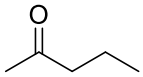
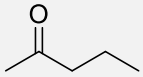
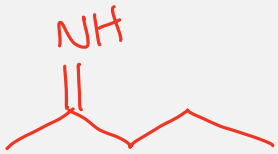
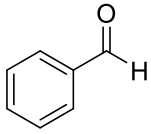
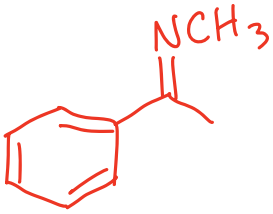
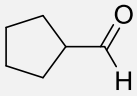
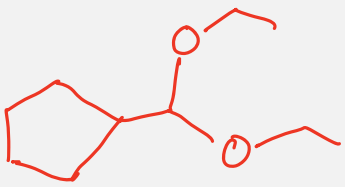
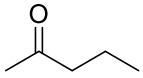
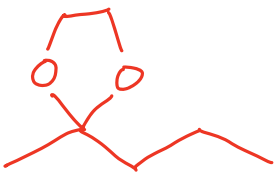
Chapter 19 Homework – Addition to Polar pi Bonds

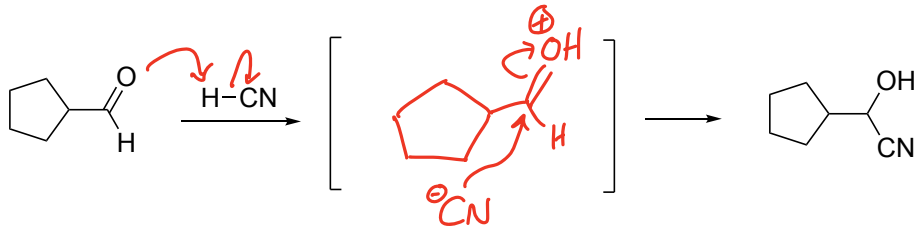
19A. NUCLEOPHILIC ADDITION REACTIONS with weak sauce nucleophiles

	Starting Material	Reagents *& translation*	Draw the Product
1		**HCN** *hydrogen cyanide*	
2		**NH_3**, H^+ ***Ammonia*** *under acidic conditions*	
3		**H_2NCH_3**, H^+ ***Methylamine*** *with acid catalyst*	
4		**CH_3CH_2OH,** H^+ *excess* ***ethanol*** *under* ***acidic*** *conditions*	
5		**$HOCH_2CH_2OH$**, H^+ ***1,2-ethanediol*** *under acidic conditions*	

19B. ACIDIC NUCLEOPHILIC ADDITION MECHANISMS

- Draw the arrow-pushing mechanism for each reaction, including all charged intermediates and product.

