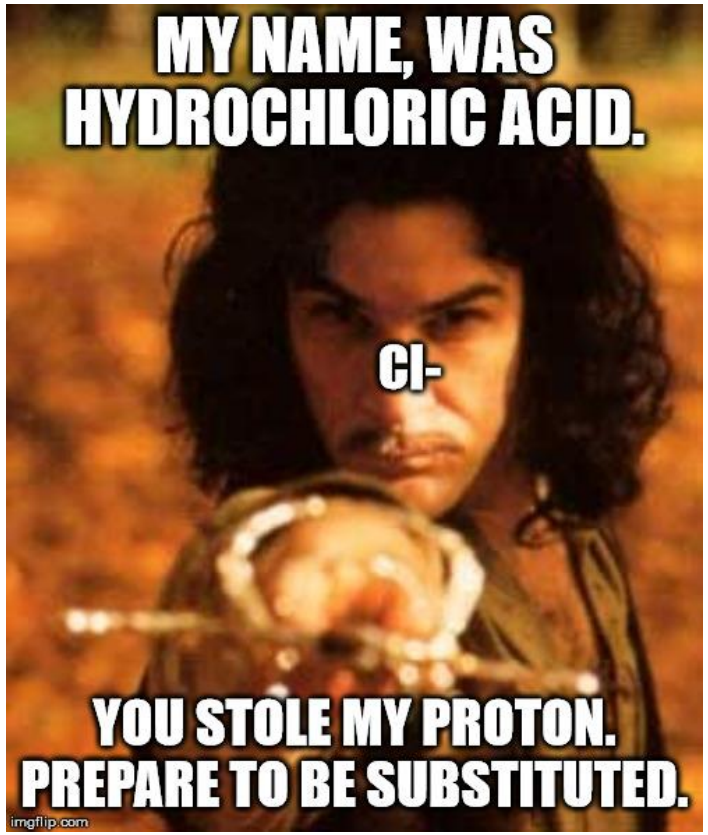
Nov 18- 22 Practice Problems



Quiz 8 this week – on last week's content

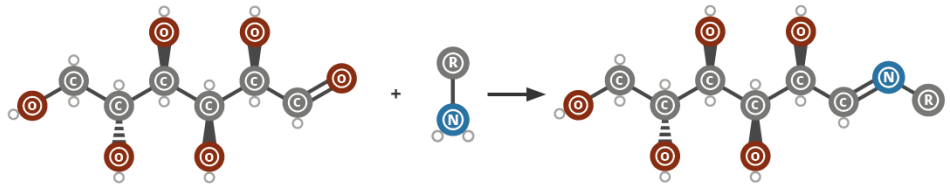
Graded Review end of this week as usual

Office hours **Tuesday Nov 19 5:30 pm to 6:30 pm in 104 Pulp and Paper Building**

A GUIDE TO THE MAILLARD REACTION

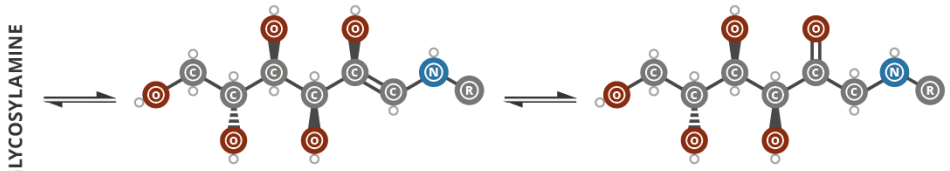
The Maillard reaction occurs during cooking, and it is responsible for the non-enzymatic browning of foods when cooked. It actually consists of a number of reactions, and can occur at room temperature, but is optimal between 140-165˚C. The Maillard reaction occurs in three stages, detailed here.

1 The carbonyl group on a sugar reacts with a protein or amino acid's amino group, producing an N-substituted glycosylamine.



SUGAR (GLUCOSE) + AMINO GROUP → GLYCOSYLAMINE (+ WATER)

2 The glycosylamine compound generated in the first step isomerises, by undergoing Amadori rearrangement, to give a ketosamine.



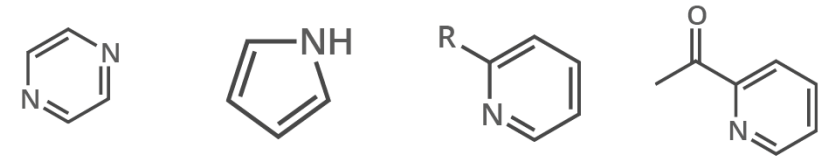
1,2-ENAMINOL AMADORI COMPOUND

3 The ketosamine can react in a number of ways to produce a range of different products, which themselves can react further.

FISSION PRODUCTS REDUCTONES HYDROXYMETHYLFURFURAL

Classes of Maillard Reaction Products

The Maillard reaction produces hundreds of products; a small subset of these contribute to flavour and aroma, some groups of which are described below. Melanoidins are also formed, brown, polymeric substances which contribute to the colouration of many cooked foods.



