

## CHM 421 ORGANIC SYNTHESSES

**ORGANIC SYNTHESIS:** Most organic compounds can be prepared by different routes and criteria are needed to select the best method. Generally the best synthesis of a substance involves the conversion of the most available and cheapest starting materials into the desired product and it should be with the least number of steps and in the highest possible overall yield.

In commercial synthesis, cost of starting materials and economy of operation play a dominant role.

Organic chemists have traditionally undertaken synthesis as the final proof of molecular structure for natural products from plants and animal sources. Identity between the natural substance and the compound produced by synthesis confirms the molecular structure deduced by chemical and physical methods. In more practical terms, synthesis can provide the supply of useful compounds like quinine, penicillin, prostaglandins, vitamins and insect attractants not available in adequate quantities from nature.

Synthesis can also be used to prepare substances previously unknown but predicted to have useful properties either to test theories or to create new chemical products. Synthetic chemistry is a major endeavour in the research laboratory of the chemical industry.

**DESIGN OF A SYNTHETIC:** There are great numbers of synthetic routes leading to any given target molecule. It is preferable to select routes with fewest steps and the cheapest or most available starting materials. However, the yields of organic reactions are in practice, rarely 100%. In a multi-step sequence, the overall yield is the mathematical product of the yields of all the individual steps. The serious decrease in efficiency caused by poor yield leads to an important guiding principle to be applied when choosing between alternative routes.

1. The central test of a good route is to have a minimum number of steps
2. The reaction selected should have at least a good precedent of high yield
3. The reaction selected must be closely examined to be as certain as possible that no competing reaction will seriously lower the yield and lead to difficult problems of separation.

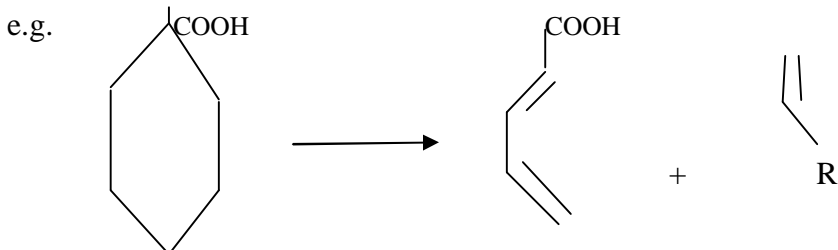
**SYNTHESIS DESIGN:** It is usually to work backwards from the target to the structures available as starting materials



Product          Synthon

The structure of the target molecule can be formally divided into 2 parts:-

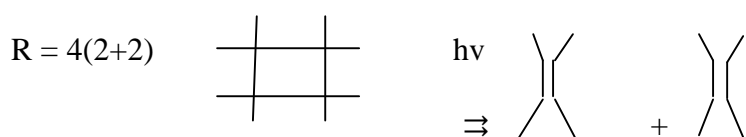
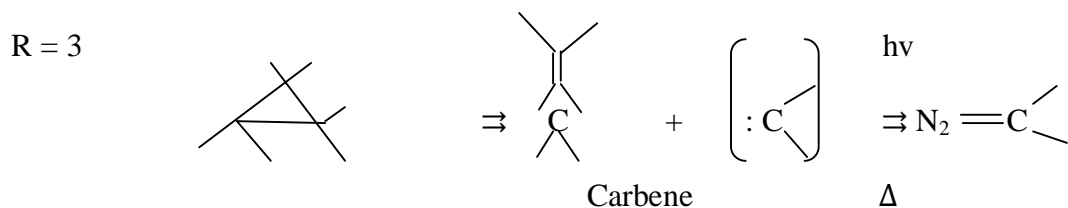
- (i) Its carbon skeleton
- (ii) Functional group located on that skeleton.