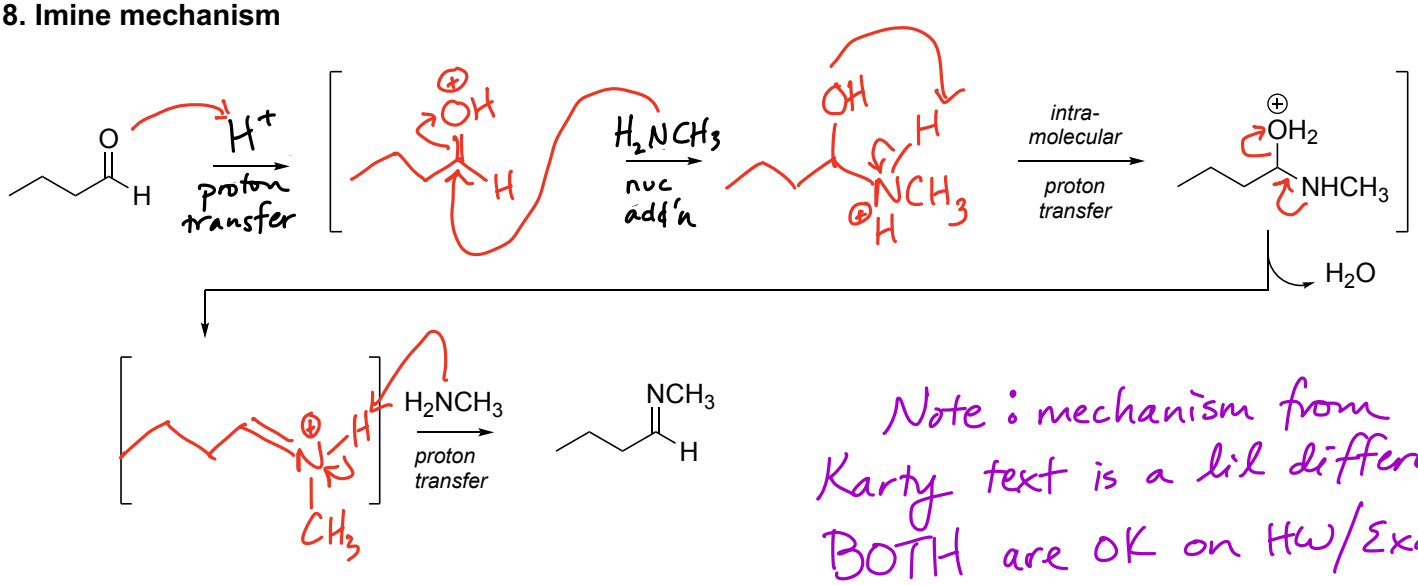
7. Cyanohydrin formation



19C. NUCLEOPHILIC ADDITION & DEHYDRATION MECHANISMS

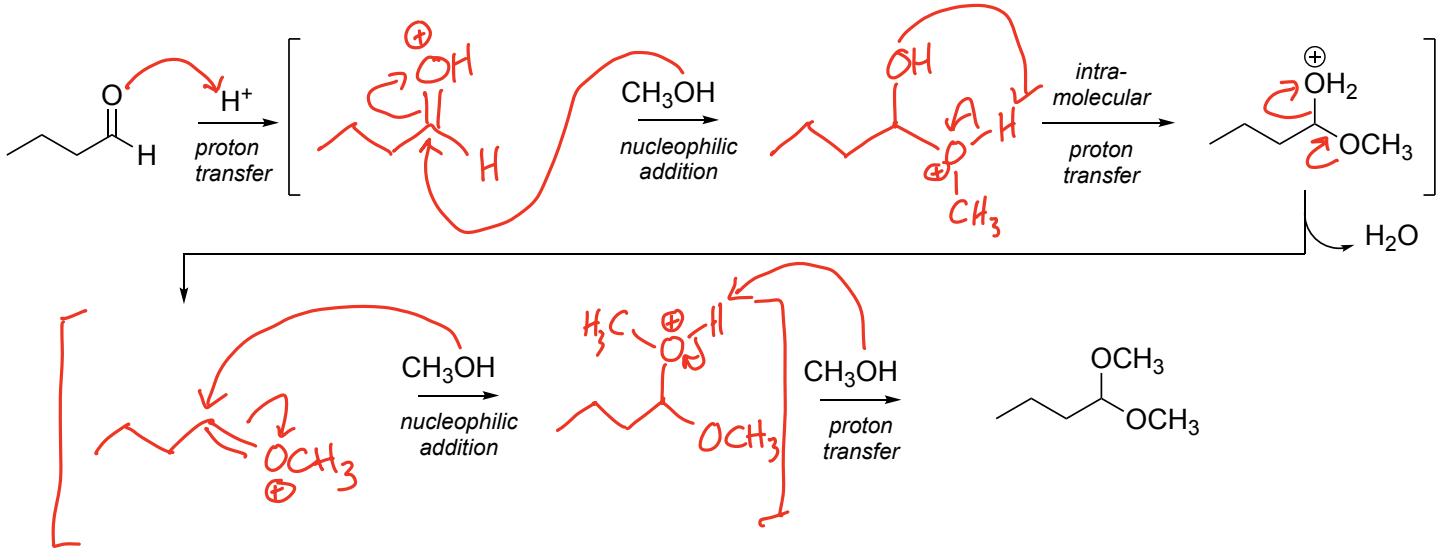
- Draw the arrow-pushing mechanism for each reaction, including all charged intermediates and product.

