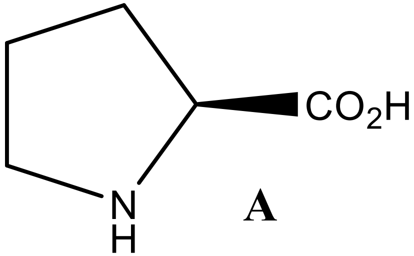
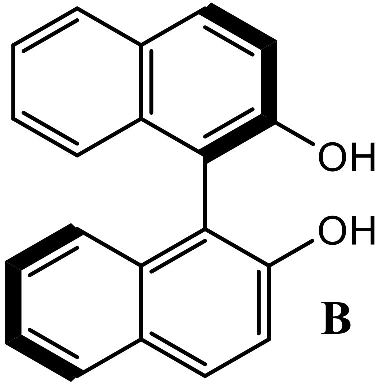
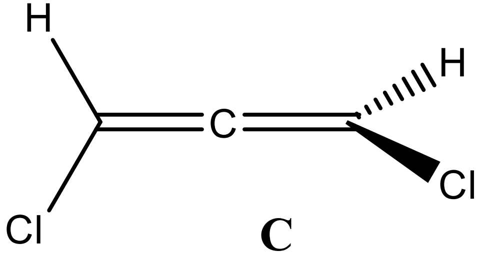
Complete the table



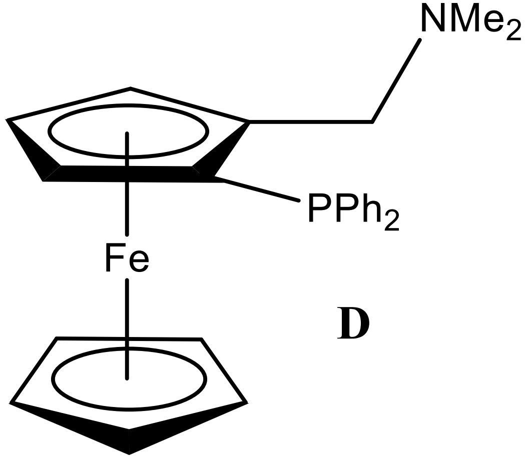
A



B



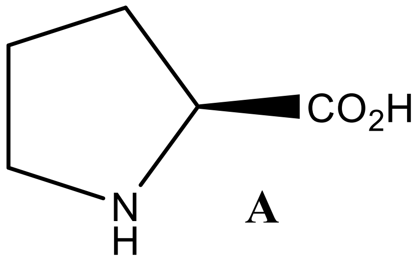
C



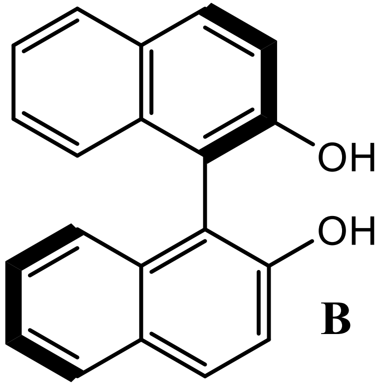
D

	A	B	C	D
Type of chirality and configuration				
Percentage of major enantiomer	60 %			20 : 1
Enantiomeric Excess		35 %		
$\Delta\Delta G^{\ddagger}_{(25^{o}C)}$			11.3 kJ mol^{-1}	

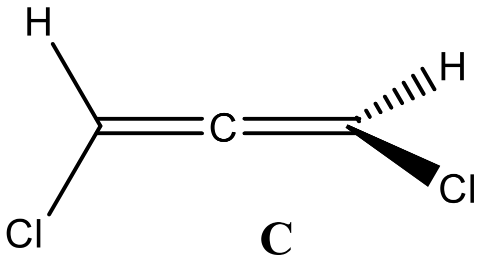
Complete the table



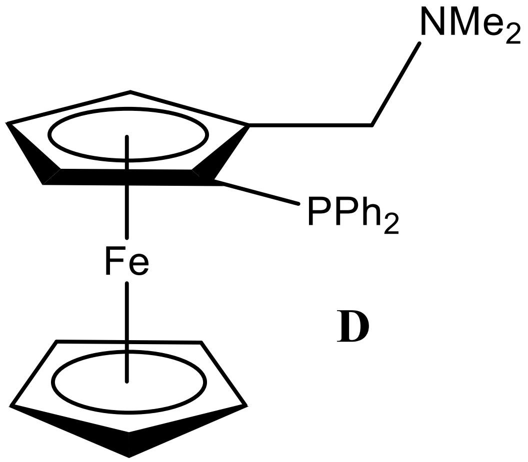
A



B



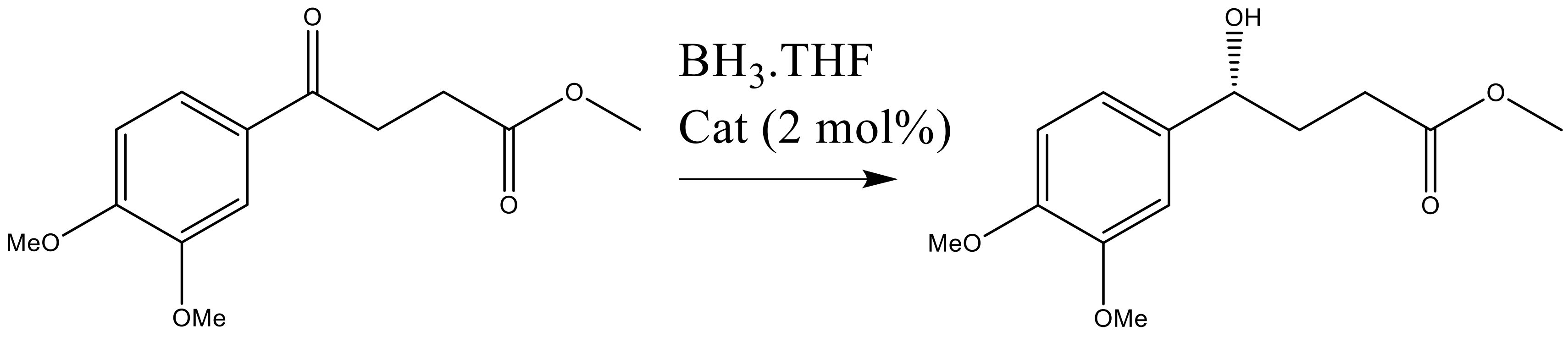
C



D

	A	B	C	D
Type of chirality and configuration	Central (S)	Axial (R_a)	Axial (R_a)	Planar (S_P)
Percentage of major enantiomer	60 %	67.5 %	99 %	20 : 1
Enantiomeric Excess	20 %	35 %	98 %	90.5 %
$\Delta\Delta G^{\ddagger}_{(25^{o}C)}$	-1.0 kJ mol^{-1}	-1.8 kJ mol^{-1}	-11.3 kJ mol^{-1}	-7.4 kJ mol^{-1}

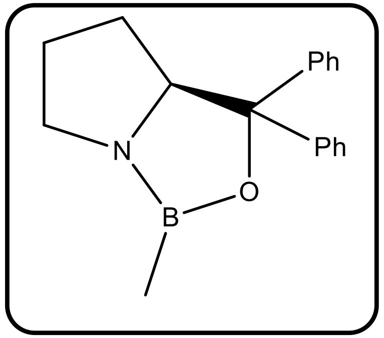
Calculate the Asymmetric Catalyst Efficiency (**ACE**) of the reaction.



Molecular Weight: 252.27

Molecular Weight: 254.28
98%, 95% ee

Cat.



