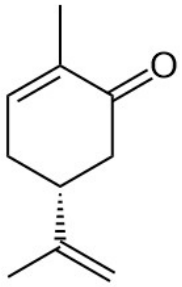
Organic Chemistry I, CHM 3140
Dr. Laurie S. Starkey, Cal Poly Pomona
Chapter 5 Stereochemistry, Part 3 – Practice Problems

For clicker question voting, go to:
https://pollev.com/lauriestarke263 or
text LAURIESTARKE263 to 37607

1

Does the following drawing represent *R* or *S* carvone? Draw its enantiomer using two methods.

(*R*)-carvone or
(*S*)-carvone?



Draw mirror image:

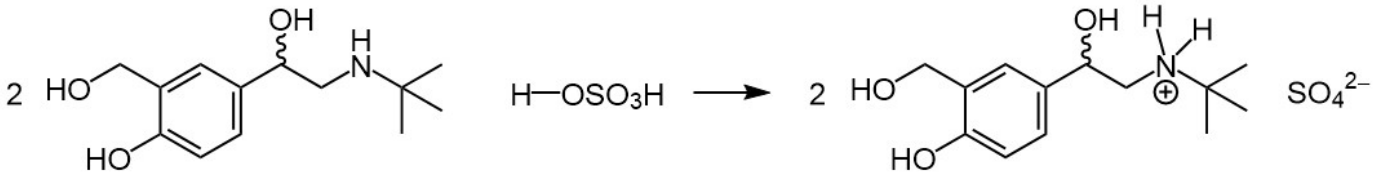
Invert all chiral centers:

(*R*)-carvone smells/tastes like spearmint, and **(*S*)-carvone** like caraway seeds (used in rye bread). What does that tell you about the odor receptors in your nose and taste receptors in your mouth?

2

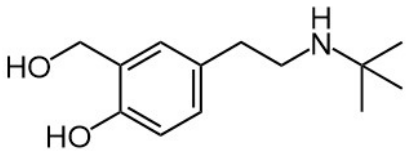
Albuterol is a bronchodilator that treats asthma when delivered by an inhaler.
The drug is marketed as a racemic mixture of its sulfate salt (formed by reaction with H_2SO_4).

Provide a mechanism to show albuterol reacting with a strong acid such as sulfuric acid.
Note: sulfuric acid is diprotic so one molecule of sulfuric acid can protonate two molecules albuterol.

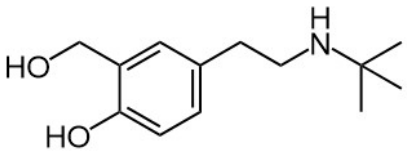


(±)-albuterol sulfuric acid (±)-albuterol sulfate
(H-albuterol$^+$ SO_4^{2-})

Complete the drawings below to draw (*R*)-(−)-albuterol and (*S*)-(+)-albuterol.



(*R*)-(−)-albuterol



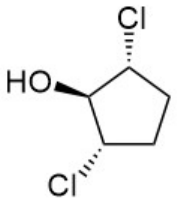
(*S*)-(+)-albuterol

The enantiomer with the pharmacological activity is marketed as a different drug, called *levalbuterol*. Do you think levalbuterol is the *R* or *S* enantiomer of albuterol? Explain.

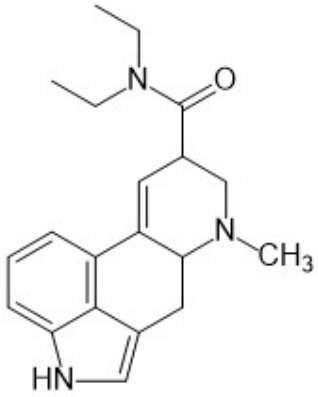
3

An asymmetric synthesis of albuterol resulted in a mixture that was 75% (*R*) and 25% (*S*). What is the expected specific rotation of this mixture? Albuter$^{D}_{20}$ [α] −32.2° (c = 0.1 in water)

4 Determine whether or not each of the following is optically active.

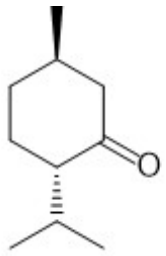
a molecule with one chiral center	(+)-Starkyne	racemic tartaric acid	

5 Identify all the chiral centers in lysergic acid diethylamide (LSD). Mark each with *.
LSD has how many possible stereoisomers?



lysergic acid diethylamide (LSD)

6 Shown below is menthone, a minor component of peppermint oil. Determine the configuration of each chiral center in menthone, draw its enantiomer, and predict its specific rotation and boiling point.

