CHEM 108A Summer 2015

1. Fundamentals & Nomenclature

(a) (*10 points*) Use the information provided below to determine the degrees of unsaturation and molecular formula of **Loratidine**, an allergy medicine that Dr. B used to give to her cat Missy ☺

Loratidine has four (4) rings and eight (8) double bonds…

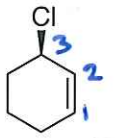
Degrees of Unsaturation 12 (2pts) **Hydrocarbon Equivalent** (with unsaturation): $C_{22}H$ 22 (2pts)

Formula of a *fully saturated* C22 molecule: $C_{22}H$ 46 (2pts)

Number of Hydrogens in Loratidine: $C_{22}H$ 23 ClN_2O_2

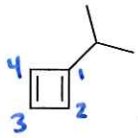
(4pts)

(b) (*15 points*) Provide the IUPAC name for the following compounds. Include stereochemistry in the name, where appropriate.

4pts 

(1) (1) (1) (1)

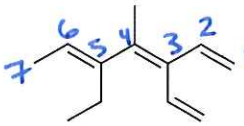
(R)-3-Chlorocyclohexene

4pts 

(1) (1) (1)

1-Isopropyl-1,3-cyclobutadiene

correct numbering (1pt)

7pts 

(1) (5E) (1) vinyl (1) (1) (1) (1)

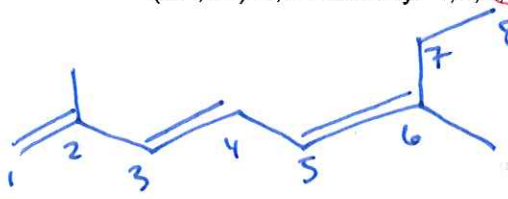
3-vinyl-5-ethyl-4-methyl-1,3,5-heptatriene

OK if not alphabetized

correct numbering (2pts)

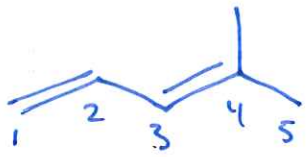
(c) (*12 points*) **Draw structures** corresponding to the following names.

(3*E*,5*Z*)-2,6-Dimethyl-1,3,5,7-octatriene (E) TYPO 7pts



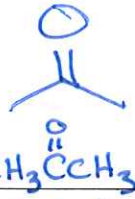
parent 2pts
alkenes 3pts
Me's 2pts

4-Methyl-1,3-pentadiene 5pts



parent 2pts
Me 1pt
alkenes 2pts

(d) (*18 points*) For each functional group, **draw a simple (3 carbon-containing) example.** 1pt 3pts ea.

Ketone	Aldehyde	Alcohol	Alkyl Halide	Alkene	Alkyne
			 Br, F, I OK too		

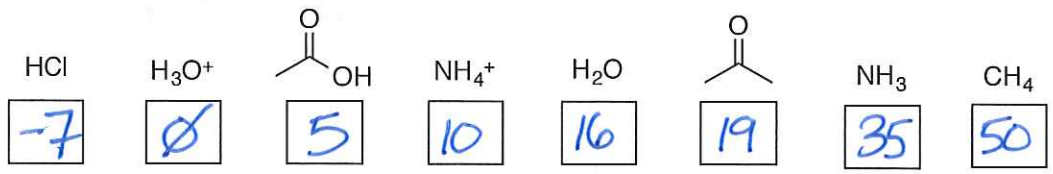
Skeletal/condensed/Lewis OK too

>OH >Cl

2. Acid-Base Chemistry

(a) (*16 points*) The following compounds are listed in order of acidity (most acidic on the left). Indicate the approximate **pKa value** that belongs to each compound in the boxes provided.

