Ministry of Higher Education and Scientific Research

Al-Muthanna University

Organic chemistry

For the 1st year students of the «faculty of Pharmacy»

Lecture (3)

Alkanes and cycloalkanes

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- Alkanes have the single bonds, they are σ - bonds, the strength of σ - bond is mor than π - bond therefor the long bond of alkane molecules is very difficult to break.
- Alkanes are saturated and stable compounds therefor the main reactions of alkenes are substitution reactions.
- The general molecular formula for alkanes is CnH_2n_{+2}

Name	Molecular Formula (C_nH_{2n+2})	Condensed Structural Formula	Number of Possible Isomers
methane	CH_4	CH_4	—
ethane	C_2H_6	CH_3CH_3	—
propane	C_3H_8	$CH_3CH_2CH_3$	—
butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$	2
pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$	3
hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$	5
heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	9
octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	18
nonane	C_9H_{20}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	35
decane	$C_{10}H_{22}$	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	75

IUPAC NOMENCLATURE of ALKANES

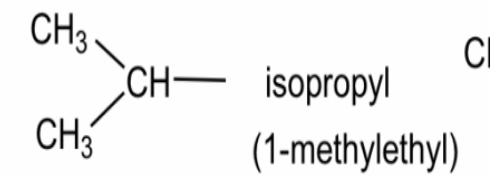
1. Identify the *longest continuous carbon chain* as the parent chain. This chain determines the parent name (or last name) of the alkane.
2. If there are two choices of the same length, then the parent chain is the longest chain with the **greatest** number of “branches”. The term **substituent** will be used from now on as the official name for “branch”.
3. Number the chain beginning at the end that is **closest** to any substituents, thus ensuring the lowest possible numbers for the positions of substituents.
4. Use these numbers to designate the location of the substituent groups, whose names are obtained by changing the “-ane” suffix to “*-yl*“.

The substituents derived from alkane are also called alkyl groups.

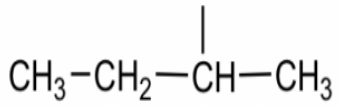
Normal alkyl groups:

$CH_3—$	methyl (Me-)
$CH_3CH_2—$	ethyl (Et-)
$CH_3CH_2CH_2—$	propyl (Pr-)
$CH_3CH_2CH_2CH_2—$	butyl (Bu-)

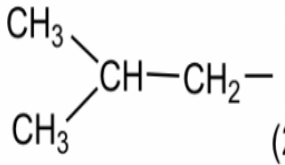
Branched alkyl groups:



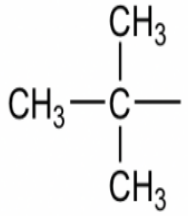
isopropyl
(1-methylethyl)



sec-butyl
(1-methylpropyl)



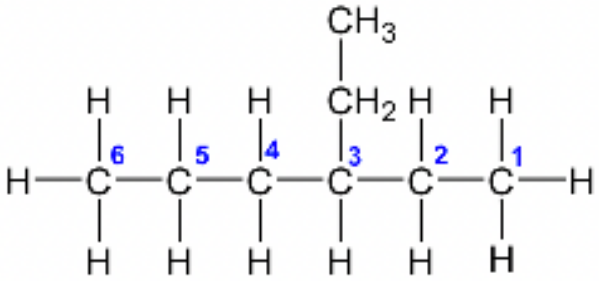
isobutyl
(2-methylpropyl)



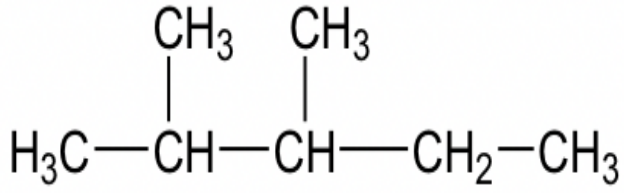
tert-butyl
(1,1-dimethylethyl)

4. If an alkyl substituent group appears more than once, use the prefixes di, tri, tetra, penta, and hexa (meaning 2, 3, 4, 5, and 6 respectively) for each type of alkyl group.
5. List the substituent groups alphabetically (use the substituent group name from step 3, ignore the prefixes from 4, but include “iso” and “cyclo”).
6. Write the name as a single word. Numbers are separated from letters by “-“; numbers are separated by “,”.