Molecular Weight: 277.17
Cost: £100 per gram

Use the ACE to calculate the **cost** of **1 mmol of the excess** of the **major enantiomer**

Calculate the Asymmetric Catalyst Efficiency (ACE) of the reaction.

$$ACE = \frac{254.28}{277.17}\ x\ \frac{1}{2}\ x\ \frac{95}{100}\ x\ 98 = 42.7$$

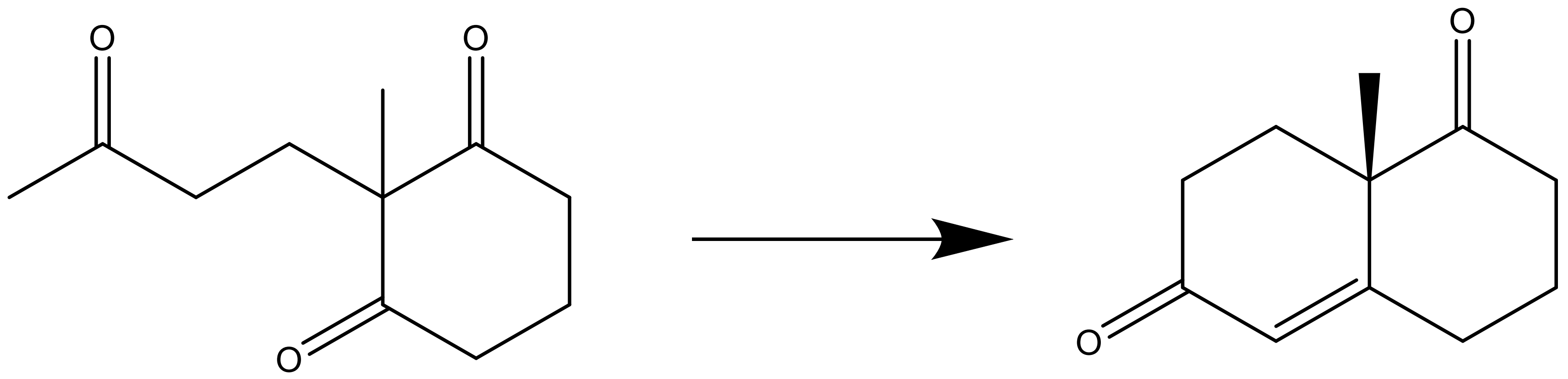
Extra Tip

The ACE is a ratio between how many grams of catalyst you put in wtr how many grams of excess of the major enantiomer you get out. So in this case if you put in 1g of catalyst you will produce 42.7 g of major enantiomer IN EXCESS.

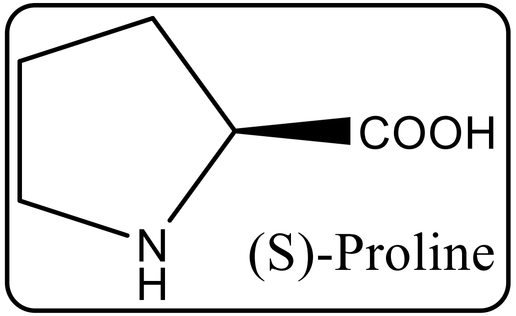
Use the ACE to calculate the cost of 1 mmol of the excess of the major enantiomer

$$= \frac{254.28}{1000}\ x\ \frac{£100}{42.7} = 60p\ per\ mmol\ of\ excess\ of\ the\ major\ enantiomer$$

Give the **mechanism** for the following reaction using **LDA**. Is any selectivity displayed, why?

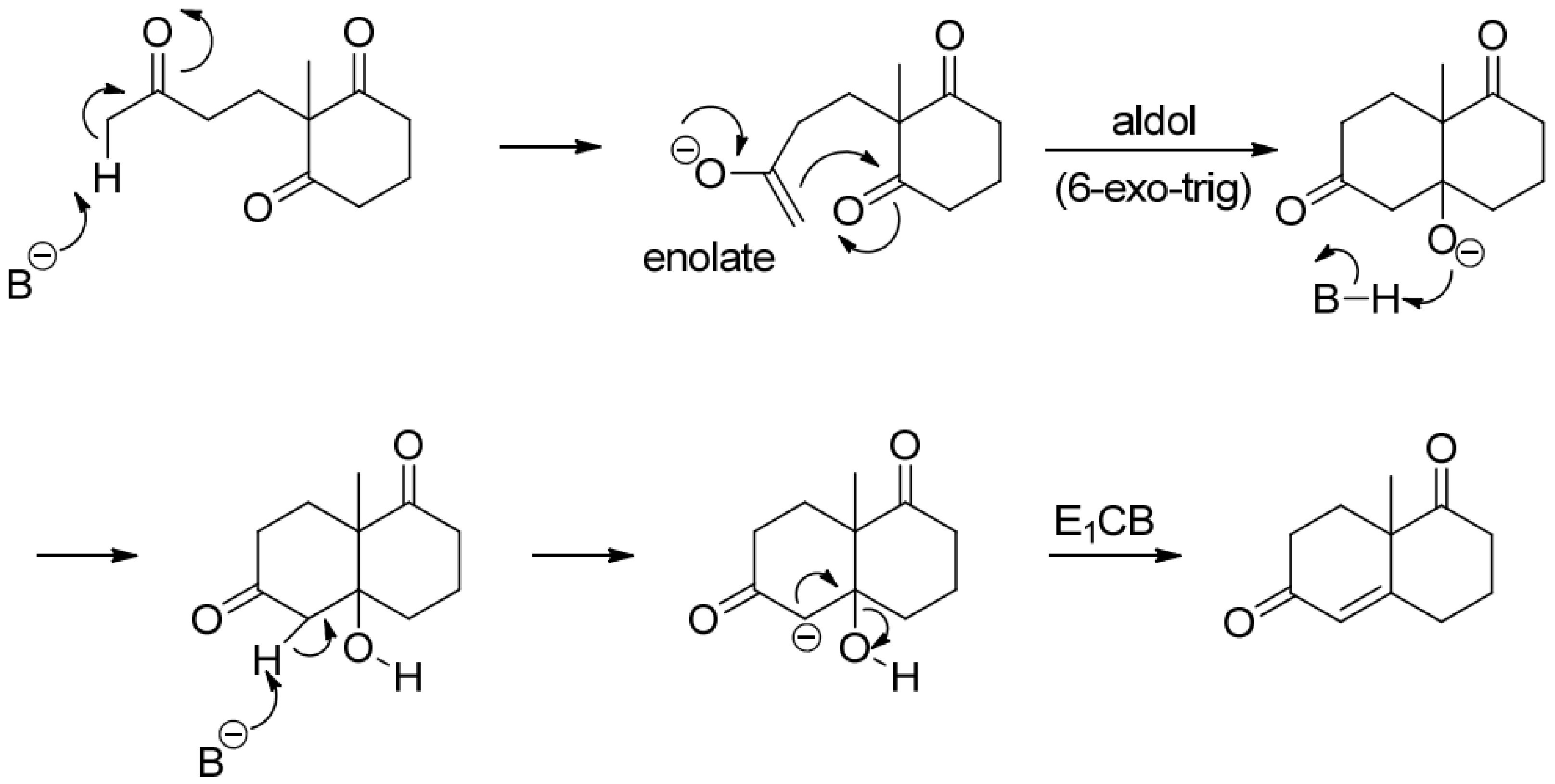


Give the **mechanism** for the catalysed reaction using **(S)-proline** and point out the key differences. (Hint: will need water)



