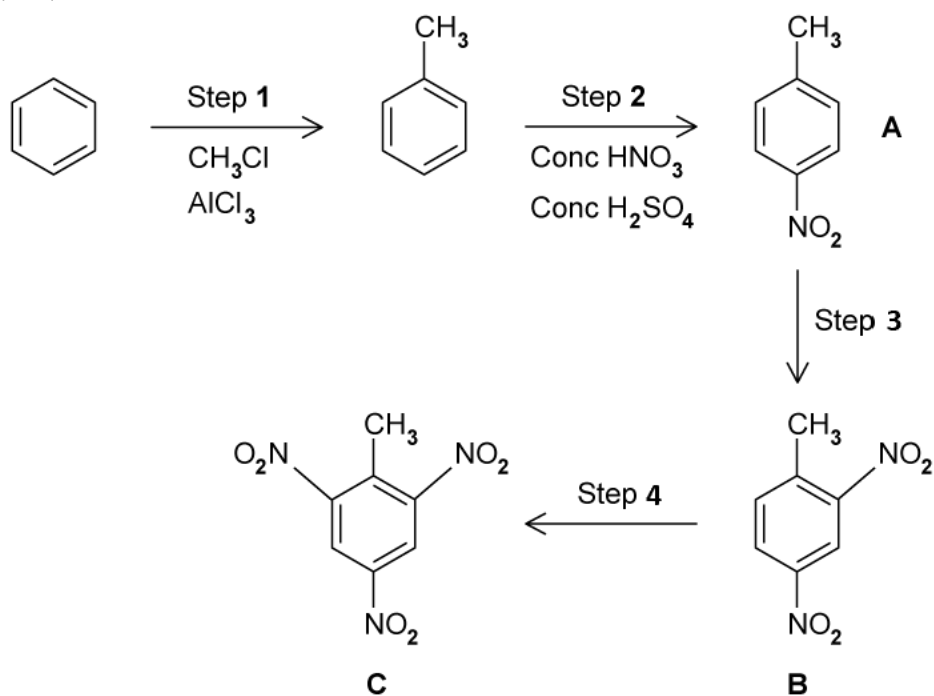


[2 marks]

Question 5b

b)

2,4,6-trinitrotoluene (TNT) can be manufactured from benzene as shown below.



5.00 g of benzene was used in step 1. Use section 6 of the data booklet to determine the theoretical yield for step 1.

[2]

[2 marks]

Question 5c

c)

Step 2 involves the formation of a nitronium ion for the nitration of Toluene, as shown in the following equation:



i)

Explain the role of the nitric acid in the formation of the electrophile.

[2]

ii)

Explain the role of the sulphuric acid in the overall nitration reaction.

[1]

[3 marks]

Question 5d

d)

Explain why the product of step 2 is most likely to have the nitro group bonded to the second or fourth carbon atom.

[1]

[1 mark]