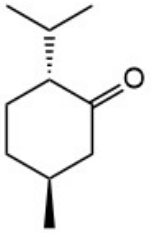


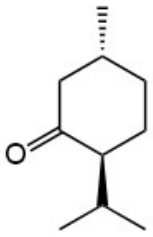
menthone
$[\alpha]_D^{20}$ -25°
bp 207°C

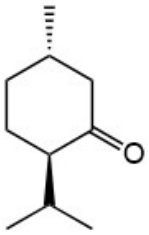
enantiomer
of menthone
$[\alpha]_D^{20}$

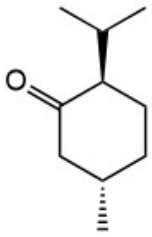
bp

Identify the drawing that does NOT represent the **enantiomer** of menthone.

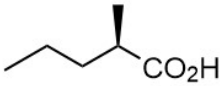
A) 

B) 

C) 

D) 

7 Which of the following statements is NOT true about a given sample of (R)-acid that has a specific rotation $[\alpha] = -45$ and 90% ee?



(R)-acid

90% ee sample of (R)-acid has $[\alpha] = -45$

A) The sample is optically active.

B) Pure (R)-acid would have $[\alpha] = -50$.

C) The sample contains 90% (R) enantiomer and 10% racemic mixture.

D) The sample contains 95% (R) enantiomer and 5% (S) enantiomer.

E) The (S)-acid enantiomer is levorotatory.

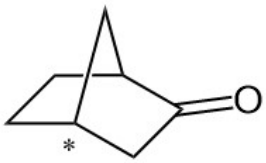
What is the configuration of the marked (*) carbon?

A) R

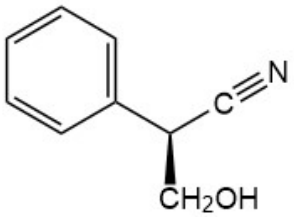
B) S

C) neither (it is achiral)

8

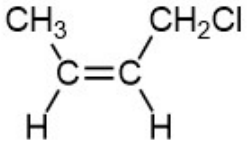


9

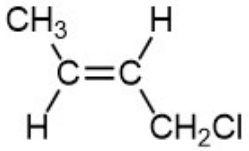


VII. Describing the Stereochemistry of Alkenes (*E* and *Z* configurations) (5.11)

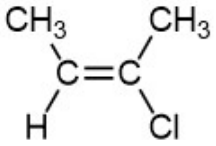
Cis and trans can be used to describe stereochemistry of *disubstituted* alkenes, but not others.



(*cis*)-1-chloro-2-butene

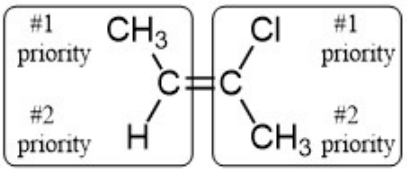


(*trans*)-1-chloro-2-butene



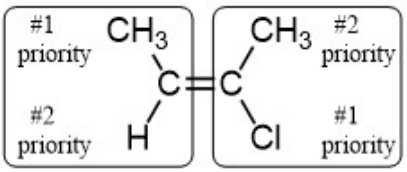
Cis? Trans? Neither!

For *trisubstituted* or *tetrasubstituted* alkenes, the stereodescriptors (*Z*) and (*E*) are used.



Are the higher priority groups on ***"ze same side"*** **?** Yes!

(*Z*)-2-chloro-2-butene



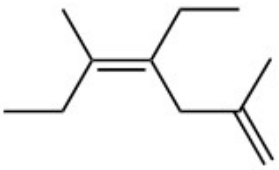
Are the higher priority groups on ***"ze same side"*** **?** No!

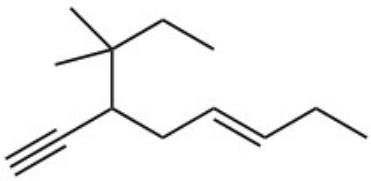
(*E*)-2-chloro-2-butene

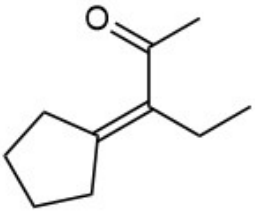
What is the relationship of (*Z*)-2-chloro-2-butene and (*E*)-2-chloro-2-butene?

A) constitutional isomers
B) enantiomers
C) diastereomers
D) the same compound
E) unrelated

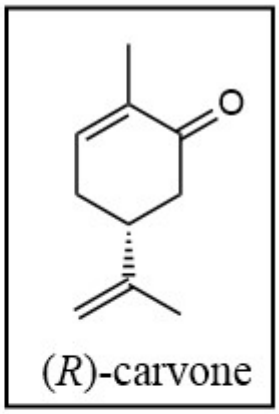
10 Determine *E* or *Z* configurations, as appropriate.