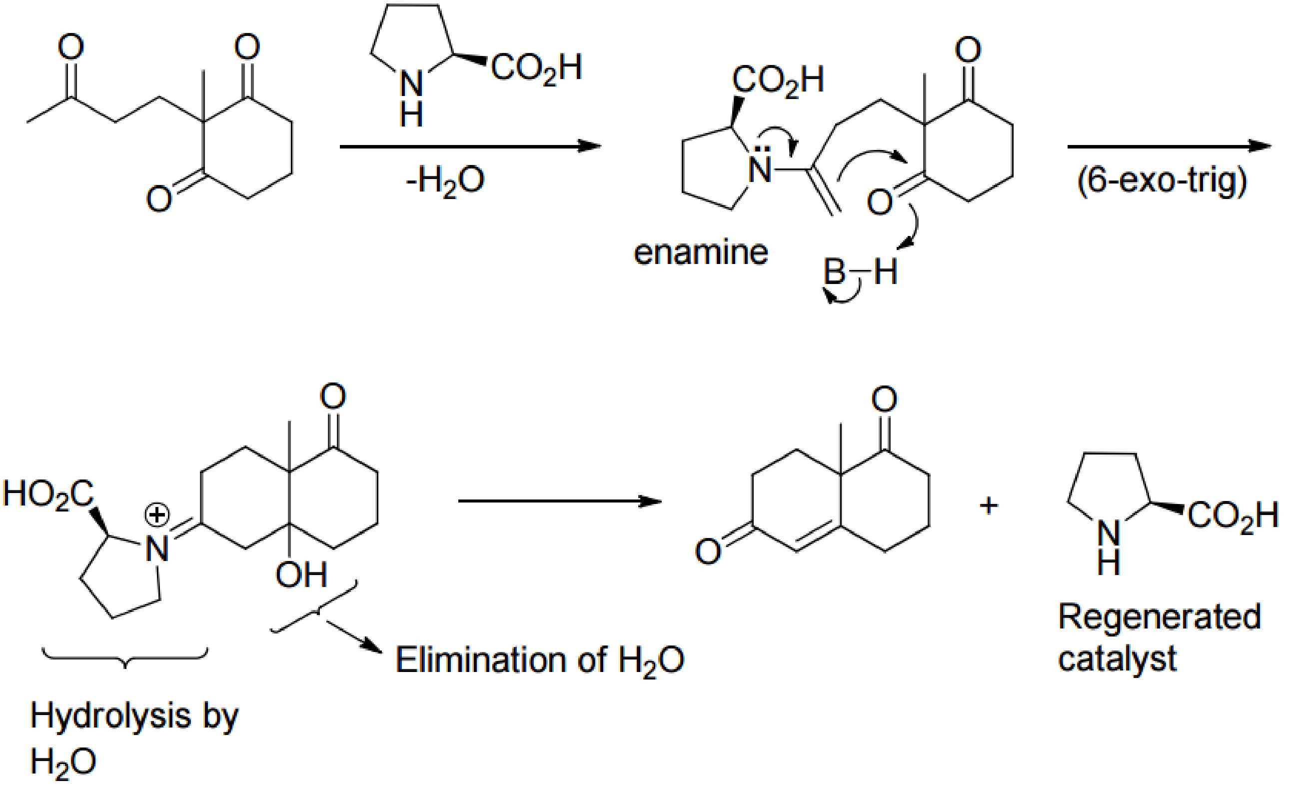
Give the mechanism for the following reaction using **just a base** such as LDA. Is any selectivity displayed and why?

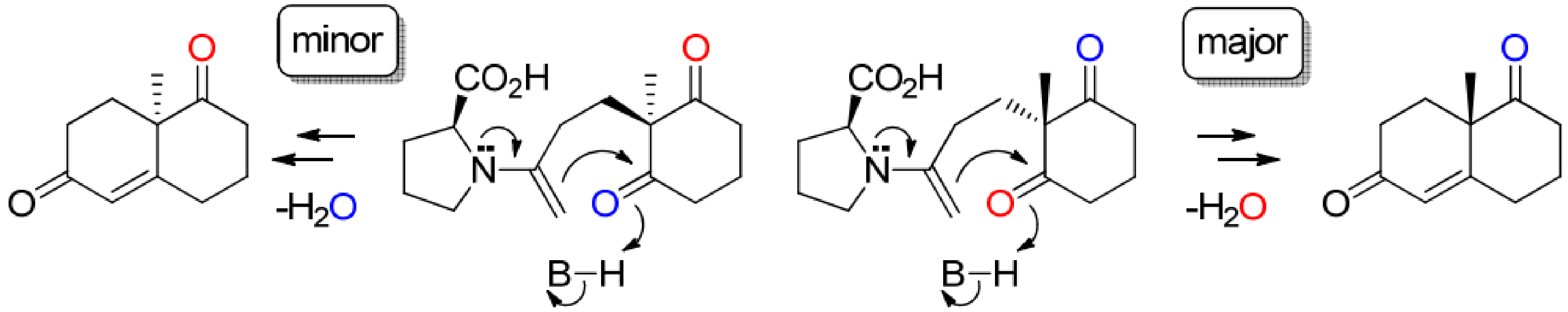
Lecture 2 notes. No selectivity as there are no chiral substituents. Prochiral aldehyde attacked from both faces equally through intramolecular aldol reaction.



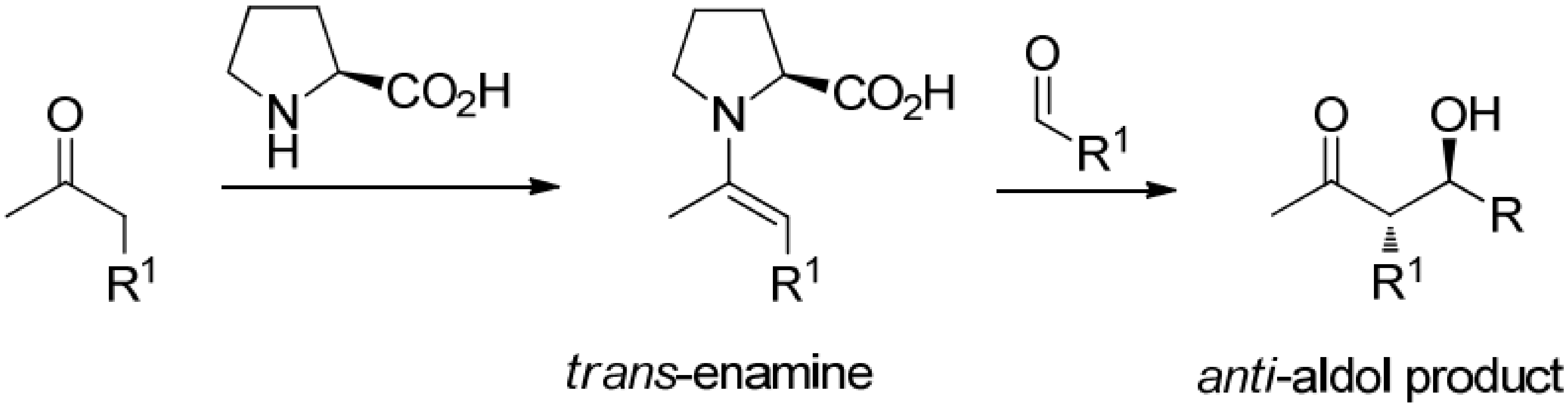
Give the mechanism for the catalysed reaction using (S)-proline and point out the key differences.

Lecture 2 notes. Proline does not act as a base so no enolate formation. Forms enamine instead which is lower in energy than the corresponding enolate. Proline regenerated at end of pathway after hydrolysis. Selectivity is determined due to diastereomeric transition states.