2pts each

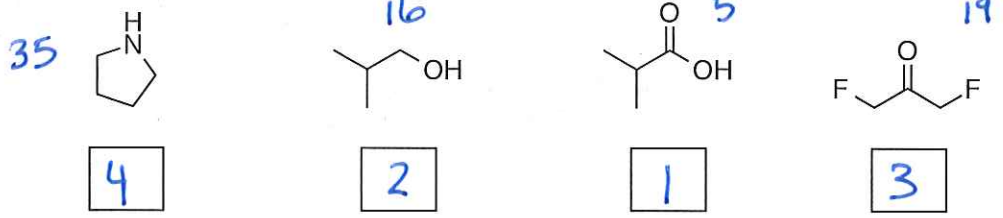


HCl	H_3O^+	OH	NH_4^+	H_2O		NH_3	CH_4
-7	Ø	5	10	16	19	35	50

±2pKa units OK

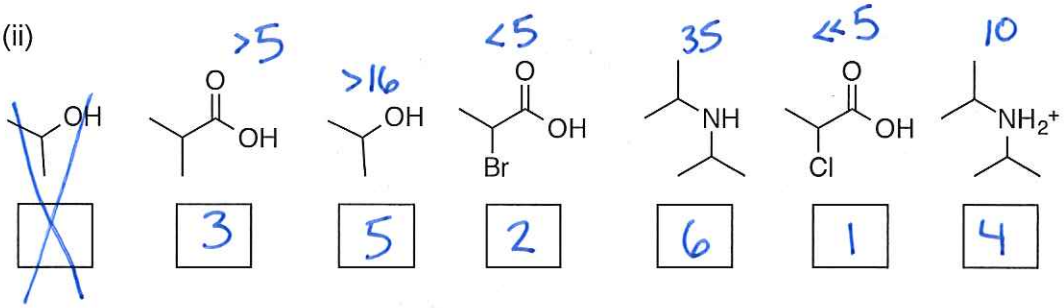
(b) (*18 points*) Rank the following sets of molecules from **most acidic (1) to least acidic (4)**.

(i)



4	2	1	3

(ii)



OH	3	5	2	6	1	4

one or two off, all # shifted but still in order; Give partial credit

(c) (*10 points*) Choose the **more acidic proton** and **draw the products** in the following reaction. *No arrow-pushing necessary.*

4pts

* *Circle the more acidic proton.*

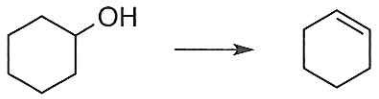
3pts 3pts

2-structure
1-charge

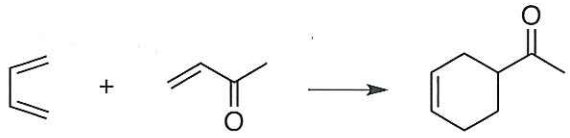
3. Reaction Warm-up

(a) (*9 points*) Identify the following reactions as **additions, eliminations, substitutions, or rearrangements**.

