

MCQs on Retrosynthesis

- Retrosynthesis is a strategy used in organic chemistry for:**
 - Predicting reaction mechanisms
 - Designing new reactions
 - Planning the synthesis of complex molecules
 - Analyzing molecular spectra→ **Answer: c) Planning the synthesis of complex molecules**
- In retrosynthetic analysis, the target molecule (TM) is systematically broken down into:**
 - Functional groups
 - Simpler starting materials
 - Catalyst fragments
 - Solvent molecules→ **Answer: b) Simpler starting materials**
- Which of the following represents a retrosynthetic step?**
 - $A \rightarrow B$ (forward reaction)
 - $B \rightarrow A$ (backward analysis)
 - $A + B \rightarrow C$
 - All of the above→ **Answer: b) $B \rightarrow A$ (backward analysis)**
- A key concept in retrosynthesis is the identification of:**
 - Leaving groups
 - Protecting groups
 - Disconnections
 - Catalysts→ **Answer: c) Disconnections**
- The term "disconnection" in retrosynthesis refers to:**
 - Breaking a bond to simplify the molecule
 - Changing a functional group
 - Identifying a protecting group
 - Naming a molecule→ **Answer: a) Breaking a bond to simplify the molecule**
- Which of the following is NOT a strategy in retrosynthesis?**
 - Functional group interconversion (FGI)
 - Functional group addition (FGA)
 - Disconnection approach
 - Synthon approach→ **Answer: b) Functional group addition (FGA)**
- A synthon is:**
 - A reagent used in organic synthesis
 - A retrosynthetic fragment representing a possible precursor
 - A catalyst for chemical reactions
 - An impurity in a reaction→ **Answer: b) A retrosynthetic fragment representing a possible precursor**
- Which of the following is a typical synthetic equivalent for a carbanion synthon ($-\text{CH}_2^-$)?**
 - Alkene
 - Grignard reagent (R-MgBr)
 - Alcohol

- d) Amide
→ **Answer: b) Grignard reagent (R-MgBr)**
9. **Functional Group Interconversion (FGI) is used in retrosynthesis to:**
a) Change one functional group into another
b) Convert a product into a reactant
c) Predict reaction conditions
d) Remove functional groups
→ **Answer: a) Change one functional group into another**
10. **The retrosynthetic approach is most useful for:**
a) Determining molecular weight
b) Predicting IR spectra
c) Synthesizing complex organic molecules
d) Calculating bond energy
→ **Answer: c) Synthesizing complex organic molecules**
11. **In retrosynthesis, an important guideline is to disconnect bonds:**
a) In the most stable part of the molecule
b) Between heteroatoms only
c) At strategic points to simplify synthesis
d) At random locations
→ **Answer: c) At strategic points to simplify synthesis**
12. **Which functional group is commonly introduced via retrosynthetic planning using Grignard reagents?**
a) Carboxylic acid
b) Ketone
c) Amine
d) Alkene
→ **Answer: b) Ketone**
13. **Which of the following is NOT a common disconnection strategy?**
a) C–C bond disconnection
b) C–N bond disconnection
c) C–O bond disconnection
d) Nuclear fragmentation
→ **Answer: d) Nuclear fragmentation**
14. **In retrosynthetic analysis, the term “umpolung” refers to:**
a) Functional group protection
b) Reversing the polarity of a functional group
c) Selective oxidation of a molecule
d) A type of catalyst
→ **Answer: b) Reversing the polarity of a functional group**
15. **The best approach in retrosynthesis for designing a synthesis is to:**
a) Consider all possible routes randomly
b) Identify key bonds for disconnection
c) Avoid disconnections
d) Use only one reagent
→ **Answer: b) Identify key bonds for disconnection**
16. **The use of protecting groups in retrosynthesis helps to:**
a) Avoid unwanted side reactions
b) Increase molecular weight
c) Decrease reaction time

