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Points by question

1 _____ / 13
2 _____ / 24
3 _____ / 20
4 _____ / 42
5 _____ / 24
6 _____ / 18
7 _____ / 18
8 _____ / 70
9 _____ / 40
10 _____ / 8
11 _____ / 22
12 _____ / 18
13 _____ / 34
14 _____ / 24

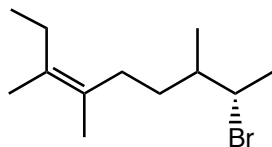
Points Removed for cover errors ____ / 2

Extra Credit ____ / 5

Total (incl Extra) _____ / 175+5

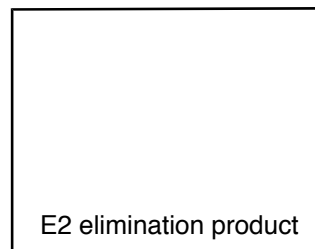
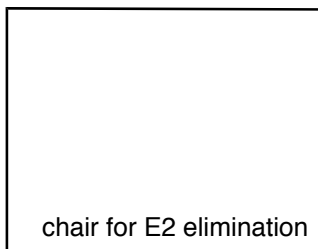
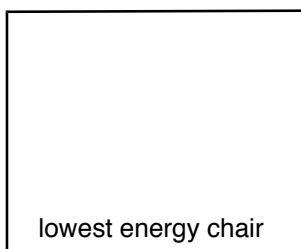
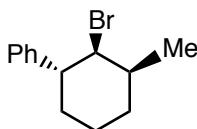
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Question 1 (13 pts.) Give the IUPAC name for the following structure. Specify stereochemistry as appropriate.



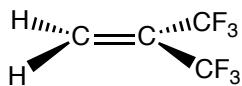
Question 2 (24 pts). For the cyclohexane structure shown below, draw....

1. The **lowest energy chair conformation**
2. The **chair conformation** required for an **E2 elimination reaction**
3. The **product of an E2 elimination reaction**

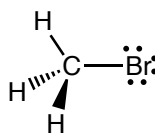


Question 3 (20 pts.)

a) Draw a picture of the wavefunction, **OR** the wavefunction squared **AS REQUESTED**, of the molecular orbitals requested, *on the molecules*. In each case **indicate the A.O.'s used to make the M.O.'s**.



Ψ^2 for the C-C π orbital



Ψ for the C-Br σ^* orbital

Extra Credit (5 pts) The hole in the ozone layer has been attributed to the atmospheric chemistry of which kind of molecule?

halides

alkanes

alkenes

alcohols

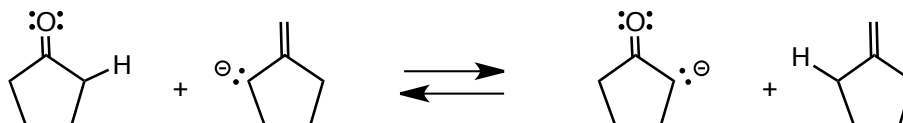
Question 4 (42 pts). For (1S)-bromo-(2S,3)-dimethyl-1-phenylbutane.....

- Draw a line-angle structure showing stereochemistry using wedged/dashed bonds
- Draw a 3-D (sawhorse) structure AND a Newman projection for the lowest energy conformation for rotation around the C1-C2 bond
- Draw a 3-D (sawhorse) structure AND a Newman projection for the conformation that is required for E2 elimination
- Draw the E2 elimination product

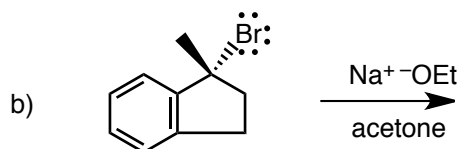
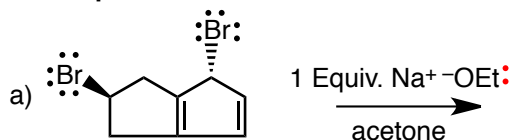
<p>(1S)-bromo-(2S,3)-dimethyl-1-phenylbutane</p> <p>a)</p> <p>line-angle structure, wedged/dashed bonds</p>	$\begin{array}{c} \ominus \oplus \\ \text{H}\ddot{\text{O}}: \quad \text{Na} \\ \xrightarrow{\text{DMF}} \end{array}$	<p>E2 product</p> <p>d)</p> <p>line-angle structure</p>
<p>b)</p> <p>3D (sawhorse) AND Newman projection for lowest energy conformation</p>		<p>c)</p> <p>3D (sawhorse) AND Newman projection for E2 reactive conformation</p>

