1. Provide the chemical structures for the following compounds:
   a) (E)-3-bromo-1-fluoro-2-methylpropene
   b) (R)-3-bromo-1-butyne

2. Provide names for the following compounds:
   a) Cl
   \( \text{(E)} - 1\text{-chloro-3-methyl-3-hexene} \)
   1 for stereo

   b) \( (1R,3R)-1,3\text{-dimethylcyclohexane} \)
   \( (R,R) \text{OK-ia} \)
   2 for stereo; 1 if only trans-

3. The structure of limonene, a compound found in citrus fruits, is shown below.

   On this structure:
   a) label all vinylic carbon(s) with a “V”
      4
   b) label all allylic carbon(s) with an “A”
      5
   c) label all sterogenic carbon(s) with an asterisk (*)
4. For each of the following pairs of structures, indicate if they represent a pair of structural isomers, diastereomers, enantiomers, or identical compounds:

a) 
\[
\begin{array}{c}
\text{Br} \quad \text{H} \quad \text{O} \\
\text{Br} \quad \text{H} \quad \text{Br}
\end{array}
\quad 
\begin{array}{c}
\text{HO} \quad \text{Br} \\
\text{H} \quad \text{Br}
\end{array}
\]
diastereomers 3 ea.

b) 
\[
\begin{array}{c}
\text{Cl} \\
\text{O}
\end{array}
\quad 
\begin{array}{c}
\text{Cl} \\
\text{CO}
\end{array}
\]
diastereomers

c) 
structural isomers

7. Rank each of the following alkenes in order of their relative stability, 1-5 (1 = most stable, 5 = least stable)

\[
\begin{array}{c}
\text{1} \\
\text{2} \\
\text{3} \\
\text{4} \\
\text{5}
\end{array}
\]

8. Which of the following alkenes is an unreasonable structure? Why?

\[
\begin{array}{c}
\text{1} \\
\text{2} \\
\text{3} \\
\text{4} \\
\text{5}
\end{array}
\]

Bratt's Rule violation
(or words to that effect)
6. The structure of (-)-menthol is shown below.

a) Would this be the d- isomer, the l-isomer, the R-isomer, or the S-isomer? (choose one): _

b) Assign the configuration (R or S) at each stereogenic carbon.

c) How many possible stereoisomers of this compound (including that shown above) are possible? _

d) Draw the two possible chair conformations of (-)-menthol. Indicate which is more stable, and explain why.

all groups equatorial

all equatorial - 1,3 diaxial interaction
5. Draw a structure for allene (CH$_2$=C=CH$_2$) that reflects the molecule's overall geometry. Also include an orbital depiction of the π bonds, and indicate the hybridization (sp/sp$^2$/sp$^3$) of each carbon.

- 2 orthogonal π bonds 3
- twist geometry 3
- end C is sp$^2$ 3
- middle C is sp 3

9. Draw all possible stereoisomers of dimethylcyclopentane and circle those that are chiral.

1 per structure = 7
4 per circle (right - wrong) = 4
1 freebie

Total = 21
10. Racemic trans-1,2-diaminocyclohexane can be separated by treatment with an equimolar amount of (2R, 3R)-tartaric acid. Show the products of this reaction, suggest how they may be separated from each other, and suggest how enantiomerically-pure diamine could be regenerated.

\[
\begin{align*}
(1R,2R) & \quad + \\
(1S,2S) & \quad +
\end{align*}
\]

(3)-trans-1,2-diaminocyclohexane

If show diastereomeric mix:

3 points

Diastereomers

\[
\begin{align*}
(1R,2R) & \quad 4. \text{ separable} \\
(1S,2S) & \quad \text{e.g. recrystallization}
\end{align*}
\]

regenerate: smoothing like acidify or add base

- extract acid out
- extract carbonate out

be generous. gist is enough.

if don't suggest method of regeneration 2