8. Imine mechanism

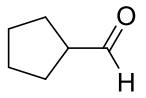
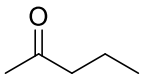
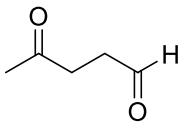
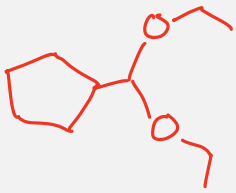
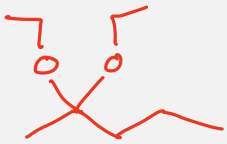
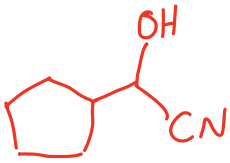
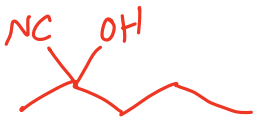
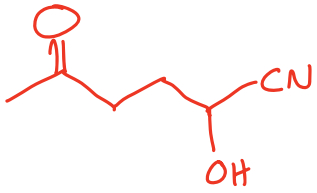
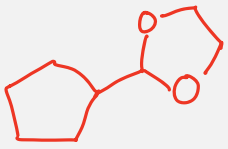
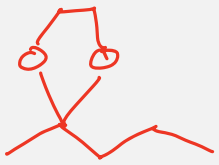
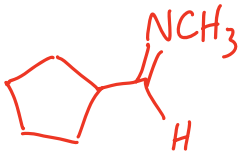
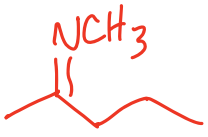
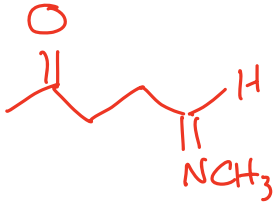
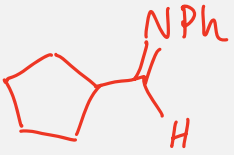
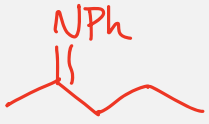
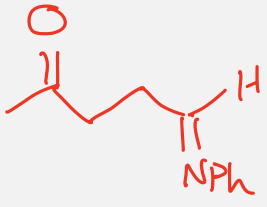


Note: mechanism from Karty text is a lil different. BOTH are OK on HW/Exams

9. Acetal Mechanism



19D. Mix & Match with Reaction Bootcamp!

