

EXERCISES ON ALKYL HALIDES

1. Chloromethane can be prepared by a reaction between methane and chlorine in the presence of ultraviolet radiation.

(i) Outline the mechanism for this reaction.

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.....
.....
.....
.....
.....

(ii) Name the first step in this mechanism.

.....

(iii) Suggest, giving a reason, how the reaction would be carried out in order to ensure that chloromethane would be the major organic product.

Suggestion.....

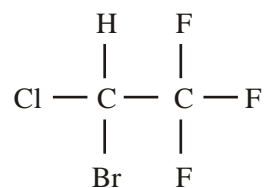
Reason.....

(Total 7 marks)

2. (a) The compound 1,2-dibromo-1,1,2,2-tetrafluoroethane is used in some fire extinguishers. Draw the structure of this compound.

(1)

- (b) Halothane is used as an anaesthetic and has the following structure.



- (i) Give the systematic name of *halothane*.

.....

- (ii) Calculate the M_r of halothane.

.....

- (iii) Calculate the percentage by mass of fluorine in halothane.

.....

(3)
(Total 4 marks)

3. (a) Give the structural formula of 2-bromo-3-methylbutane.

(1)

- (b) Write an equation for the reaction between 2-bromo-3-methylbutane and dilute aqueous sodium hydroxide. Name the type of reaction taking place and outline a mechanism.

Equation

.....

Type of reaction

Mechanism

(4)

- (c) Two isomeric alkenes are formed when 2-bromo-3-methylbutane reacts with ethanolic potassium hydroxide. Name the type of reaction occurring and state the role of the reagent. Give the structural formulae of the two alkenes.

Type of reaction

Role of reagent.....

Structural formula of alkene 1

Structural formula of alkene 2

(4)
(Total 9 marks)

4. (a) Chloromethane can be made by the reaction of chlorine with methane.

- (i) Give **one** essential condition for this reaction.

.....

- (ii) Name the mechanism for this reaction.

.....

- (iii) Further substitution can occur during this reaction. Identify the main organic product when a large excess of chlorine is used in this reaction.

.....

(3)

- (b) Ethanenitrile can be made by reacting chloromethane with potassium cyanide.

- (i) Write an equation for this reaction.

.....

- (ii) Name the mechanism for this reaction.

.....

(iii) Explain, in terms of bond enthalpies, why bromomethane reacts faster than chloromethane with potassium cyanide.

.....
.....
.....

(3)

(c) Chloromethane can react with ammonia to produce a primary amine.

(i) What feature of the chloromethane molecule makes it susceptible to attack by an ammonia molecule?

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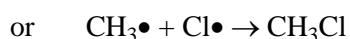
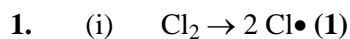
(ii) Name the amine produced in this reaction.

.....

(iii) Outline a mechanism for this reaction.

(6)
(Total 12 marks)

ANSWERS



etc.(1)

(ii) Initiation (1)

(iii) Suggestion Use excess methane or limit the amount of Cl_2 (1)

Reason Idea of - to minimise multiple substitutions (1)

or to minimise or prevent further reaction or substitution
(of CH_3Cl)

or more chance of $\text{Cl}\cdot$ colliding with CH_4 or methane

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[7]

2.

(a) Correct structure for $\text{CF}_2\text{BrCF}_2\text{Br}$ drawn out 1
(penalise "Fl" for fluorine)

(b) (i) 2-bromo-2-chloro-1,1,1-trifluoroethane 1
OR 1-bromo-1-chloro-2,2,2-trifluoroethane
(insist on all numbers, but do not penalise failure to use alphabet)
(accept "flourine" and "cloro" in this instance)

(ii) 197.4 only 1
(ignore units)

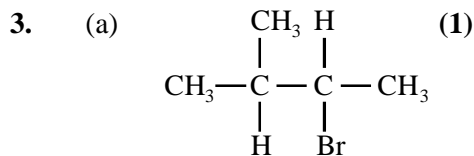
(iii) $(57/197.4 \times 100) = 28.9\%$ OR 28.88% 1
(credit the correct answer independently in part (d)(iii), even if (d)(ii) is blank or incorrectly calculated, but mark consequential on part (d)(ii), if part (d)(ii) is incorrectly calculated, accepting answers to 3sf or 4sf only)
(penalise 29% if it appears alone, but not if it follows a

correct answer)

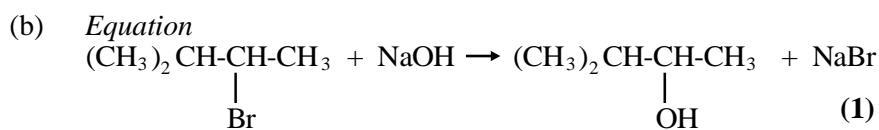
(do not insist on the % sign being given)

(the percentage sign is not essential here, but penalise the use of units e.g. grams)

[4]

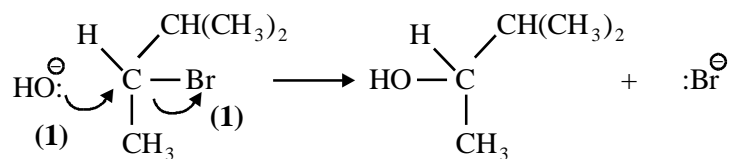


1



Type of reaction hydrolysis or nucleophilic substitution (1)

Mechanism

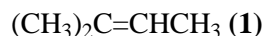


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(c) *Type of reaction* elimination (1)

Role of reagent base (1)

Structural formula of alkene 1



Structural formula of alkene 2



4

[9]

4. (a) (i) UV light OR sunlight OR $T \geq 450^\circ\text{C}$ (1)
NOT high T

(ii) (free) radical substitution (1)

(iii) CCl_4 (1) OR named

3



(ii) nucleophilic substitution (1)

(iii) C-Br bond is weaker (than C-Cl bond)

OR C-Br bond enthalpy is less than C-Cl (1)
Ignore electronegativity

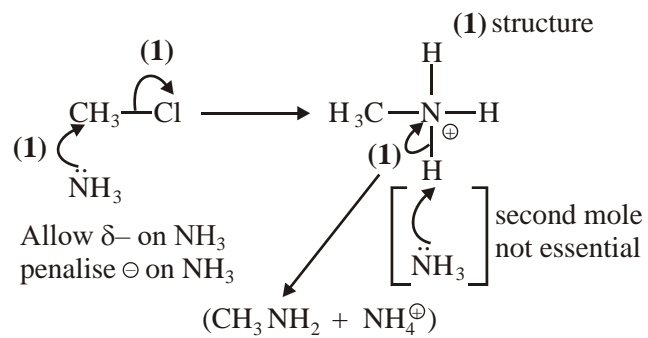
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(c) (i) $\overset{\delta+}{\text{C}}-\overset{\delta-}{\text{Cl}}$ OR C-Cl is polar (1) OR C atom is electron deficient / $\delta+$

(ii) methylamine (1) only

(iii) $\text{S}_{\text{N}}1$ scores full marks

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[12]