Haloalkanes
AS & A Level

Question Paper 1

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Haloalkanes
Paper	AS & A Level
Booklet	Question Paper 1

Time allowed: **49 minutes**

Score: **/36**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

Question 1

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Which compound does **not** react with nucleophiles? **[1]**

A. CH_3CH_2CHO

B. CH_3CHCH_2

C. $CH_3CH_2COCH_3$

D. $CH_3CH_2CH_2Cl$

Question 2

A chemist compares the rates of hydrolysis of 1-chloropropane and 1-bromopropane in ethanol.

Which reagent in aqueous solution should be used? **[1]**

A. Silver chloride

B. Silver nitrate

C. Potassium chloride

D. Potassium nitrate

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When heated with NaOH(aq), 1-iodobutane is hydrolysed at a much faster rate than 1-chlorobutane.

Which statement explains the different rates? **[1]**

A. The C–I bond enthalpy is greater than the C–C*l* bond enthalpy.

B. The C–I bond is less polar than the C–C*l* bond.

C. The C–I bond has a C atom with a greater δ+ charge than in the C–C*l* bond.

D. The C–I bond requires less energy to break than the C–C*l* bond.

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1-Bromobutane, $CH_3CH_2CH_2CH_2Br$, reacts with methoxide ions, CH_3O^-, by nucleophilic substitution.

(a) Suggest how the methoxide ion can act as a nucleophile. [1]

(b) Using the 'curly arrow' model, suggest the mechanism for this reaction.

Show any relevant dipoles. [3]

(c) 1-Iodobutane also reacts with methoxide ions.

Indicate, by placing a tick in one of the boxes, how the use of 1-iodobutane would affect the rate of reaction compared with that of 1-bromobutane.

1-Iodobutane does not change the rate	
1-Iodobutane increases the rate	
1-Iodobutane decreases the rate	

Explain your answer. [1]

(d) The ethanoate ion, CH_3COO^- also acts as a nucleophile when reacting with 1-bromobutane in a substitution reaction.

Draw the skeletal formula and give the name of the organic product formed in this reaction.

skeletal formula [2]

(e) 1-Bromobutane (M_r, 136.9) can be made from a reaction of butan-1-ol, C_4H_9OH, as shown in the equation below.

$$C_4H_9OH + KBr + H_2SO_4 \rightarrow C_4H_9Br + KHSO_4 + H_2O$$

(i) Calculate the atom economy for the formation of 1-bromobutane in this reaction. [1]

(ii) Suggest a reactant, other than a different acid, that could be used to improve the atom economy of making 1-bromobutane by the same method. [1]

(iii) A student prepares a sample of 1-bromobutane.

5.92 g of butan-1-ol are reacted with an excess of sulfuric acid and potassium bromide. After purification, 9.72 g of 1-bromobutane are collected.

Calculate the percentage yield.

Give your answer to **three** significant figures. [3]

[Total 12 Marks]

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Chloroethene, CH_2CHCl, can be polymerised to form poly(chloroethene).

(a) Write an equation, using displayed formulae, to show the formation of this polymer. [2]

(b) Incineration of plastics containing poly(chloroethene) produces waste gases that can damage the environment.

Incineration carried out in the presence of oxygen produces carbon dioxide, carbon monoxide and hydrogen chloride as waste gases and one other non-toxic product.

(i) Write an equation for the incineration of the monomer, chloroethene, with oxygen. [1]

(ii) Chemists have developed ways of removing hydrogen chloride from these waste gases. Sodium hydrogencarbonate, $NaHCO_3(s)$, is frequently used in industry for this purpose.

Explain how sodium hydrogencarbonate removes hydrogen chloride. [1]

(c) Carbon dioxide is a greenhouse gas that is linked to global warming.

The greenhouse effect of carbon dioxide in the atmosphere is dependent on two factors.

What are these **two** factors? [2]

(d) Chemists are trying to minimise climate change as a result of global warming.

One way is to use Carbon Capture and Storage (CCS). One method of CCS is to react the carbon dioxide with metal oxides.

(i) Write an equation to illustrate this method of CCS. [1]

(ii) State one other method of CCS. [1]

[Total 8 Marks]

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Iodine monobromide, IBr, has a permanent dipole.

Alkenes react with IBr in a similar way to the reactions of alkenes with HBr.

(a) Propene reacts with IBr to make two possible organic products.

One of these products is 2-bromo-1-iodopropane.

(i) Using the curly arrow model, complete the mechanism to make 2-bromo-1-iodopropane.

[3]

(ii) What is the name of this mechanism? [1]

(iii) Draw the structure of the other possible organic product of the reaction of propene with IBr. [1]

(b) Methane reacts with IBr to form many products.

Two of these products are iodomethane and hydrogen bromide.

(i) Suggest the essential condition needed for this reaction. [1]

(ii) The mechanism of the reaction involves three steps, one of which is called termination.

Describe the mechanism of the reaction that forms iodomethane and hydrogen bromide.

Include in your answer:

- the name of the mechanism
- the names for the **other two** steps of the mechanism
- equations for these two steps of the mechanism
- the type of bond fission
- one equation for a termination step.

Your answer should link the named steps to the relevant equations. [7]

[Total 13 Marks}