Exam

Name		

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) What type of isomers are $CH_3CH_2OCH_3$ and $CH_3CH_2CH_2OH$?

A) symmetrical
B) constitutional
C) conformational
D) configurational
E) stereochemical

Answer: B Section: 5-1

2) What is the relationship between the following compounds?



A) positional isomersB) configurational isomersC) constitutional isomersD) conformational isomersE) structural isomers

Answer: B Section: 5-1

3) What is the relationship between the following compounds?

$$H \approx \begin{array}{c} CH_3 \\ H \approx C \\ CH_3 \\ CH_3 \end{array} \qquad \text{and} \qquad \begin{array}{c} CH_3 \\ H \\ CH_2 \\ CH_2$$

Answer: E Section: 5-1

2)

1)



Section: 5-1

5) What is the relationship between the structures shown below?



6) Which of the following compounds is never chiral?

A) 1, 3- dibromobutane

B) 1- bromo- 2- chlorobutane

C) 1, 4- dibromobutane

D) 2, 3- dibromobutane

E) 1, 2- dichlorobutane

Answer: C Section: 5-2

7) Which of the following compounds is chiral?

CH3

6)



2



8) Is the molecule shown below chiral or achiral?

8)



Answer: achiral Section: 5-2



Answer: chiral Section: 5-2

10) Is the molecule shown below chiral or achiral?



Answer: achiral Section: 5-2

11) Is the molecule shown below chiral or achiral?



Answer: achiral Section: 5-2

9)

10)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) Which of the following compounds has an asymmetric center?



12)

- 13) How many asymmetric centers are present in a molecule of 2,4,6- trimethylheptane?
 13)

 A) 0
 B) 1
 C) 2
 D) 3
 E) 4

 Answer: A
 Section: 5-3
 Section: 5-3
 Section: 5-4
- 14) How many asymmetric centers are present in the compound shown below?



15) How many asymmetric centers are present in the compound below?

15)



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) A and B are stereoisomers. They are nonsuperimposable and are mirror images of one another.16) Which of the following best describes the relationship between A and B?

A) diastereomers

B) structural isomers
C) enantiomers
D) conformational isomers
E) constitutional isomers

Section: 5-4

17) What is the relationship between the structures shown below?

Cl Cl Cl H- -Br and Br- $-CH_3$ CH_3 H A) configurational isomers B) enantiomers C) diastereomers D) constitutional isomers E) identical compounds Answer: E Section: 5-4



E) It does not have an enantiomer.

Answer: E Section: 5-4

19) Which of the following statements correctly describes the molecule shown below?

19)



A) It is achiral.

B) The mirror image of this molecule is its enantiomer.

C) It is meso.

D) It's asymmetric center possesses the *R* configuration.

E) The molecule possesses enantiotopic hydrogens.

Answer: B Section: 5-4 20) Choose the enantiomer of the compound below.



SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

21) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound? 21)





Answer: the same compound Section: 5-4

22) The compound CH₃CHClCH₂CH=CHCH₂CH₃ contains only one asymmetric center.

Explain why it has four stereoisomers.

Answer: In addition to the single asymmetric center which may be either R or S, it also contains a carbon- carbon double bond which may be either E or Z. Thus, the four stereoisomers can be designated E, R; E, S; Z, R; and Z, S.

Section: 5-5

23) Draw the enantiomer of the compound below.

 $\begin{array}{c} OH \\ \hline \\ Br \\ Answer: \\ \hline \\ OH \\ Section: 5-6 \end{array}$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

24) Which of the following compounds has an S configuration?

24)



25) Which of the following compounds has an *R* configuration?



26) Which of the following groups has the highest priority using the Cahn, Ingold, Prelog rules?



27) The configuration of R- (+)- glyceraldehyde is as follows:



What is the absolute configuration of (-)-lactic acid?

 $\begin{array}{c} 0 \\ \parallel \\ C - OH \\ H - \left| -OH \\ CH_2OH \\ A \right) L configuration \\ B) S configuration \\ C) R configuration \\ D) R and S configuration \\ E) D and L configuration \\ Answer: C$

Section: 5-7

27)

28) Indicate whether each of the following structures has the *R* or *S* configuration. What is 28)

the relationship between the two structures?

$$\begin{array}{c|c} Br & OH \\ HO - \begin{vmatrix} -CH_3 & and & CH_3CH_2 - \end{vmatrix} -Br \\ | \\ CH_2CH_3 & CH_3 \end{vmatrix}$$

assign priorities to each group.

Answer:

Br¹
HO²-
$$|$$
-CH₃⁴ Configuration is R
 $(3)|$
CH₂CH₃
 (2)
CH₃CH₂- $|$ -Br⁽⁰⁾ Configuration is S
 $(3)|$
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Therefore, the two compounds are enantiomers.

Section: 5-7

29) Label each asymmetric center in the compound below as R or S.

S

29)



Section: 5-7

30) Draw the structure of (*S*)- 1- bromo- 1- chloropropane. Take particular care to indicate three- dimensional stereochemistry detail properly.

Answer:





31) Provide the structure of (*R*)- 4- octanol. Be careful to indicate proper stereochemistry.