PYRAZINES
cooked
roasted
toasted

PYRROLES
cereal-like
nutty

ALKYLPYRIDINES
bitter
burnt
astringent

ACYLPYRIDINES
cracker-like
cereal

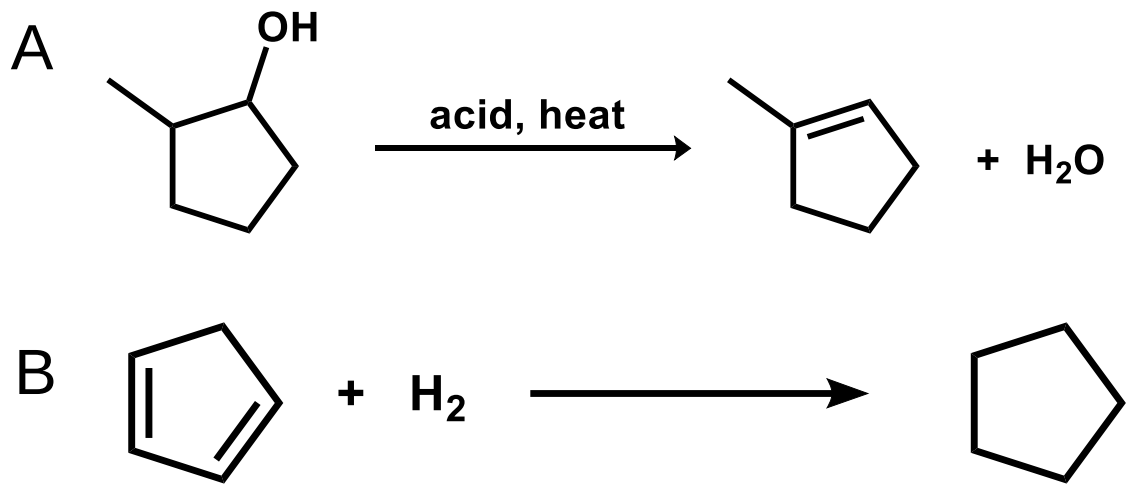
FURANONES
sweet
caramel
burnt

FURANS
meaty
burnt
caramel-like

OXAZOLES
green
nutty
sweet

THIOPHENES
meaty
roasted

Answer: What type of reactions are the following reactions?



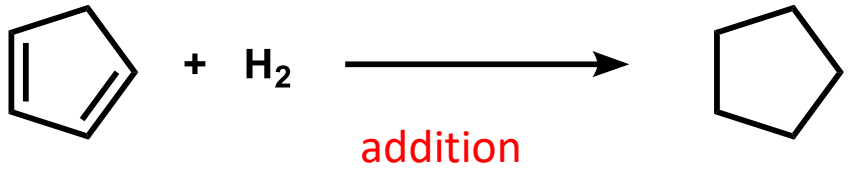
A. A :Addition; B:Elimination

B. A:Elimination; B:Addition

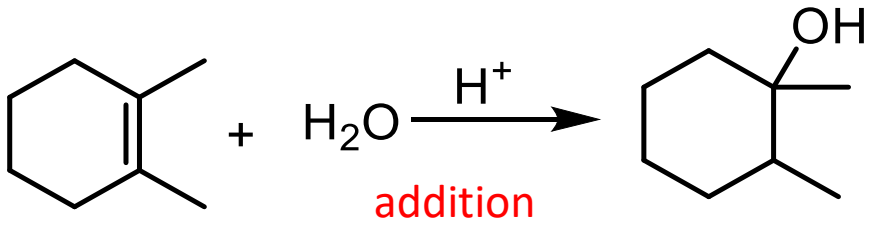
C. A:Substitution; B:Addition

D. A:Elimination; B:Substiution

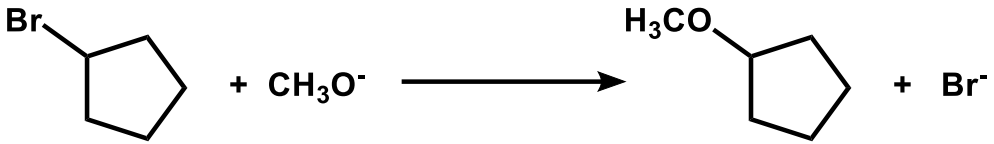
Q1. Classify the following reactions



addition

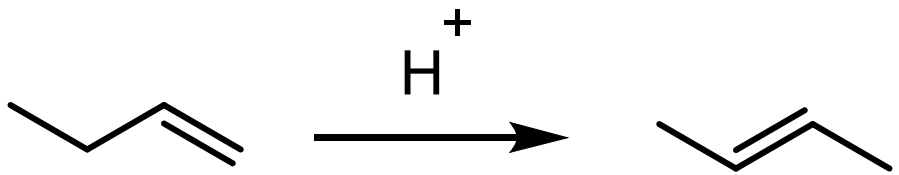


addition

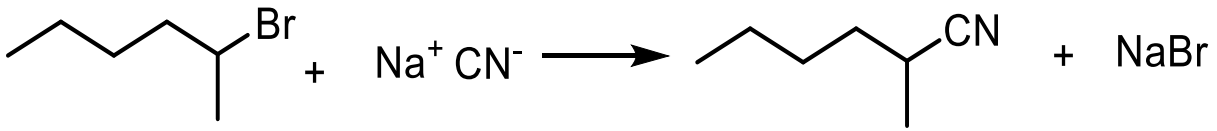


substitution

elimination



rearrangement



substitution

Q2. Electrophiles and nucleophiles

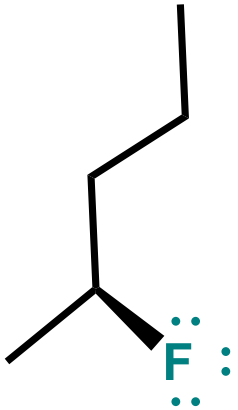
a) What is the definition of an electrophile? Provide one example.

- An electrophile is an electron acceptor (electron poor/ deficient)
- Examples: carbocation; a "slightly positive" carbon; Br^+, H^+, etc.

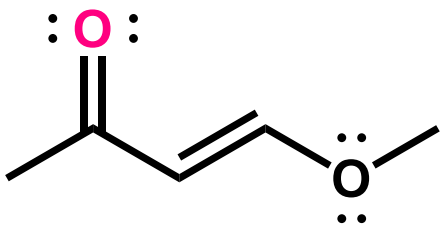
b) Rank the following nucleophiles from weakest nucleophile (# 4 starting on the left) to strongest nucleophile (ending on the right at # 1). Provide an explanation for the ranking.

Nucleophiles	Rank	Explanation
Cl^-, F^-, Br^-, I^-	**4** F^- **3** Cl^- **2** Br^- **1** I^-	When you go down the group, the outer shell electrons are further away and thus are more polarizable
CH_3^-, OH^-, NH_2^-, F^-	**4** F^- **3** OH^- **2** NH_2^- **1** CH_3^-	When you compare the electronegativity of the central atom, carbon is the least electronegative and therefore is the most polarizable.

