

## MCQs on Retrosynthesis

1. **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**
2. **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**
3. **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)**
4. **A key concept in retrosynthesis is the identification of:**
  - Leaving groups
  - Protecting groups
  - Disconnections
  - Catalysts

→ Answer: **c) Disconnections**
5. **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**
6. **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)**
7. **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**
8. **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  $\text{NaBH}_4$

b) Friedel-Crafts alkylation

c) Diels-Alder reaction

d) Aldol condensation

→ Answer: a) Reduction with  $\text{NaBH}_4$

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  $\beta$ -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**

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## Disconnection Strategies & Synthon 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 ( $\text{^-\text{CN}}$ )
  - b) Amine ( $\text{R-NH}_2$ )
  - c) Alcohol ( $\text{R-OH}$ )
  - d) Carboxylate ion ( $\text{R-COO}^-$ )

→ **Answer: a) Cyanide ion ( $\text{^-\text{CN}}$ )**

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## Common Synthetic Routes

11. **Which reagent can be used to synthesize alcohols from aldehydes in a forward synthetic approach?**
  - a)  $\text{LiAlH}_4$
  - b) PCC
  - c)  $\text{H}_2\text{SO}_4$
  - d)  $\text{NaNO}_2$

→ **Answer: a)  $\text{LiAlH}_4$**
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  $\alpha,\beta$ -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  $\beta$ -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 +  $\text{CO}_2$

b) Alcohol +  $\text{NaOH}$

c) Amine +  $\text{HCl}$

d) Alkene +  $\text{O}_3$

→ Answer: a) Grignard reagent +  $\text{CO}_2$

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  $\text{HBr}$  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 +  $\text{HNO}_3$

→ 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)  $\text{NaBH}_4$
- b) HCl
- c) NaOH
- d)  $\text{H}_2\text{SO}_4$

→ Answer: a)  $\text{NaBH}_4$

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 +  $\text{H}_2\text{O}$
- d) Benzoic acid + HCl

→ Answer: a) Benzoyl chloride + Benzene

19. Which reagent is commonly used for forming carbon-carbon bonds?

- a) Grignard reagent
- b)  $\text{H}_2\text{O}_2$
- c) NaCl
- d)  $\text{CH}_3\text{OH}$

→ 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

## Basic Named Reactions in Retrosynthesis

21. Which reaction forms  $\beta$ -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**