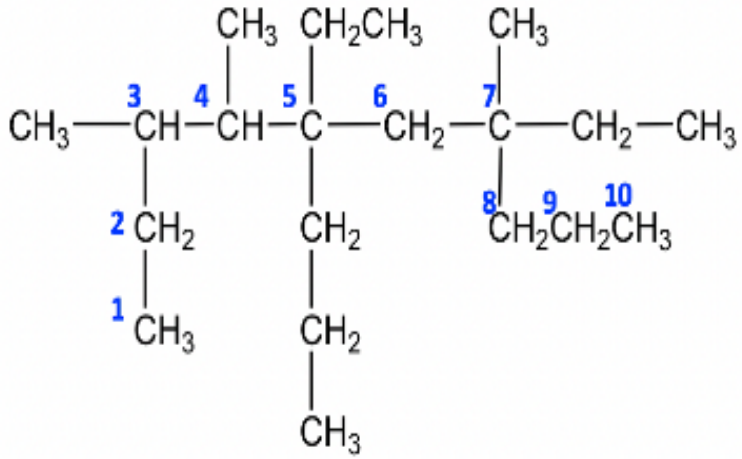
Alkane Naming Examples:



3-ethylhexane



2,3-dimethylpentane



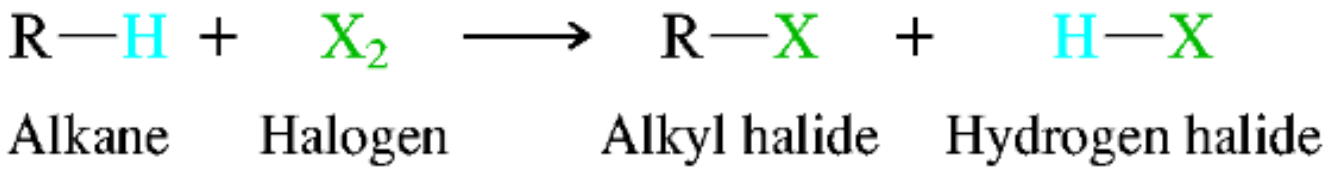
Find the parent chain correctly is the key step for naming this structure.

5,7-diethyl-3,4,7-trimethyl-5-propyldecane

The chemical reactions of alkanes

- Alkanes do not react with halogens in the dark at room temperature, but will react in the presence of sunlight (UV).

- A substitution reaction will occur where some or all of the hydrogens will be replaced with a halogen.



1. Initiation

UV light provides energy so that the covalent bond can be broken by homolytic fission.

$$Cl_2 \xrightarrow{\text{UV light}} Cl^* + Cl^*$$

2. Propagation

The reaction both use and produce free radicals.

$$Cl^* + CH_4 \longrightarrow CH_3^* + HCl$$

3. Termination

The reaction remove free radicals by having them reacting with each other.

