

Halogen derivatives – 2021 AS

1. Nov/2021/Paper_12/No.21

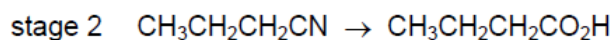
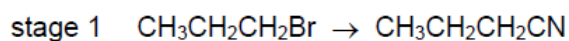
Bromomethane, CH_3Br , decomposes in the stratosphere forming methyl free radicals and bromine free radicals.

Which row correctly describes this decomposition?

	type of bond fission	number of electrons in a bromine free radical
A	homolytic	35
B	heterolytic	35
C	homolytic	36
D	heterolytic	36

2. Nov/2021/Paper_12/No.24

Butanoic acid can be made from 1-bromopropane in two stages.



Which types of reaction are stage 1 and stage 2?

	stage 1	stage 2
A	electrophilic addition	hydrolysis
B	electrophilic addition	oxidation
C	nucleophilic substitution	hydrolysis
D	nucleophilic substitution	oxidation

3. Nov/2021/Paper_12/No.25

A halogenoalkane has the molecular formula $\text{C}_5\text{H}_{11}\text{Br}$. The halogenoalkane does not form an alkene when treated with ethanolic sodium hydroxide.

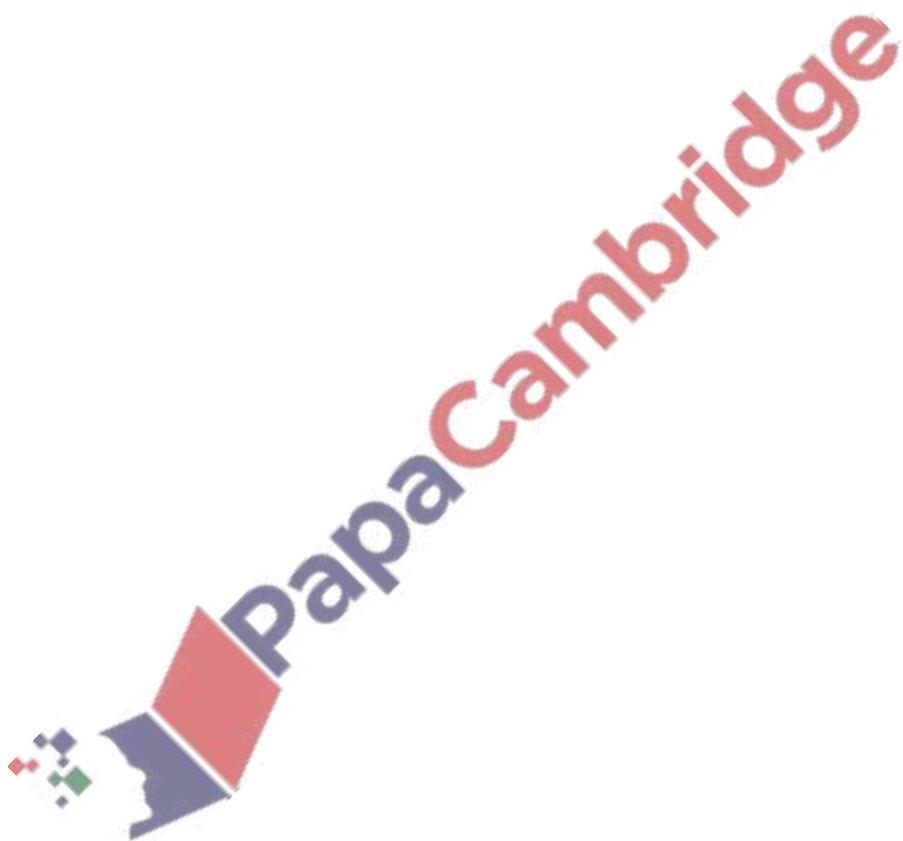
What could be the halogenoalkane?

- A 1-bromo-2-methylbutane
- B 2-bromo-2-methylbutane
- C 3-bromopentane
- D 1-bromo-2,2-dimethylpropane

4. Nov/2021/Paper_12/No.39

Which statements about chlorofluoroalkanes are correct?

- 1 Both the C-Cl and C-F bonds are readily dissociated by ultra-violet light.
- 2 They have caused ozone depletion.
- 3 They are relatively chemically inert.



