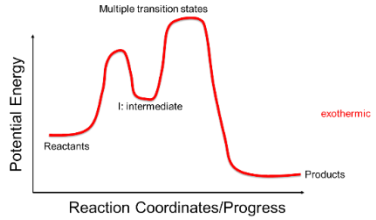
In class review (November 21 and 22)

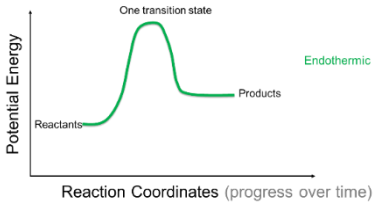
Major Concepts Covered from Videos 30-33:

Reaction pathways

Step-wise reaction

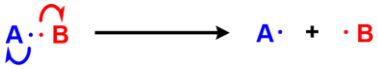


Concerted (one-step) reaction

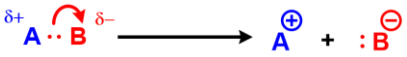


Bond cleavage and formation

Homolysis

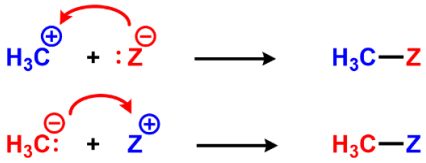


Heterolysis



Bond formation

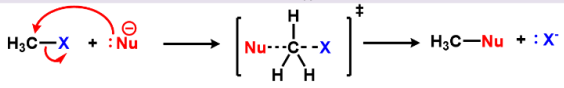
NUCLEOPHILE – electron rich species (seeks a positive center)
ELECTROPHILE – electron deficient species (seeks e⁻ to fill octet)



Nucleophilic substitution mechanisms

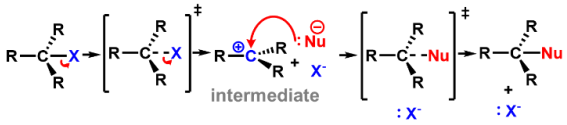
Two nucleophilic substitution (SN) reaction mechanisms

A: The nucleophilic attack and the leaving group departure occurs in one-step: Concerted: S_N2



transition state

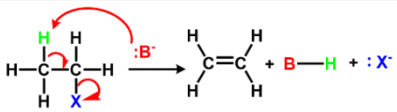
B: Reactants converted to products via more than one step: S_N1
Step 1: Heterolytic **cleavage** of C-X bond – carbocation formed
Step 2: Then nucleophile attacks the electrophile



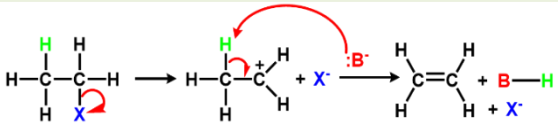
Elimination mechanisms

Two elimination (E) reaction mechanisms

1: Bond breaking and bond formation occur one-step: E2

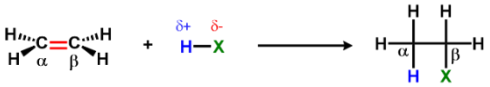


2: Reactants converted to products via more than one step: E1
Step 1: Heterolytic cleavage of C-X bond – carbocation formed
Step 2: Nucleophile attacks the electrophile

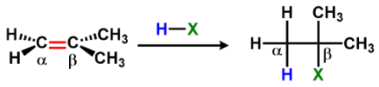


Electrophilic addition to alkenes

ELECTROPHILE – hydrogen of H-X (or other δ+ of x-X reagent)
NUCLEOPHILE – "attacking" π bond



Markovnikov's rule: hydrogen adds to the carbon in the double bond that has more hydrogen atoms, and **the halogen adds to the carbon with fewer hydrogen atoms**



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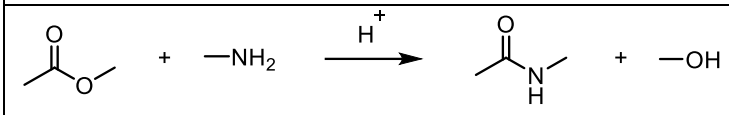
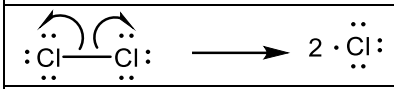
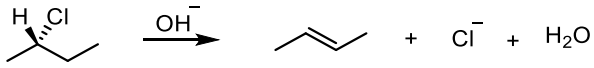
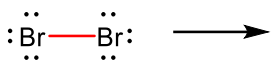
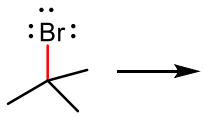
Question 1. Label each reaction event below with either the bonding-breaking type or the specific reaction type. Choose the type that **best** describes the reaction event drawn.
Choices: substitution, addition, elimination, heterolytic cleavage, homolytic cleavage

Reaction scheme	Reaction type (one **best** choice)
	
	
	
	

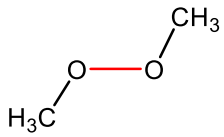
Question 2. Break the red bond of the following molecules in either a homolytic or heterolytic fashion, as indicated. Show the cleaved products produced with the appropriate electrons and charge. Be sure to draw in the correct arrows to show the movement of electrons.
a)