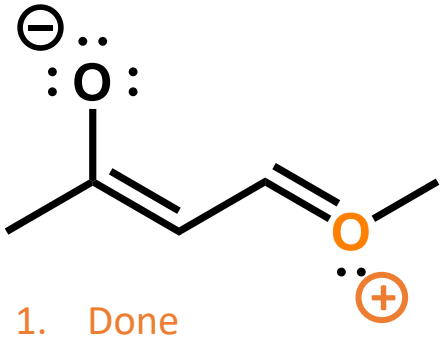
Q3. Determine the formal charge on the colored atoms. Show your work.



1. Done
2. 7
3. 6 from lone pair electrons
   + ½ (2 e for the bond), so 7 total
4. 7-7 = 0

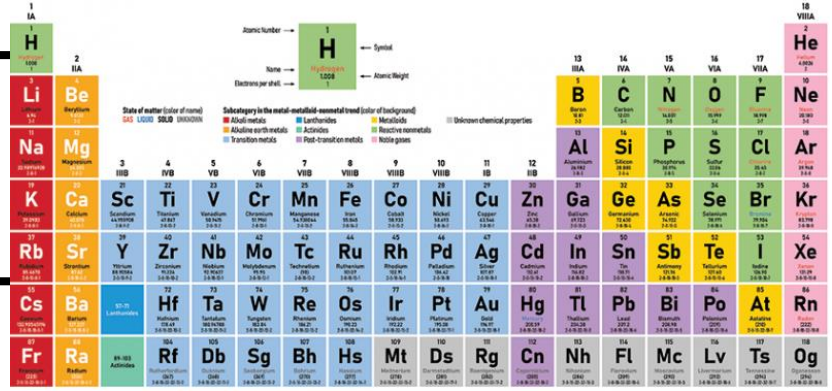


1. Done
2. 6
3. 4 from lone pair e^- + ½ (4 e in double bond), so 6
4. 6-6 = 0

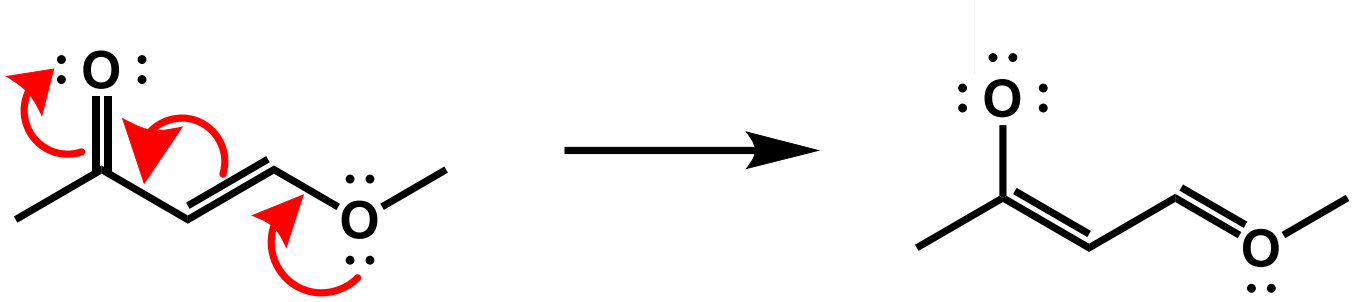


1. Done
2. 6
3. 2 from lone pairs + ½ (6 e in 3 bonds), so 5
4. 6-5 = 1 (i.e. + 1)

1. Draw Lewis Structure
2. Determine neutral valence of atom
3. Assign to each atom ½ for each bonding electrons + 1 for each lone pair electron
4. FC = Neutral Valence – Assigned electrons

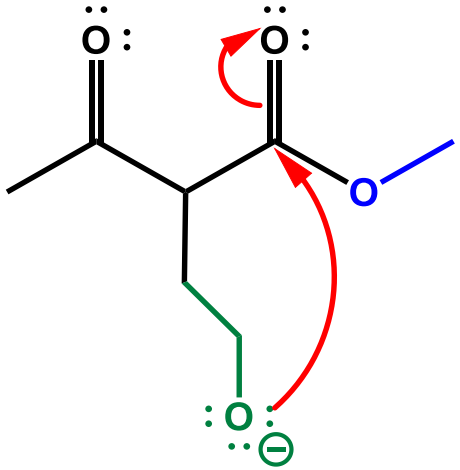


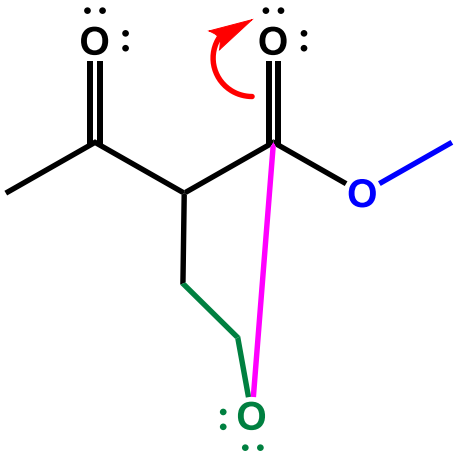
Q4: Show the product of the following arrow pushing