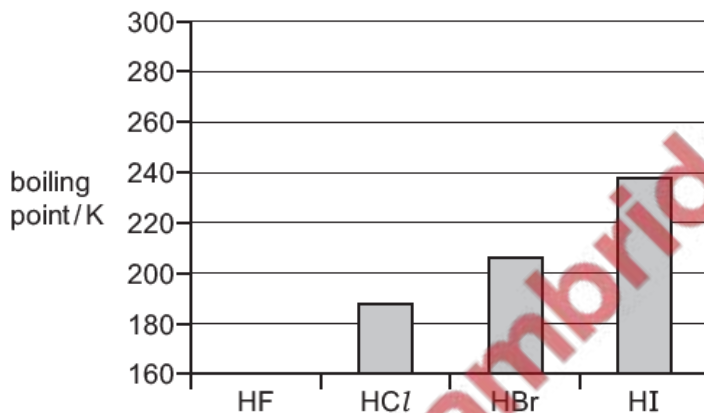
5. Nov/2021/Paper_22/No.1

Hydrogen iodide, HI, is a colourless gas at room temperature.

(a) (i) Explain why HI has a higher boiling point than HCl and HBr.

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.....
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..... [2]

(ii) The bar chart shows the boiling points of HCl, HBr and HI. The boiling point of HF is not shown.



Hydrogen bonds form between HF molecules.

Draw a bar on the bar chart to predict the boiling point of HF.

Explain your answer.

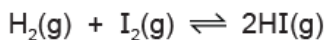
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..... [2]

(b) The standard enthalpy change of formation, ΔH_f^\ominus , of HI(g) is $+26.5 \text{ kJ mol}^{-1}$.

Define the term *standard enthalpy change of formation*.

.....
.....
..... [2]

(c) HI(g) can be formed by reacting H₂(g) with I₂(g). The reaction is reversible, and an equilibrium forms quickly at high temperatures.



(i) Construct an expression for the equilibrium constant, K_p , for the reaction of H₂(g) and I₂(g) to form HI(g).

$K_p =$

[1]

(ii) The equilibrium partial pressures of the gases at 200 °C are as follows.

$$p_{\text{H}_2(\text{g})} = 895 \text{ Pa}$$

$$p_{\text{I}_2(\text{g})} = 895 \text{ Pa}$$

$$p_{\text{HI}(\text{g})} = 4800 \text{ Pa}$$

Calculate K_p for this reaction.

$K_p =$ [1]

(iii) State how the value of K_p would change, if at all, if the reaction were carried out at 100 °C rather than 200 °C.

Explain your answer.

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.....

.....

..... [2]

(d) HI reacts with oxygen to form iodine and water.

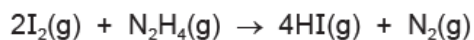
(i) Construct an equation for the reaction of HI with oxygen.

..... [1]

(ii) Explain, with reference to oxidation numbers, why this reaction is a redox reaction.