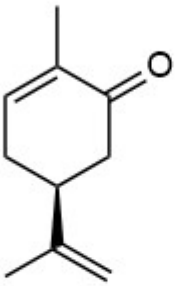


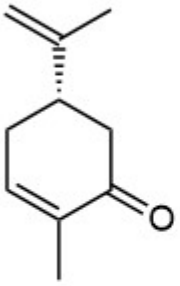


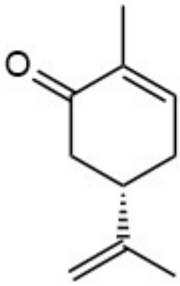


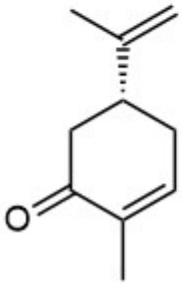
1 Identify the drawing that does NOT represent the **enantiomer** of (*R*)-carvone.


(*R*)-carvone

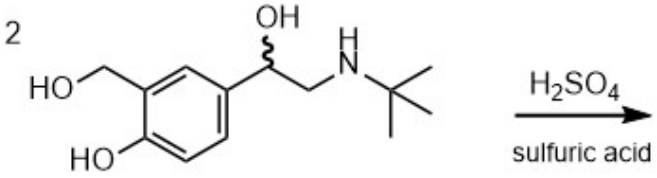
A) 

B) 

C) 

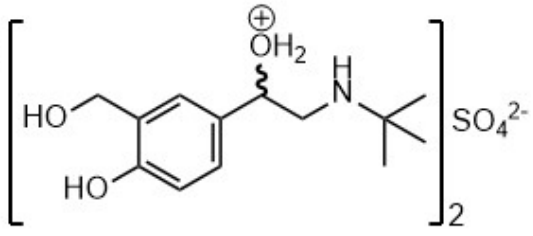
D) 

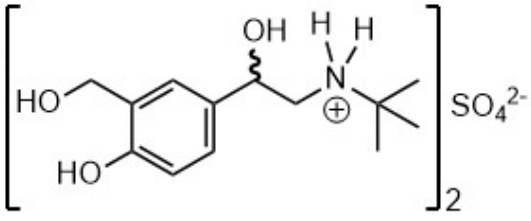
2

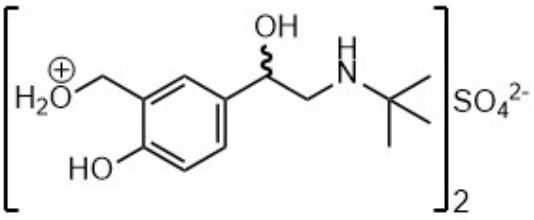


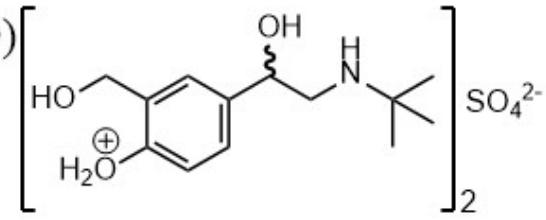
(±)-albuterol

(±)-albuterol sulfate (H-albuterol$^+$ SO_4^{2-})

A) 

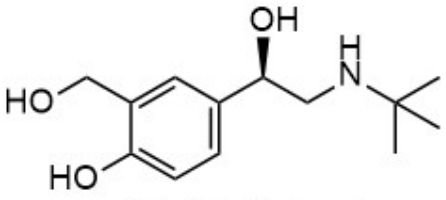
B) 

C) 

D) 

3

An asymmetric synthesis of albuterol resulted in a mixture that was 75% (R) and 25% (S). What is the expected specific rotation of this mixture? Albuterol $[\alpha]_{20}^{D}$ –32.2 (c = 0.1 in water)



(*R*)-(–)-albuterol

A) mixture $[\alpha]_{20}^{D}$ = –24.2

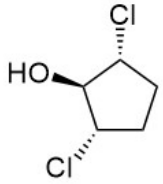
B) mixture $[\alpha]_{20}^{D}$ = +24.2

C) mixture $[\alpha]_{20}^{D}$ = +16.1

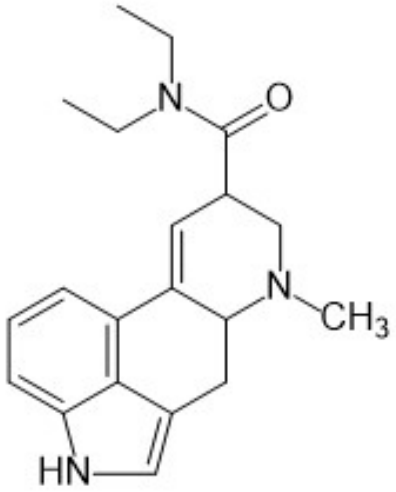
D) mixture $[\alpha]_{20}^{D}$ = –16.1

4

Determine whether or not each of the following is optically active.

