

17. ORGANOMETALLIC COMPOUNDS

Introduction

Compounds in which metal is bonded with carbon atoms of the alkyl (organic) group.

R-Li: Alkyl lithium

R₂CuLi: Lithium dialkyl cuprate

R₂Cd: Dialkyl cadmium

Grignard reagent: It has the general formula RMgX; its general name is alkylmagnesium halide, a well-known example of organometallic compound.

- Which of the following compounds is organometallic compound which has Ethene as one of its components and is first synthesized organometallic compounds?
 - Zeise's salt**
 - Dibenzene chromium
 - Ferrocene
 - Tetraethyl tin
- Which of the following is organometallic compound
 - CH₃ONa
 - CH₃COONa
 - (CH₃)₃Zn
 - CH₃COOLi
- Identify the organometallic compounds.
 - CH₃MgI
 - (CH₃)₂CuLi
 - [Co(NH₃)₆]Cl₃
 - C₂H₅ONa
 - I and III only
 - I and II only
 - I, II and IV only
 - II and IV only

17.2 Nature of Metal-Carbon bond

Highly polar covalent bonds

17.3 Grignard reagent

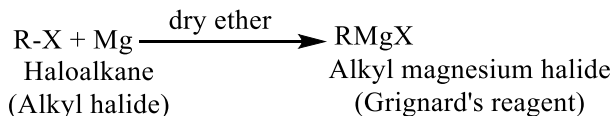
RMgX or Alkyl magnesium halide

- Which metal is used in a Grignard's reagent?

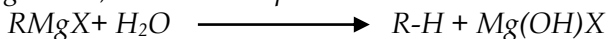
a. Ca b. Li c. Zn d. Mg

17.3.1 Preparation (using haloalkane and haloarene)

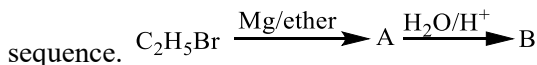
Haloalkanes or haloarenes react with magnesium metal in presence of dry ether forming alkyl magnesium halide or the Grignard's reagent.



Precaution: While preparing Grignard's reagent the conditions must be dry or moist free. If water is present it reacts with Grignard's reagent resulting alkane, an undesired product.



1. How would you convert a primary alcohol to Grignard's reagent? 2
2. Give reason: Grignard's reagent is stored in dry ether. 1
3. Identify the major product A and B in the following reaction



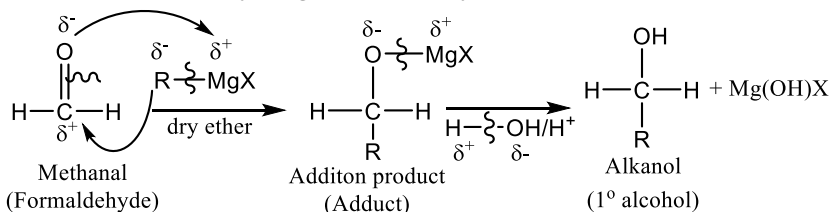
5. What is the solvent used during the preparation of grignard's reagent?
a. alkyl halide b. ester c. dry ether d. heat
6. Grignard's reagent can be prepared by the reaction between alkyl halide and
a. Zinc in presence of alcohol
b. Magnesium in the presence of dry ether
c. Magnesium in presence of alcohol
d. Magnesium in presence of moist ether
7. The solvent used during preparation of Grignard's reagent is
a. Alkyl halide b. Ester c. Ether d. H_2O
8. What is the product of the reaction of Ethylmagnesium bromide with water?
a. Methane b. Ethane c. Propane d. Butane
9. An alkyl halide forms a Grignard's reagent which reacts with water to form propane. Identify the original alkyl halide of the following.
a. Methyl iodide b. ethyl iodide c. ethyl bromide d. propyl bromide