- d) Change stereochemistry
→ **Answer: a) Avoid unwanted side reactions**
17. **Which of the following is a common precursor in retrosynthesis for an ester (-COOR)?**
a) Aldehyde
b) Alcohol + Carboxylic acid
c) Amide
d) Amine
→ **Answer: b) Alcohol + Carboxylic acid**
18. **Which reaction is often used in retrosynthesis to introduce a carbon-carbon double bond?**
a) Wittig reaction
b) Diels-Alder reaction
c) Friedel-Crafts reaction
d) Grignard reaction
→ **Answer: a) Wittig reaction**
19. **Which of the following is a key retrosynthetic step in peptide synthesis?**
a) Amide bond formation
b) Reductive amination
c) Epoxide opening
d) Ozonolysis
→ **Answer: a) Amide bond formation**
20. **Which reaction can be useful in retrosynthesis for making alcohols from ketones?**
a) Reduction with NaBH₄
b) Friedel-Crafts alkylation
c) Diels-Alder reaction
d) Aldol condensation
→ **Answer: a) Reduction with NaBH₄**
21. **The retrosynthetic analysis of benzophenone suggests the use of:**
a) Grignard reaction
b) Aldol reaction
c) Perkin reaction
d) Cannizzaro reaction
→ **Answer: a) Grignard reaction**
22. **A key retrosynthetic strategy for β -lactams involves:**
a) Cyclization of an amide precursor
b) Reduction of a ketone
c) Nucleophilic addition to a nitrile
d) Hydrolysis of an ester
→ **Answer: a) Cyclization of an amide precursor**
23. **Retrosynthetic analysis of ibuprofen suggests the use of which key reaction?**
a) Friedel-Crafts acylation
b) Kolbe-Schmitt reaction
c) Sandmeyer reaction
d) Gabriel synthesis
→ **Answer: a) Friedel-Crafts acylation**
24. **Which of the following is NOT typically involved in retrosynthesis of carbohydrates?**
a) Glycosylation

- b) Ozonolysis
 - c) Epoxidation
 - d) Hydrolysis
 - **Answer: b) Ozonolysis**
25. Which software tool is commonly used for retrosynthetic analysis?
- a) ChemDraw
 - b) SciFinder
 - c) Reaxys
 - d) All of the above
- **Answer: d) All of the above**
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MCQs on Retrosynthesis (Advanced Level)

Concepts & Fundamentals

1. The main objective of retrosynthetic analysis is to:
 - a) Predict reaction mechanisms
 - b) Determine molecular weight
 - c) Identify a synthetic route for complex molecules
 - d) Measure bond lengths→ **Answer: c) Identify a synthetic route for complex molecules**
2. Which of the following is NOT a fundamental principle of retrosynthesis?
 - a) Disconnection approach
 - b) Functional group interconversion (FGI)
 - c) Umpolung strategy
 - d) Crystallization→ **Answer: d) Crystallization**
3. Which of the following is an example of umpolung in retrosynthesis?
 - a) Converting an aldehyde into a nucleophilic species
 - b) Reducing a ketone to an alcohol
 - c) Oxidizing an amine to a nitro compound
 - d) Hydrolyzing an ester→ **Answer: a) Converting an aldehyde into a nucleophilic species**
4. In retrosynthesis, a “synthetic equivalent” is used to:
 - a) Predict reaction conditions
 - b) Replace a synthon with a real reagent
 - c) Identify reaction byproducts
 - d) Remove a functional group→ **Answer: b) Replace a synthon with a real reagent**
5. Which of the following reactions is commonly used for C–C bond formation in retrosynthesis?
 - a) Aldol reaction
 - b) Hoffmann rearrangement
 - c) Sandmeyer reaction
 - d) Beckmann rearrangement→ **Answer: a) Aldol reaction**

Disconnection Strategies & Synthons Approaches

6. **The best strategy for retrosynthetic analysis is to:**
- a) Work from the simplest reactants
 - b) Identify key bonds for disconnection
 - c) Avoid any disconnections
 - d) Use only Grignard reagents
- **Answer: b) Identify key bonds for disconnection**
7. **In retrosynthetic planning, functional group interconversion (FGI) helps in:**
- a) Changing one functional group into another
 - b) Predicting product stability
 - c) Analyzing spectroscopic data
 - d) Identifying catalysts
- **Answer: a) Changing one functional group into another**
8. **Which disconnection would be most useful for synthesizing an ester?**
- a) Between carbonyl carbon and oxygen
 - b) Between two carbon atoms
 - c) Between nitrogen and hydrogen
 - d) Between two oxygen atoms
- **Answer: a) Between carbonyl carbon and oxygen**
9. **A key retrosynthetic strategy for ketones involves which precursor?**
- a) Alcohol
 - b) Aldehyde
 - c) Carboxylic acid
 - d) Grignard reagent + ester
- **Answer: d) Grignard reagent + ester**
10. **What is the synthon for a nitrile (-CN) in retrosynthesis?**
- a) Cyanide ion (^-CN)
 - b) Amine ($R-NH_2$)
 - c) Alcohol ($R-OH$)
 - d) Carboxylate ion ($R-COO^-$)
- **Answer: a) Cyanide ion (^-CN)**
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Common Synthetic Routes