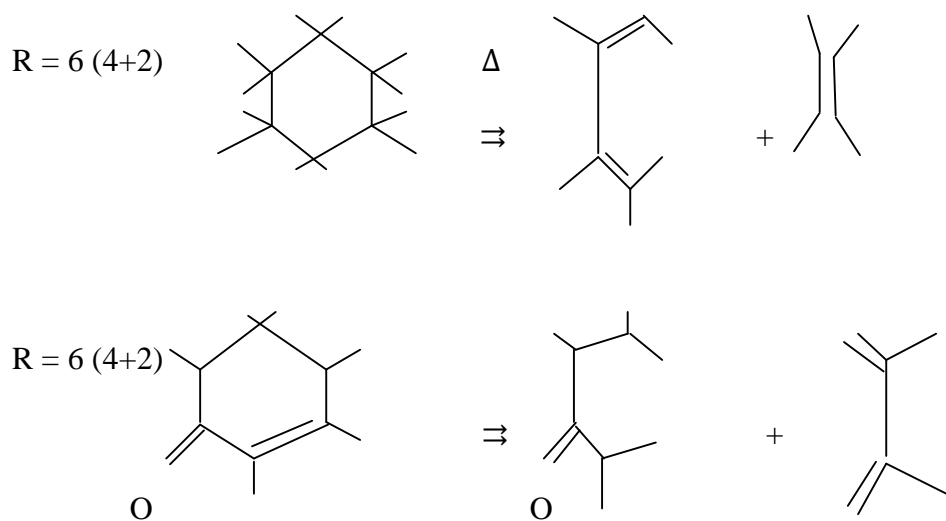


The structure of the target must be constructed from smaller units (synthons)

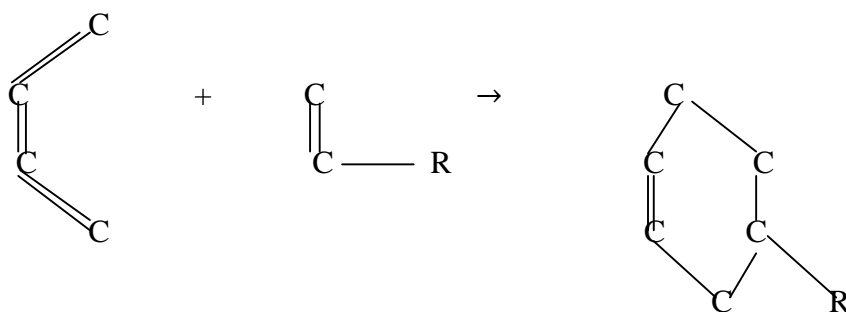
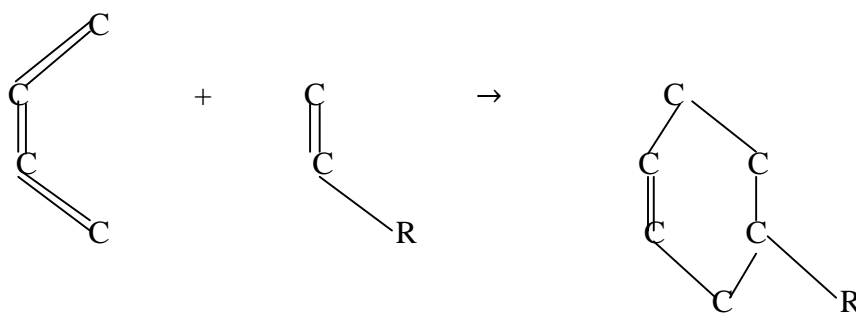
**ANNELATION REACTION:** - Ring forming reactions are of special importance since many of the usual synthetic targets contain cyclic skeleton. In order to synthesis a ring from 2 separate synthons, we must construct 2 bonds of that ring, the 1<sup>st</sup> to pull the synthons together and the second to cyclise them.

An annelation reaction is one which creates both bonds in one step, or at least in one laboratory operation cycle addition such as Dial Alder's rxn is an example. If the ring size is Rr and the two synthons contribute m & n atoms to the ring, then,  $r = m+n$  and the operation is an (m+n) annelation. E.g.





