Addition To Carbon – Carbon Multiple Bonds

(Part I)

M. Sc. (Chemistry) - Semester II

Core Course – 4

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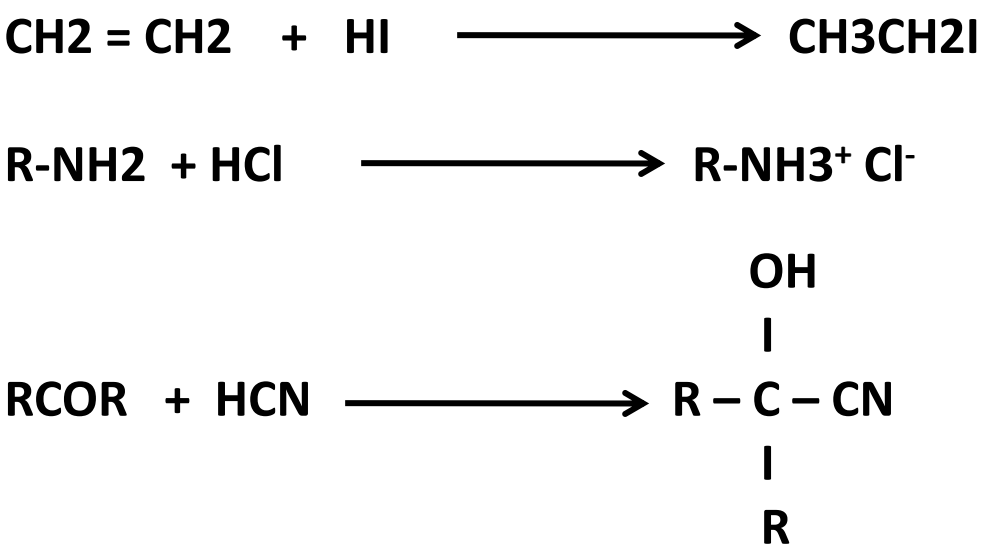
Introduction

A reaction in which two molecules combine to form a single molecule of the product is known as addition reaction . Addition reactions are the characteristics of unsaturated compounds.



Addition is the opposite to elimination reactions.

A carbon-carbon double bond consist of a strong sigma bond and a weak pi bond. The pair of electron in the pi- bond is less firmly held between two carbon nuclei due to lateral overlapping of orbitals. The pi –bond is capable of being readily polarised. This property results in the reactivity of the olefinic compounds.

There are three ways in which addition to a double bond can take place :

