For questions 1-5, identify the following pairs of compounds as identical or isomers. If they are isomers, are they constitutional isomers of stereoisomers? If they are stereoisomers, are they enantiomers or diastereomers? Circle all meso compounds. (15 points)

3 points each

- enantiomers
- constitutional isomers
- diastereomers
- identical

enantiomers
6. Circle ALL stereogenic centers in the following molecule.

7. Assign absolute configuration (R or S) to each stereocenter in the compounds shown below.

Write the major organic product formed in each of the following reactions taken from chapters 7, 8, and 9. Pay attention to stereochemistry and include the correct stereochemistry in the product if necessary. If diastereomers are formed, you must draw both diastereomers. If you expect no reaction to occur, write NR.

8. [Diagram of reaction with HBr]

9. [Diagram of SN2 reaction]

10. [Diagram of E2 reaction]

11. [Diagram of SN1 solvolysis reaction]

12. [Diagram of SN2 reaction]

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13. strong base

14. must show stereochem
-S 2 if missing
-S 2 if incorrect stereochem

15. bulky strong E 2

16. NR
-OH is NOT a leaving group

17. good NU

18. solvolysis (see rearrangements)

19. ozonolysis

<table>
<thead>
<tr>
<th>Compound</th>
<th>pKa</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBr</td>
<td>-5.8</td>
</tr>
<tr>
<td>CH₃COOH</td>
<td>4.7</td>
</tr>
<tr>
<td>H₂S</td>
<td>7.0</td>
</tr>
<tr>
<td>HCN</td>
<td>9.1</td>
</tr>
<tr>
<td>HN₃</td>
<td>9.2</td>
</tr>
<tr>
<td>H₂O</td>
<td>15.7</td>
</tr>
<tr>
<td>CH₃CH₂OH</td>
<td>16.0</td>
</tr>
<tr>
<td>CH₂C₆H₅OH</td>
<td>26</td>
</tr>
<tr>
<td>NH₃</td>
<td>36</td>
</tr>
</tbody>
</table>
20. Prepare the following cis alkene starting with an alkyne of not more than FIVE carbon atoms and other reagents of your choice. If you clearly show your steps you may earn partial credit.

\[ \text{C≡CH} \text{NaNH}\text{H}_2 \rightarrow \text{Br} \]

1. \text{NaNH}_2

2. \text{Br}

the other combination using is incorrect

For questions 21-23, write the reagents necessary to form the products in the following reactions.

\[ \text{C≡CH} \text{HBr} \rightarrow \text{H}_2\text{O} \]

1. \text{NaNH}_2

2. \text{CH}_3\text{Br}

3. \text{Na}/\text{NH}_3

\[ \text{C} = \text{O} \text{CH}_3 \]

\[ \text{4 pts} \]

24-25. Provide reagents necessary to carry out the following transformations. More than one step may be necessary.

\[ \text{TsO} \text{H} \text{NaBr} \rightarrow \text{NC} \text{H} \]

1. \text{NaBr}

2. \text{NaCN}

double \text{Sn2}, double inversion

\[ \text{1. Br}_2, h\nu \rightarrow \text{OCCCH}_3 \]

1. \text{Br}_2, h\nu

2. \text{OCCCH}_3

Page 4 of 5
26. Indicate a plausible mechanism for the following reaction. Be sure to show bond making and bond breaking as well as all electron movement.

27. Indicate a plausible mechanism for the following reaction. Be sure to show bond making and bond breaking as well as all electron movement.

1 pt each arrow. must have 4 arrows, exactly as shown

28. Indicate a plausible mechanism for the following reaction. Be sure to show bond making and bond breaking as well as all electron movement.
For questions 1-5, identify the following pairs of compounds as identical or isomers. If they are isomers, are they constitutional isomers of stereoisomers? If they are stereoisomers, are they enantiomers or diastereomers? Circle all meso compounds. (15 points)
6. Circle ALL stereogenic centers in the following molecule.

7. Assign absolute configuration (R or S) to each stereocenter in the compounds shown below.

Write the major organic product formed in each of the following reactions taken from chapters 7, 8, and 9. Pay attention to stereochemistry and include the correct stereochemistry in the product if necessary. If diastereomers are formed, you must draw both diastereomers. If you expect no reaction to occur, write NR.

8.

9.

- OH is NOT a leaving group

10.

11.

12.
13. $\text{SN}_2$

$$\text{Br} \quad \text{NaOCH}_2\text{CH}_3 \quad \text{good nucleophile}$$

$$\text{OCH}_2\text{CH}_3$$

14. $\text{E}_2$

$$\text{Br} \quad \text{NaOCH}_3 \quad \text{strong base}$$

15. $\text{Cl} \quad \text{NaOCH}_3 \quad \text{good nucleophile} \quad \text{strong base, no } \alpha \text{ H} \quad \text{OCH}_3$$

16. $\text{Br} \quad \text{NaOCH}_3 \quad \text{strong base}$$

17. $\text{Br} \quad \text{CH}_3\text{OH} \quad \text{solvolysis} \quad \text{(see rearrangement)}$$

18. $\text{Cl} \quad 1. \text{NaNH}_2 \quad \text{NH}_3 \quad 2. \text{H}_2\text{O}$$

19. $\text{HBr}$

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<td>36</td>
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</table>

must show diastereomers
20. Prepare the following cis alkene starting with an alkyne of not more than SEVEN carbon atoms and other reagents of your choice. If you clearly show your steps you may earn partial credit.

1. Na\(\text{NH}_2\)
2. \(\text{H}_2/\text{Lindlar}\)

For questions 21-23, write the reagents necessary to form the products in the following reactions.

1. Na\(\text{NH}_2\)
2. \(\text{CH}_3\text{Br}\)
3. Na\(\text{CN}\)/NH\(\text{H}_3\)

24-25. Provide reagents necessary to carry out the following transformations. More than one step may be necessary.

1. Na\(\text{Br}\)
2. \(\text{NaN}_3\)

"double \text{SN}_2, double inversion"

Page 4 of 5
26. Indicate a plausible mechanism for the following reaction. Be sure to show bond making and bond breaking as well as all electron movement.

27. Indicate a plausible mechanism for the following reaction. Be sure to show bond making and bond breaking as well as all electron movement.

1 pt each arrow
must have 4 arrows, exactly as shown

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