	a molecule with one chiral center	(+)-Starkyne	racemic tartaric acid	
A)	optically active	optically active	optically inactive	optically active
B)	optically active	optically active	optically inactive	optically inactive
C)	optically inactive	optically active	optically inactive	optically inactive
D)	can't tell	can't tell	can't tell	optically inactive
E)	can't tell	can't tell	can't tell	optically active

5 Identify all the chiral centers in lysergic acid diethylamide (LSD). Mark each with *.
LSD has how many possible stereoisomers?

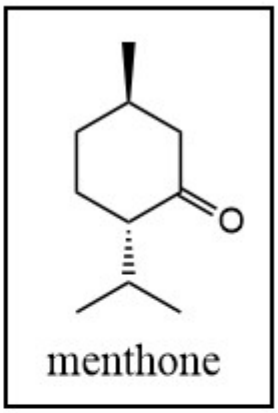


lysergic acid diethylamide (LSD)

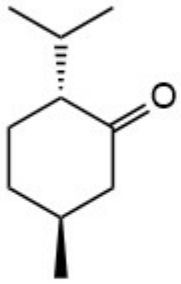
Number of isomers?

A) 2
B) 4
C) 8
D) 16
E) 32

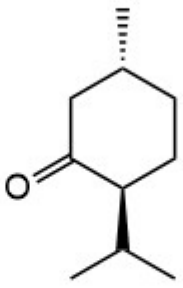
6 Identify the drawing that does NOT represent the **enantiomer** of menthone.



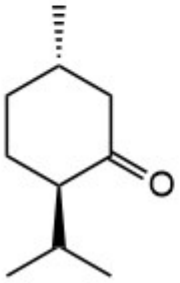
A)



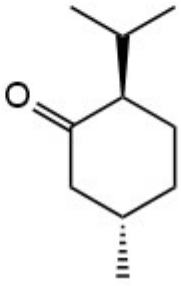
B)



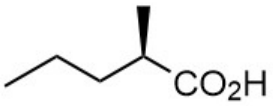
C)



D)



7 Which of the following statements is NOT true about a given sample of (R)-acid that has a specific rotation [α] = −45 and 90% ee?



(R)-acid

90% ee sample of (R)-acid has [α] = −45

A) The sample is optically active.

B) Pure (R)-acid would have [α] = −50.

C) The sample contains 90% (R) enantiomer and 10% racemic mixture.

D) The sample contains 95% (R) enantiomer and 5% (S) enantiomer.

E) The (S)-acid enantiomer is levorotatory.

What is the configuration of the marked (*) carbon?

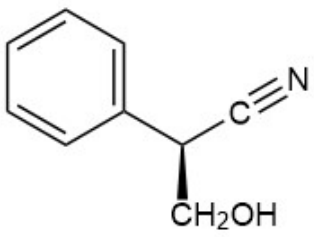
A) R

B) S

C) neither (it is achiral)

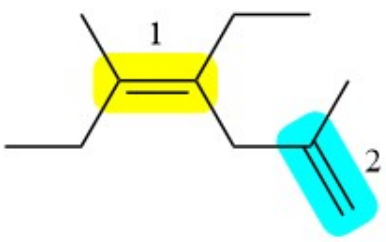
8

9



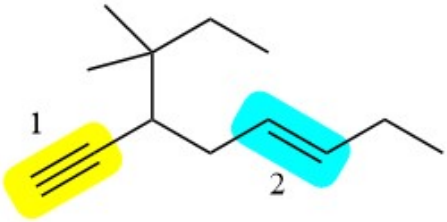
Determine the configuration(s) of the following compound.

10a



	1	2
A)	*E*	*Z*
B)	*Z*	*Z*
C)	*E*	neither
D)	*Z*	neither

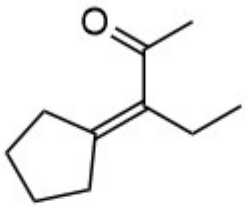
10b



	1	2
A)	neither	*E*
B)	neither	*Z*
C)	*Z*	*E*
D)	*Z*	*Z*

Determine the configuration of the given alkene.

10c



A) *E*

B) *Z*

C) neither (non-stereoisomeric)

D) neither (achiral)