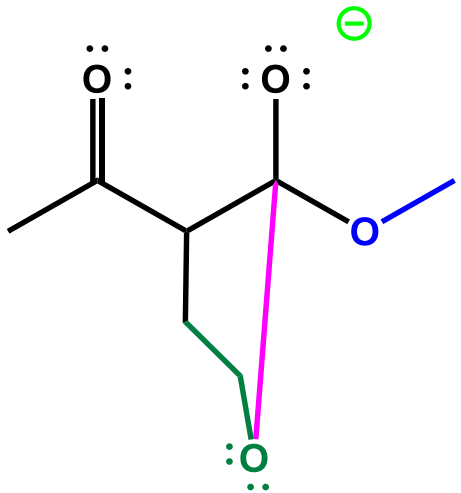


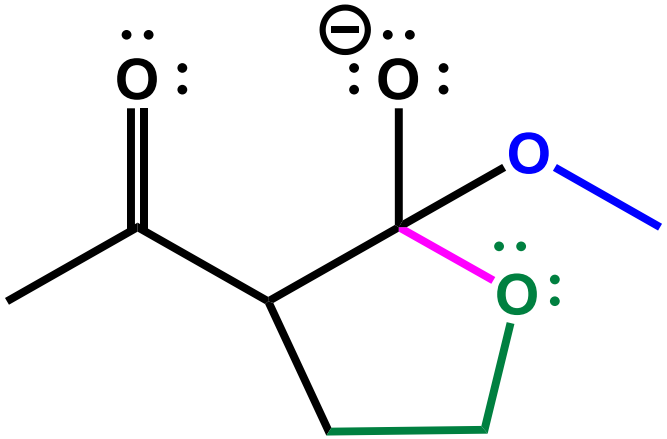
Reminder

1. Draw Lewis Structure
2. Determine neutral valence of atom
3. Assign to each atom ½ for each bonding electrons + 1 for each lone pairs
4. FC = Neutral Valence – Assigned electrons

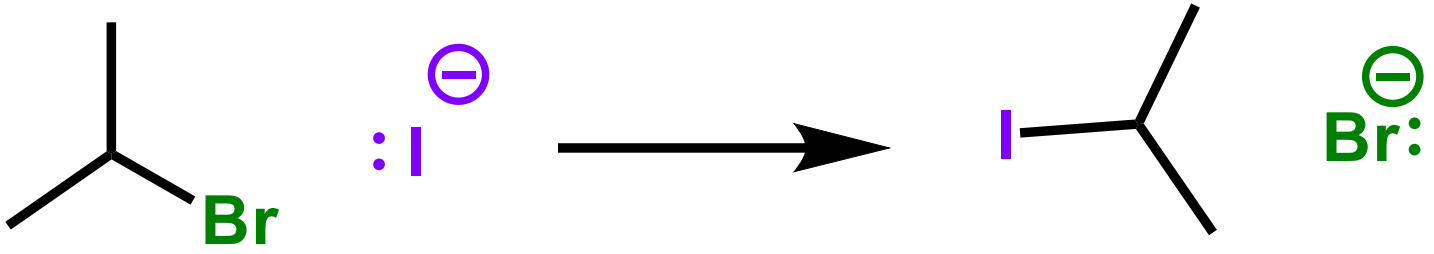








Q5: Show all steps of the mechanism of the reaction between 2-bromopropane and sodium iodide as an SN1 reaction. Include all transition states and intermediates. Add the lone pairs involved in the reaction.



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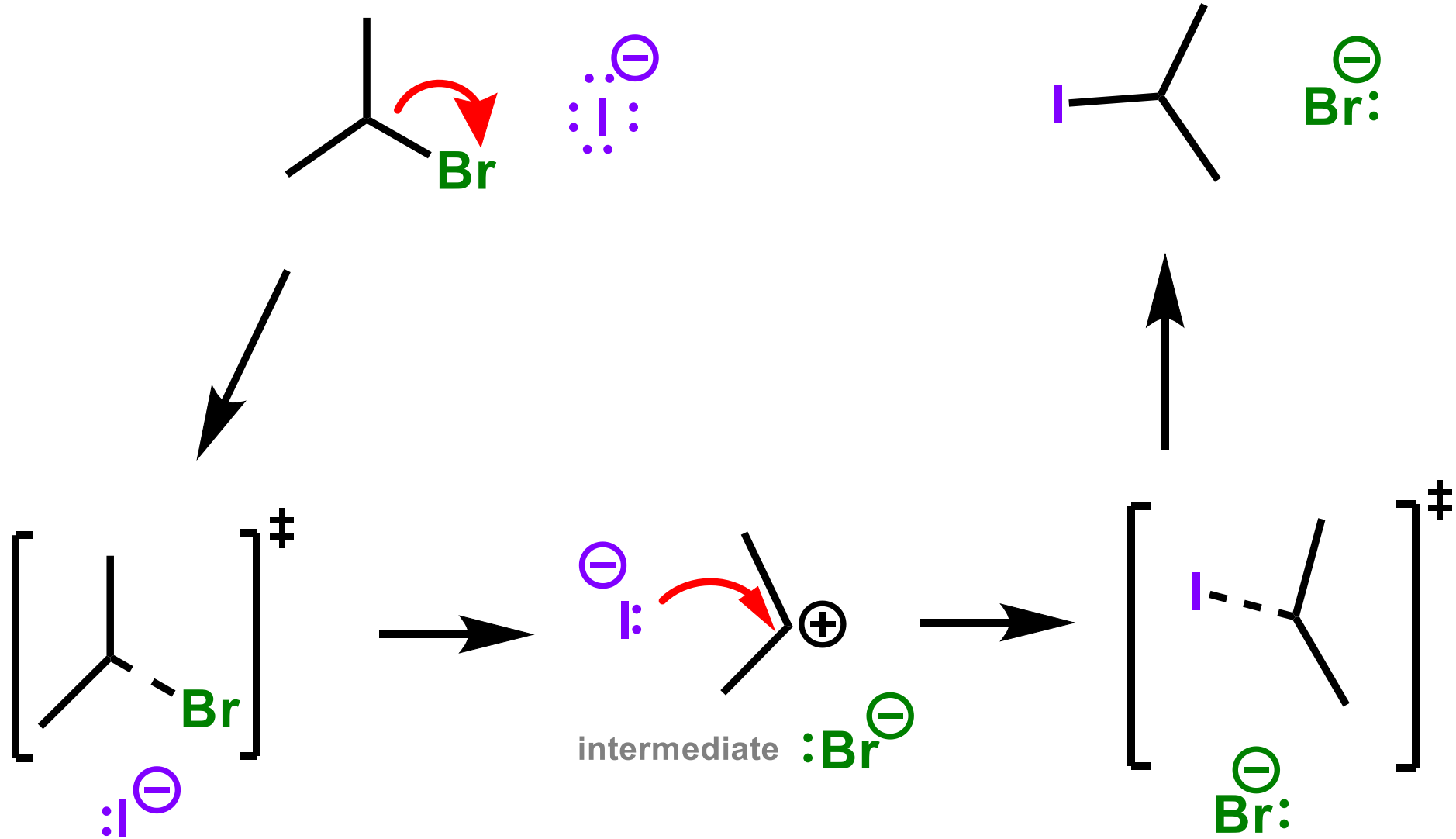