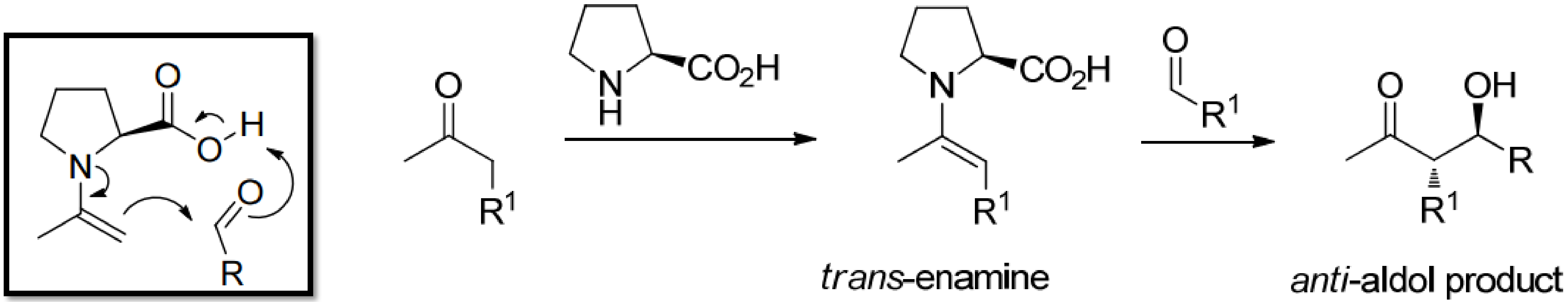


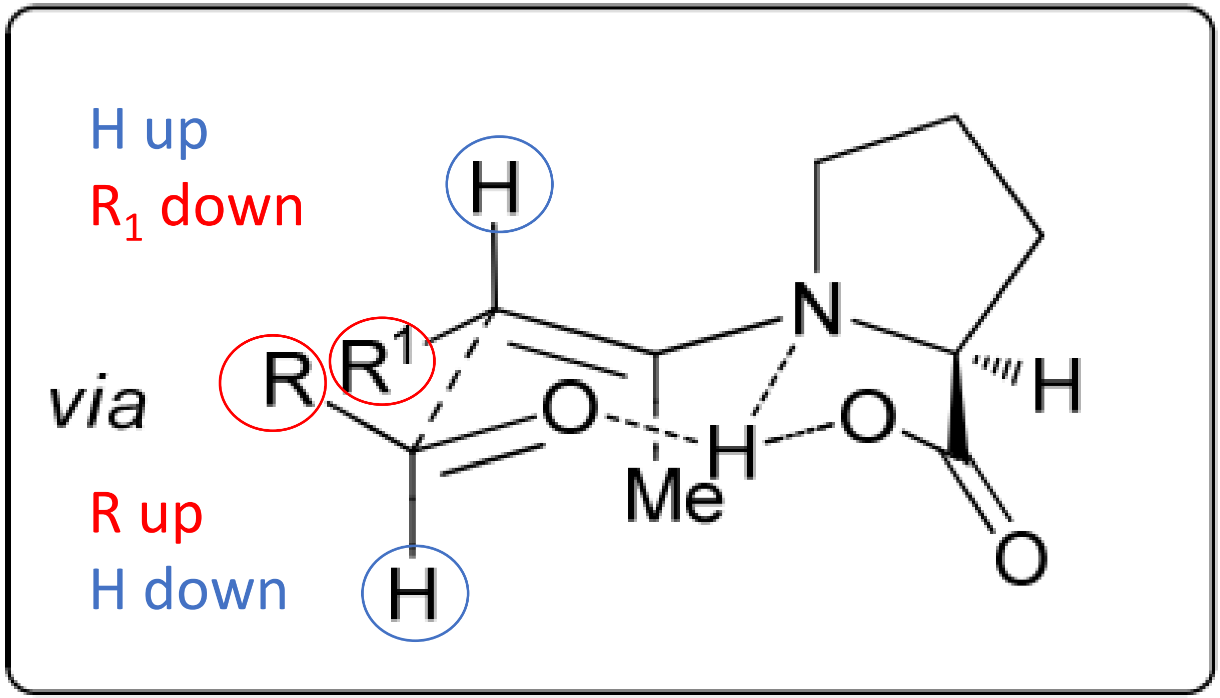


Sketch the **six membered cyclic transition state** in the following reaction and use this to **prove** that the **product is *anti***. (Hint: carboxylic acid can act as source of proton)



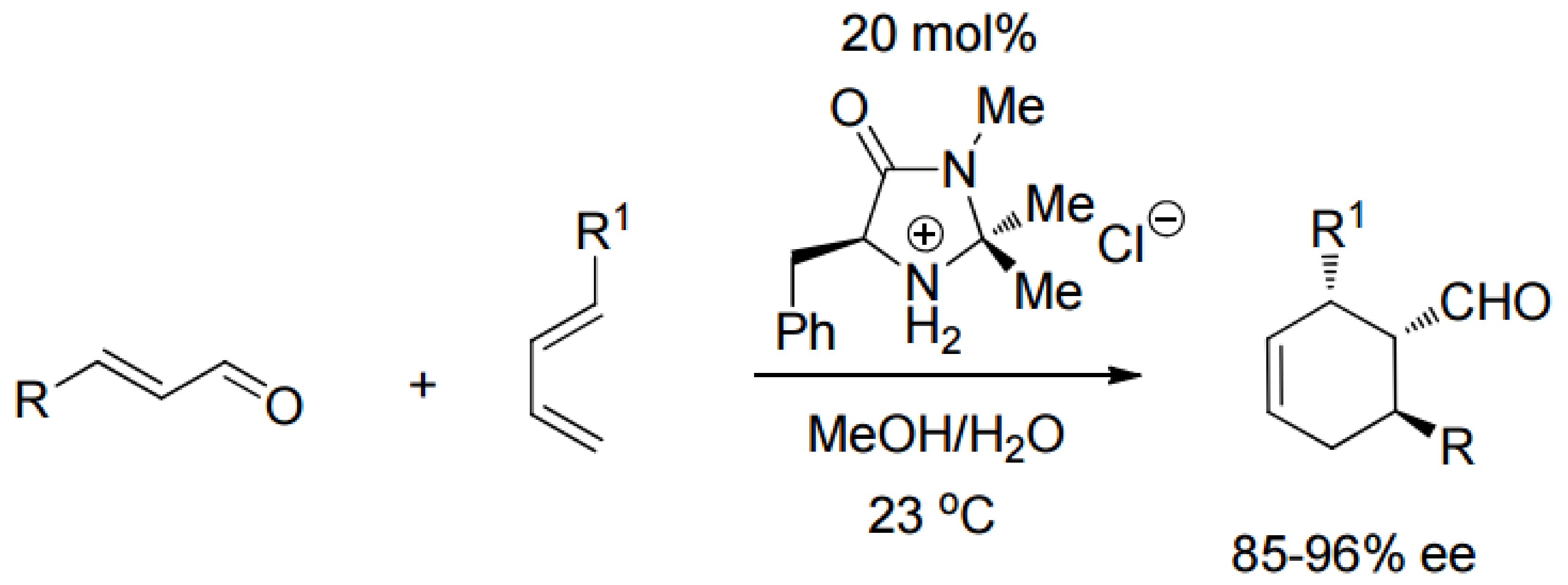
Sketch the **six membered cyclic transition state** in the following reaction and use this to **prove** that the **product is *anti***.