17.3.2 Reactions of Grignard reagent

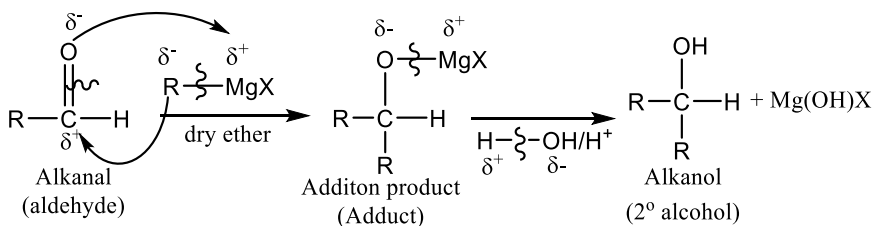
1. With Aldehydes and Ketones (formation of 1^o, 2^o and 3^o alcohol)

Addition of Grignard's reagent to aldehydes and ketones give addition products which on hydrolysis produce alcohols.

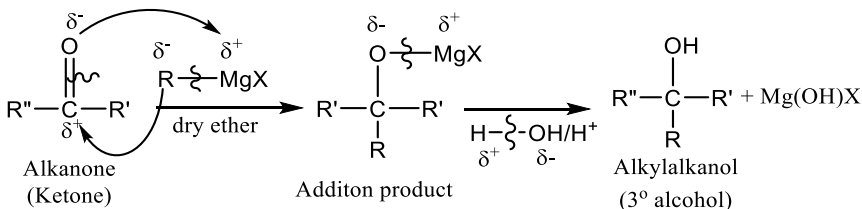
Formaldehyde gives primary alcohols.



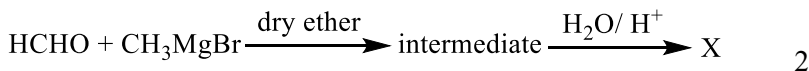
Other aldehydes give secondary alcohols.



Ketones give tertiary alcohol.



4. Write short note on: use of Grignard's reagent in the synthesis of 1°, 2° and 3° alcohols. 5
5. Identify X in:



6. How does $\text{CH}_3\text{CH}_2\text{MgBr}$ react with: a) H_2O b) HCHO c) CO_2 d) CH_3COCl ; Show the final products after aqueous workup. 6
7. Give action of Propanone on Grignard's reagent. 2
8. Starting from methyl magnesium bromide (CH_3MgBr) how would you prepare Ethanol? 3
9. Write chemical reaction for the preparation of Ethanol and Propan-2-ol from Methyl magnesium bromide. 2
10. Prepare Butan-2-ol and 2-methylpropan-2-ol by using CH_3MgBr . 2