11. **Which reagent can be used to synthesize alcohols from aldehydes in a forward synthetic approach?**
- a) $LiAlH_4$
 - b) PCC
 - c) H_2SO_4
 - d) $NaNO_2$
- **Answer: a) $LiAlH_4$**
12. **Which reaction is most useful for synthesizing amides?**
- a) Carboxylic acid + amine
 - b) Aldol condensation
 - c) Perkin reaction

- d) Ozonolysis
→ **Answer: a) Carboxylic acid + amine**
13. Which reaction is commonly used in retrosynthetic analysis to form an alkene?
a) Wittig reaction
b) Fischer esterification
c) Gabriel synthesis
d) Kolbe-Schmitt reaction
→ **Answer: a) Wittig reaction**
14. Which of the following is a useful disconnection strategy for an α,β -unsaturated ketone?
a) Aldol reaction
b) Cannizzaro reaction
c) Gabriel synthesis
d) Friedel-Crafts acylation
→ **Answer: a) Aldol reaction**
15. The retrosynthetic approach for a β -hydroxy ketone would involve:
a) Aldol condensation
b) Diels-Alder reaction
c) Claisen condensation
d) Nucleophilic substitution
→ **Answer: a) Aldol condensation**
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Advanced Disconnections & Named Reactions

16. What is the precursor for a carboxylic acid in retrosynthesis?
a) Grignard reagent + CO₂
b) Alcohol + NaOH
c) Amine + HCl
d) Alkene + O₃
→ **Answer: a) Grignard reagent + CO₂**
17. Which of the following is a good precursor for an alkyne in retrosynthesis?
a) Vicinal dihalide
b) Amide
c) Ether
d) Ketone
→ **Answer: a) Vicinal dihalide**
18. Which named reaction is useful in retrosynthesis for making lactones?
a) Baeyer-Villiger oxidation
b) Sandmeyer reaction
c) Cannizzaro reaction
d) Finkelstein reaction
→ **Answer: a) Baeyer-Villiger oxidation**
19. What is the key retrosynthetic approach for synthesizing epoxides?
a) Oxidation of alkenes
b) Reduction of ketones
c) Acid hydrolysis of ethers
d) Addition of HBr to alkenes
→ **Answer: a) Oxidation of alkenes**

20. **The retrosynthetic precursor for benzophenone is typically:**

- a) Benzoyl chloride + Benzene
- b) Phenol + HCl
- c) Benzyl alcohol + NaOH
- d) Toluene + HNO₃

→ **Answer: a) Benzoyl chloride + Benzene**

Basic MCQs on Retrosynthesis

1. **Retrosynthesis is also known as:**

- a) Forward synthesis
- b) Reverse synthesis
- c) Functional analysis
- d) Oxidation

→ **Answer: b) Reverse synthesis**

2. **In retrosynthesis, a complex molecule is broken into:**

- a) Larger molecules
- b) Smaller, simpler molecules
- c) Isotopes
- d) Radicals

→ **Answer: b) Smaller, simpler molecules**

3. **The symbol used for retrosynthetic analysis is:**

- a) \rightarrow
- b) \rightleftharpoons
- c) \longrightarrow
- d) \Leftarrow

→ **Answer: d) \Leftarrow**

4. **Which of the following is a key step in retrosynthesis?**

- a) Disconnection
- b) Polymerization
- c) Crystallization
- d) Boiling

→ **Answer: a) Disconnection**

5. **Retrosynthesis is mainly used in:**

- a) Physical Chemistry
- b) Organic Chemistry
- c) Inorganic Chemistry
- d) Analytical Chemistry

→ **Answer: b) Organic Chemistry**

6. **Which of the following is a retrosynthetic tool?**

- a) Spectroscopy
- b) X-ray diffraction
- c) Synthon approach
- d) Distillation

→ **Answer: c) Synthon approach**

7. **A synthon is:**

- a) A molecule in forward synthesis
- b) A retrosynthetic fragment
- c) A catalyst