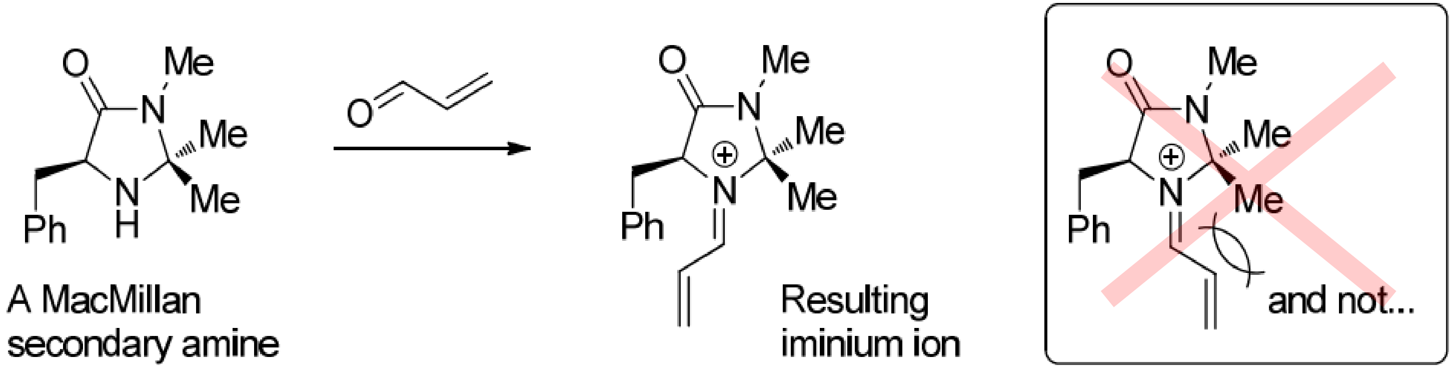
R groups need to be **equatorial** to be in a more energetically favourable state. As the R groups are next to eachother, one must be on the 'top' and one must be on the 'bottom', hence anti.

Give appropriate intermediates for the reaction to explain the product formed.

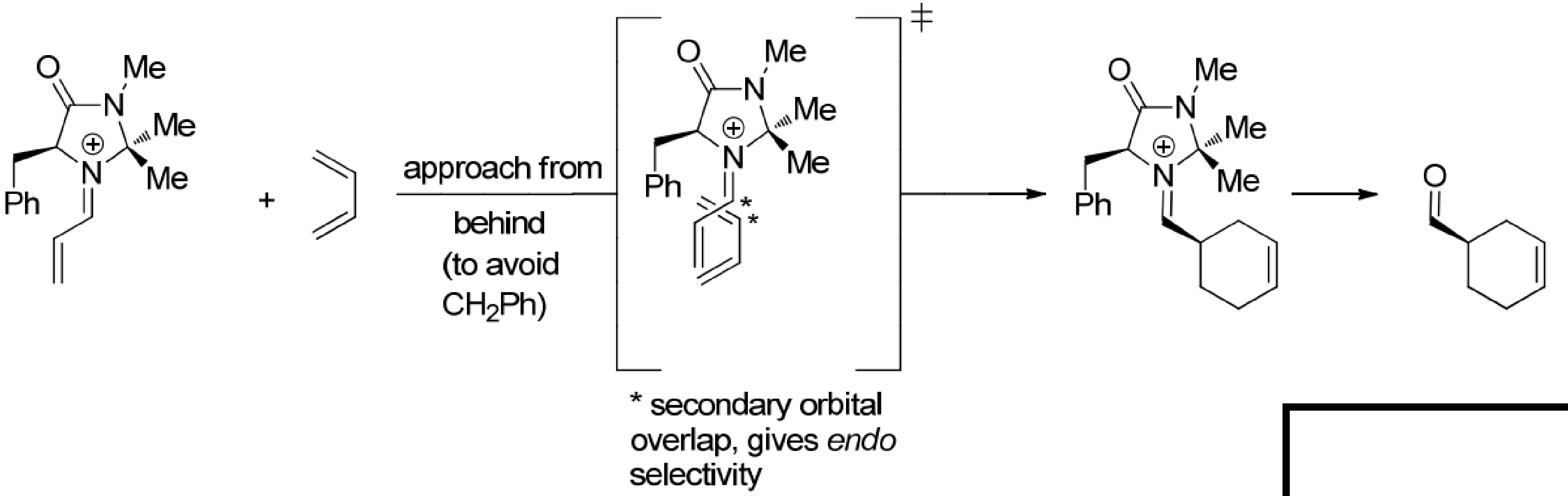


Show the structure of the transition state to explain all stereo chemical outcomes.

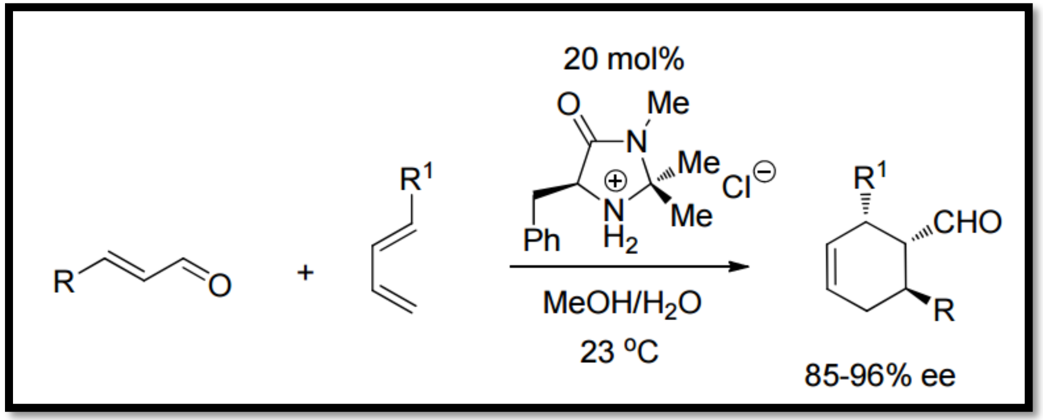
Give appropriate intermediates for the reaction to explain the product formed.



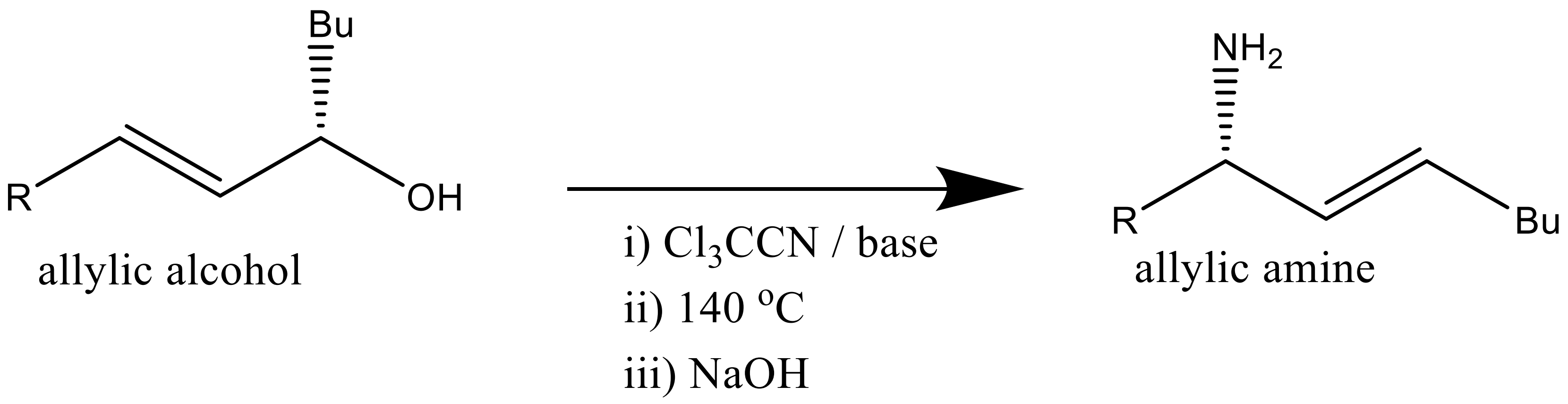
Vinyl iminium salt group moved away from methyl as clashes to greater extend than projected phenyl. Makes reaction STEREOSPECIFIC



Secondary orbital overlap in diels alder reaction persuades diene to overlap dienophile. STEREOSELEVIVE (Endo). Forced underneath due to projected phenyl group.