3 pts each



elimination

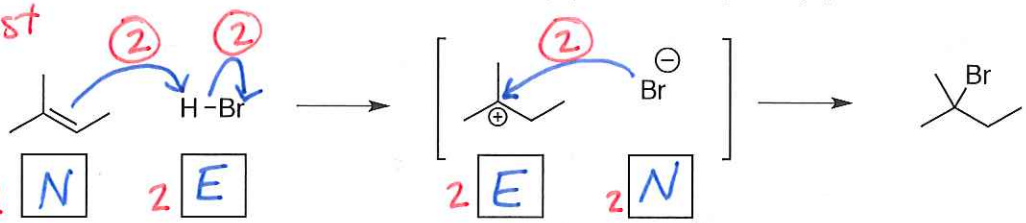


addition

substitution

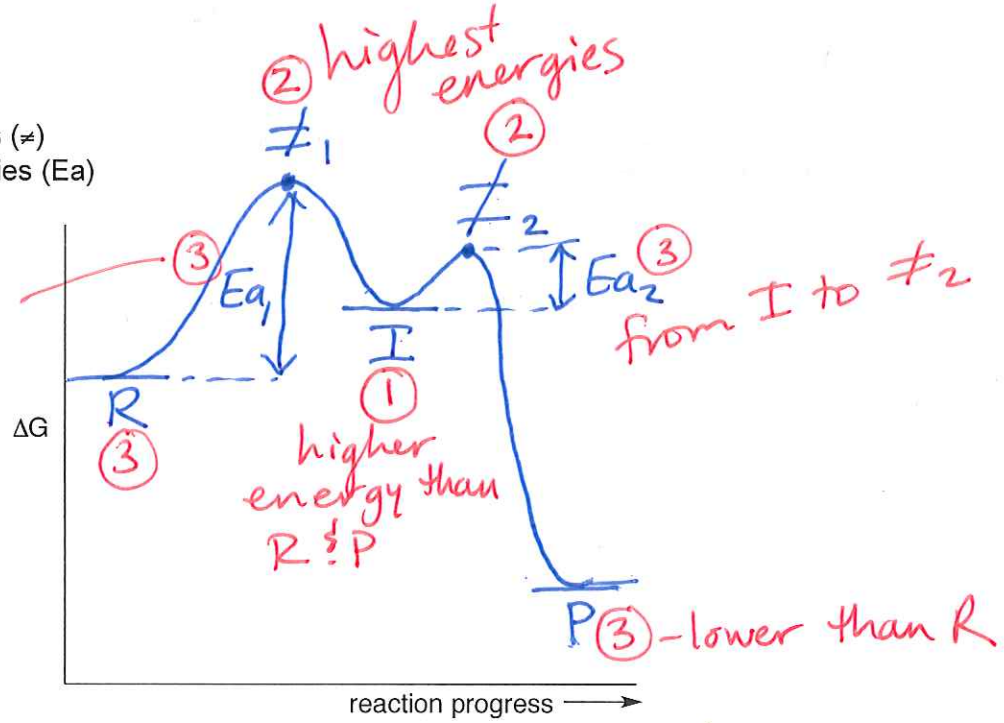
(b) (*14 points*) **Add curved arrows** to show the mechanism in the following reaction. Clearly label the reactants in both steps as either a **nucleophile (N) or electrophile (E).**

Arrows must point in this direction!



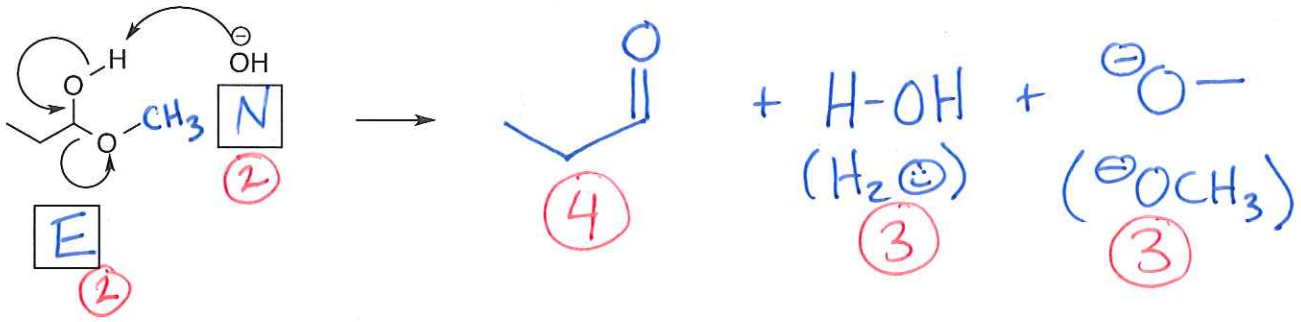
(c) (*17 points*) **Sketch a reaction energy diagram** for the reaction above. This is an **exergonic reaction** where the **first step is rate limiting**. Be sure to label the following on the diagram:

- Reactant (R)
- Product (P)
- Intermediate (I)
- Transition States (≠)
- Activation Energies (Ea)



4. More Reaction Warm-Ups

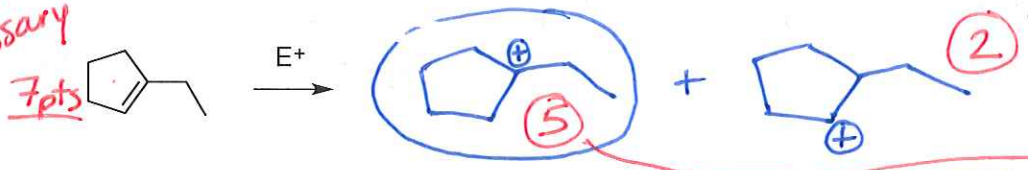
(a) (*14 points*) Follow the arrows in the reaction and **draw the products**. Clearly label both reactants as either a **nucleophile (N) or electrophile (E).**



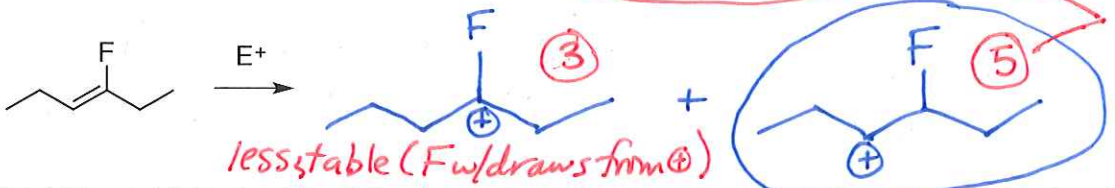
(b) (*15 points*) **Draw the two carbocations** that could theoretically form in the first step of the electrophilic addition to the following alkenes (even though we know only one is actually formed!). **Circle the more stable carbocation** in each case.