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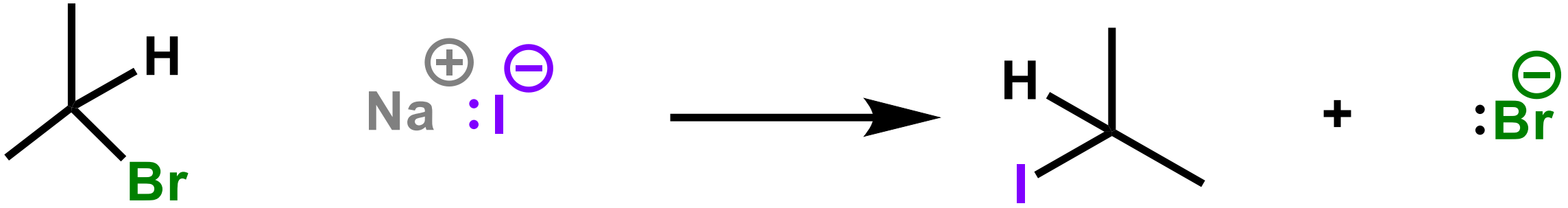
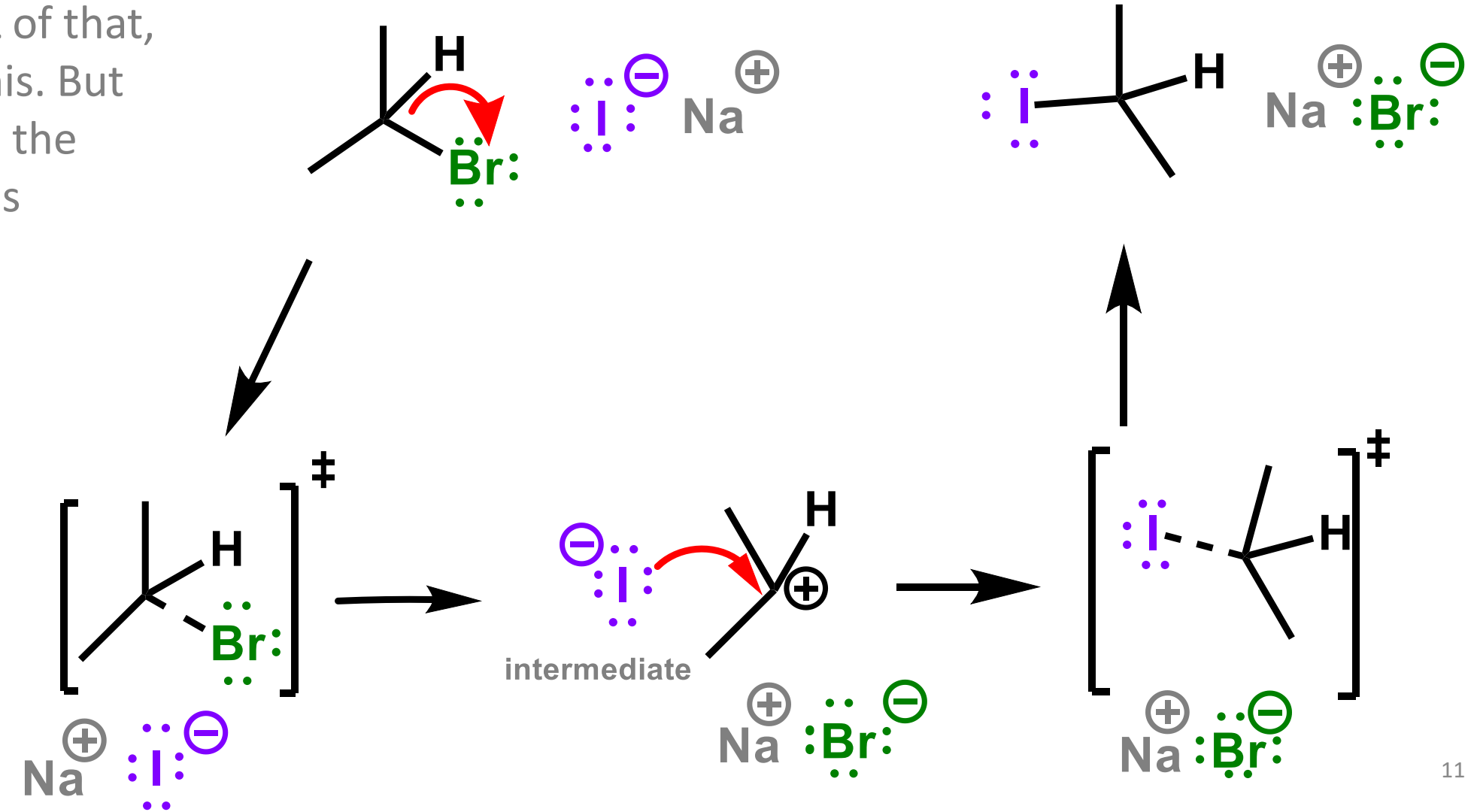


Notes:

1) There will be a counter ion (sodium) in solution. I've removed it for most examples to reduce confusion. It does not participate in the reaction.
2) You may draw in any extra hydrogen's if it helps you. (not required)
3) **You must show charge (+ or -). (required)**
4) **You must draw the lone pair of electrons participating in the reaction. (required)**
   -You may add all the electrons if you like.

Q5: Show all steps of the mechanism of the reaction between 2-bromopropane and sodium iodide as an SN1 reaction. Include all transition states and intermediates. Add the lone pairs involved in the reaction.

