



PennState

Engaging STEM Students Online: Insights from the CHEM Classroom

Kate Masters, Ph.D.

est. 2001

Teaching Professor of Chemistry

better taught



better trained



better opportunities



better coached



I want my students to
be **better** than me!

My Teaching Philosophy

My students inspire me with their feedback, which fuels my imagination and innovation! Positive, engaging, and challenging learning experiences are my main teaching objectives. It's a blast brainstorming and trying new teaching methods and assessments in my courses!

OICHEM Classrooms

LECTURES: SYNCHRONOUS

LABS: HYBRID

Active learning
worksheets,
Kahoot!

Zoom Help
Sessions

DQs, ShowOffs,
ShowCases

Virtual
Coach

CREATE
Method

Journal
Club

Grant
Reviews

NIH-Style
Grant
Proposal

Virtual
(Poster)
Presentations +
Peer Review

Lecture In-class sessions are held synchronously via Zoom. Students use the chat feature to answer and ask questions.

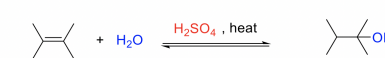
Active learning worksheets are designed to engage students in their learning and to train them to think like an expert.

- Answer the how and why via guiding questions
- Compare/contrast
- Sentence frames
- Discover trends
- Reflect and connect call-outs
- Relevant examples

Kahoot!

- Free app/website
- Fun alternative to clickers

D1. Here is an example of an **alkene hydration reaction**.



1. How is the reactant changing to form the product?

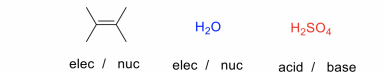
2. Identify the elec and nuc in the reactants.

3. In what category does this reaction fit?

4. What type of organic intermediate is allowed?

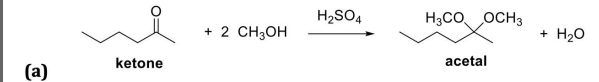
Answer question 1:

Considering **question 2**, identify the function of each reactant:



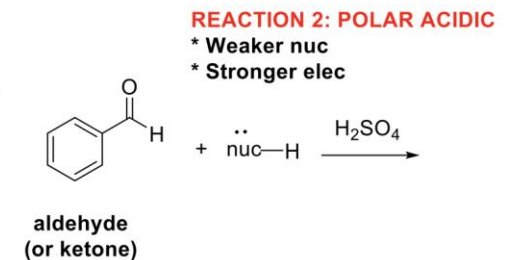
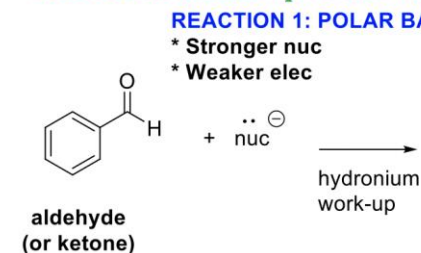
Based on your answer above, answer **question 3**: _____, which then answers **question 4**: _____.

A2. First, here are two examples of **polar acidic reactions** that we will investigate more deeply this semester.



- Overall, this reaction is an (addition / elimination / substitution) reaction.
- An **acetal** is a carbon with two _____ groups bonded to it. These two groups come from _____.

A4. Now a look at how **similar and different** the polar basic and polar acidic aldehyde reactions are!
***Fa21: show addition product. Keep generic. Go thru mechanism.**



1. How is the reactant changing to form the product?



2. Identify the elec and nuc in the reactants.

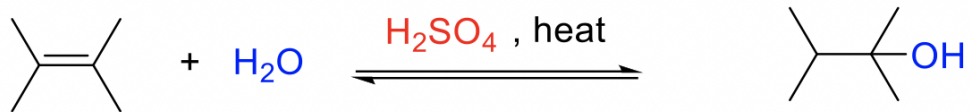


3. In what category does this reaction fit?



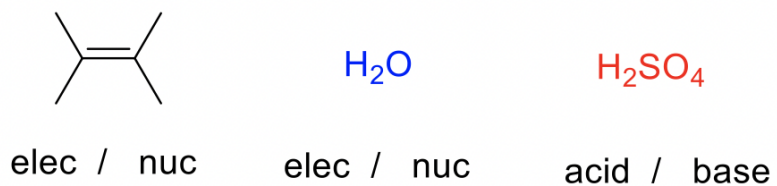
4. What type of organic intermediate is allowed?

