CHEMISTRY ONLINE
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CHEMISTRY

ORGANIC CHEMISTRY

Level & Board	AQA (A-LEVEL)
TOPIC:	ALKANES
PAPER TYPE:	SOLUTION - 1
TOTAL QUESTIONS	10
TOTAL MARKS	36

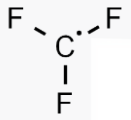
Alkanes - 1

1.

(a)

Equation: $CBrF_3 \rightarrow {}^{\cdot}CF_3 + Br^{\cdot}$

Formula:



(1)

(b)

The C–Br bond breaks more readily in $CBrF_3$ than the C–Cl bond in $CClF_3$. This difference is due to the fact that the C–Br bond is weaker compared to the C–Cl bond.

It can be explained by stating that the C–Br bond enthalpy (bond strength) is less than that for C–Cl. This difference arises from a direct comparison between the strengths of the two different carbon-halogen bonds.

(1)

(c)

$Br^{\cdot} + O_3 \rightarrow BrO^{\cdot} + O_2$

$BrO^{\cdot} + O_3 \rightarrow Br^{\cdot} + 2O_2$

Explanation of Catalytic Behavior:

Initiation:

- The first equation represents the initiation step: $Br^{\cdot}$ reacts with O_3 to form BrO and O_2.
- The bromine radical is produced, denoted with a dot: $Br^{\cdot}$

Propagation:

- The second equation represents the propagation step: BrO reacts with another O_3 molecule, regenerating $Br^{\cdot}$ and producing $2O_2$
- The bromine radical is regenerated in this step, ensuring the continuity of the catalytic cycle.

Overall Catalytic Behavior:

- The bromine radical ($Br^{\cdot}$) does not appear in the overall equation as a reactant or product.

- It is regenerated in the process, remaining unchanged at the end of each cycle.
- The bromine radical is not used up in the overall reaction, highlighting its role as a catalyst.

(3)

2. D

(1)

3.

(a)

Initiation

$Cl_2 \xrightarrow{\text{UV light}} 2Cl\cdot$

First propagation

$Cl\cdot + CHF_3 \rightarrow CF_3\cdot + HCl$

Second propagation

$Cl_2 + CF_3\cdot \rightarrow CClF_3 + Cl\cdot$

Termination

$2CF_3\cdot \rightarrow C_2F_6$ or CF_3CF_3

(4)

(b)

An essential condition for the free-radical substitution reaction of CHF_3 with Cl_2 is the presence of ultraviolet (UV) light. The UV light is required to initiate the reaction by breaking the chlorine molecule (Cl_2) into chlorine radicals (Cl) in the initiation step.

(1)

4. B

(1)

5.

(a)

Hydrocarbons are compounds composed exclusively of carbon and hydrogen atoms.

A **saturated hydrocarbon** is a type of hydrocarbon in which all carbon-carbon bonds are single bonds. This means that each carbon atom in the hydrocarbon chain is bonded to four other atoms (either carbon or hydrogen), and there are no double or triple bonds present. Saturated hydrocarbons are also known as alkanes.

(2)

(b)

$C_{16}H_{34} + 16.5O_2 \rightarrow 16CO + 17H_2O$

(1)

(c)

On combustion, sulfur dioxide (SO_2) is produced, and it is this SO_2 that causes acid rain when released into the atmosphere.
Acid rain occurs when sulfur dioxide reacts with atmospheric water vapor to form sulfuric acid (H_2SO_4).

(2)

6. B

(1)

7.

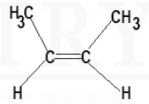
(a)

Compounds with the same molecular formula but different structural formula, displayed formula, structures, or skeletal formula are termed to as structural isomers.
These isomers have different arrangement of atoms giving distinct chemical structures while maintaining an identical number of atoms for each element.

(2)

(b)

IUPAC name of the position isomer of but-1-ene: But-2-ene



(1)

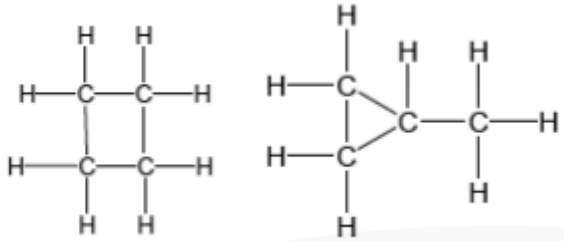
(c)

IUPAC name of the chain isomer of but-1-ene: methylpropene

(1)

(d)

Formula for a functional group isomer of but-1-ene



(1)

8. C

(1)

9.

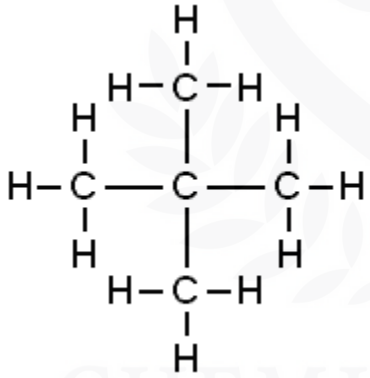
(a)

General formula for the homologous series of alkanes: C_nH_{2n+2}

(1)

(b)

The displayed formula of 2,2-dimethylpropane.



The type of structural isomerism shown is Chain isomerism.

(2)

(c)

Deducing the Molecular Formula of Y:

The molecular formula of hydrocarbon Y is C_9H_{20}, as given.

Reason for High Temperatures in Cracking:

High temperatures are necessary in cracking reactions to break the strong carbon-carbon (C–C) or carbon-hydrogen (C–H) bonds present in larger hydrocarbons.

The thermal energy supplied at high temperatures helps overcome the activation energy required to break these bonds.

Reason for Industrial Thermal Cracking:

Thermal cracking reactions are carried out in industry for several reasons:

- To produce products that are in greater demand.
- To obtain higher-value products.
- To specifically generate alkenes, such as ethene and propene, which are essential feedstocks for the petrochemical industry.

(3)

(d)

An equation for the incomplete combustion of pentane

$C_5H_{12} + 3O_2 \rightarrow 5C + 6H_2O$

Formation of Solid Pollutant:

Incomplete combustion of pentane ($C_5 H_{12}$) produces solid carbon (C), contributing to smog.

Equation for Incomplete Combustion:

$C_5H_{12} + 3O_2 \rightarrow 5C + 6H_2O$

Environmental Impact:

Solid pollutants exacerbate asthma, cause breathing problems, reduce visibility, and contribute to smog, while also causing global dimming.

(2)

(e)

$$\text{Percentage Atom Economy} = \frac{\text{Molecular mass of desired product}}{\text{Sum of molecular masses of all reactants}} \times 100$$

$$\text{Percentage Atom Economy} = \frac{106.5}{143} \times 100 = 74.48\%$$

(3)

10. C

I am Sorry !!!!!

(1)

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