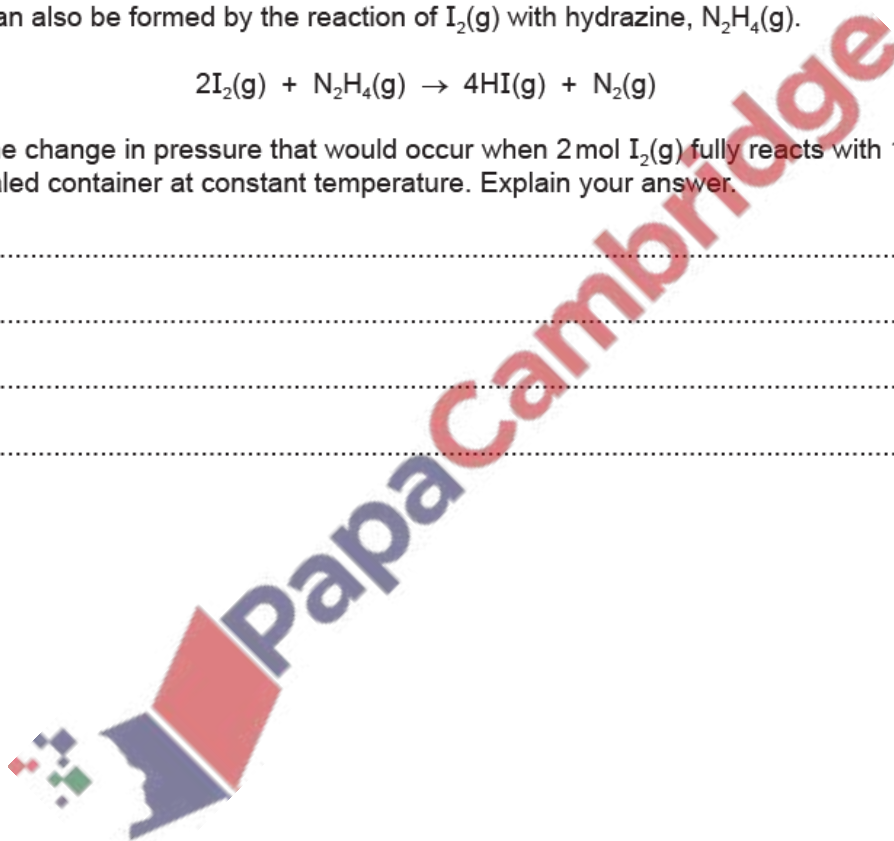
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(e) HI(g) can also be formed by the reaction of I₂(g) with hydrazine, N₂H₄(g).

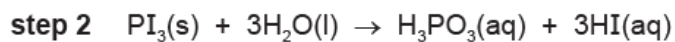
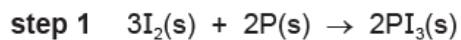


State the change in pressure that would occur when 2 mol I₂(g) fully reacts with 1 mol N₂H₄(g) in a sealed container at constant temperature. Explain your answer.

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..... [2]



(f) In the laboratory, HI(aq) can be formed in a two-step process.



(i) Draw a 'dot-and-cross' diagram of a PI_3 molecule.

[2]

(ii) Name the type of reaction in step 2.

[1]

(iii) $\text{H}_3\text{PO}_3(\text{aq})$ and $\text{HI}(\text{aq})$ are both strong Brønsted–Lowry acids.

Give the meaning of the term *strong Brønsted–Lowry acid*.

[2]

(iv) Give the formula of the conjugate base of H_3PO_3 .

[1]

(g) HI(g) reacts with propene, $\text{CH}_3\text{CH}=\text{CH}_2(\text{g})$ to form a mixture of 1-iodopropane and 2-iodopropane.

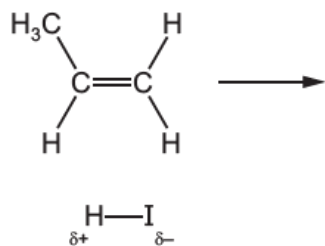
(i) Identify which of 1-iodopropane and 2-iodopropane is the major product of this reaction.

Explain your answer.

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..... [2]

