20.1 Types of Organic Reactions

Question Paper

Course	DP IB Chemistry
Section	20. Organic Chemistry (HL only)
Topic	20.1 Types of Organic Reactions
Difficulty	Medium

Time allowed: 60

Score: /43

Percentage: /100

Question 1a

a)
The results of a series of experiments performed to determine the order of reaction between an isomer of bromobutane, C_4H_9Br, and aqueous sodium hydroxide are shown.

Experiment	$[C_4H_9Br]$ / mol dm^{-3}	$[OH^-]$ / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.10	0.20	2.90×10^{-4}
2	0.15	0.20	4.35×10^{-4}
3	0.30	0.40	8.70×10^{-4}

Determine, explaining your method, the rate expression for the reaction of the bromobutane isomer with aqueous sodium hydroxide.

[3 marks]

Question 1b

b)
Use your answer to (a) to deduce the type of mechanism for the reaction of the bromobutane isomer with aqueous sodium hydroxide, explain your reasoning.

[2 marks]

Question 1c

c)
Sketch the mechanism, using curly arrows to represent the movement of electrons.

[4 marks]

Question 1d

d)
State, giving your reason, the role of the hydroxide ion in the nucleophilic substitution.

[1 mark]

Question 2a

a)
The starting material for many products are alkenes such as propene.

State the type of reaction that occurs when propene is converted into chloropropane.

[1 mark]

Question 2b

b)
Two possible isomeric products can be formed in the conversion of propene to chloropropane.

State the type of isomerism that is exhibited by these chloropropane products.

[1 mark]

Question 2c

c)
Explain the mechanism of the reaction that forms the major product when propene is converted to chloropropane using curly arrows to represent the movement of electron pairs.

[4 marks]

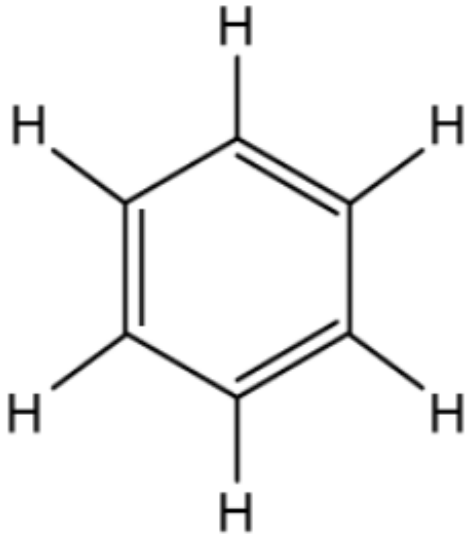
Question 2d

d)
Outline why the major product is formed.

[1 mark]

Question 3a

a)
Kekulé proposed the following structure of benzene.



Discuss the physical and chemical evidence to suggest that the Kekulé structure of benzene is incorrect.

[3 marks]

Question 3b

b)
State the reagents and the name of the mechanism used to convert benzene into nitrobenzene.

[2 marks]

Question 3c

c)
Using your answer to (b), formulate the equation for the formation of the nitronium ion.

[1 mark]

Question 3d

d)
Using curly arrows to indicate the movement of electron pairs, explain the mechanism for the nitration of benzene.

[4 marks]

Question 3e

e)
Nitrobenzene can be converted into aniline in a two-step process. State the reagents for this conversion.

[2 marks]

Question 4a

a)
State a halogenoalkane reactant that can be used to **slowly** produce butan-1-ol by reacting with aqueous sodium hydroxide.

[1 mark]

Question 4b

b)
Butan-1-ol can also be formed by the catalytic reduction of butanal. State the reagents for this reduction to occur

[1 mark]

Question 4c

c)
State the reagent required to reduce butanoic acid to butan-1-ol.

[1 mark]

Question 4d

d)
Using your answer to (c), write the equation for the reduction reaction of butanoic acid.

[1 mark]

Question 5a

a)
1–bromobutane and 2–bromo-2–methylpropane are isomers. State the type of structural isomerism that they exhibit, explaining your reasoning.

[2 marks]

Question 5b

b)
Using curly arrows to indicate the movement of electron pairs, explain the mechanism for the reaction of 1–bromobutane with aqueous sodium hydroxide.

[4 marks]

Question 5c

c)
Consider the reactions of 1–bromobutane and 2–bromo-2–methylpropane with aqueous sodium hydroxide.

Compare and contrast the mechanisms for these reactions.

[3 marks]

Question 5d

d)
Explain why an inversion of configuration occurs during the reaction described in (c).

[1 mark]