1. (16) a. Provide complete names or structures for the given molecules.

\[
\begin{align*}
(4S) - 4\text{-ethyl-3,3-dimethylheptane} \\
(1S,3S) - 1,3\text{-dimethylcyclohexane} \\
\text{(R)-3methylhexane} \\
\end{align*}
\]

b. Give a condensed formula or line structure for each compound.

\[
\begin{align*}
\text{CH}_3\text{(CH}_2\text{)}_3\text{CH(CH}_3\text{)}_2 \\
\text{(CH}_3\text{)}_3\text{CCH}_2\text{CHCH}_3\text{CH}_2\text{CH}_3 \\
\end{align*}
\]

c. Identify if the organic compound in each of the following reactions was oxidized, reduced, or did not undergo redox.

\[
\begin{align*}
\text{red.} & \rightarrow \text{not redox} \\
\end{align*}
\]

e. An mixture of two stereoisomers has an optical rotation of \(-13.6^\circ\). Which of the following statements is true?

\[\text{C}\]

2. (10) The structure of \((2S,3S)\)-(+)tartaric acid is shown below. Assume this compound has a specific rotation of \([\alpha]_D = +25^\circ\). A mixture of \((2S,3S)\)-(+)tartaric acid and its enantiomer has a specific rotation of \(-12.5^\circ\).

- What is the %e.e. of this mixture?
- What is the % composition of each enantiomer in this mixture?

\[
\%\text{e.e.} = \frac{-12.5}{-25} \times 100 = 50\% \\
\therefore 75\% (2R,3R) \\
25\% (2S,3S)
\]
3. (18) a. Draw all stereo-isomers of the following molecule (Hint ≤ 6 exist).
b. Draw the most stable conformation of each stereo-isomer you drew for a.
c. Give the relationship between each stereo-isomer you drew for a.

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<tr>
<th></th>
<th>MOST</th>
<th>STABLE</th>
<th>CONFORMATION GIVEN</th>
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d. Circle the most stable in part a and BRIEFLY explain how you arrived at this conclusion.

C : b/c both subst. can be axial.

4. (14) a. Draw all constitutional isomers with the formula \( C_5H_{10} \).
b. Circle all optically active compounds.
c. Underline the isomer containing the most \( 1^\circ \) hydrogens.

- 5
- 6
- all achiral
- 4
- 3 for pentane/dien
- 1 repeat
5. (14) For the following molecule, draw a Newman projection of the most stable conformation and the least stable conformation. BRIEFLY but clearly explain the reason for their difference in energy.

Most stable

Least stable

Eclipsed bonds destabilizing due to $e^-/e^-$ repulsion plus steric hindrance from largest groups eclipsed.

anti - largest groups far away to minimize steric hindrance

staggered - no eclipsed bonds

6. (18) Indicate how the following pairs of compounds are related (identical, constitutional isomers, conformers of the same species, enantiomers, diastereomers). NOTE: Conformers of enantiomers or diastereomers should be considered enantiomers or diastereomers, not conformers.

constitutional isomers

conformers (same stereochemistry but different axial/equatorial)

diastereomers

enantiomers

identical