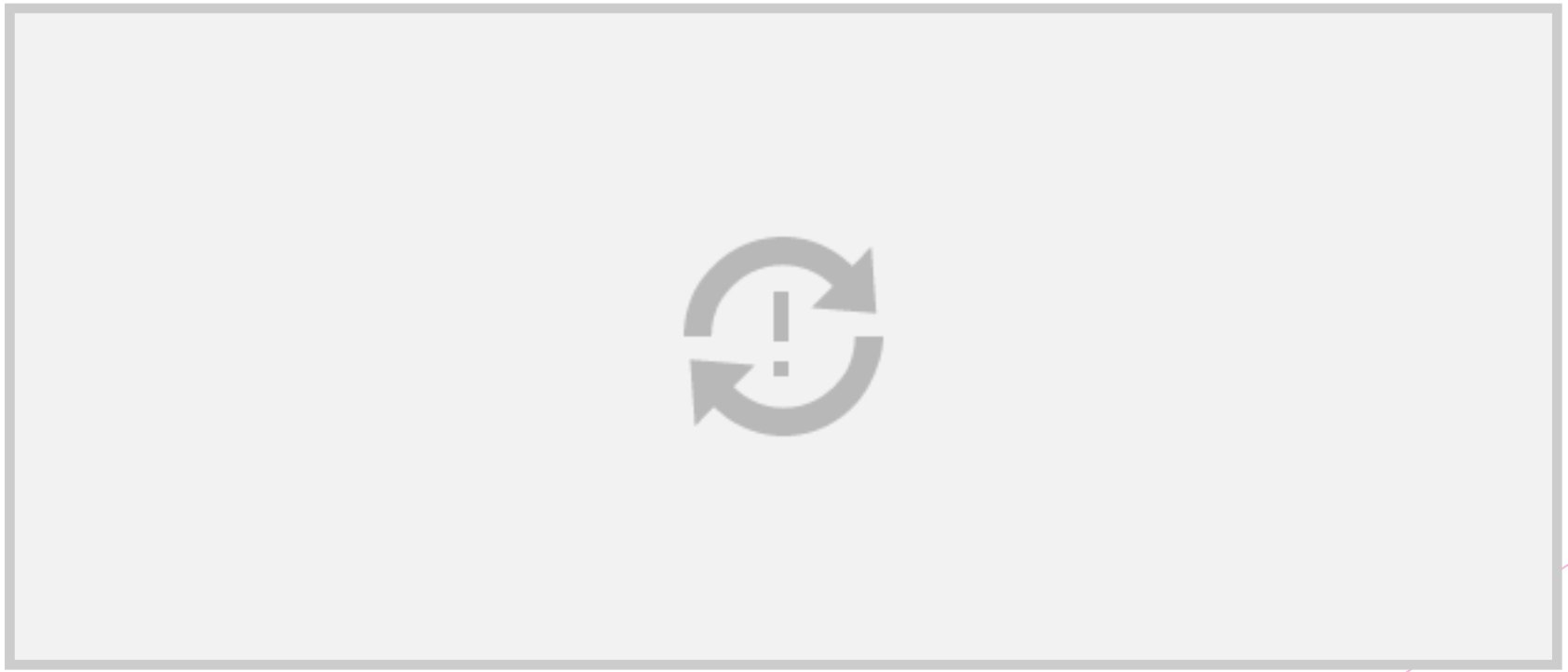
$$Cl^* + CH_3^* \longrightarrow CH_3Cl$$