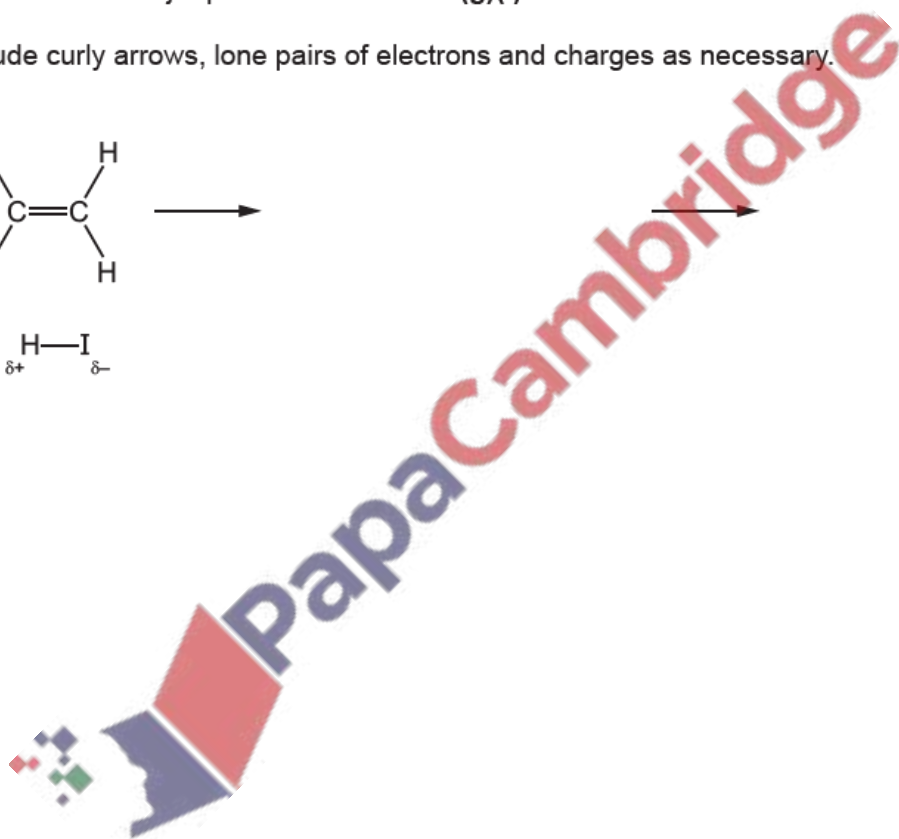
(ii) Complete the diagram to show the mechanism of the reaction between HI and $\text{CH}_3\text{CH}=\text{CH}_2$ that forms the major product identified in (g)(i).

Include curly arrows, lone pairs of electrons and charges as necessary.



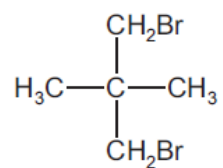
[3]

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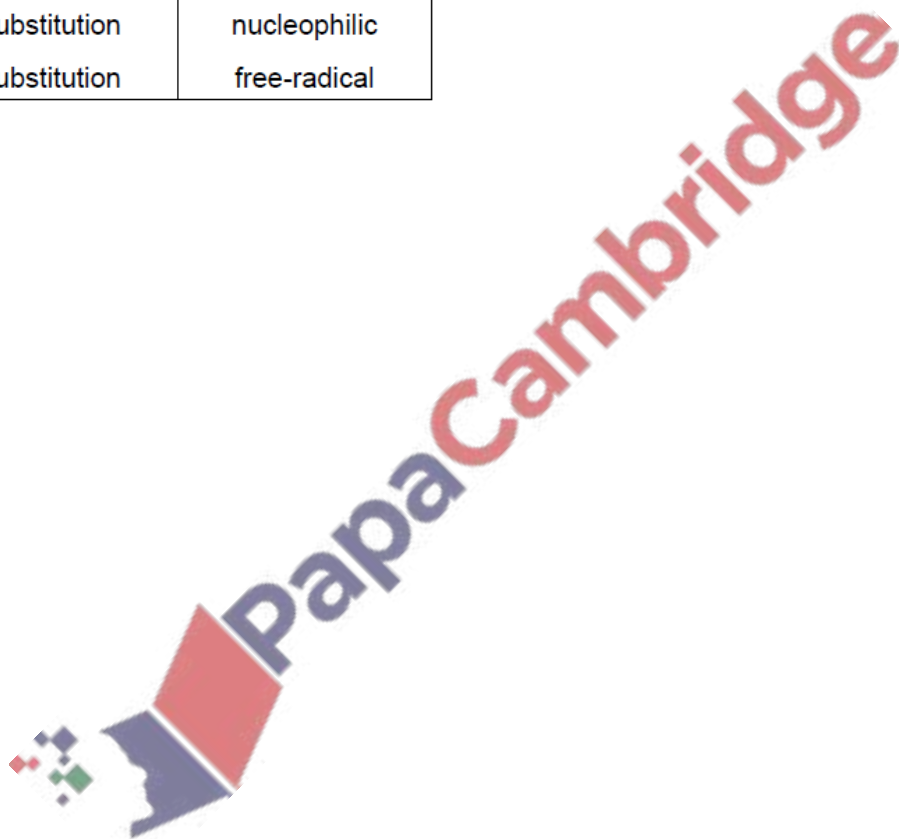
6. March/2021/Paper_12/No.22

The diagram shows the structure of a bromo compound that may be formed by the reaction of bromine with a hydrocarbon.