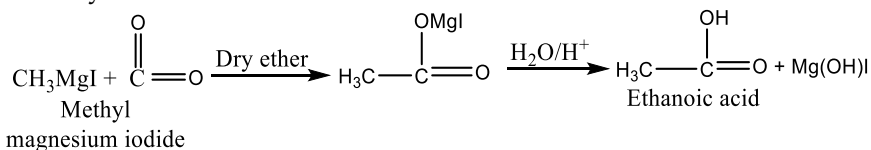
11. A carbonyl compound 'X' gives addition product 'Y' with Methyl magnesium bromide. 'Y' on hydrolysis gives isopropyl alcohol. Identify X and Y. 2
12. Write a structural formula of secondary alcohol of C_3H_8O and give its method of preparation using Grignard reagent. 2
13. Using suitable Grignard's reagent, how would you synthesize 2-methylpropan-2-ol. 1
14. Write the structural formula for 3° alcohol of $C_4H_{10}O$. How is this alcohol prepared by using Grignard's reagent? 2
15. Give the reactions of Benzaldehyde with $RMgX$. 1
16. An alcohol (P) having molecular formula C_3H_8O undergoes Victor Meyer's test to give blood red colour at the end of reaction (after adding KOH solution).
 - i) Write the structural formula of (P) and give its IUPAC name. 1
 - ii) Write down complete Victor-Meyer's test of (P). 2
 - iii) Starting from CH_3CH_2MgBr , how can you obtain (P)? 2
 - iv) What happens when (P) is heated with copper at $300^\circ C$? 1
 - v) How do you convert (P) into propanone? 2
17. An alcohol (A) having molecular formula C_3H_8O undergoes Victor Meyer's test to give blue colour at the end of reaction (after adding KOH solution).
 - i) Write the structural formula of (A) and give its IUPAC name. 1
 - ii) Write down complete Victor-Meyer's test of (A). 2
 - iii) Starting from CH_3MgBr , how can you obtain (A)? 2
 - iv) What happens when (A) is oxidized? 1
 - v) How do you convert (P) into propene? 2
18. An alcohol (M) having molecular formula $C_4H_{10}O$ undergoes Victor Meyer's test but no specific colour is seen at the end of reaction when KOH solution is added.
 - i) Write the structural formula of (M) and give its IUPAC name. 1
 - ii) Write down complete Victor-Meyer's test of M. 2
 - iii) Starting from CH_3MgBr , how can you obtain (M)? 2
 - iv) Write down structural formula and IUPAC name of isomeric alcohol of M which gives iodoform test. 1
19. A compound X reacts with ethyl magnesium iodide to form an addition product which on acidic hydrolysis yields 2-methyl-3-pentanol. Identify X.

- | | |
|---------------------|--------------|
| a. 2-methylpropanal | c. Butanone |
| b. Butanal | d. Propanone |

20. If phenyl magnesium bromide and acetaldehyde are the reactants the product formed after hydrolysis would be
- | | |
|--------------------|---------------------|
| a. Benzyl alcohol | c. Acetone |
| b. 1-phenylethanol | d. 2-phenyl alcohol |
10. Which of the following compounds will react with Grignard's reagent to give primary alcohol?
- | | | | |
|-------------|------------|--------------|------------------|
| c. Methanal | b. Ethanal | c. Propanone | d. Ethyl acetate |
|-------------|------------|--------------|------------------|
11. Which of the following gives secondary alcohol when treated with Grignard's reagents?
- | | | | |
|----------------------------|-------------------------------|------------------|------------------|
| d. CH_3CHO | b. CH_3COCH_3 | c. HCHO | d. CH_4 |
|----------------------------|-------------------------------|------------------|------------------|
12. You are asked to prepare a primary alcohol using Grignard's reagent, what will you start with
- | | | | |
|-------------|------------|--------------|--------------------|
| e. Methanal | b. ethanal | c. propanone | d. acetyl chloride |
|-------------|------------|--------------|--------------------|
13. What type of alcohol is generated in the reaction between ketone and Grignard's reagent?
- | | |
|---------------------|----------------------|
| f. Primary alcohol | b. Secondary alcohol |
| g. Tertiary alcohol | c. None of these |
14. Which would be produced when ketone is treated with Grignard's reagent?
- | | |
|--------------------|----------------------|
| h. Primary alcohol | b. Secondary alcohol |
| Tertiary alcohol | |
| c. methyl alcohol | |
15. In Grignard's reagent, alkyl part behaves as
- | | | | |
|----------------|-----------------|---------|-----------------|
| a. Nucleophile | b. Electrophile | c. Base | d. Both a and c |
|----------------|-----------------|---------|-----------------|
16. Which of the following can act as nucleophile?
- | | | | |
|------------------|--------------------|--------------------|--------------------------------------|
| a. BF_3 | b. FeCl_3 | c. ZnCl_2 | d. $\text{C}_2\text{H}_5\text{MgBr}$ |
|------------------|--------------------|--------------------|--------------------------------------|
17. Consider the following statements
- Organomagnesium halides are called Grignard's reagents.
 - The carbon-magnesium bond in Grignard reagent is ionic in nature.
 - Grignard's reagents can act as carbanions or nucleophiles.
 - For the preparation of Grignard's reagent, the reagents must be dry.
- | |
|-----------------------------|
| a. Only I and III are true. |
| b. Only IV is false. |
| c. All are right. |
| d. Only II is wrong. |