So if you added ALL of that, it would look like this. But this is not required, the other slide is what is required ☺

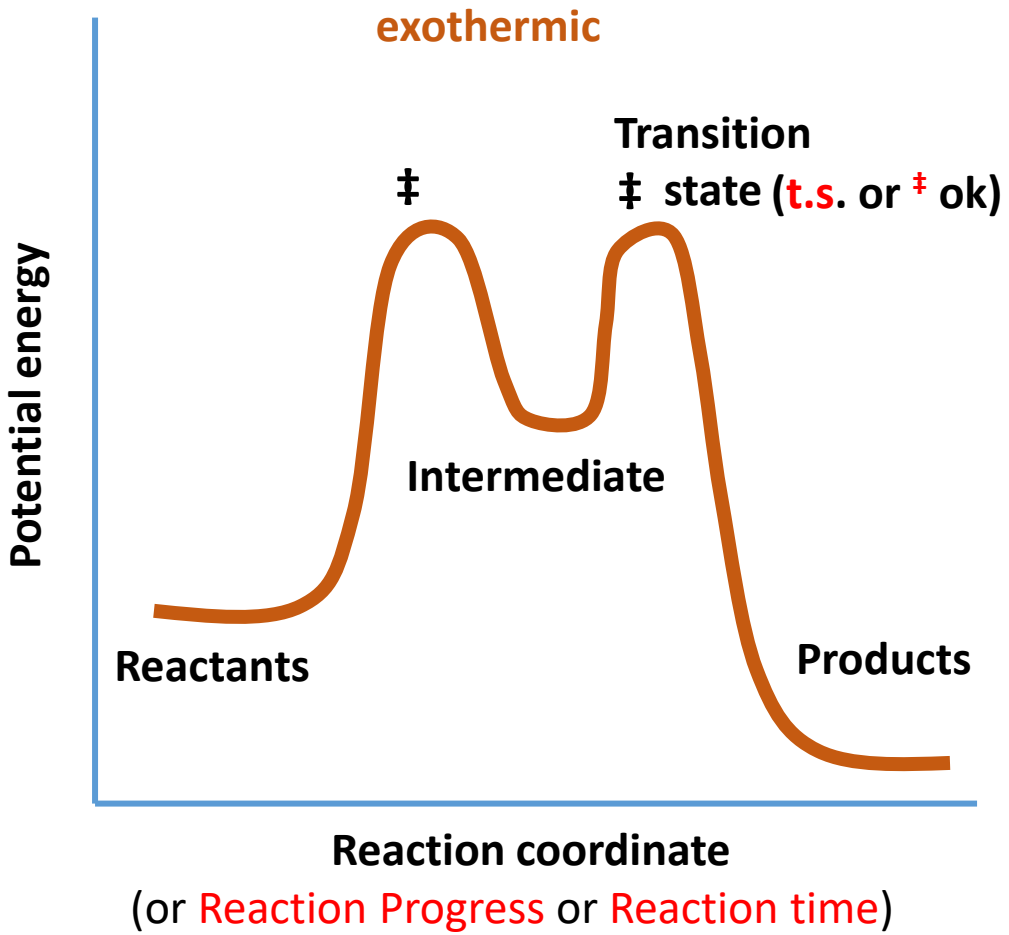


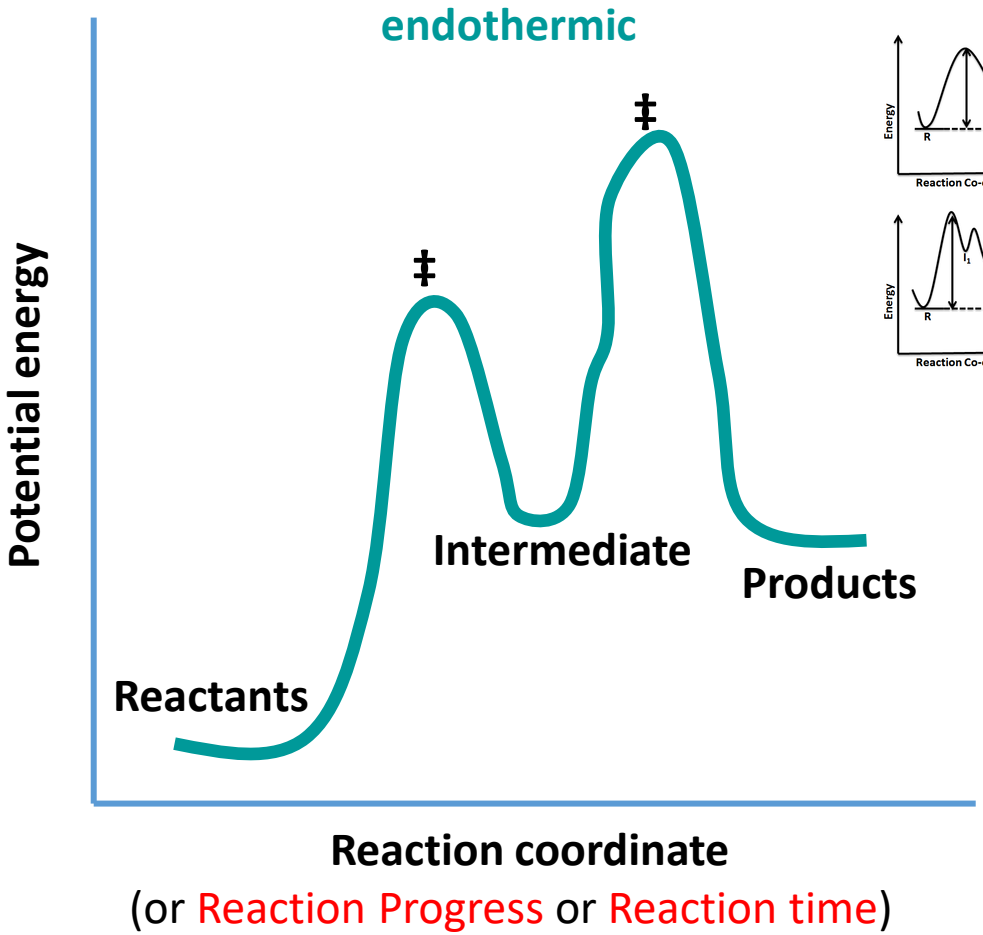
Sodium hydroxide

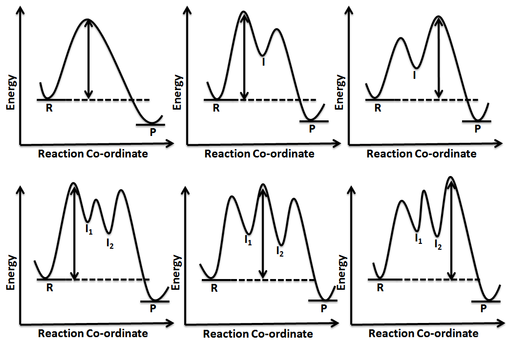
- NaOH
- That is the same as Na^+ and OH^-
- Same as