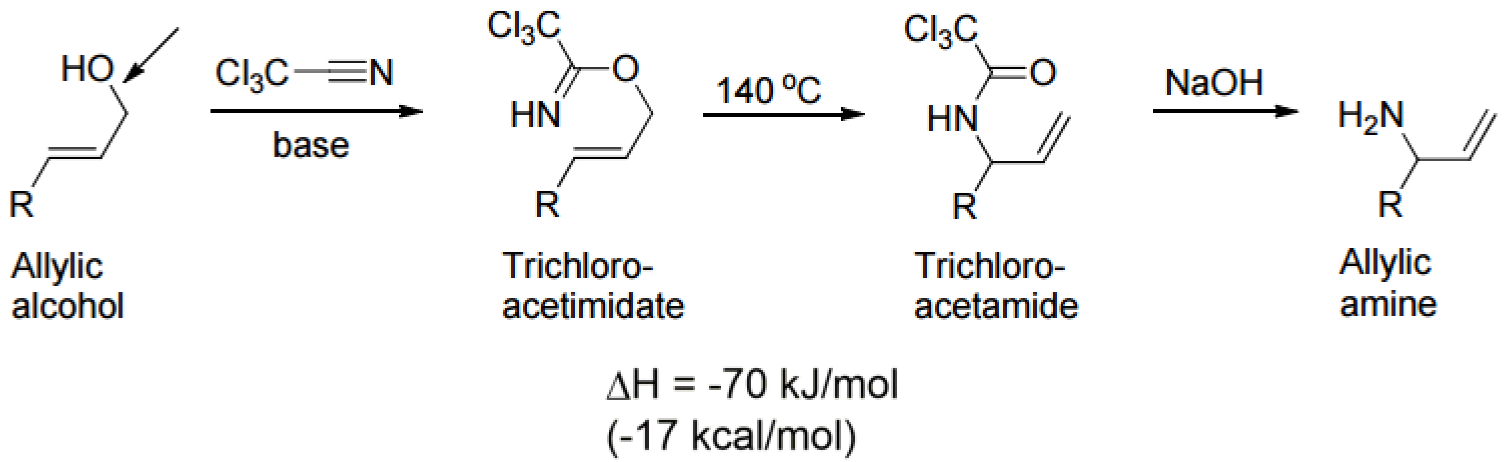
Give a plausible mechanism for the following reaction (Stereochemistry not important at this stage so you may get racemic product)



Give the mechanism for the same reaction but catalysed using $PdCl_2(PhCN)_2$. Show how the stereo chemistry of the product is dictated by palladium.
Normally palladium acts as a redox metal where reactions such as oxidative additions take place, however this is not the case here. So how does palladium catalyse the reaction?

Mechanism

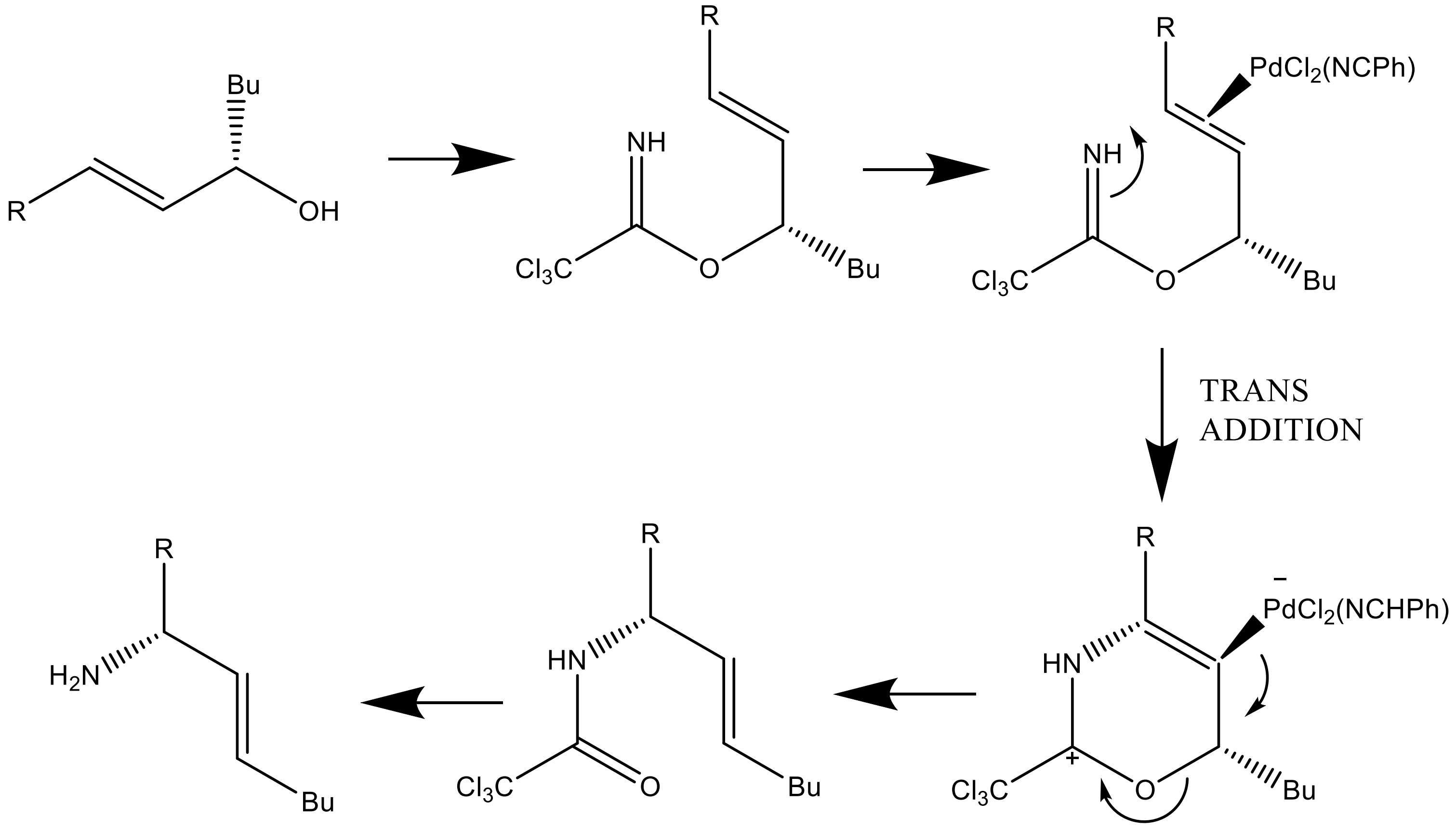
1) Alcohol deprotonated by base. Oxyanion attacks cyanide, nitrogen picks up proton to form first intermediate.
2) Concerted pericyclic reaction to form amide
3) Base catalysed hydrolysis of amide



Give the mechanism for the same reaction but catalysed using $PdCl_2(PhCN)_2$. Show how the stereo chemistry of the product is dictated by palladium.

Normally palladium acts as a redox metal where reactions such as oxidative additions take place, however this is not the case here. So how does palladium catalyse the reaction?