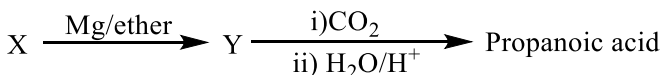
2. With carbon dioxide (formation of carboxylic acids)

Carbon dioxide gas if passed through dry ether solution of Grignard's reagent produces an addition product. The addition product undergoes hydrolysis with mineral acid to giving carboxylic acid.



21. Give an example of carboxylation reactions. 1

22. Identify X and Y in the following



2

23. Starting from methyl magnesium bromide how would you prepare Ethanoic acid? 2

24. Write down the correct reaction for the preparation of Ethanoic acid from CH_3MgBr . 1

25. Grignard's reagent is an organometallic compound which is used to synthesize various organic compounds. Starting from CH_3MgBr , how would you prepare

- | | | |
|----------------|------------------------|------------|
| A. Methane | C. Ethanoic acid | E. Ethanol |
| B. Propan-2-ol | D. 2-methylpropan-2-ol | |

26. A carbonyl compound (M) contains three carbon atoms and it undergoes iodoform test.

- Identify the compound (M).
- Write down a chemical reaction for the preparation of (M).
- How is (M) converted into Propane?
- Predict the final product obtained when (M) is treated with CH_3MgI in presence of dry ether and followed by hydrolysis.
- Give a laboratory test of carbonyl compound. 5

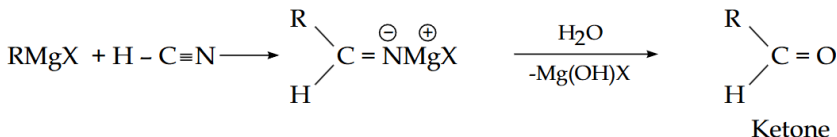
27. For the following reaction sequence,

- a. Methanoic acid c. Ethanoic acid
b. Methyl iodide d. Acetaldehyde

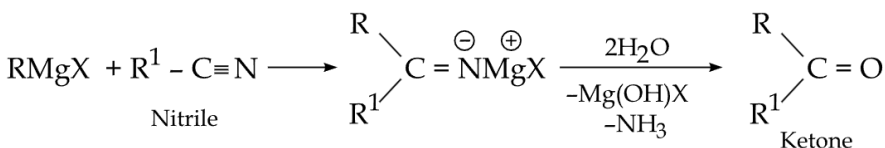
19. Carbonation of Grignard's reagent gives