Question 5 (24 pts.) For the following Bronsted acid/base reaction (not all H atoms are included in the provided structures)

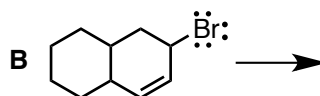
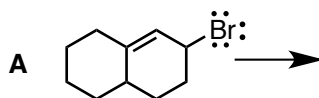
- Draw the curved-arrows that describes the bond making and breaking in BOTH directions
- Label the **STRONGER** acid/base and the **WEAKER** acid/base on EACH side
- Indicate which reaction would be faster, left to right or right to left
- Indicate on which side the equilibrium will lie
- Indicate which acid has the smaller and which the larger pKa
- Give a BRIEF explanation for your choice of stronger/weaker Bronsted acids/bases that includes drawings of ALL relevant resonance contributors



Question 6 (18 pts.) For each reaction, decide whether the mechanism would be SN1/SN2/E1 or E2 and give a brief explanation. Draw the product and **show stereochemistry** where appropriate and **state whether a solution of the product would be optically active** or not **AND give a BRIEF explanation.**

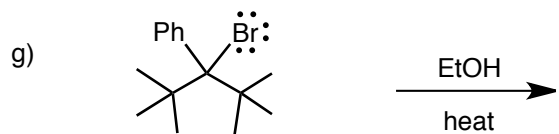
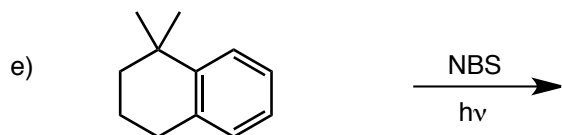
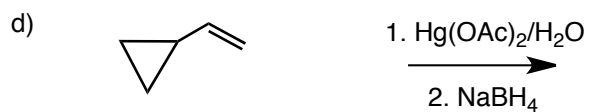
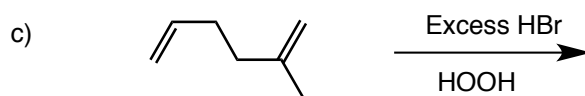
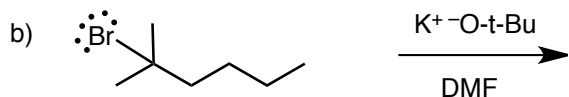
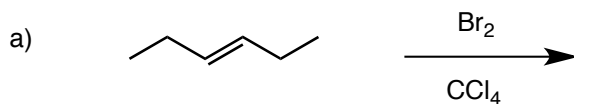


Question 7 (18 pts.) For E1 elimination in the following two structures (assume a polar protic solvent and heat), give the curved arrow pushing and the intermediates formed **for FIRST STEP of the mechanism ONLY**, include resonance contributors as appropriate. Which E1 elimination reaction would you expect to be faster, A or B, give a **BRIEF** explanation.



Question 8 (70 pts.) Give the missing major **ORGANIC PRODUCT** for each reaction

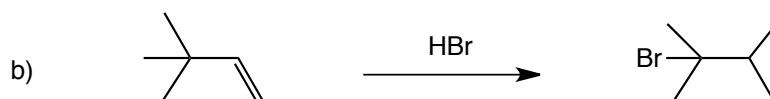
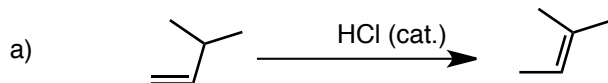
- a) **Show all stereochemistry** as appropriate, **identify any MESO compounds**
b) **Briefly explain whether and why a solution of the product would be optically active or not**
c) assign each reaction as addition, elimination, substitution or rearrangement



Question 9 (40 pts.) For each of the the following two reactions:

a) Give a curved arrow mechanism, indicate the Lewis acid and Lewis base (LA or LB) for each INTERMOLECULAR step, and whether they are also Brønsted acids and bases (BA or BB).