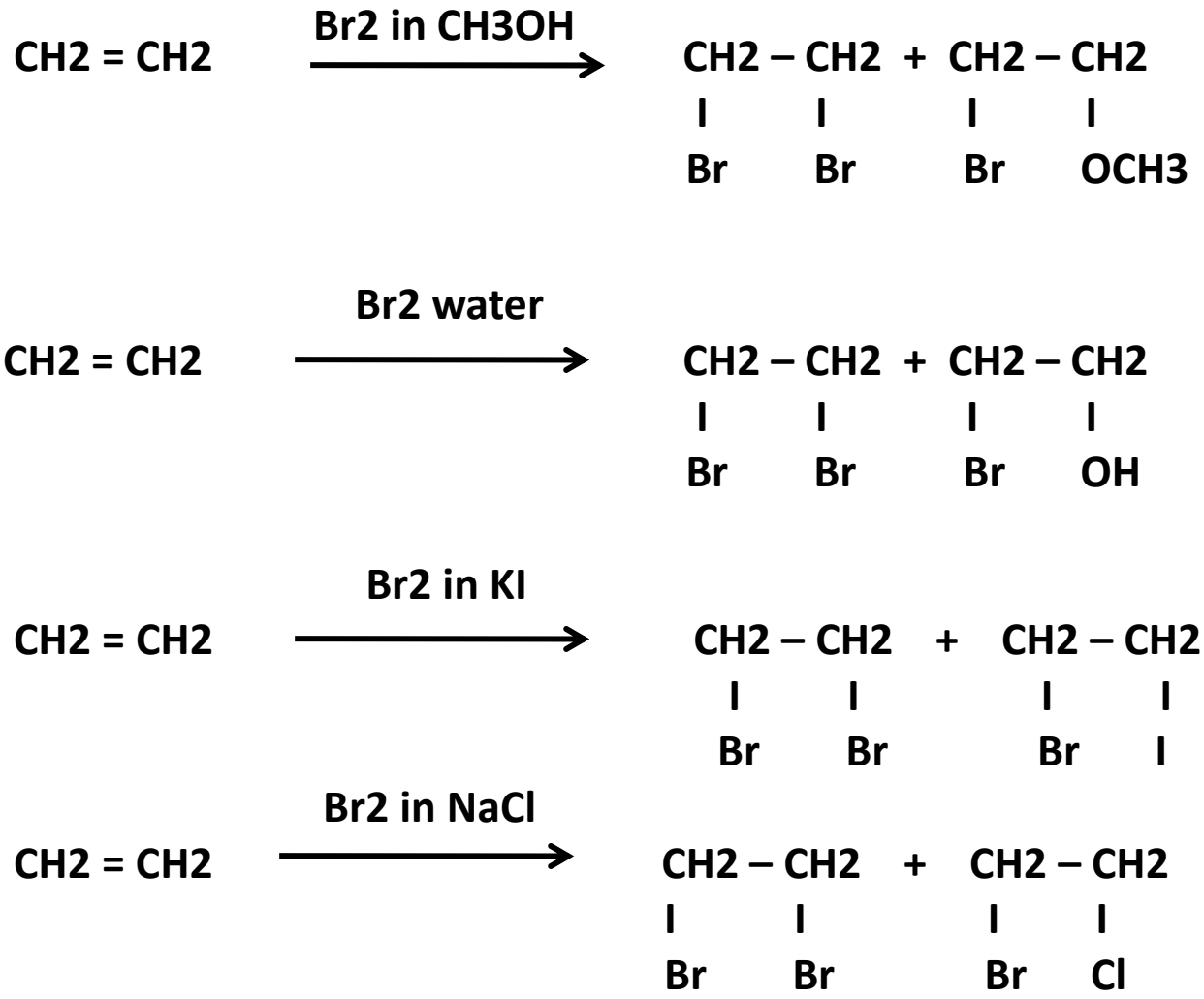
i) **Electrophilic**

ii) **Nucleophilic, and**

iii) **Free radical**

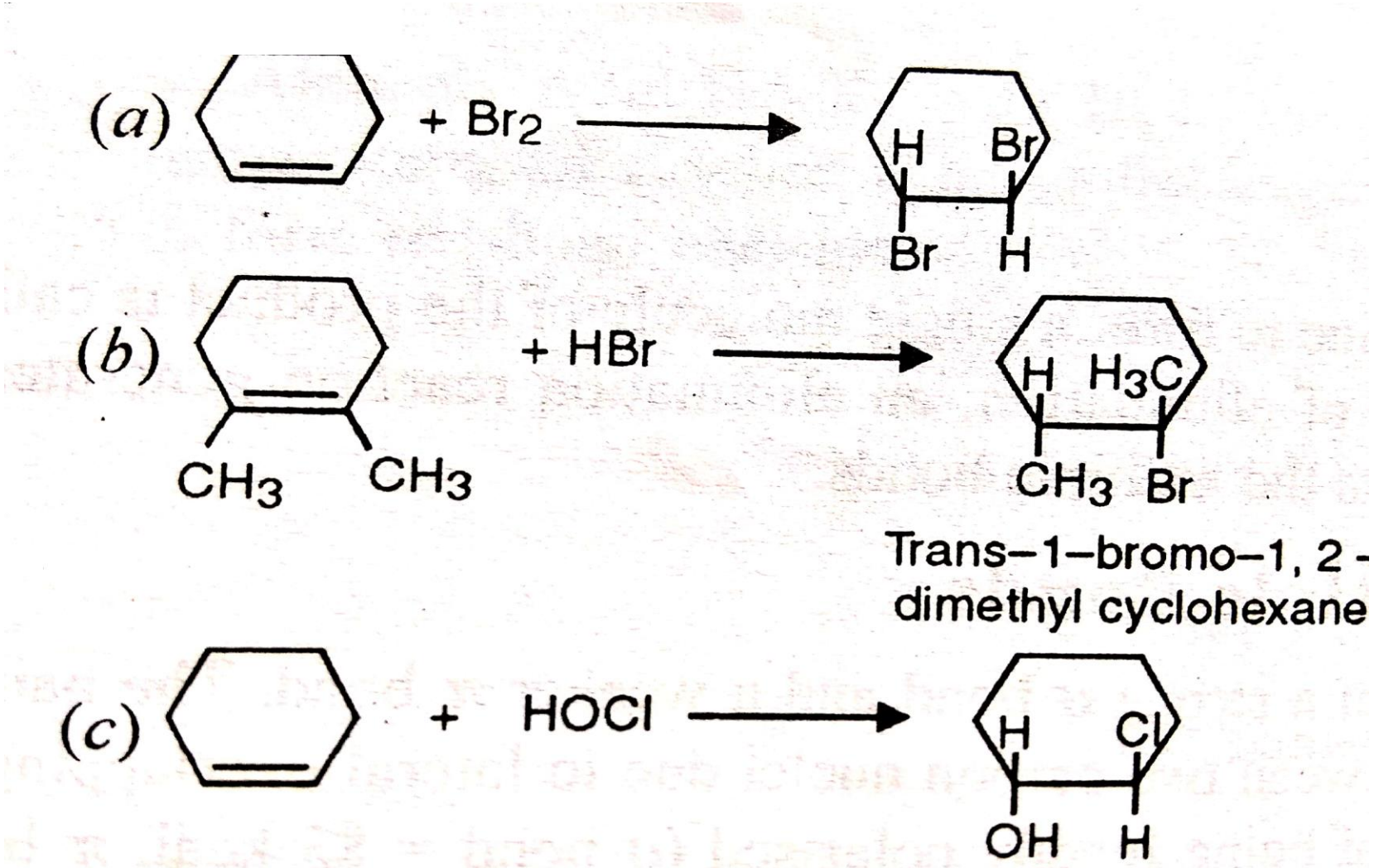
Electrophilic addition reaction – The most characteristic reaction of an alkene is 'Electrophilic addition' to the double bond.. Which type of mechanism is operating can be ascertained by knowing the reaction products obtained by the interaction of the reagent and substrates and also stereochemistry of the product.