- a. Ketone b. Carboxylic acid c. Alcohol d. Alkane

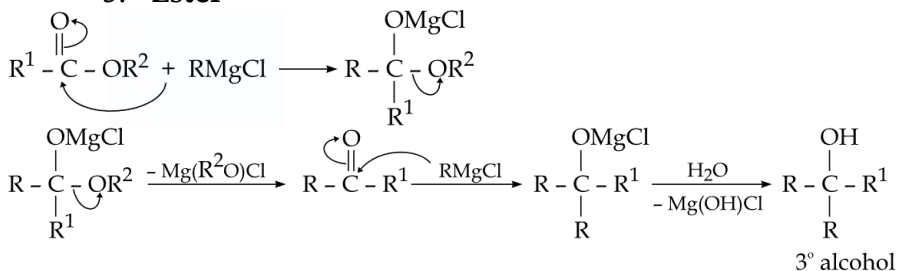
3. With HCN



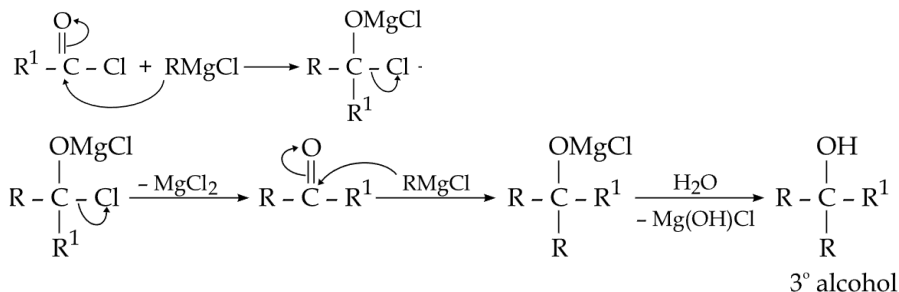
4. With RCN



5. Ester



6. Acid chloride

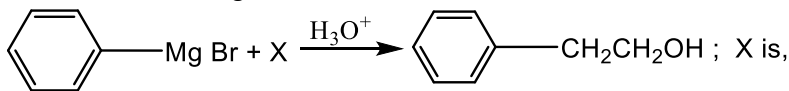


20. When two equivalents of Grignard reagent react with acid chloride, it gives

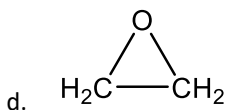
- a. Methyl alcohol c. 1° alcohol
b. 2° alcohol d. 3° alcohol

21. Methyl magnesium chloride reacts with acetyl chloride to produce

- a. Ethanol b. acetone c. methanol d. ether
22. Grignard's reagents do not show any reaction with
- a. Ketones b. Water c. Acid halides d. Ethers
23. Consider the following reaction

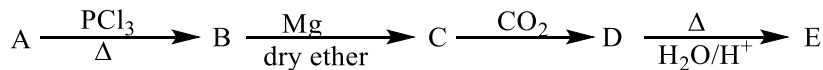


- a. $\text{OH}-\text{CH}_2-\text{CH}_2-\text{OH}$
 b. $\text{CH}_3-\text{CH}_2-\text{OH}$
 c. $\text{O}=\text{C}=\text{O}$



31. Convert Acetaldehyde to Acetone. 2
32. Convert Ethanal to Propanone. 2
33. Convert Ethanol to Propanone. 2
34. How would you convert Ethanol to Propanol? 2.5
35. An alcohol (A) of molecular formula $\text{C}_3\text{H}_8\text{O}$ undergoes Victor Meyer's reaction to give blue colour at the end of reaction when added KOH solution.
- Draw the structural formula and write the IUPAC name of (A). 1
 - Give the complete chemical reaction for the Victor-Meyer's test of (A). 2
 - Starting from CH_3MgBr , how would you prepare compound A? 2
 - What happens when (A) is oxidized? 1
 - Convert (A) into propene. 2
36. An alcohol (M) having molecular formula $\text{C}_4\text{H}_{10}\text{O}$ undergoes Victor Meyer's test but not specific colour is seen at the end of the reaction when KOH solution is added.
- Draw the structural formula of M and write IUPAC name. 1
 - Give the correct reaction for Victor-Meyer's test of M. 2
 - How is (M) prepared from CH_3MgBr ? 2
 - Write down structural formula and IUPAC name of isomeric alcohol of (M) which gives iodoform test. 1
 - How is propan-2-ol converted into propan-1-ol? 2
37. An organic compound A reacts with PBr_3 to give B. Compound B produces C when heated with alc. KOH. The compound C undergoes ozonolysis to yield Ethanal and Methanal as major products. The compound A responds iodoform test. Identify A, B, C and write reactions involved. How is A obtained from CH_3MgBr . 5

38. Consider the following reaction



The compound A is a primary alcohol which on oxidation gives Ethanal. Identify A, B, C, D and E.

Convert the above compound A into Methanol and Ethyne.

5

*****This is not a complete note. It is just to guide you. It is recommended to study prescribed textbooks along with this material. *****