NO arrows necessary

7pts

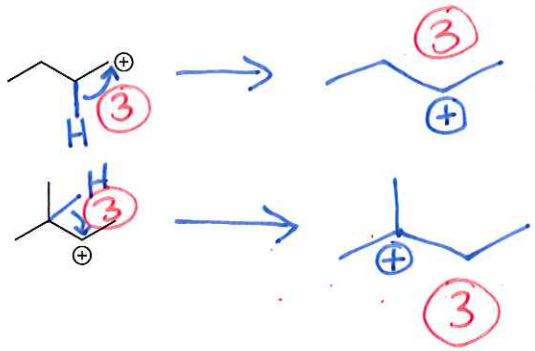


8pts



3-structure
2-circled

(c) (*12 points*) Each of the following carbocations can rearrange to a more stable ion. Propose structures for the likely **rearrangement product** in each and use **arrow-pushing** to explain this rearrangement.



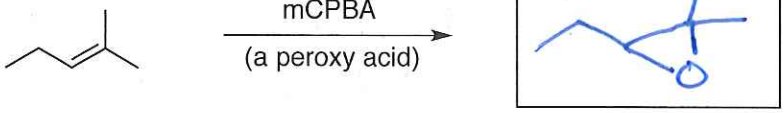
5. Single step reactions – FILL IN THE BOX. ***Choose any four*** of the five reactions below and fill in the missing reactant, reagent/solvent, or product. Put a large "X" over the problems you are skipping. Otherwise the first four will be graded.

no stereochemistry/arrows/ by-prods necessary

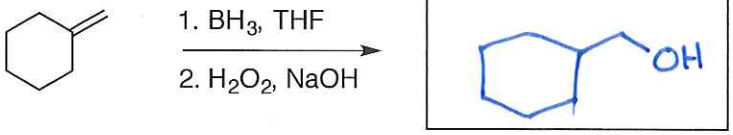
(*40 points*) Complete any four of the reactions below.

10pts each

(a)



(b)

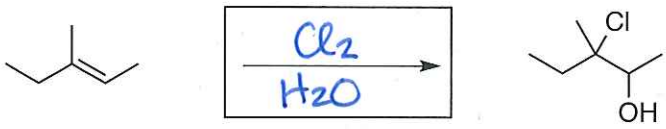


wrong answers, but partial credit...

5pts

7pts

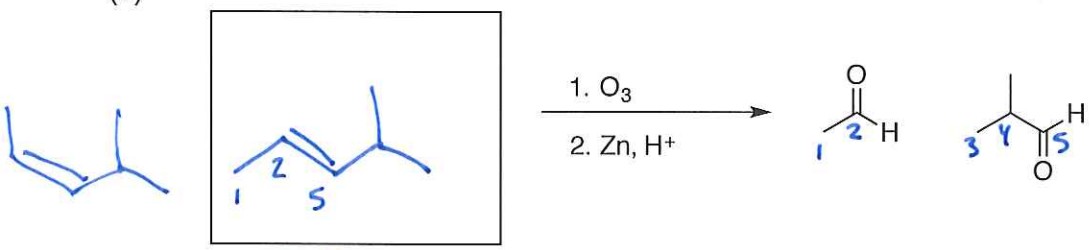
(c)



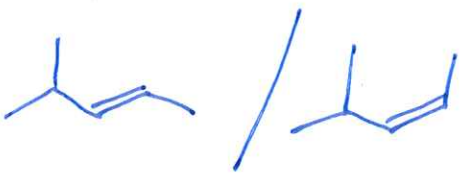
just Cl_2 → 7pts
just H_2O → 5pts

(d)

(e)