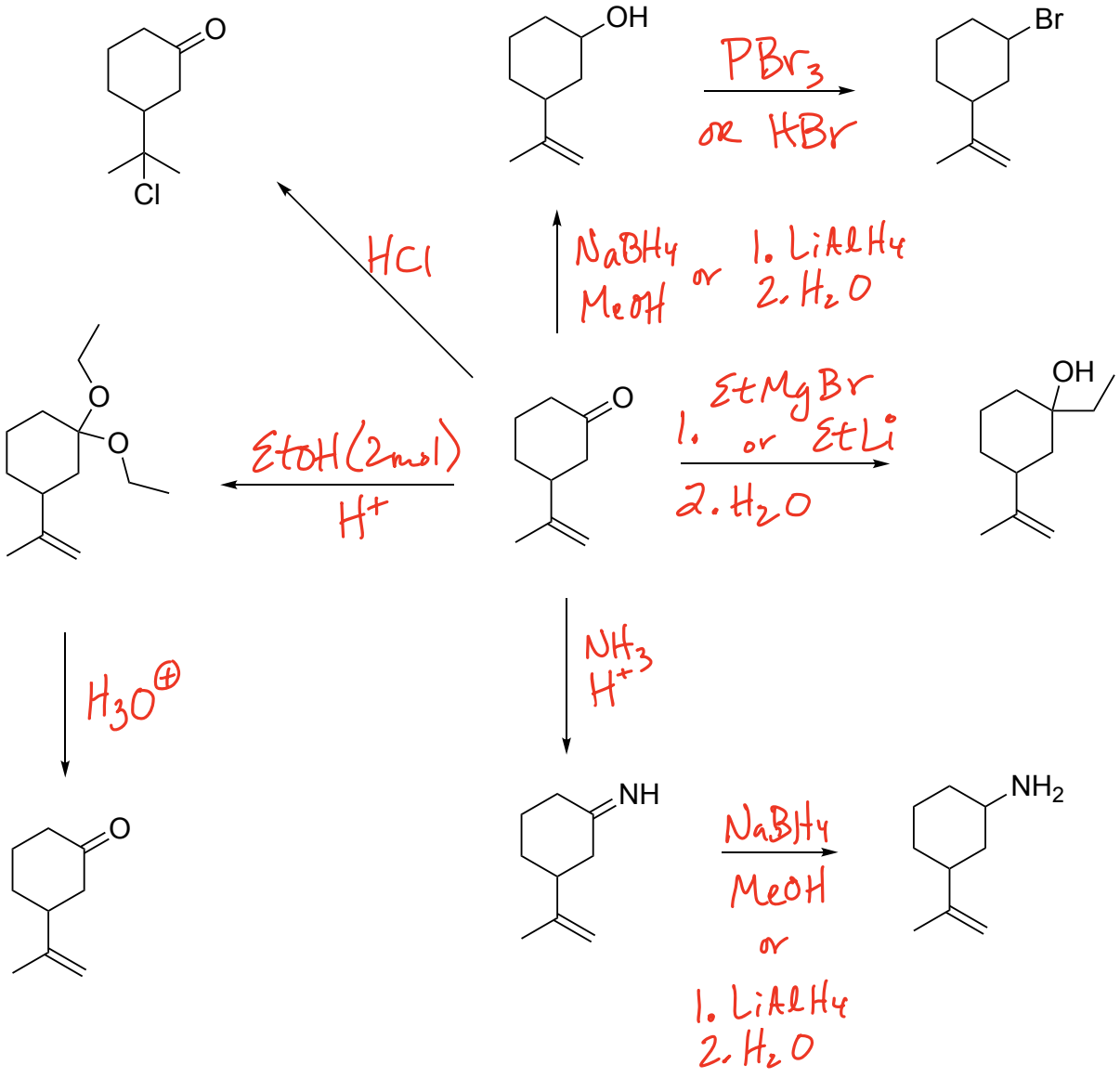
React each **aldehyde or ketone** with each **reagent** and **<u>draw the product</u>** in the box.			
CH_3CH_2OH (2 mol), H^+			
HCN			
$HOCH_2CH_2OH$, H^+			
H_2NCH_3, H^+			
$PhNH_2$, H^+			

19E. Reaction Puzzle - "training wheels" for multi-step synthesis

The "puzzle" below covers Chapter 19 and previous reactions. Take it one step at a time.

Add all missing reagents to the arrows.

- Hydride and organometallic addition reactions require a separate, second step for addition of water.
- Be sure to add those numbers for separate steps (1…. 2….) where applicable for full credit.



19F. Chemoselective Reaction Puzzles - "training wheels" for multi-step synthesis

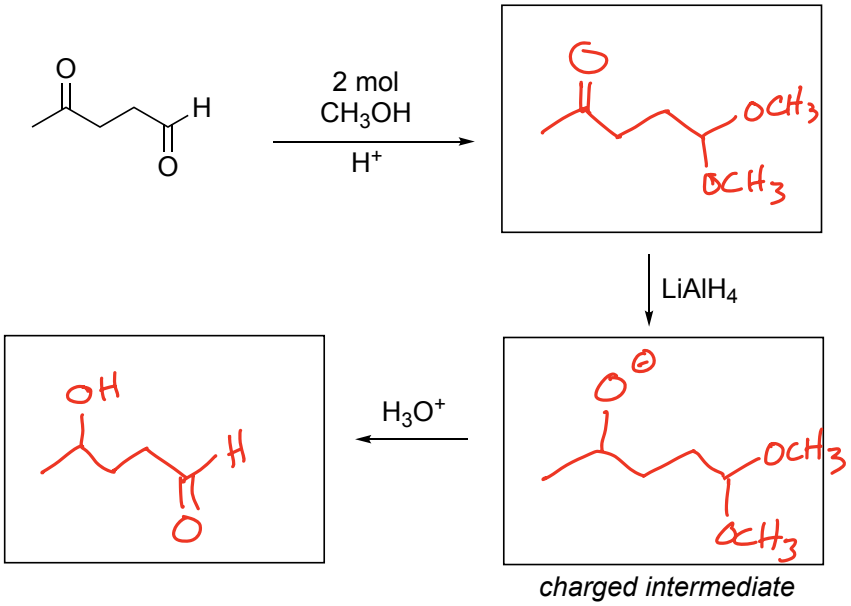
Aldehydes are more reactive than ketones, but what if you want the ketone to react instead?