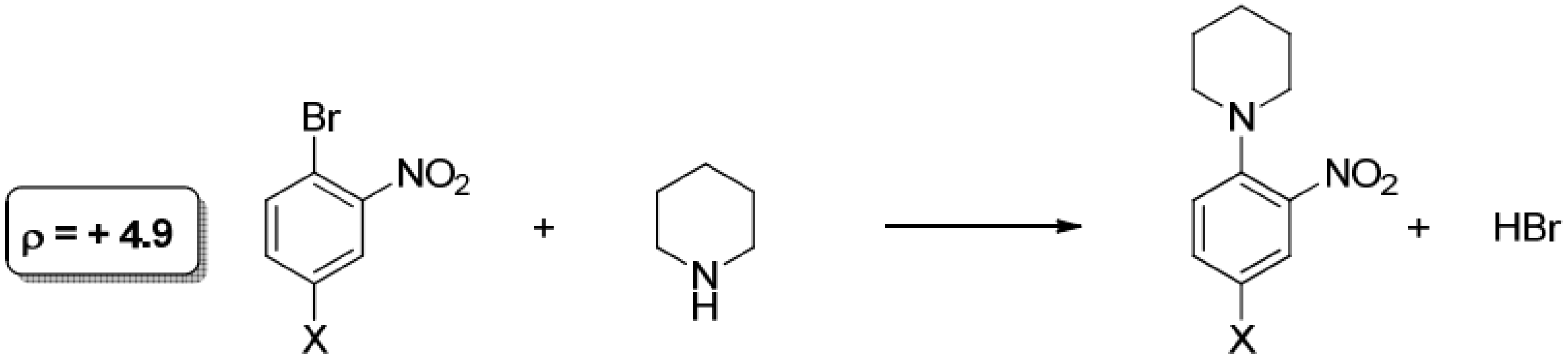
Palladium acts as a LEWIS ACID when it coordinates alkene side on (Pd loses a PhCN group)



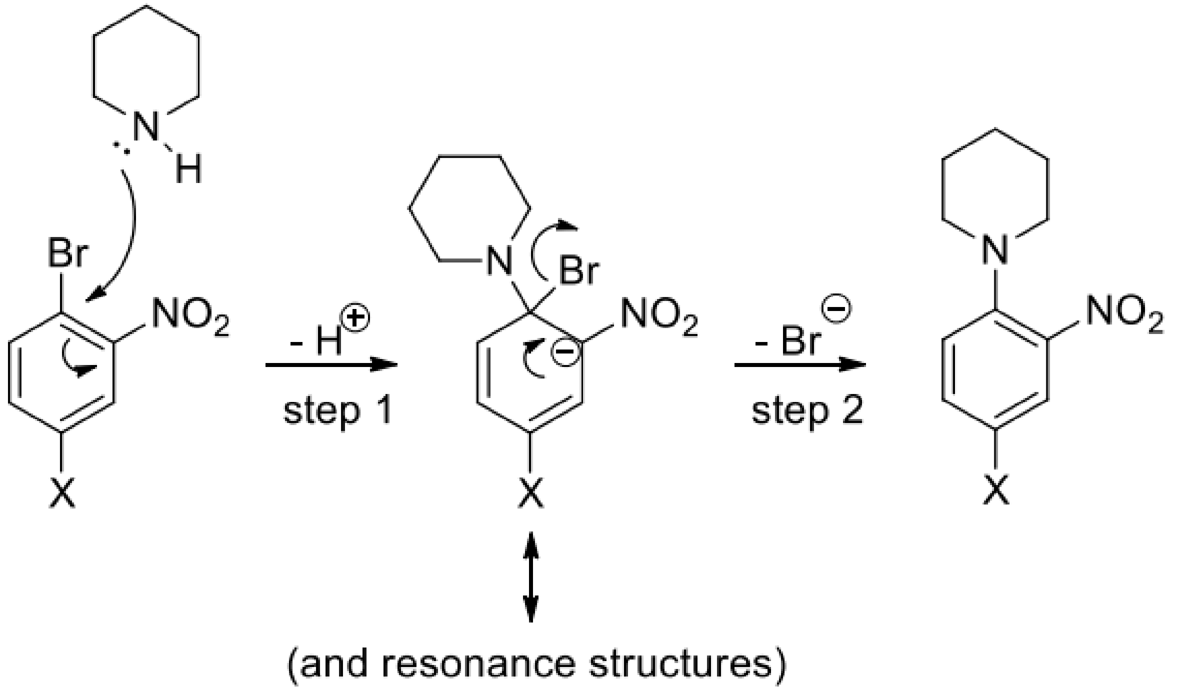
Butyl group pointing down means Pd coordinates up.

Trans addition means nucleophile attacking alkene comes in opposite direction to pd when it shifts away

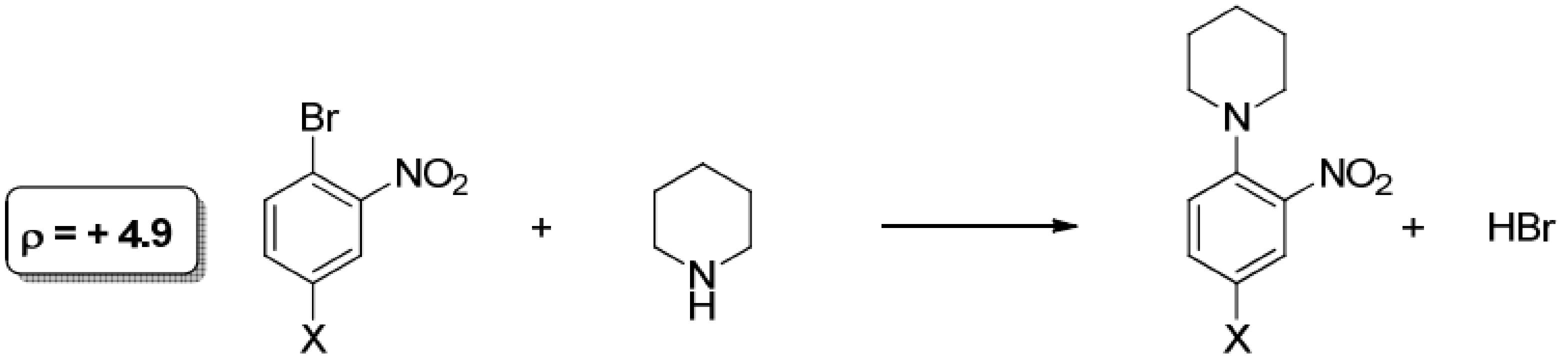
What is the rate determining steps in the following reaction? What kind of X group would increase rate of reaction (give one example)?



Mechanism



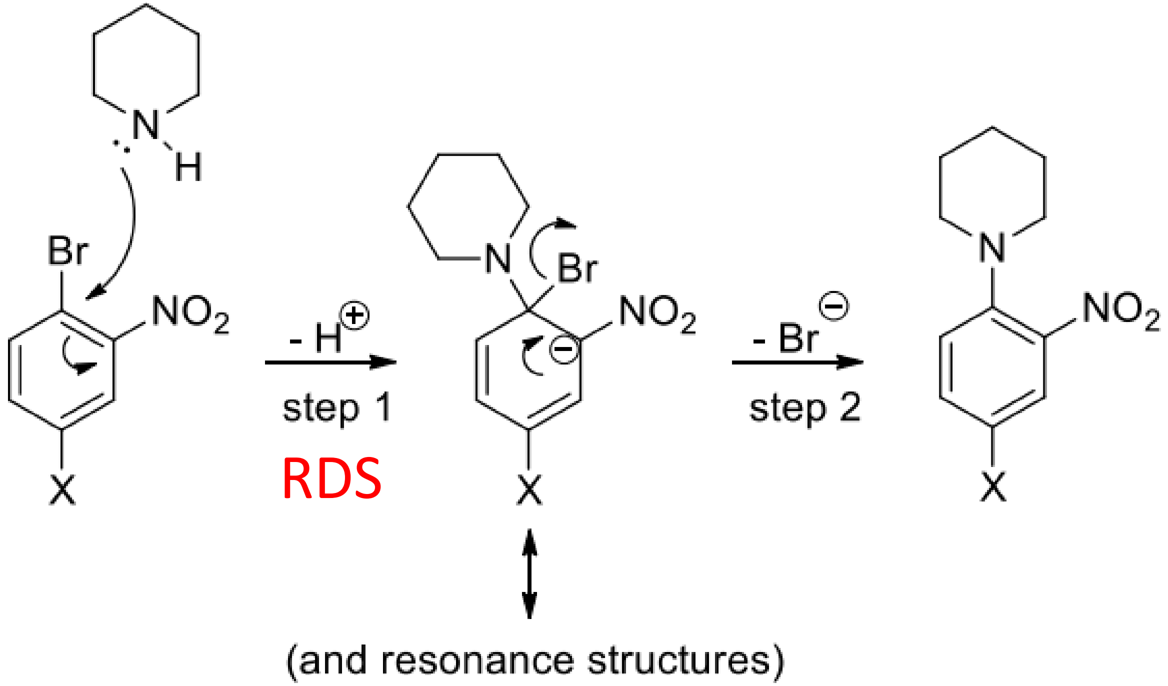
What is the rate determining steps in the following reaction? What kind of X group would increase rate of reaction (give one example)?