2-5

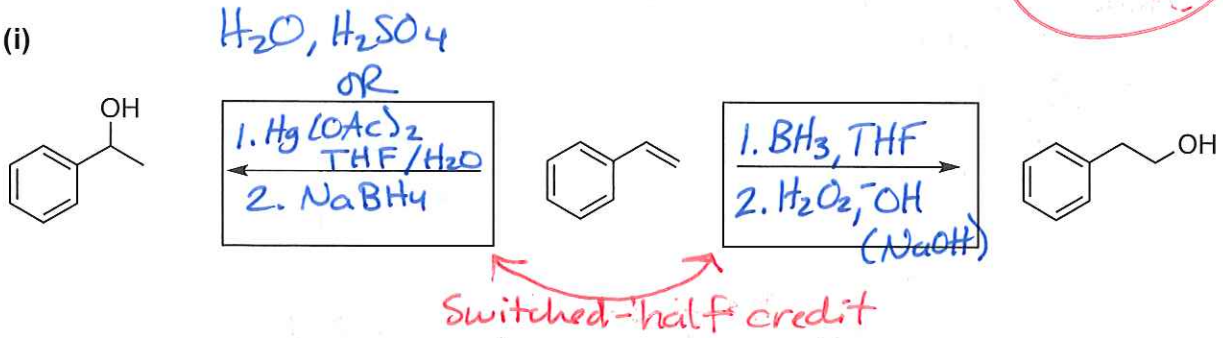


6. Reaction Puzzles

5pts/box

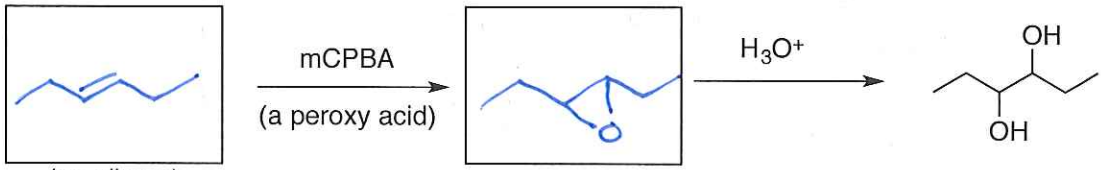
(a) (*40 points*) Fill in the box with the missing reactants, reagents, or products.

(i)



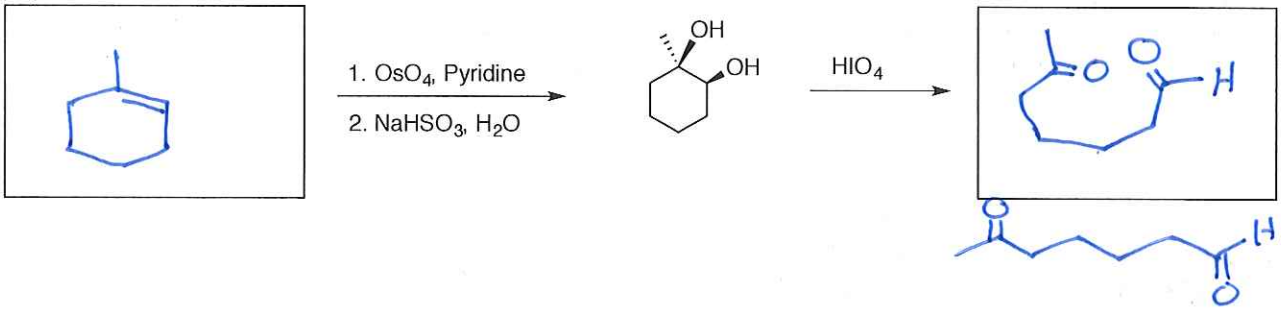
Switched - half credit

(ii)

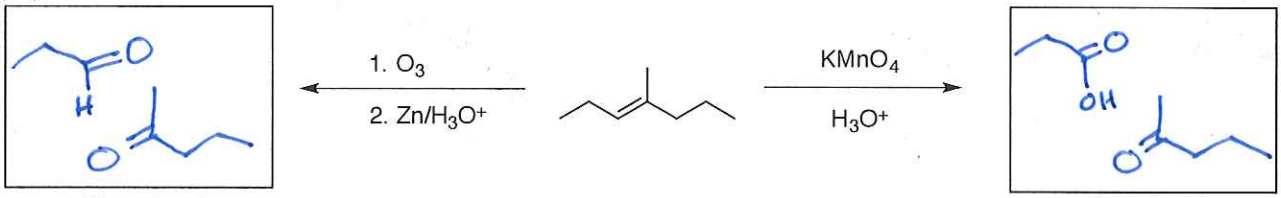


(an alkene)

