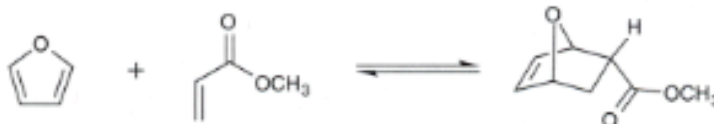


1. The following is an example of a Diels-Alder reaction which you will learn more about next semester. This reaction is believed to proceed through a single step. At room temperature, the reaction enthalpy is $-9.1 \text{ kcal} \cdot \text{mol}^{-1}$ and the entropy is $-0.027 \text{ kcal} \cdot \text{mol}^{-1}$. Calculate the equilibrium constant for the reaction. Show all your work. (You do not need to know anything about the Diels-Alder Reaction to answer the question.) (5 pts)

$1 \text{ kcal} \approx 4.3 \text{ kJ}$



$$\begin{aligned} \Delta G &= \Delta H - T\Delta S \\ &= (-9.1) - (298)(-0.027) \\ &= -2.0 \text{ kcal/mol} \end{aligned}$$

$$\begin{aligned} \Delta G &= -RT \ln K_{eq} \\ K_{eq} &= e^{\frac{-1.0}{(8.314)(298)}} = 5.5 \end{aligned}$$

2. a. Calculate the degrees of unsaturation of a compound with the formula $C_{11}H_{13}Cl_2NO_3$. (3 pts)

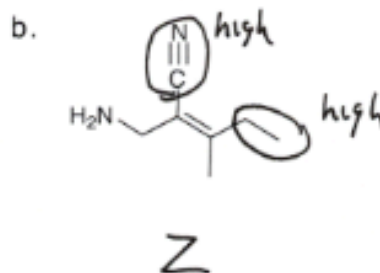
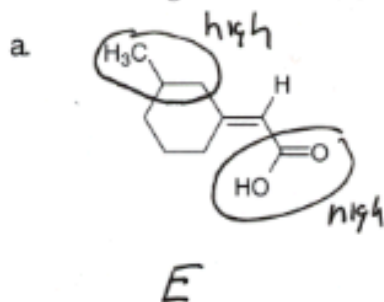
saturated alkane	$C_{11}H_{24}$	$\frac{10}{2} = 5$ degrees of unsaturation
	$- H_{13}$	
	$\frac{H_{11}}$	
	$- H_2$	

Correction for: 2 Cl	$- H_2$
1 N	$+ H_1$
	$\frac{H_{10}}$

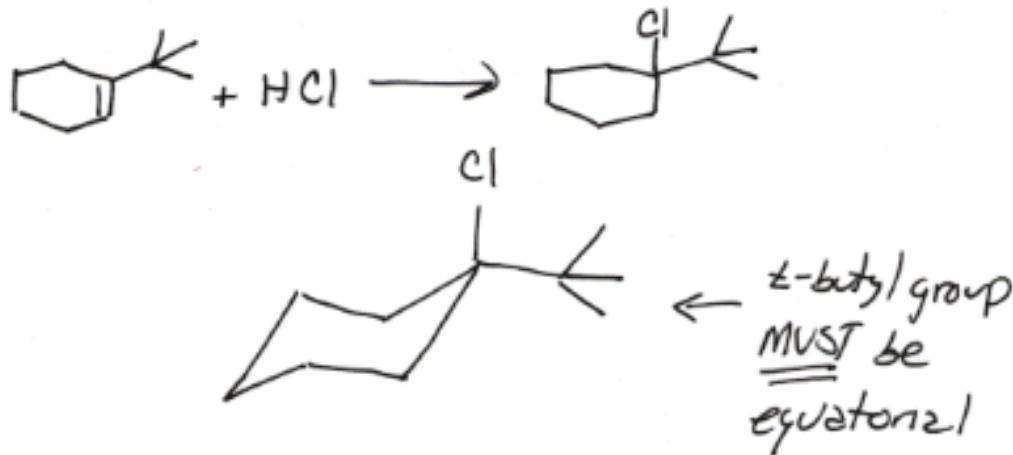
- b. What does this mean? (2 pts)

There is some combination of rings & π -bonds that add up to 5

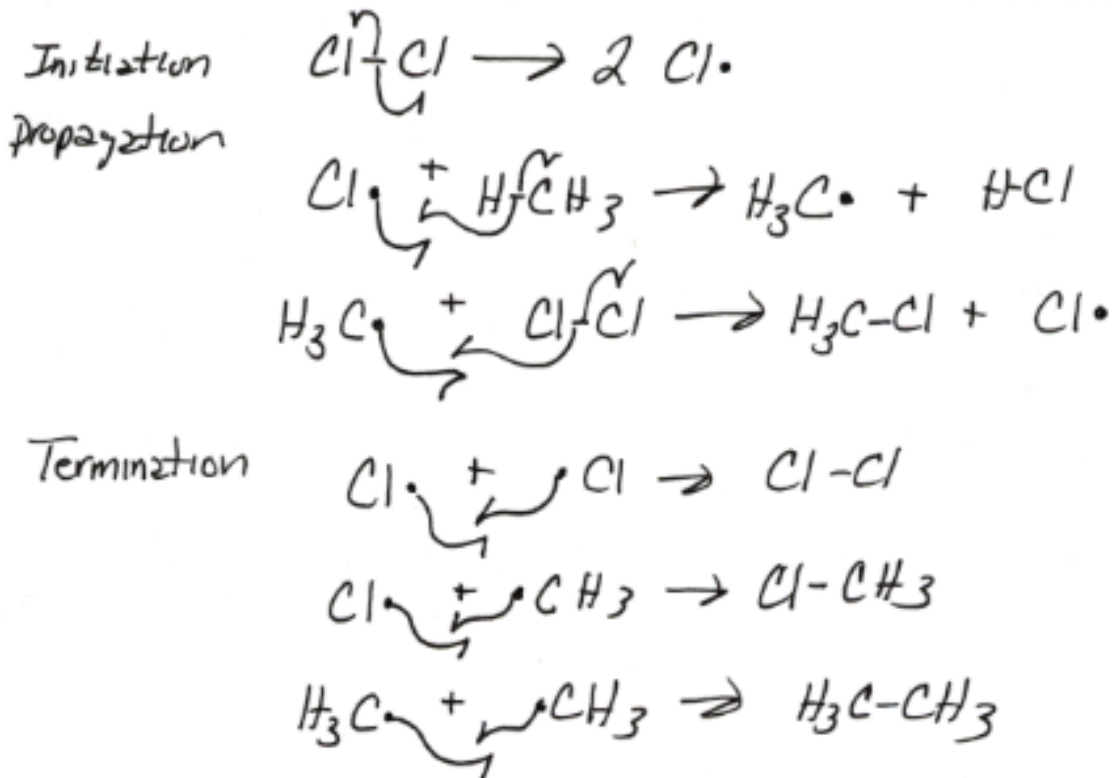
3. Designate the following alkenes as (E) or (Z). (4 pts)



4. Give the product for the electrophilic addition of HCl to 1-(1,1-dimethylethyl)-cyclohexene. Draw the most stable chair conformation of the product. (5 pts)



5. Give the mechanism for the free radical chlorination of methane to chloromethane. (6 pts)



Problem 1: _____ (5 pts) 2: _____ (5 pts) 3: _____ (4 pts)

4: _____ (5 pts) 5: _____ (6 pts)

Total out of 25: _____