31)

Answer:



Section: 5-7

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

32) Which of the following is a true statement?	32)
A) A mixture of achiral compounds will be optically inactive.	
B) All chiral molecules possess a plane of symmetry.	
C) All achiral molecules are meso.	
D) All molecules which possess a single chirality center of the S configuration are	
levorotatory.	
E) All molecules which possess 2 or more chirality centers will be chiral.	
Answer: A	
Section: 5-8	
33) Which of the following is not true of enantiomers?	33)
A) They have the same specific rotation.	
B) They have the same boiling point.	
C) They have the same chemical reactivity with non-chiral reagents.	
D) They have the same density.	
E) They have the same melting point.	
Answer: A	
Section: 5-9	
34) Which of the following is /are optically inactive?	34)
A) every achiral compound	
B) a racemic mixture	
C) a meso compound	
D) a 50-50 mixture of R and S enantiomers	
E) all the above	
Answer: E	
Section: 5-9	
35) Which of the following statements correctly pertains to a pair of enantiomers?	35)
A) They rotate the plane of polarized light by differing amounts and in the same direction.	
B) They have the same melting point, but they have different boiling points.	
C) They rotate the plane of polarized light by differing amounts and in opposite directions.	

- D) They rotate the plane of polarized light by exactly the same amount and in opposite directions.
- E) They have different melting points.

Answer: D

Section: 5-9

36)

37)

38)

36) If (S)- glyceraldehyde has a specific rotation of - 8.7°, what is the specific rotation of

(R)-glyceraldehyde? A) 0.0° B) - 8.7° C) +8.7° D) cannot be determined from the information given Answer: C Section: 5-9 37) A mixture of equal amounts of two enantiomers _____. A) is called a racemic mixture B) is optically inactive C) implies that the enantiomers are meso forms D) both A and B

E) none of the above

Answer: D Section: 5-9

Answer: $\left[\alpha\right]^{T} = \frac{\alpha}{1c}$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

38)	A solution containing 0.96 g of 2- bromooctane in 10 mL ether solution gave an
	observed rotation of - 1.8° in a 10 cm cell at 20 °C. Calculate the specific rotation of this
	solution.

$$\left[\alpha\right]_{D}^{20^{\circ}C} = \frac{1.8^{\circ}}{1 \text{ dm} \times \frac{0.96 \text{ g}}{10 \text{ mL}}} = -18.75^{\circ} \text{ in ether}$$

Section: 5-9

39) A newly isolated natural product was shown to be optically active. If a solution of 2.0 g 39) in 10 mL of ethanol in a 50 cm tube gives a rotation of +2.57°, what is the specific rotation of this natural product?

Answer: +2.57° Section: 5-9

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

40) The specific rotation of a pure substance is 1.68° . What is the specific rotation of a mixture					40)
containing 75% o	of this isomer and 25	% of the (-) isomer?			
A) +1.68°	B) +0.84°	C) +1.26°	D) +.042°	E) 0°	
Answer: B					
Section: 5-10					
41) The specific rota	tion of a pure substa	nce is - 5.90°. What	is the percentage of t	his isomer in a	41)
mixture with an	observed specific ro	tation of - 2.95°?			
A) 50%	B) 75%	C) 0%	D) 80%	E) 25%	
Answer: B					

Section: 5-10

42) (-)- Mandelic acid has a specific rotation of - 158°. What would be the specific rotation of a				42)	
solution which c	ontains 40% (-)- ma	ndelic acid and 60%	(+)- mandelic acid?		
A) +32°	B) - 32°	C) +63°	D) +95°	E) - 63°	

Answer: A Section: 5-10

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

43) The specific rotation of (*R*)- (+)- glyceraldehyde is +8.7°. If a mixture of glyceraldehydes
43) _______
enantiomers is 80% *S* and 20% *R*, what is the specific rotation of the mixture?

Answer: - 5.2° Section: 5-10

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

44) What is the relationship between the following compounds?

44)



- A) constitutional isomers
- B) enantiomers
- C) superimposable without bond rotation
- D) conformational isomers
- E) diastereomers Answer: B

Section: 5-11

45) What is the relationship between the structures shown below?

45)



A) diastereomersB) configurational isomersC) constitutional isomersD) identical compoundsE) enantiomers

Answer: A Section: 5-11



47) What is the relationship between the following compounds?



```
48) Which of the following is chiral?
```