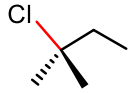
Homolytic cleavage



Heterolytic cleavage



Homolytic cleavage



Heterolytic cleavage

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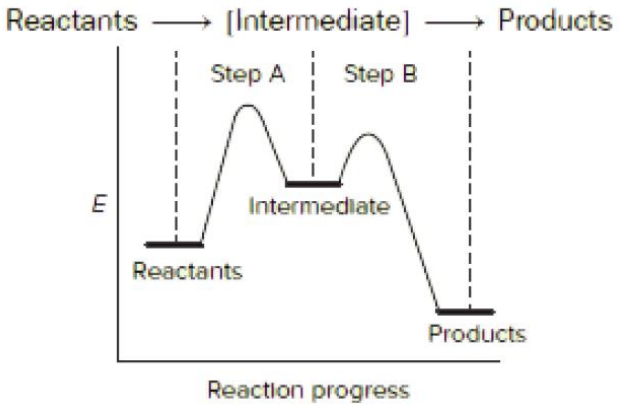
Question 3. Answer the questions below based on the following reaction energy diagram

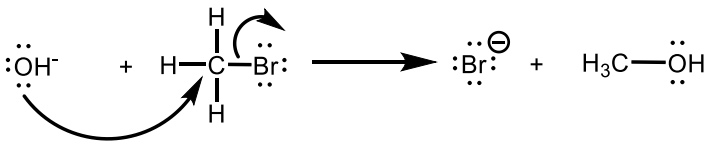
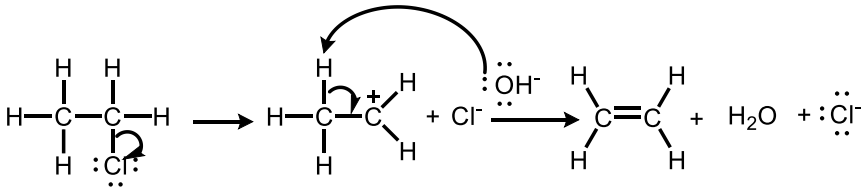


i. Is the reaction concerted or stepwise?

ii. Is the reaction endothermic or exothermic overall?

iii. How many transition states are there in this reaction pathway?

Question 4. Identify the mechanism below as either S_N1, S_N2, E2 or E1. Circle the leaving group in each reaction. Put a square around the nucleophile.

Reaction mechanism	**Mechanism type**
	
	

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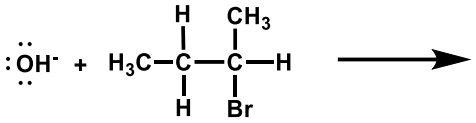
Question 5. Draw the mechanism of reaction and the product formed resulting from an <u>E1</u> reaction of the following reactant and substrate:



Question 6. a) Provide the detailed mechanism of the SN2 reaction of methylchloride with sodium hydroxide. Include any transition states or intermediates of the reaction. Use arrows to indicate the flow of electrons and indicate any charge/lone pairs that are important.

b) Assume that the SN2 reaction above is exothermic, draw the associated reaction energy diagram for this reaction. Include all the necessary labels.

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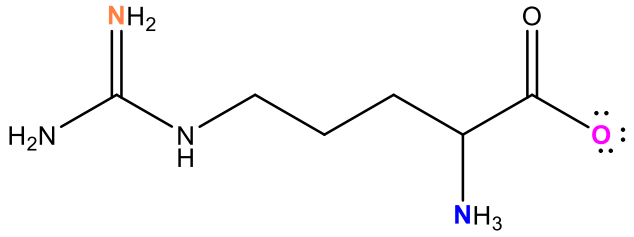
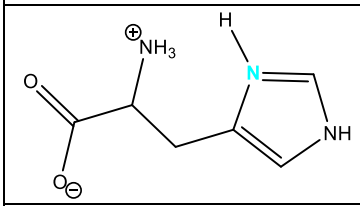
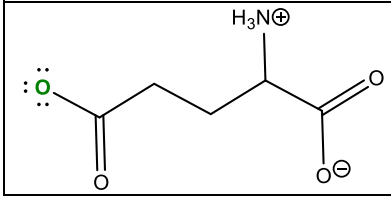
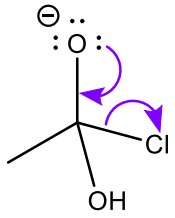
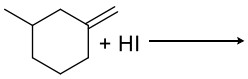
Question 7. What is the formal charge on each indicated atom? Show the calculation.

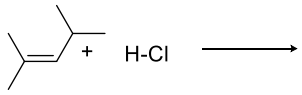
	N N O
	N
	O

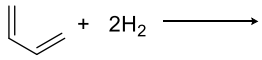
Question 8. Draw the product(s) of the arrow pushing.

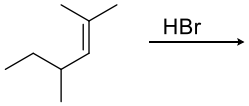


Question 9. Draw the products of the reactions.









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Question 10. Which is the better nucleophile from each pair and why?

NH_2^- vs NH_3	
Br^- vs Cl^-	
OH^- vs NH_2^-	