Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Halogenoalkanes

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Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

CCl_4 is an effective fire extinguisher but it is no longer used because of its toxicity and its role in the depletion of the ozone layer. In the upper atmosphere, a bond in CCl_4 breaks and reactive species are formed.

(a) Identify the condition that causes a bond in CCl_4 to break in the upper atmosphere. Deduce an equation for the formation of the reactive species.

Condition _____

Equation

_____

(2)

(b) One of the reactive species formed from CCl_4 acts as a catalyst in the decomposition of ozone.

Write **two** equations to show how this species acts as a catalyst.

Equation 1

_____

Equation 2

_____

(2)

(c) A small amount of the freon CF_3Cl with a mass of 1.78×10^{-4} kg escaped from a refrigerator, into a room of volume 100 m^3. Assuming that the freon is evenly distributed throughout the air in the room, calculate the number of freon molecules in a volume of 500 cm^3.
Give your answer to the appropriate number of significant figures.

The Avogadro constant = 6.02×10^{23} mol^{-1}.

Number of molecules = _____

(3)
(Total 7 marks)

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Q2.

Refrigerants are substances used to cool refrigerators and freezers. Until recently, many of the compounds used as refrigerants were chlorofluorocarbons (CFCs), but these are now known to form chlorine radicals. CFCs have been phased out in many countries by international agreement.

(a) Write **two** equations to show how chlorine radicals react with ozone molecules in the upper atmosphere.

1. _____

2. _____

(2)

(b) Chloropentafluoroethane is a CFC that has been used as a refrigerant.

Draw its displayed formula.

(1)

(c) 1,1,1-trifluoroethane (CF_3CH_3) is one of the molecules that has been used as a refrigerant in place of CFCs.

Explain why 1,1,1-trifluoroethane does not lead to the depletion of the ozone in the upper atmosphere.

_____

_____

_____

(1)

(d) One of the steps in the synthesis of 1,1,1-trifluoroethane (CF_3CH_3) is the reaction of 1,1-difluoroethane (CHF_2CH_3) with fluorine in a free-radical substitution reaction.

Write **two** equations to represent the propagation steps in this conversion of CHF_2CH_3 into CF_3CH_3

Propagation step 1

_____

Propagation step 2

_____

(2)

(e) A refrigerator contains 1.41 kg of 1,1,1-trifluoroethane (CF_3CH_3).

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Calculate the number of molecules of 1,1,1-trifluoroethane in the refrigerator.
Give your answer to an appropriate number of significant figures.
(The Avogadro constant L = 6.022×10^{23} mol^{-1})

_____

_____

_____

(2)

(f) There are growing concerns about the use of 1,1,1-trifluoroethane as a refrigerant as it is a greenhouse gas that absorbs some of Earth's infrared radiation.

Give **one** reason why bonds in molecules such as carbon dioxide and 1,1,1-trifluoroethane absorb infrared radiation.

_____

_____

(1)

(Total 9 marks)

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Q3.

Haloalkanes are used as refrigerants, solvents and anaesthetics.

(a) Trichloromethane ($CHCl_3$) is a haloalkane that can be formed by heating a mixture of chloromethane (CH_3Cl) and chlorine.

(i) Write an overall equation for the formation of trichloromethane by the reaction of chloromethane with chlorine.

_____

(1)

(ii) Name the mechanism for this formation of trichloromethane.

_____

(1)

(iii) Dichloromethane (CH_2Cl_2) is an intermediate in this formation of trichloromethane.

Write an equation for each of the following steps in the mechanism for the reaction of dichloromethane with chlorine.

Initiation step

_____

First propagation step

_____

Second propagation step

_____

A termination step leading to the formation of a compound with formula $C_2H_2Cl_4$

_____

(4)

(b) Chlorotrifluoromethane ($CClF_3$) is used as a refrigerant, but is being phased out due to concerns about ozone depletion in the upper atmosphere.
In the upper atmosphere, $CClF_3$ decomposes in the presence of UV light forming a reactive intermediate that catalyses the decomposition of ozone.

(i) Write an equation to show how $CClF_3$ decomposes to form the reactive intermediate.

_____

(1)

(ii) Write two equations to show how this reactive intermediate is involved in catalysing the decomposition of ozone.

1. _____

2. _____

(2)

(Total 9 marks)

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