A) cis-1-bromo-3-chlorocyclobutane

B) *cis*-1,4- dimethylcyclohexane

C) *trans*-1,3- dimethylcyclohexane

D) *trans*-1-bromo-3-chlorocyclobutane

E) *cis*- 1,3- dimethylcyclohexane

```
Answer: C
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Section: 5-11

48)

47)

17



50) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound?





Answer: enantiomers Section: 5-11

51) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound? 51)





Section: 5-11

50)

""/_{Cl}

CH3

52) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound?



Answer: diastereomers Section: 5-11

53) Draw the structure of (2R,3S)- dichloropentane. Take particular care to indicate three- dimensional stereochemistry detail properly.





- 54) Draw the structure of $(2S_r3R)$ dichloropentane. Take particular care to indicate three- dimensional stereochemistry detail properly.
 - Answer:





 55) Draw the structure of any diastereomer of (2*R*,3*S*)- dichloropentane. Take particular
 55)

 care to indicate three- dimensional stereochemistry detail properly.
 55

Answer:





Answer: diastereomers Section: 5-11

54)

53) ____

52)

57) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound?



Answer: the same compound Section: 5-11

58) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound?



Answer: the same compound Section: 5-11

59) Which of the following terms best describes the pair of compounds shown: enantiomers, diastereomers, or the same compound?



Answer: enantiomers Section: 5-11

60) Draw the stereoisomers of 1, 3- dichlorocyclopentane.

Answer:



Section: 5-11

60)

58)

57)

61) Provide a perspective drawing of (2*R*,3*S*)- 1,2,3- trichloropentane.

Answer:



62) Provide a perspective drawing of the enantiomer of (2*R*,3*S*)-1,2,3- trichloropentane.

62)

61)

Answer:



63) Provide a perspective drawing of each diastereomer of (2*R*,3*S*)-1,2,3- trichloropentane. 63)

Answer:



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

64) Which of the following is a meso compound?

64)



21



65) What is the relationship between the following compounds?



66) Which of the following is a meso compound?					66)
A) <i>cis</i> - 1, 3- di	methylcyclohexane				
B) <i>trans</i> -1,2-	dimethylcyclohexa	ne			
C) <i>cis</i> - 1, 4- di	methylcyclohexane				
D) <i>tmns</i> -1,3-	dimethylcyclohexa	ne			
E) <i>tmns</i> -1,4-	dimethylcyclohexa	ne			
Answer: A					
Section: 5-12					
67) How many ster	67) How many stereoisomers exist with the following basic connectivity?				
BrCH ₂ CH(0	CH ₃)CH ₂ CH ₃				
A) 0	B) 1	C) 2	D) 4	E) 8	
Answer: C Section: 5-12					
68) How many stereoisomers exist with the following basic connectivity?					68)
CH ₃ CHCIC	H ₂ CHClCH ₃				
A) 0	B) 1	C) 2	D) 3	E) 4	
Answer: D Section: 5-12					
69) Which of the statements below correctly describes an achiral molecule?					69)
A) The molecule might be a meso form.					
B) The molec	ule has a nonsuperi	mposable mirror in	nage.		
C) The molec	C) The molecule exhibits optical activity when it interacts with plane-polarized light.				
D) The molec	rule has an enantion	ner.			
E) none of th	e above				

Answer: A Section: 5-12

70) Consider the molecules with molecular formula C2H2Br2Cl2.

70)

a) Draw a structure that is optically inactive because it does not have an asymmetric center.

b) Draw a structure that is optically inactive because it is a meso compound.

c) Draw a structure that is optically active because it is chiral.

Answer: a)



71) Draw the structure of a meso form of 1, 3- dichlorocyclopentane. Take particular care to 71) indicate three- dimensional stereochemistry detail properly.





73) Label the molecule shown as chiral or achiral.





74) Label the molecule shown as chiral or achiral.



Section: 5-12

75) Label the molecule shown as chiral or achiral.



Answer: Chiral Section: 5-12

73)



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

76) What is the configuration of the following compound?

CH₃ H--ClCl--HCH₂CH₃ A) 3*R*, 3*S* B) 2*R*, 3*R* C) 2*S*, 3*R* D) 2*S*, 3*S* E) Can't do *R* and *S*; the compound is achiral. Answer: D

Section: 5-13

77) In the Fischer projection below, what are the configurations of the two asymmetric centers? 77)



E) cannot be determined from structure

Answer: A Section: 5-13

26

78) Label each asymmetrical carbon in the compound below as *R* or *S*.

78)



Answer:



Section: 5-13

79) Draw a perspective formula of (2*R*,3*S*)- 3- bromo- 2- butanol.

Answer:



80) Draw any diastereomer of (2R,3R)- 2,3- dichloropentane. Be careful to indicate proper stereochemistry.





79)

81) Can one predict whether a compound with a single asymmetric center is dextro- or levorotatory based on the *R/S* assignment at this asymmetric center? Explain briefly.

Answer: No. *R/S* assignment is purely a convention of nomenclature and is completely independent of the direction in which plane-polarized light is rotated by the compound.

Section: 5-13

82) Assign an *R* or *S* configurational label to each asymmetric center in the molecule below. 82)



83) Briefly describe how two enantiomers might be separated.

Answer: The two compounds can be converted to diastereomers, separated based on different physical properties of these diastereomers, and subsequently returned to their original forms or chromatographic separation using a chiral stationary phase.

- Section: 5-16
- 84) The compound below contains an asymmetric center at nitrogen. Why can't individual 84) stereoisomers of this compound be isolated at room temperature?

Answer: Nitrogen has a pair of nonbonding electrons that allow it to turn "inside out" at room temperature. Because of rapid inversion, the individual stereoisomers cannot be isolated.

Section: 5-17



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

85) What configurations are found in the product(s) of the reaction below?

85)



SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

86) Provide the structure of the major organic product of each of the following reactions.