Q6. Use reaction energy diagrams to compare exothermic and endothermic E1 reactions. Be sure to include all the labels.

E1 means that there is only one molecule involved in the rate limiting step; which means the reaction proceeds via 2 steps (*i.e.* 2 transition states, with 1 intermediate)





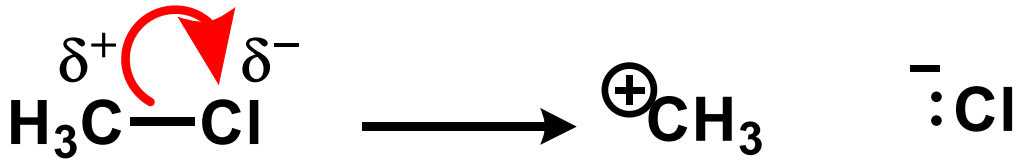


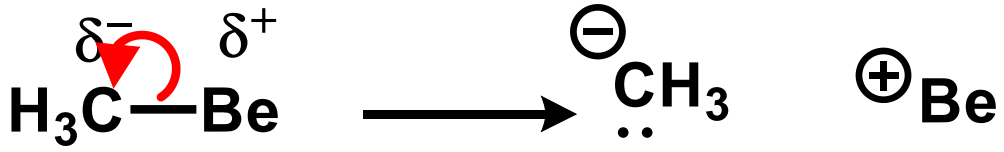
Note – do not worry about how high the transition state bumps are relative to each other!

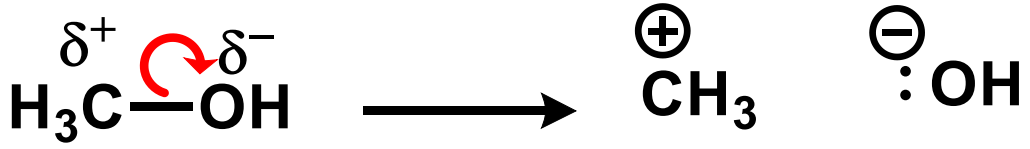
Q7. Show the movement of the electrons with arrows and then draw the products of heterolytic cleavage

Remember: *hetero*lytic cleavage, hetero = not the same, so that means that **both electrons** in the bond will move to **one atom**. To show movement of two electrons we use a **normal arrow (double headed).** For homolytic cleavage, one electron moves to each atom of the bond. To show one electron moving, we use a single-headed arrow (half arrow)

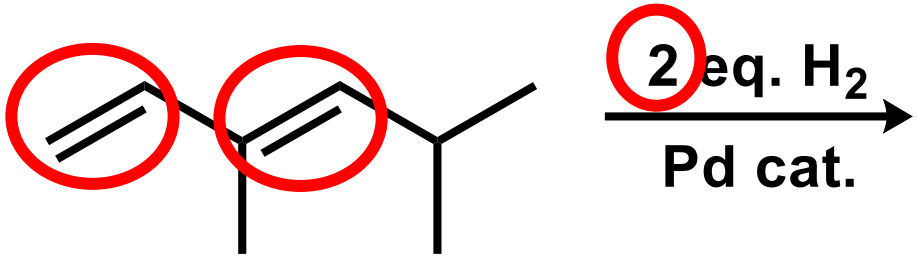
Q7. Show the movement of the electrons with arrows and then draw the products of heterolytic cleavage