D1. Here is an example of an **alkene hydration reaction**.



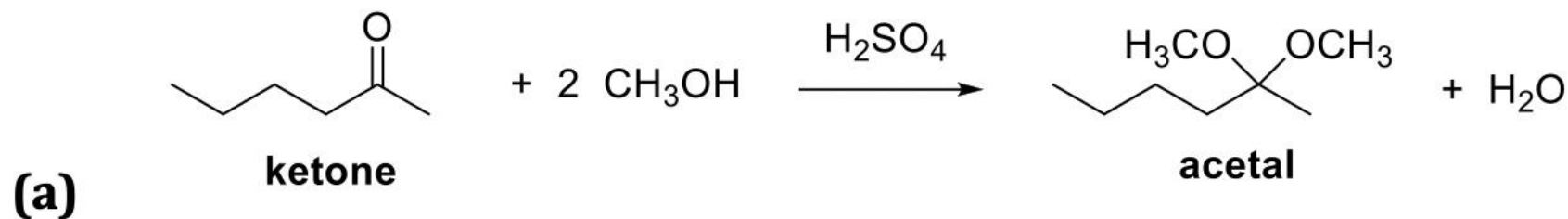
Answer question 1:

Considering **question 2**, identify the function of each reactant:



Based on your answer above, answer **question 3**: _____, which then answers **question 4**: _____.

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- Overall, this reaction is an (addition / elimination / substitution) reaction.
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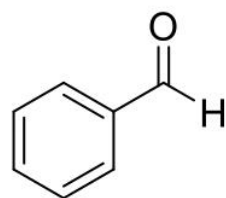
A4. Now a look at how **similar and different** the polar basic and polar acidic aldehyde reactions are!

***Fa21: show addition product. Keep generic. Go thru mechanism.**

REACTION 1: POLAR BASIC

* Stronger nuc

* Weaker elec



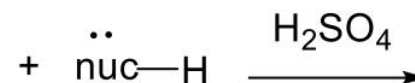
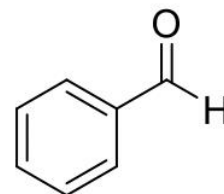
hydronium
work-up

aldehyde
(or ketone)

REACTION 2: POLAR ACIDIC

* Weaker nuc

* Stronger elec



aldehyde
(or ketone)

Questions for You!

- **What are your course's key concepts?** Start here and continue to "reflect and connect" back to them!
- **How do you make connections of concepts? Trends?** Organize the content in the same way – even if different than the textbook. Show them how to connect!
- **How do you solve problems? What questions do you ask yourself?** Ask your students these questions! Give them time in class to work through them!

My instructional team is a key part to student success! It consists of a TA, an army of LAs, and me.

Students can earn extra credit for attendance and participation at help sessions.

The Fall Zoom Help Session Schedule:

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
8 to 8:30 am	Katelyn: 9 to 11	Julia: 8 to 10		Hope: 8 to 10		Kristen: 8 to 10
8:30 to 9 am						
9 to 9:30 am						
9:30 to 10 am	Matt: 11 to 1	Reiley: 10 to 11	Kayla: 10 to 11	Reiley: 10 to 11	Mica: 9 to 11	
10 to 10:30 am						
10:30 to 11 am						
11 to 11:30 am	Ashley: 1 to 3		Emily: 11 to 12	Karleigh: 11 to 12	Emily: 11 to 12	
11:30 am to 12						
12 to 12:30 pm						
12:30 to 1 pm	Phil: 3 to 5	Maanasi: 12 to 1	Britney: 12 to 1		Britney: 12 to 1	
1 to 1:30 pm						
1:30 to 2 pm						
2 to 2:30 pm	Eris: 5:30 to 7:30	Jenna: 1 to 2	Max: 1 to 2			Taylor: 1 to 2
2:30 to 3 pm						
3 to 3:30 pm						
3:30 to 4 pm	Max: 8:30 to 10:30	Lauren: 2 to 3	Jenna: 2 to 3	Kayla: 1:30 to 2:30	Karleigh: 2 to 3	Lauren: 2 to 3
4 to 4:30 pm						
4:30 to 5 pm						
5 to 5:30 pm	Eris: 6 to 8	Savannah: 3 to 4		Maanasi: 2:30 to 3:30	Sheel: 3 to 4	
5:30 to 6 pm						
6 to 6:30 pm						
6:30 to 7 pm	Eris: 6 to 8	Dr. Masters: 4 to 5	Dr. Schmid: 4 to 5	Dr. Masters: 4 to 5	Dr. Schmid: 4 to 5	
7 to 7:30 pm						
7:30 to 8 pm						
8 to 8:30 pm	Eris: 6 to 8	Jess: 5 to 7	Savannah: 5 to 6	Sheel: 5 to 6		
8:30 to 9 pm						
9 to 9:30 pm						
9:30 to 10 pm	Eris: 6 to 8		Eris: 6 to 8	Mike: 6 to 8	Davy-Anna: 6 to 8	
10 to 10:30 pm						
10:30 to 11 pm						
11 to 11:30 pm	Eris: 6 to 8	Vivian: 8 to 9		Kate: 8 to 10	Vivian: 8 to 9	
11:30 to 12 pm						
12 to 12:30 pm						
12:30 to 1 pm	Eris: 6 to 8	Taylor: 9 to 10				
1 to 1:30 pm						
1:30 to 2 pm						
1:30 to 2 pm	Eris: 6 to 8		Paulina: 9 to 11			
2 to 2:30 pm						
2:30 to 3 pm						

Practice Sets: fluency + application

- Work-It-Out Worksheets
- LA Sets
- Jeopardy!
- Reaction Roulette

All lecture assessments are given asynchronously and allow the use of class notes and the class textbook.

Daily Questions (DQs):

- Canvas quiz
- 2 questions on last and that day's lectures
- Timed at 15 minutes
- One attempt
- Assigned almost every lecture day

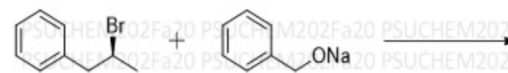
ShowOffs:

- Canvas quiz
- One upload question
- Canvas questions (mc, t/f, etc.)
- Timed at 90 min; one attempt
- **Virtual Coach**

Virtual Coach

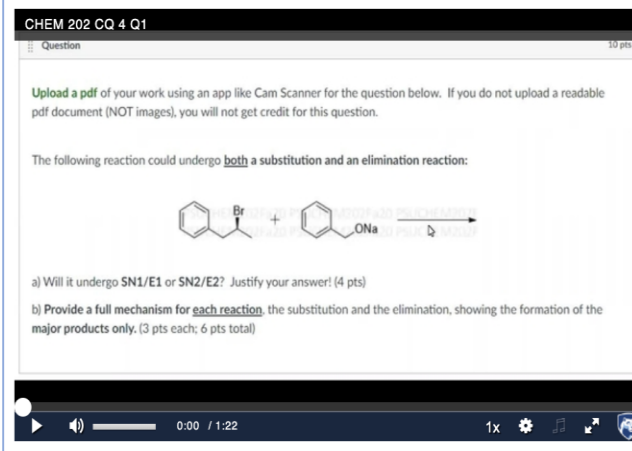
Upload a pdf of your work using an app like Cam Scanner for the question below. If you do not upload a readable pdf document (NOT images), you will not get credit for this question. Here's a [template](#) to use!

The following reaction could undergo both a substitution and an elimination reaction:



- a) Will it undergo SN1/E1 or SN2/E2? Justify your answer! (4 pts)
- b) Provide a full mechanism for each reaction, the substitution and the elimination, showing the formation of the major products only. (3 pts each; 6 pts total)

VIRTUAL COACH! Double click on the video to make it full screen!



