

# Research Methodology in Chemistry

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Edited by  
Fiona N.-F. How, Ph.D



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# **RESEARCH METHODOLOGY IN CHEMISTRY**

**Edited by**

**Fiona N.-F. How, Ph.D**



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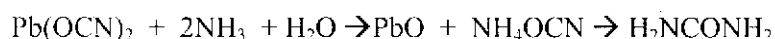
# CHAPTER – 1

## CHEMICAL SYNTHESIS IN GENERAL

Shafida Binti Abd Hamid

Chemical compounds are substances that are made up of atoms joined together by chemical bonds. Chemical synthesis is a construction of complex chemical compounds involving the reaction of two or more chemical species. Through chemical species, chemists are able to produce compounds that do not form naturally for research and to make large quantity of products for industrial purposes. The process of making new compounds poses a great challenge for chemists. How do they go about them making it and what drives them?

The development of synthetic chemistry began *circa*. Nineteenth century when Friedrich Wöhler, a German chemist managed to prepare urea synthetically:



It is considered as a historical significance because organic compound was produced from inorganic material for the first time. This discovery also made a huge impact in the history of chemical synthesis as chemists began to realise that they could actually synthesis molecules that did not exist in nature rather than just analysing the compounds obtained in nature (Yeh and Lim, 2007). It is also important to note that the fundamental theories of chemical structure and reactivity develop with the growth of chemical synthesis. Edward Frankland, a pioneer in structural and organometallic chemistry proposed the theory of valence that states individual atoms would combine with a fixed number of other atoms. Kekulé then used this theory to propose many simple organic structures before famously proposing the structural formula for benzene. Kekulé's idea then led a Russian chemist, Alexander Butlerov to propose the tetrahedral arrangement of valence bonds of carbon. The field of chemical synthesis expands further when Jacobus Henricus van't Hoff found the phenomenon of optical activity possessed by some organic molecules. Today, many aspects of our lives have been transformed by synthetic materials surrounding us.

Successful chemical synthesis requires a good plan. The first step is by visualising the target compound and work backwards toward simpler molecules. This technique is called retrosynthetic analysis (refer Chapter -2). Other factors such as the cost and availability of the starting materials, amount of yield, ease