**DIEL – ALDER’S REACTION:** - This is a rxn undergone by conjugated diene. It is the most important type of (the) rxn. These are addition rxn in which the ring system are formed continue the elimination of any compound in general term the Diel – Alder’s rxn may be written as follows:



A- diene

B (dienophile)

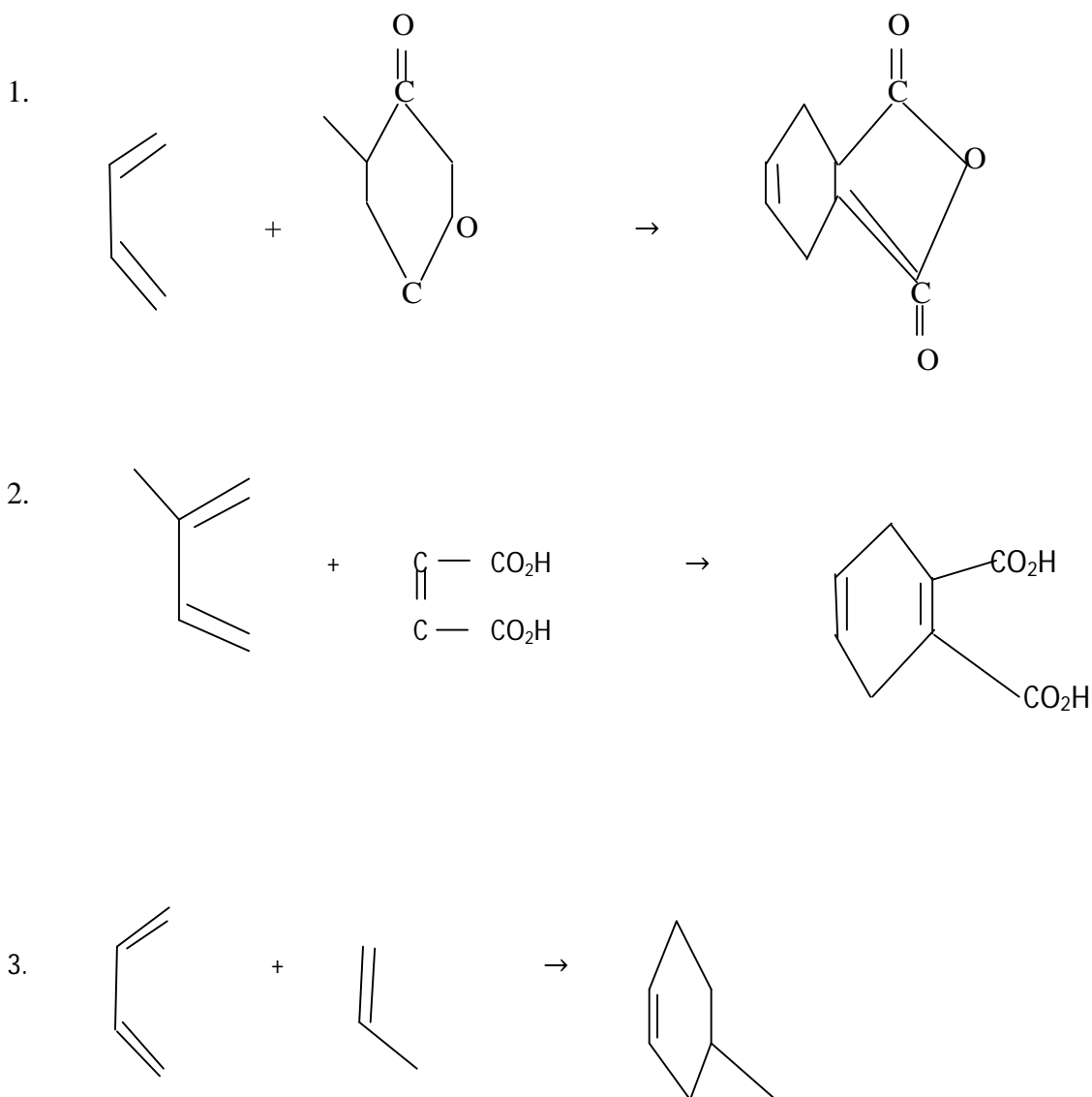
Adduct

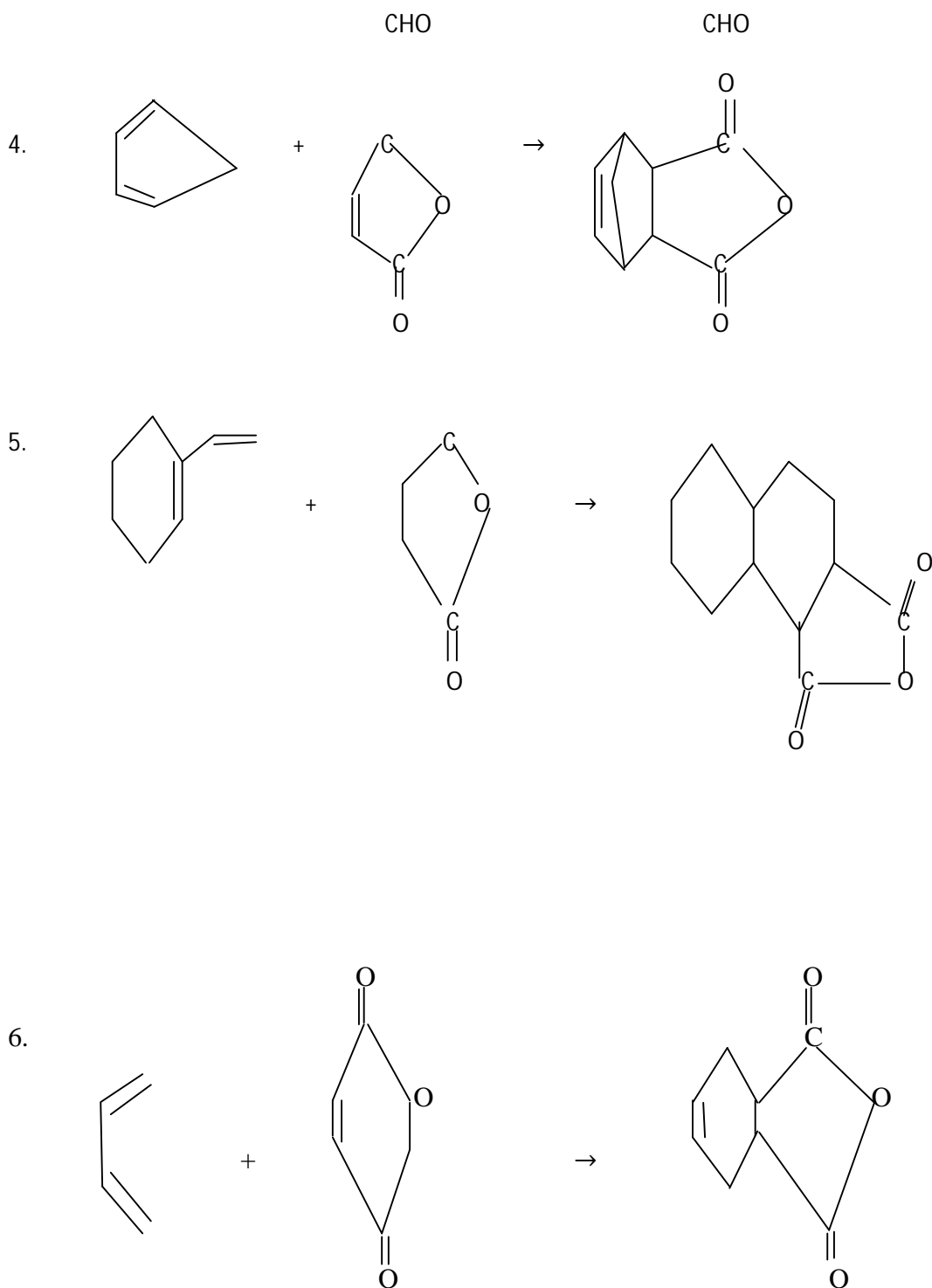
Compound A is usually referred to as the diene (whether it be a conjugated diene, polyene, enyne or diene). Compound B is usually referred to as a dienophile. R is usually a group which contains a carbonyl group attached to one of the ethylenic or acetylenic carbon atoms. E.g. The dienophile is usually an  $\alpha, \beta$  unsaturated carbonyl. E.g.  $\alpha, \beta$  unsaturated acids and anhydride, esters, aldehydes or ketones.

The dienophile may also be quinone. The presence of a carbonyl group (I effect) in the dienophile is essential, compounds which contain -I group such as nitro or cyano can also behave as dienophile.