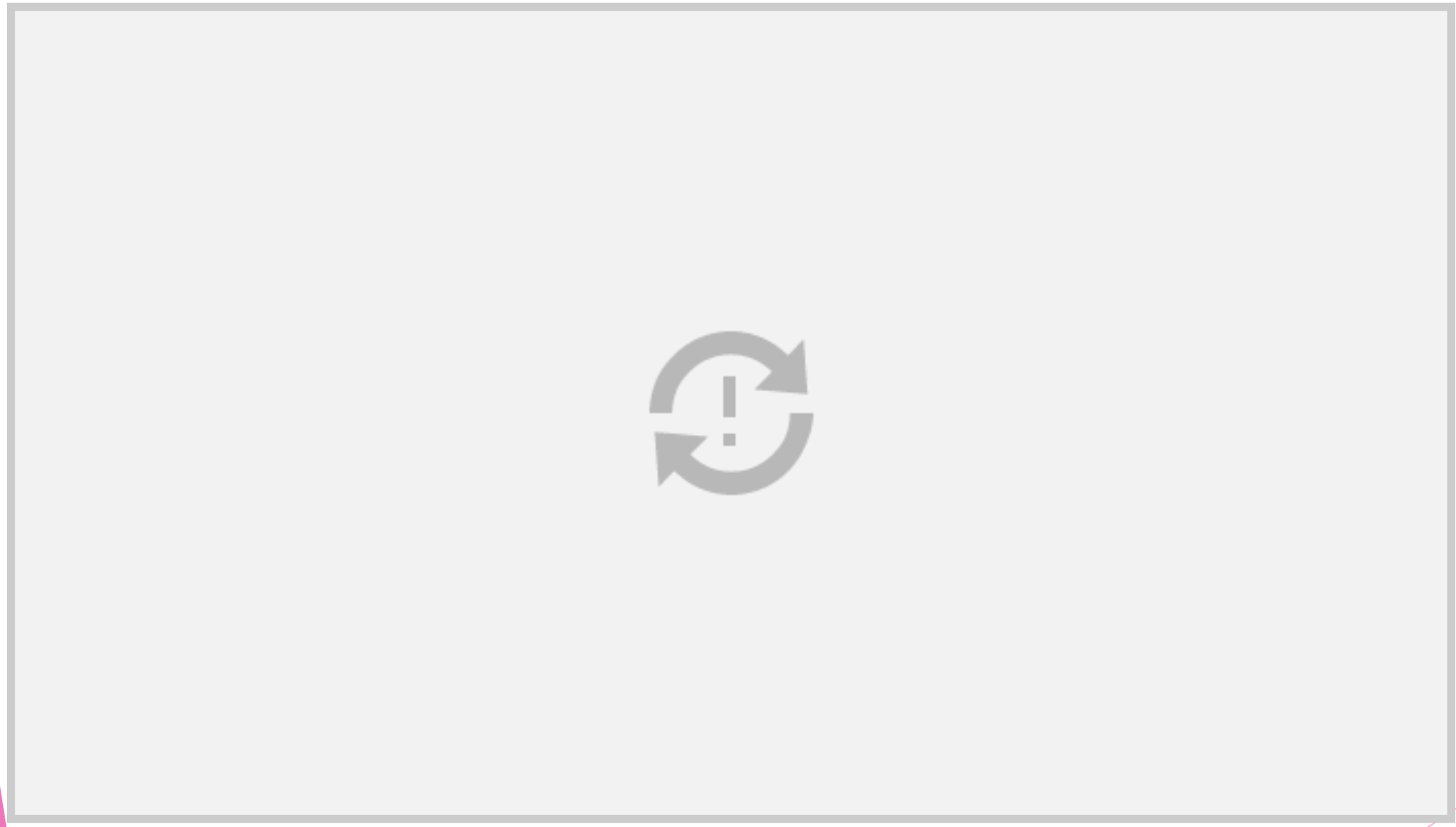
$$CH_4 + Cl_2 \xrightarrow[\text{or } h\nu]{\Delta} CH_3Cl + HCl$$