Experimental observation for mechanism – The best evidence for the mechanism emerges from the observation that when ethylene is treated with bromine in presence of other nucleophiles, mixture of products are obtained.

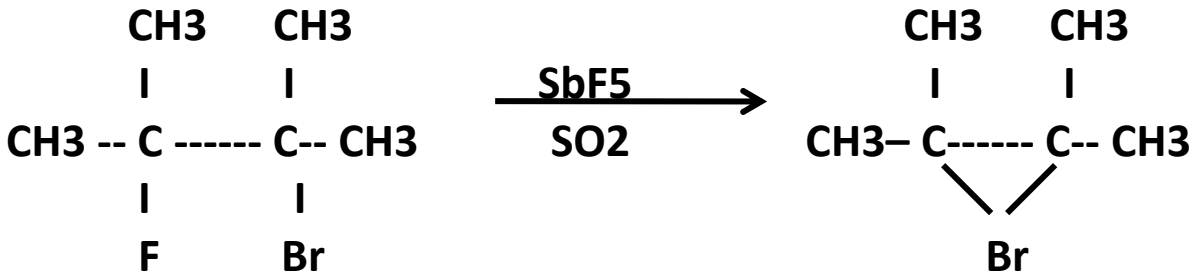


The formation of mixed products suggest that two parts of the addendum do not add simultaneously but add in two steps.

Stereochemical evidence –It has been found that addition occurs invariably across the double in a trans and antiparallel manner.

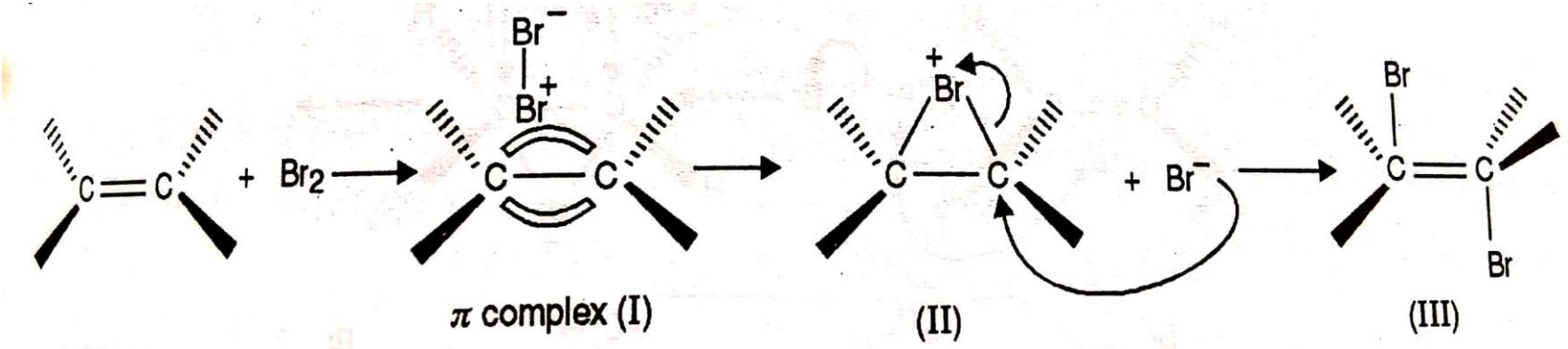


Direct evidence for the intermediacy of three membered cyclic bromonium ion has been furnished by nmr studies.



The product gives only one signal in nmr as 12 protons are in the same environment.

Mechanism :



The mechanism of halogen addition to olefins is believed to be involve the following steps :

First step – The pi electrons of the alkenes molecule polarises the covalent bond of the bromine molecule in such a way as one of the bromine atoms becomes more positive and other more negative .

Second step - The formation of pi-complex (I) which does not involve actual bonding and may be regarded as an association in which the positive part of bromine molecule is embedded in the pi orbital of the alkene and this leads to the formation of a three membered cyclic intermediate known as bromonium ion (II).

Third step – Attack of the bromide ion takes place from opposite side, resulting in the exclusive formation of the anti addition product (III).

……..to be continued in next Class lecture, Addition Reaction - Part -II

THANK YOU