The dienes may be of various types as cyclic, acyclic, alicyclic, semicyclic compounds containing 2 double bonds in conjugation, bicyclic compounds, aromatic h/c containing at least 3 linear benzene rings e.g. Anthracene also, heterocyclic compounds (furan)

It is important to note that only cisoid and not transoid dienes enter into Diels-Alder's rxn.

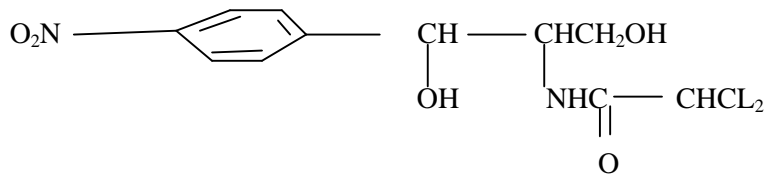




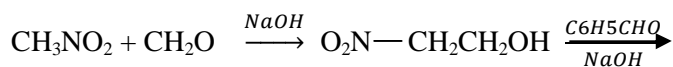
### **SPECIAL TECHNIQUES**

A variety of indigenous techniques have been invented by research xmistis to overcome special obstacles to successful synthesis. These methods are best described by illustrating their use in actual synthesis

- 1) **SYNTHESIS OF CHLORAMPHENICOL** :- It is an aromatic compound of commercial importance and was isolated from cultures of certain enlarge and was found to possess the structure stated below:-

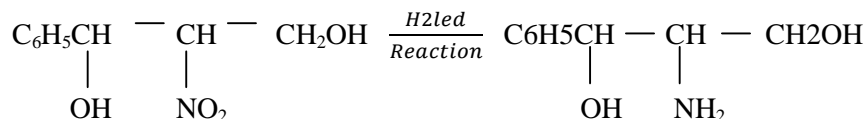


### **PREPARATION**

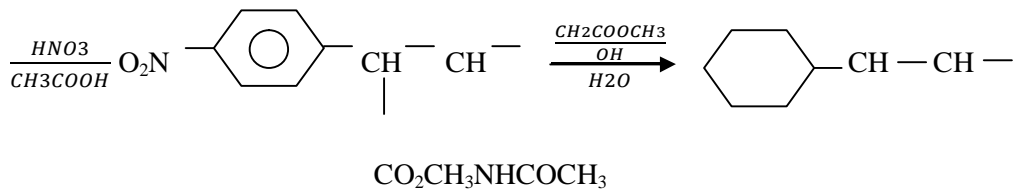


Nitro      HCHO

Methane    methanol



CH<sub>2</sub>



- 2) **SYNTHESIS OF VITAMIN A**

This is important in nutrition.

The starting material is readily available terpene, citral see is converted to □ ionone to (a) provide the cyclic end of the target.

### **Preparation**

diagram

## **INDUSTRIAL SYNTHESIS OF VINYL CHLORIDE**

Vinyl chloride is used to make PVC of it is the second largest tonnage polymer.

### **PREPARATION**

(1).Acetylene or Ethyne base the

Diagram

The reaction proceeds through an intermediate vinyl Hg (oc) compound as shown:

Diagram

% yield is 80-95%

### **DESIRABILITY OF THE METHOD (MERITS)**

1. It is a one-stage process process.
2. Relatively mild reaction condition.
3. Endothermic reaction, no heat is required. Hence, money is saved. Pyrolysis:-heating (2) high temperation.
4. Favourable stoichiometry i.e almost 100% yield, all draw materials appear in the product. The only disadvantages of this method as the supply of raw materials (acetylene) see are expensive. It is a highly corrosive gas of transportation is costly. The high cost of acetylene provides a considerable economic incentive to base vinyl chloride manufacture on a cheaper to carbon raw material such as ethylene.

(2). Ethylene dichloride process

This involves the use of ethylene.

Diagram

The reaction can be carried out in gas phase at a temperature of 360-400k.

The reaction flows free radical mechanical.

Diagram

It can also take place in liquid phase in the presence of  $\text{FeCl}_3$  at 340k.

The reaction follows ionic mechanical