(iii)



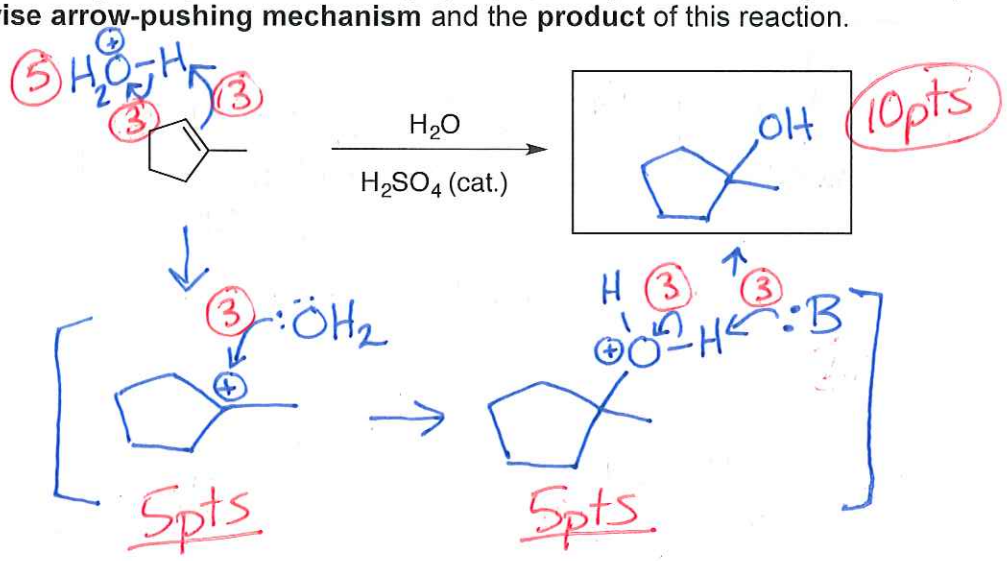
(iv)



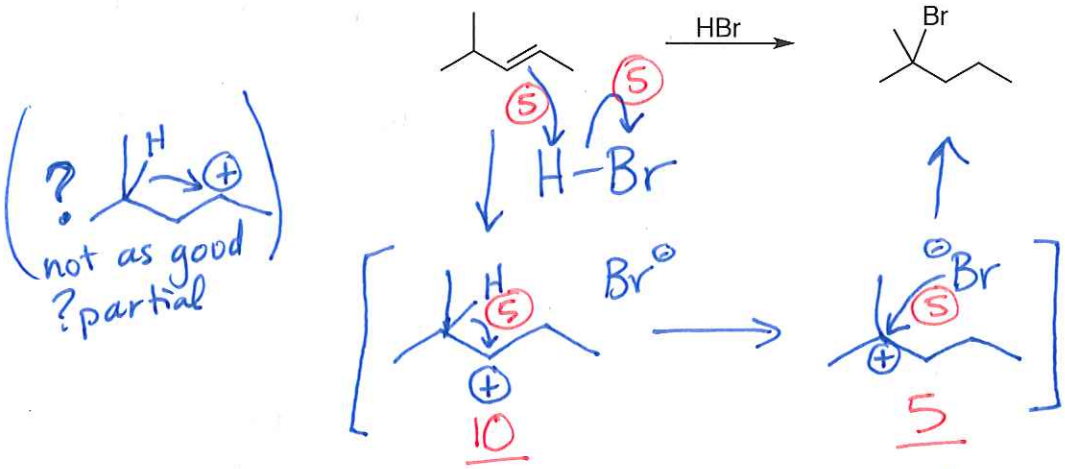
(2 products) (2 products)

7. *(40 points)* Reaction Mechanisms – <u>Choose one</u> of the following. Draw a large "X" over the part you are skipping, otherwise the first problem will be graded.

(a) The acid-catalyzed hydration of methylcyclopentene provides a single alcohol product. Draw the **step-wise arrow-pushing mechanism** and the **product** of this reaction.



(b) The electrophilic addition of hydrobromic acid to 4-methyl-2-pentene gives an unexpected product due to a rearrangement. Show the **step-wise arrow-pushing mechanism** for this reaction and **briefly explain** why this rearrangement may have occurred.



5pts Rearrangement occurs to get to more stable 3° carbocation