- d) A reagent
→ **Answer: b) A retrosynthetic fragment**
8. **Which bond is commonly disconnected in retrosynthesis?**
a) C–C
b) C–H
c) O–H
d) N–N
→ **Answer: a) C–C**
9. **A precursor is:**
a) A final product
b) An intermediate compound
c) A reactant in retrosynthesis
d) A byproduct
→ **Answer: c) A reactant in retrosynthesis**
10. **Which reaction is useful in retrosynthesis for making ketones?**
a) Aldol condensation
b) Hydrolysis
c) Hydrogenation
d) Precipitation
→ **Answer: a) Aldol condensation**
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More Simple MCQs on Retrosynthesis

11. **Which reaction is commonly used in retrosynthesis for forming alcohols?**
a) Reduction
b) Oxidation
c) Hydrolysis
d) Decarboxylation
→ **Answer: a) Reduction**
12. **What is the precursor of an ester?**
a) Carboxylic acid and alcohol
b) Amine and ketone
c) Alkane and alcohol
d) Aldehyde and acid
→ **Answer: a) Carboxylic acid and alcohol**
13. **Which reaction is useful for forming amides in retrosynthesis?**
a) Amine + Carboxylic acid
b) Alcohol + Aldehyde
c) Ketone + Amine
d) Ester + Alkene
→ **Answer: a) Amine + Carboxylic acid**
14. **Which is a common method to make an alkene in retrosynthesis?**
a) Dehydration of alcohol
b) Hydrolysis of ketone
c) Hydrogenation of alkane
d) Oxidation of amine
→ **Answer: a) Dehydration of alcohol**

15. Which reaction is used in retrosynthesis to introduce a C=C bond?
- a) Wittig reaction
 - b) Friedel-Crafts acylation
 - c) Kolbe reaction
 - d) Sandmeyer reaction
- Answer: a) Wittig reaction
16. Which reagent is commonly used in retrosynthesis for alcohol formation?
- a) NaBH₄
 - b) HCl
 - c) NaOH
 - d) H₂SO₄
- Answer: a) NaBH₄
17. Which of these is NOT used in retrosynthetic analysis?
- a) Functional group interconversion (FGI)
 - b) Disconnection
 - c) Functional group addition (FGA)
 - d) Synthon approach
- Answer: c) Functional group addition (FGA)
18. What is the precursor of benzophenone?
- a) Benzoyl chloride + Benzene
 - b) Phenol + Acetone
 - c) Toluene + H₂O
 - d) Benzoic acid + HCl
- Answer: a) Benzoyl chloride + Benzene
19. Which reagent is commonly used for forming carbon-carbon bonds?
- a) Grignard reagent
 - b) H₂O₂
 - c) NaCl
 - d) CH₃OH
- Answer: a) Grignard reagent
20. Which reaction is useful for forming an epoxide in retrosynthesis?
- a) Oxidation of an alkene
 - b) Reduction of a ketone
 - c) Hydrolysis of an ester
 - d) Dehydration of an alcohol
- Answer: a) Oxidation of an alkene
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Basic Named Reactions in Retrosynthesis

21. Which reaction forms β-lactams?
- a) Staudinger reaction
 - b) Aldol reaction
 - c) Friedel-Crafts reaction
 - d) Cannizzaro reaction
- Answer: a) Staudinger reaction
22. Which of the following is useful for ester formation?
- a) Fischer esterification
 - b) Wittig reaction

- c) Sandmeyer reaction
- d) Gabriel synthesis

→ **Answer: a) Fischer esterification**

23. **Which reaction is commonly used for ketone synthesis?**

- a) Friedel-Crafts acylation
- b) Claisen condensation
- c) Cannizzaro reaction
- d) Perkin reaction

→ **Answer: a) Friedel-Crafts acylation**

24. **Which reaction is used for aromatic aldehyde synthesis?**

- a) Reimer-Tiemann reaction
- b) Grignard reaction
- c) Diels-Alder reaction
- d) Baeyer-Villiger oxidation

→ **Answer: a) Reimer-Tiemann reaction**

25. **Which reaction is useful for alkene formation?**

- a) Wittig reaction
- b) Hydrolysis
- c) Reduction
- d) Oxidation

→ **Answer: a) Wittig reaction**