ρ is large positive.
Means at TS:

- +ve: extra electrons flow towards aromatic ring in TS
- large: electrons delocalised into ring so X affected more

Mechanism



Electron Withdrawing Groups (Cl, CO_2Et, CN, NO_2) would increase rate of reaction.

Below is a reaction.

$$A + B + C \rightarrow ABC$$

The reaction was found to be **first order in each A and B** and **zeroth order in C**. Reactants A and B are UV-Vis active and have different peak absorption wavelengths λ_{max}. As of yet there are no methods to directly measure the concentration of reactant C over time.

- Write out a rate equation for the formation of product
- Give a method to how you could prove that there is first order in each A and B?
- Give a method to how you could prove that there is zeroth order in C?
- What is the total order of the reaction?

Below is a reaction.

$$A + B + C \rightarrow ABC$$

The reaction was found to be **first order in each A and B** and **zeroth order in C**. Reactants A and B are UV-Vis active and have different peak absorption wavelengths λ_{max}. As of yet there are no methods to directly measure the concentration of reactant C over time.

- Write out a rate equation for the formation of product

$d[ABC]/dt = k_{obs} [A]^1 [B]^1 [C]^0$

- Give a method to how you could prove that there is first order in each A and B?

Plot $\ln[Abs']_{\lambda max}$ vs t for each reactant. A straight line would show first order

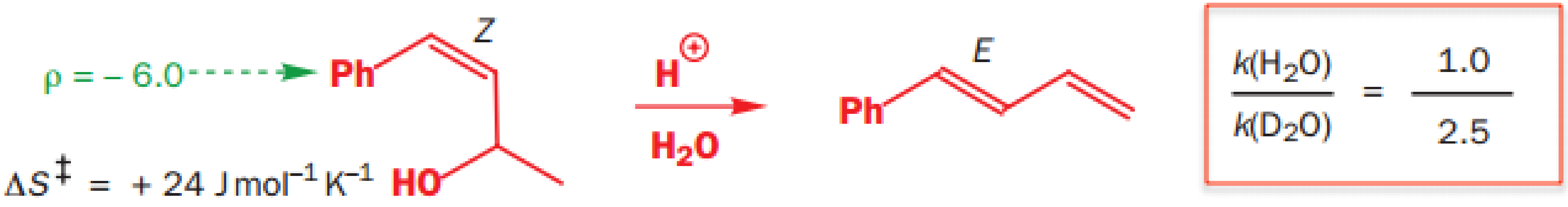
- Give a method to how you could prove that there is zeroth order in C?

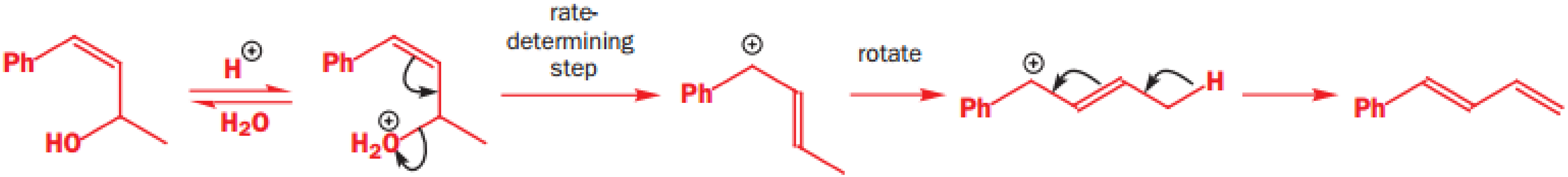
Cant measure directly so measure change in rate of either reactant A or B using absorbance with various concentrations of C. Should see no change in rate wtr change in concentration

- What is the total order of the reaction?

$1 + 1 + 0 = 2^{nd}$ order

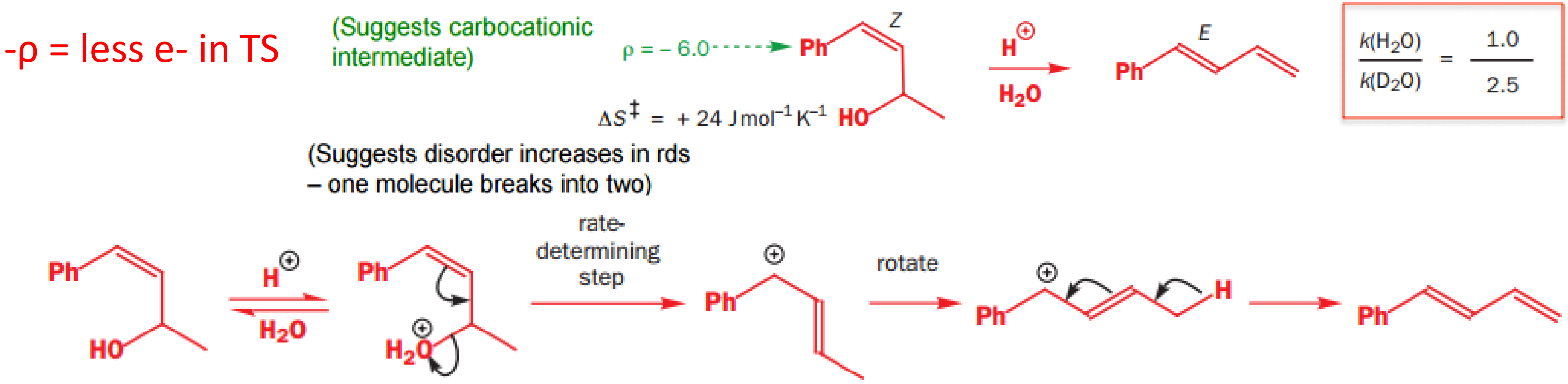
Would the following reaction be an example of (specific / general) (acid / base) catalysis, or even no effect at all? Explain why.





How does the values of ρ and $\Delta S^{\ddagger}$ conform with the proposed mechanism

Would the following reaction be an example of (specific / general) (acid / base) catalysis, or even no effect at all? Explain why. How does the values of ρ and $\Delta S^{\ddagger}$ conform with the proposed mechanism



Specific Acid Catalysis

- Affect of treatment with acid – therefore acid catalysis
- Specific because proton not transferred in RDS (otherwise general)
- Specific acid catalysis to do with solvent isotope effect. D_3O^+ is better solvated in D_2O (wtr to H_3O^+ in H_2O) and therefore has a faster rate.