Stereochemistry Exam Preparation Pack
Answer Key - Advanced

Section A: Find Chiral Centers and Determine R/S
Find the chiral centers in each of these molecules with “alternative uses” and determine R/S for each chiral center.

Section B: Convert to Fischer Projection
For each of the three molecules below:
• Label each chiral center as R/S
• Convert the drawing into a Fischer projection
• Draw the other stereoisomers as Fischer projections
• Indicate which of these stereoisomers is the enantiomer
• Indicate which stereoisomer(s) are diastereomers

Cocaine

LSD

Heroin
B-1 2,3-Dibromosuccinic acid

2,3-Dibromosuccinic acid has no enantiomer (meso!).

Other stereoisomers (both diastereomers):

B-2 2,3-Dichlorobutane

2,3-Dichlorobutane has Fischer projections that show enantiomers and diastereomers (meso!).

B-3 3-Chlorobutan-2-ol

3-Chlorobutan-2-ol has Fischer projections that show diastereomers and enantiomers (meso!).

Section C: Chiral or Achiral Molecules?

C-1 Chiral or achiral molecules? If meso, indicate

achiral  meso  chiral  chiral  achiral  meso
C-2  Chiral or achiral molecules? If meso, indicate


C-3  Chiral or achiral molecules? Indicate if meso


C-4  Chiral or achiral molecules? Indicate meso (if present)

D-1  **Draw the enantiomer (+ more)**

Your mission is to:
1) identify all chiral centers in Zocor
2) Draw the enantiomer
3) How many stereoisomers are possible for Zocor?

![Zocor](https://www.masterorganicchemistry.com)

**enantiomer**

*2^7* stereoisomers possible

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E-1  **Enantiomers, Diastereomers, Constitutional Isomers, or the Same?**

For each pair: Are these molecules enantiomers, diastereomers, the same, or constitutional isomers? Would an equal mixture of these two compounds rotate plane-polarized light?

![Molecules](https://www.masterorganicchemistry.com)

*a) same  
b) yes*  
*a) enantiomers  
b) no*

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https://www.masterorganicchemistry.com
E-2  Enantiomers, Diastereomers, Constitutional Isomers, or the Same?

- Me
  - O
  - H
  - a) same
  - b) no

- HO
  - D
  - a) diastereomers
  - b) yes

- O
  - C
  - H
  - H
  - C
  - CH₃
  - CH₂OH
  - a) same
  - b) yes

E-3  Enantiomers, Diastereomers, Constitutional Isomers, or the Same?

- HO
  - H
  - CH₃
  - H
  - CH₃
  - a) same
  - b) no

- H₃C
  - C=C
  - C=CH₃
  - H
  - a) enantiomers
  - b) no

- O
  - C
  - H
  - H₂N
  - CH₃
  - a) same
  - b) yes
E-4 Enantiomers, Diastereomers, Constitutional Isomers, or the Same?


- A: enantiomers
- B: no

E-5 How are these three molecules (A, B, and C) related to each other?


- A and B: same
- A and C: diastereomers
- B and C: diastereomers

Section F: Given the name, draw the structure

a) Draw (2S,3R)-2,3-Difluorohexane using wedge/dash
b) Draw the diastereomers


- 2S, 3R diastereomer
- 2R, 3R diastereomer
- 2S, 3S diastereomer
- 2R, 3S diastereomer (enantiomer)
**Section G, H, I: Cycloalkanes**

**G-1**  
a) Draw the two *achiral* forms of 1,3,5-Trimethylcyclohexane  
b) Which is more stable?

\[\text{achiral #1} \quad \text{most stable chair form} \quad \text{achiral #2} \quad \text{most stable chair form (most stable overall)}\]

**H-1**

a) Draw the most stable *achiral* isomer of a cyclohexane with a single fluoro and a single bromo substituent on the ring  
b) Draw the most stable *chiral* isomer of a cyclohexane with a single fluoro and a single bromo substituent on the ring

\[\text{achiral} \quad \text{most stable chair form} \quad \text{chiral} \quad \text{most stable chair form}\]

**I-1**  
a) Draw one version of 1,3-Dimethylcyclohexane that is chiral, and one that is achiral  
b) One of these isomers has two conformers of very different energy. Draw those two chair conformations.

\[\text{chiral} \quad \text{achiral} \quad \text{achiral has conformers of very different energy}\]
J-1 Draw The Enantiomer (+ more)

Escitalopram (Celexa):

- Pure S enantiomer shows a specific rotation of +120°. Sven, a worker in the quality control unit, observed a specific rotation of −30° for a test sample. What is the percentage of (R) and the percentage of (S) in that sample?

62.5 % (R) 37.5 % (S)

K-1 Optical Activity

An 80:20 mixture of the (R,R) and (S,S) enantiomers of 2,3-dibromobutane has an optical rotation of −30°. Using these templates, show the stereochemical representation of these compounds, their stereoisomers, and their optical rotations:

2R, 3R 2S, 3S 2R, 3S

[ α ]: −50° [ α ]: +50° [ α ]: 0°C
L-1 Resolution

Draw the two products of the following reaction, clearly showing stereochemistry (it’s OK to use “R₃N” for (+)-brucine). Note that (+/−) implies a 1:1 mixture of enantiomers.

Racemic mixture of mandelic acid: reaction with (+)-Brucine

![Reaction Diagram]

(+)-mandelic acid  (−)-mandelic acid

• How are these products related to each other?  **diastereomers**
• How might you exploit this to resolve mandelic acid into its enantiomers? Describe this process briefly

1) add (+)-brucine to racemic mixture. 2) recrystallize, and separate crystals (one diastereomer) from mother liquor, which contains other diastereomer. 3) add acid to crystals, re-forming mandelic acid, then extract in separatory funnel using water and organic solvent to separate optically active mandelic acid from the salts (can do the same for the mother liquor)

M-1 Chiral Nitrogens

Although the nitrogen in the molecule A below has four different substituents, the nitrogen does not give rise to a pair of enantiomers. Why not?

Would you expect the nitrogen in molecule B to be a chiral center? Why or why not?

![Nitrogen Structures]

**inverts rapidly, can’t be separated**

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