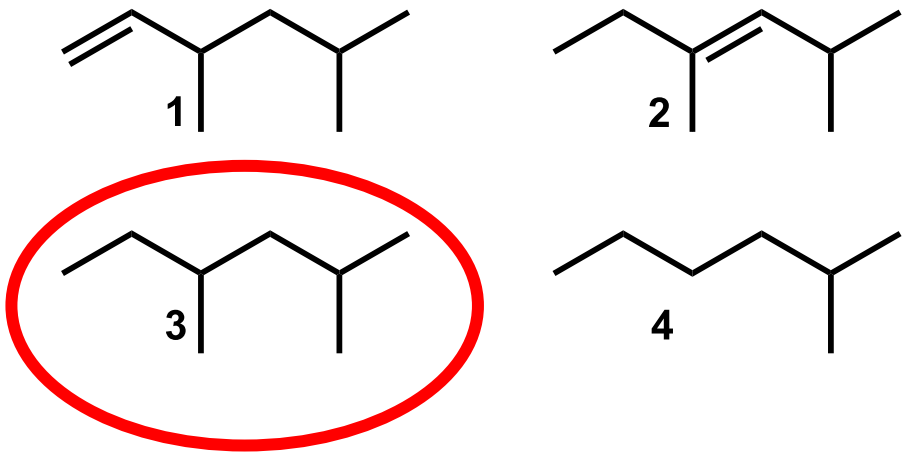


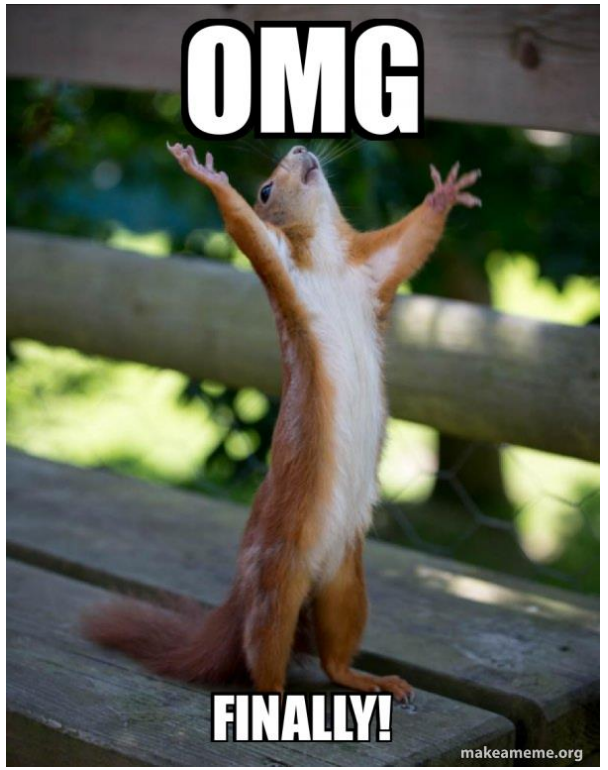


What is the product from the following hydrogenation reaction?



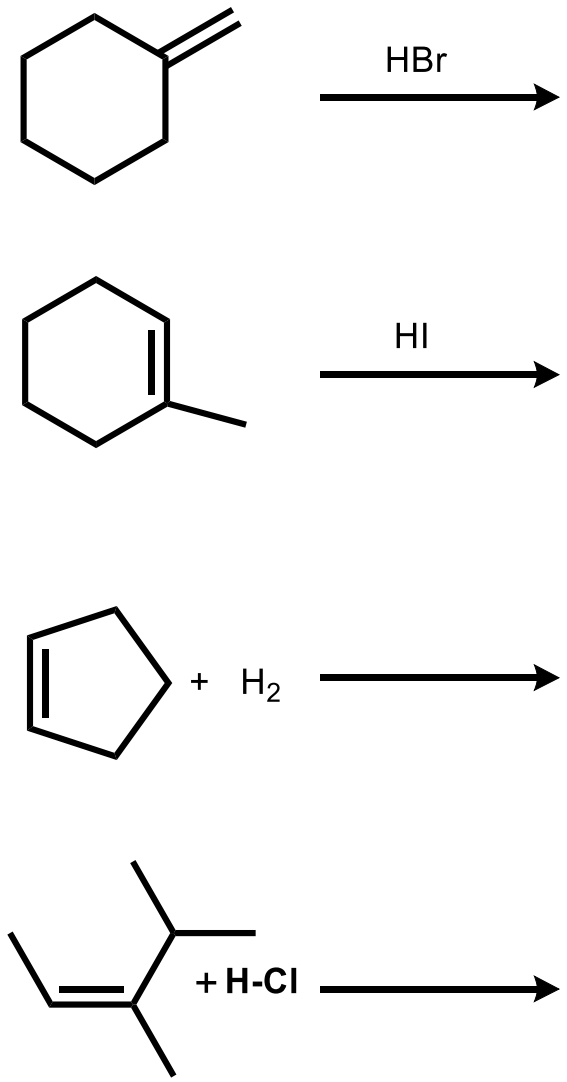
A. 1
B. 2
C. 3
D. 4





Finally! The degrees of unsaturation work paid off!!!

Q8. Predict the products. Draw as skeletal diagrams.



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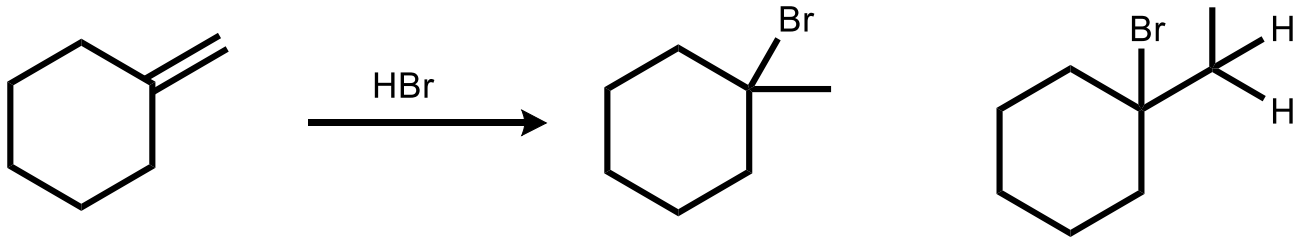
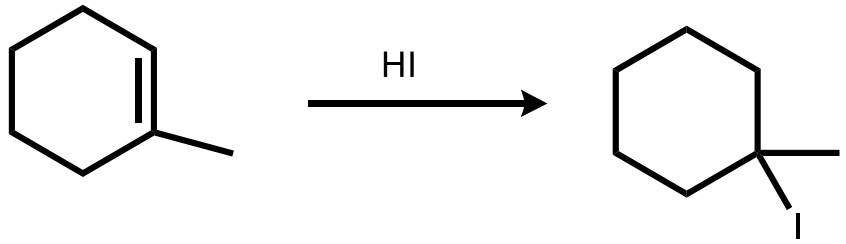


Markovnikov's rule



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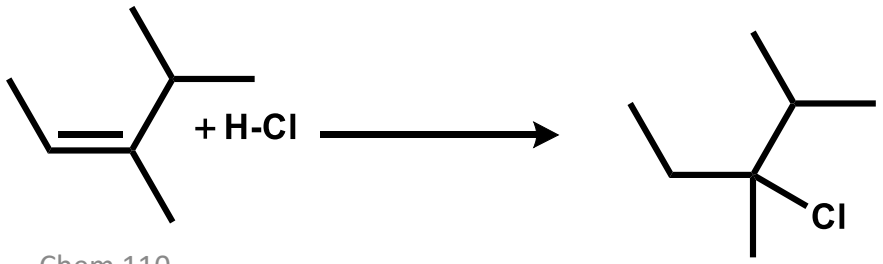

Markovnikov's rule