1. The aldehyde is reacted with alcohol to form an acetal "protecting group",
2. then the desired addition reaction takes place on the ketone,
3. and finally the acetal is removed (hydrolyzed) to reveal the original aldehyde.

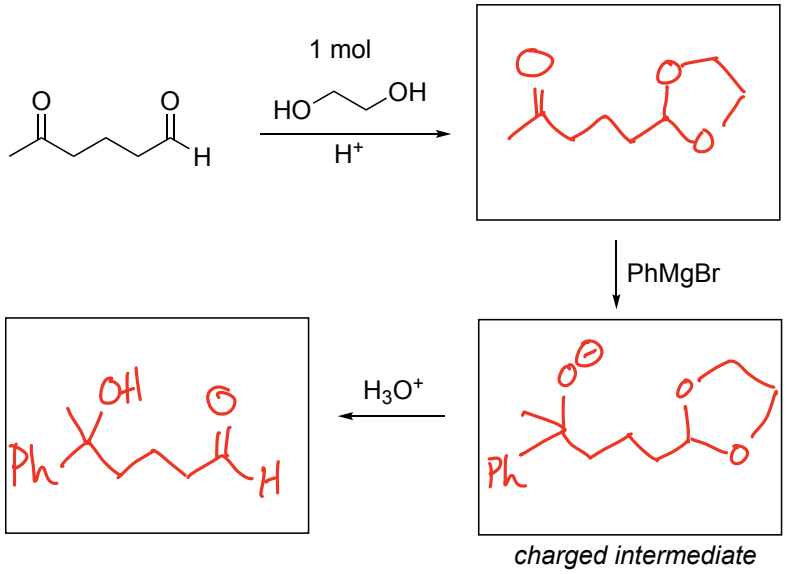
Cool, right?!

Draw the missing products of each reaction in the boxes.

11. Chemoselective reduction



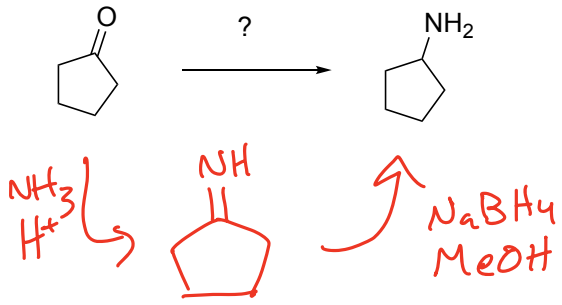
12. Chemoselective organometallic addition



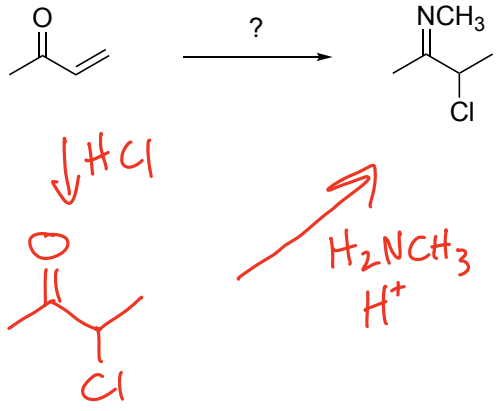
19F. Multi-Step Synthesis

- Each transformation requires **at least two synthetic steps** to reach the target product.
  - These problems were designed to use no more than three reactions.
  - There are multiple pathways and it's ok if you use a feasible pathway with more than three steps ☺
- Show each set of **reagents and reaction products** on the journey.
  - Mechanisms are not required, but may be helpful.
- If there is a mixture of products (ex. *major* and *minor*), assume the minor product can be removed.
  - You can just draw the desired *major* product.

13. Ketone to amine



14. Conjugated ketone to alpha-chloro-imine



15. Chemoselective organometallic addition – see "training wheels" on pg 5