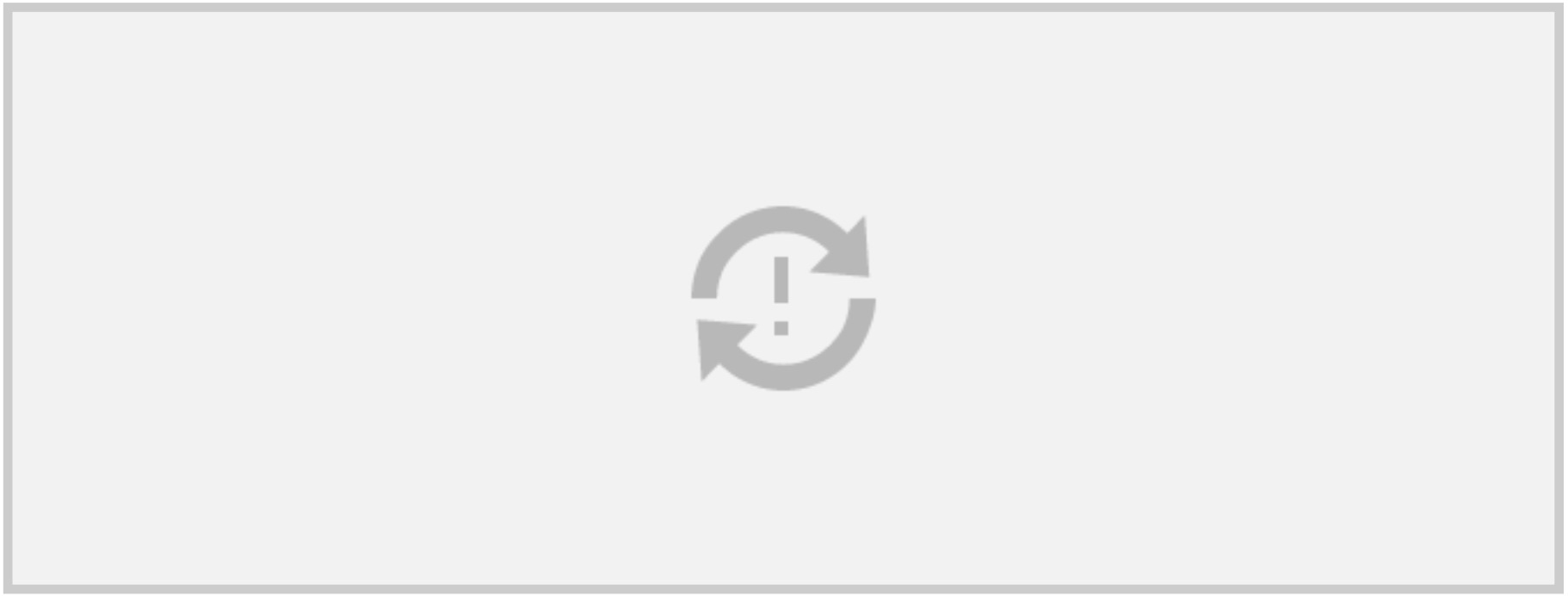
methyl chloride

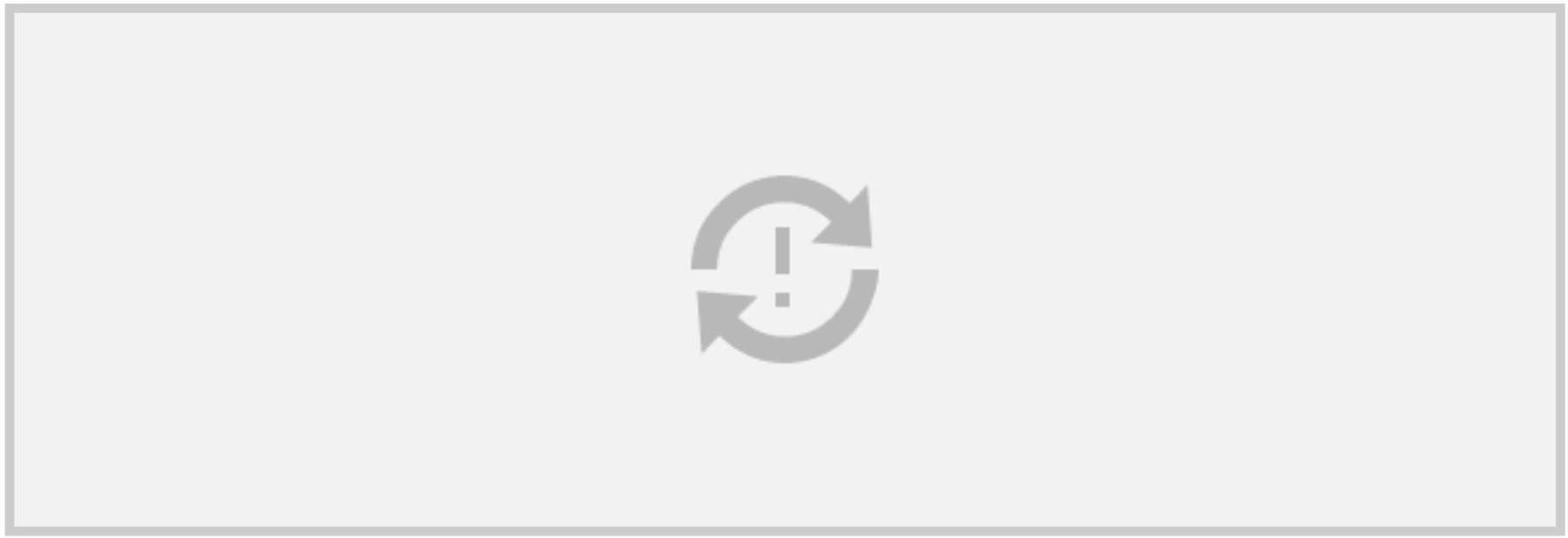
$$CH_3CH_3 + Br_2 \xrightarrow[\text{or } h\nu]{\Delta} CH_3CH_2Br + HBr$$