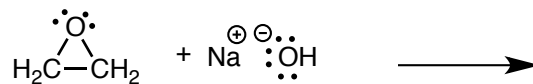
b) State whether you would expect the reaction to be exothermic or endothermic and give a brief (1 sentence) explanation for your choice.



Question 10 (8 pts.) The t-butoxide anion (t-BuO⁻) is a strong base but a weak nucleophile. Give a brief 1 sentence explanation for this.

Question 11 (22 pts.)

- a) Give the product of the following Lewis acid/base reaction, indicate the Lewis acid and base (LA/LB) and if they are also Bronsted acids/bases (BA/BB).
 b) Draw a reaction energy diagram for the reaction with properly labelled axes, draw the transition state and indicate its position on the diagram.
 c) BRIEFLY explain why your reaction is exothermic or why it is endothermic

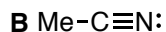
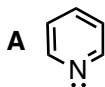


Question 12 (18 pts)

- a) Indicate which of the following two structures is the stronger Bronsted base, and give a brief explanation for your choice.

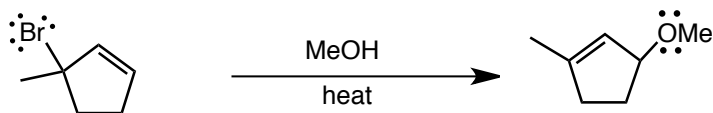


- b) Indicate which of the following two structures A or B is the stronger Bronsted base, and give a brief explanation for your choice.



Question 13 (34 pts.)

a) Give a full curved arrow mechanism, indicate the Lewis and Bronsted acids and bases at each step as appropriate. **Give the number of sets of intermediates that are included in your mechanism and also how many transition states are associated with your mechanism.** (This may not be the only product of this reaction, but you need to show the mechanism for formation of THIS product)



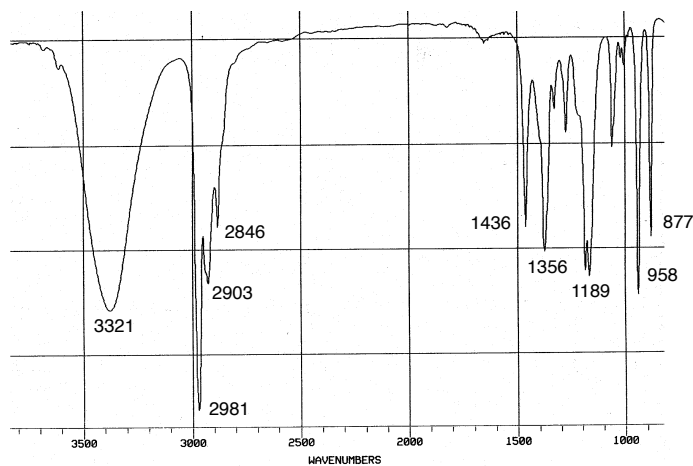
of sets of intermediates =
of transition states =

b) Draw a reaction energy diagram for the mechanism you drew, do not draw them but indicate the locations of each of the sets of intermediates and the transition states on your diagram. Indicate also the activation energy for the rate determining step and also the reaction exothermicity.

Question 14 (24 pts) Provided are spectra for a compound with molecular formula $C_6H_{14}O$

a) Give the degrees of unsaturation _____

b) On the infrared spectrum, indicate the peaks that identify the functional groups in the molecule (including $C(sp^3)-H$). Indicate **BOTH the functional group**, and where appropriate, **the specific BOND** in the functional that corresponds to the peak.



c) draw the structure and clearly indicate which hydrogens correspond to which signals **in the proton nmr spectrum (only)**