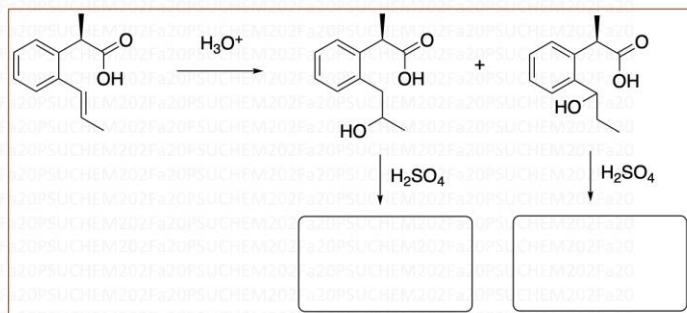
**Video is embedded
Kaltura media.**

ShowCases (case studies) are the main assessment. They may work with a partner.
Averages are similar to in-person exams.

FOCUS OF CASE STUDY 3: A Tale of Two Products!

In this **Tale of Two Products**, you will investigate a synthetic scheme:

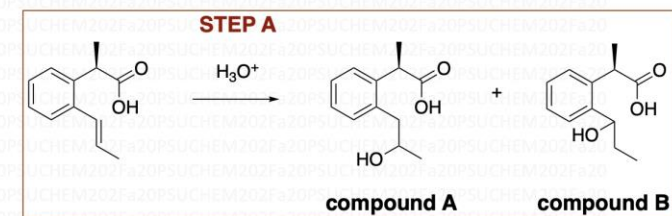
- To rationalize reaction outcomes
- To look for stereoisomer formation
- To predict specified reaction outcomes
- To evaluate structures, plus more!
- **You write the end of this tale!** 😊



Question 1: STEP A!

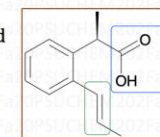
GOAL of Question 1: Determine if **compound A** or **compound B** is the major product of **STEP A**.

Let's start this tale by answering leading questions.



TALE QUESTIONS:

Q1(a). List the **two circled functional groups** in the reactant: _____ and _____ (2 pts)



Q1(b). Describe **what is changing** in the reactant to become compound A or compound B. (3 pts)

Q1(c). What is the **name** of this reaction (STEP A)? _____ (2 pts)

Q1(d). Draw out an example of this reaction from our class notes. Reference the page # of the worksheet file. (3 pts)

Organic CHEM Labs: Hybrid Asynchronous Assignments

CREATE:

Consider

Read

Elucidate the hypotheses

Analyze and interpret the data

Think of the next Experiment

<https://poorvucenter.yale.edu/teaching/ideas-teaching/teaching-journal-articles>

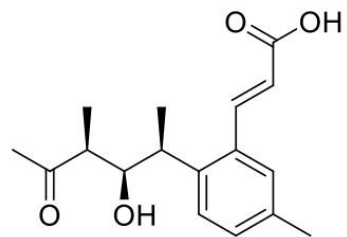
Journal Club

Student teams choose a reaction method or a research professor.

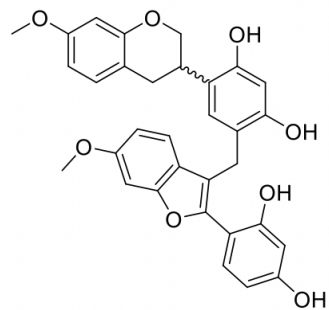
- 10 min presentation uploaded
- Peer reviews – learn new chem!
- Graded on content and fluency

Team Project

NIH-Style Grant Proposal



J. Nat. Prod. **2020**, 83, 1, 111-117



propolone B

Grant Reviews
of Former
Team Grants

Literature &
Database
Searching

Live Virtual
Team
Presentation

NIH-Style
Grant Proposal



Strategies for teaching chemistry online

Private group · 4.7K members



+ Invite

Thank you for this opportunity to share!

And a big shout-out to
my instructional team!