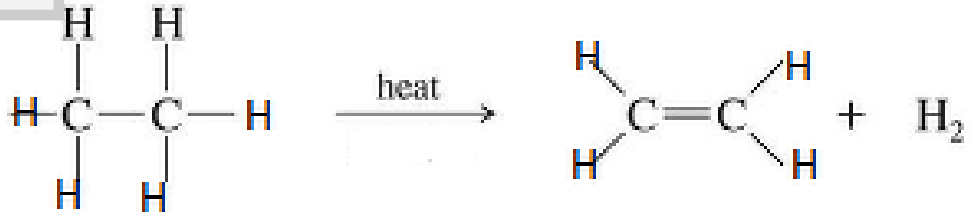
ethyl bromide



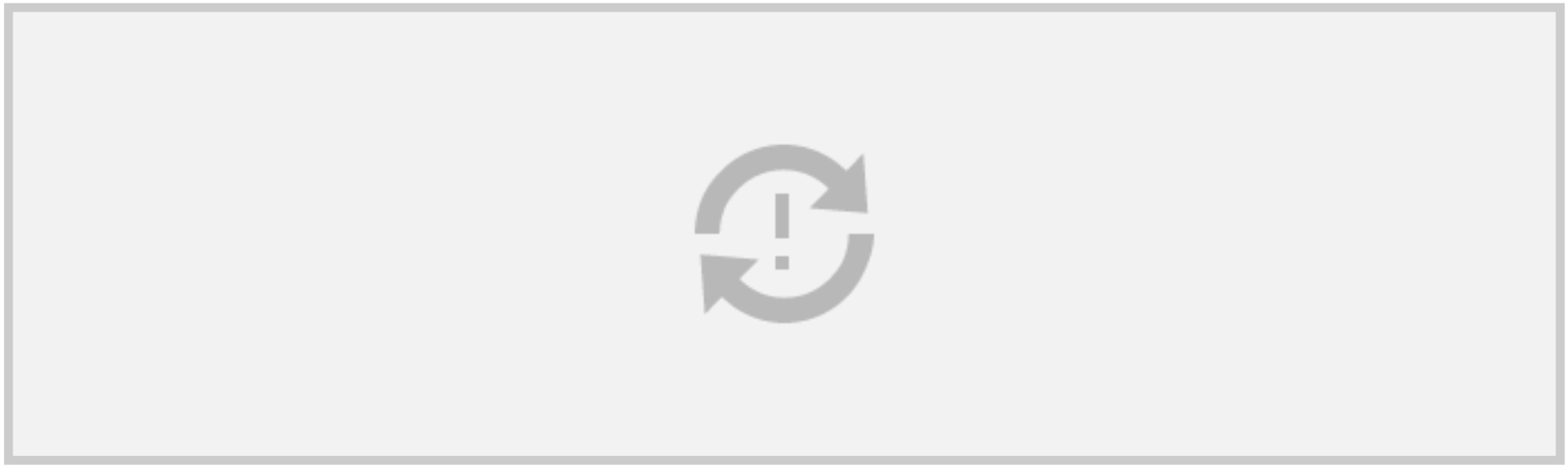








ethane ethene




Best Regards!
Thank you!