Which row is correct?

	type of reaction	mechanism
A	addition	electrophilic
B	addition	nucleophilic
C	substitution	nucleophilic
D	substitution	free-radical



7. June/2021/Paper_11/No.37

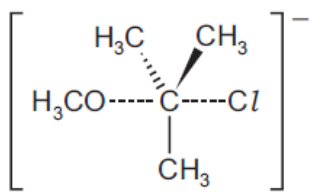
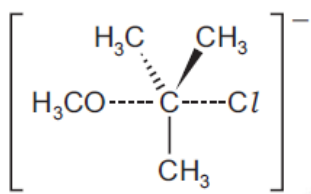
Which statements are correct?

- 1 1,1-difluoroethane is less reactive than 1,1-dichloroethane.
- 2 1,1-difluoroethane is polar.
- 3 The C–F bond is stronger than the C–Cl bond.

8. June/2021/Paper_12/No.25

Sodium methoxide, $\text{Na}^+\text{CH}_3\text{O}^-$, reacts with 2-chloro-2-methylpropane in a nucleophilic substitution reaction. The nucleophile is the CH_3O^- ion.

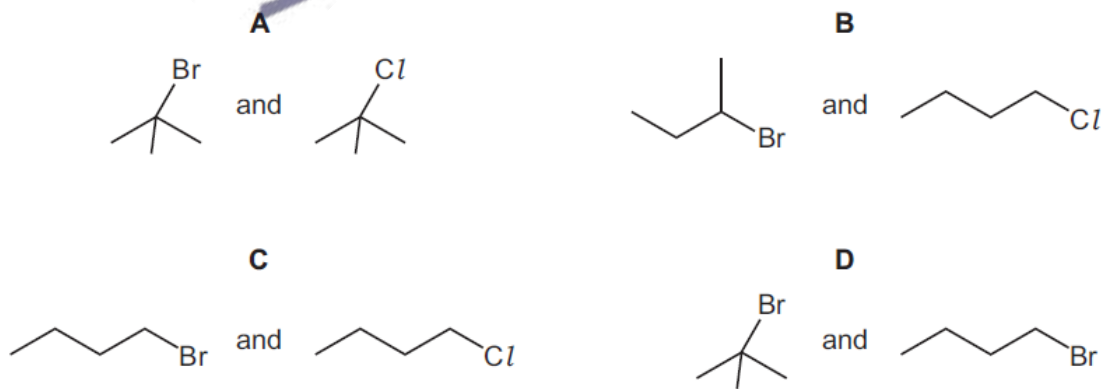
Which row is correct?

	intermediate or transition state	product
A	$(\text{CH}_3)_3\text{C}^+$	$(\text{CH}_3)_3\text{COCH}_3$
B	$(\text{CH}_3)_3\text{C}^+$	$(\text{CH}_3)_3\text{CCH}_2\text{OH}$
C		$\text{HOCH}_2\text{C}(\text{CH}_3)_3$
D		$\text{H}_3\text{COC}(\text{CH}_3)_3$

9. June/2021/Paper_13/No.23

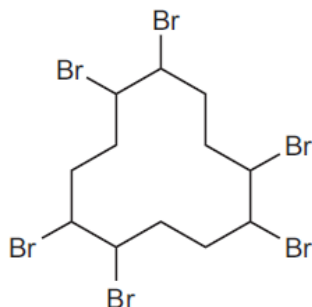
Halogenoalkanes react with nucleophiles such as OH^- .

Which pair of halogenoalkanes **both** react via an $\text{S}_{\text{N}}1$ mechanism?



10. June/2021/Paper_13/No.37

The diagram shows a molecule of a compound used as a flame retardant.



Which statements about this structure are correct?

- 1 Each brominated C atom is chiral.
- 2 The molecular formula is $C_{12}H_{20}Br_6$.
- 3 The C—C—C bond angles are all 120° .

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

11. June/2021/Paper_13/No.38

Bromoethane reacts with NaOH in different ways depending on the solvent used.

Which rows about these reactions are correct?

	solvent used	organic product
1	water	ethan-1,2-diol
2	ethanol	ethene
3	water	ethanol