
In-Lecture Guided Inquiry for Large Organic Chemistry Classes

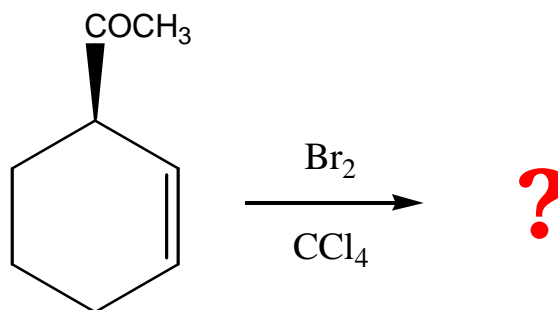
Dr. Angela L. Sauers
Dr. Richard W. Morrison

University of Georgia
April 28, 2007

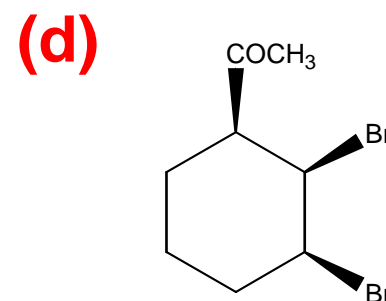
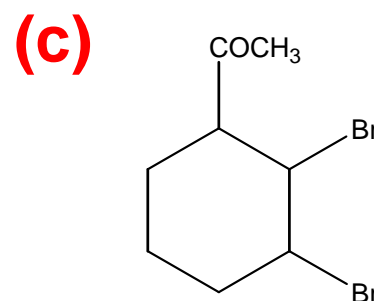
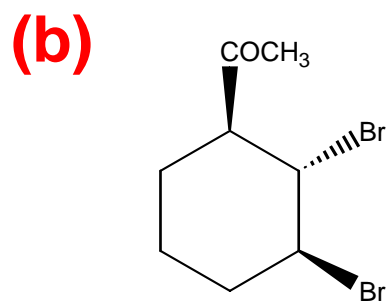
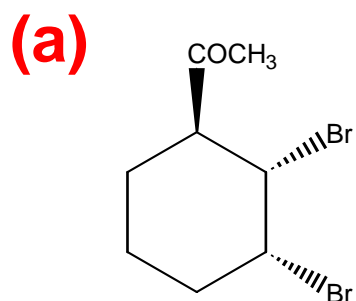


Example Concept Test

Traditional MCQ



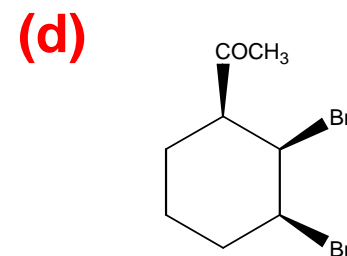
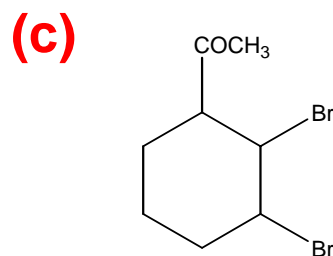
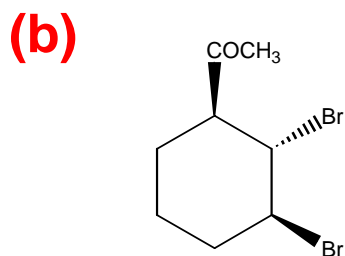
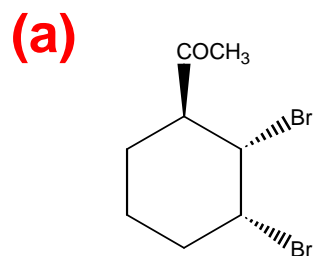
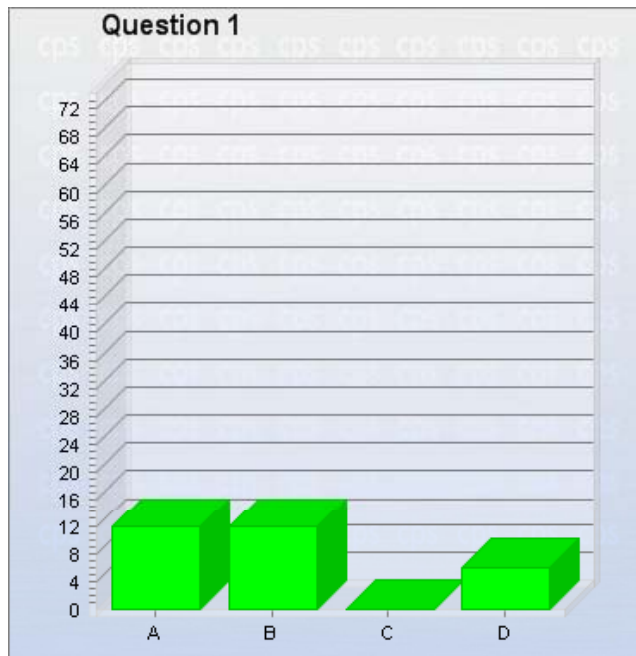
Q: Which of the following is the *major* product of the reaction shown?



Example Concept Test

Traditional MCQ

OUTPUT:



Multiple Choice Questions

Limitations as Assessment Tool

1. “Cueing Effect”[‡]
2. No distinction between correct answer and guess[†]
3. “All or nothing” evaluation[†]

[†] Denyer, G.; Hancock, D. *J. Chem. Ed.* **2002**, 79 (8), 961-964.

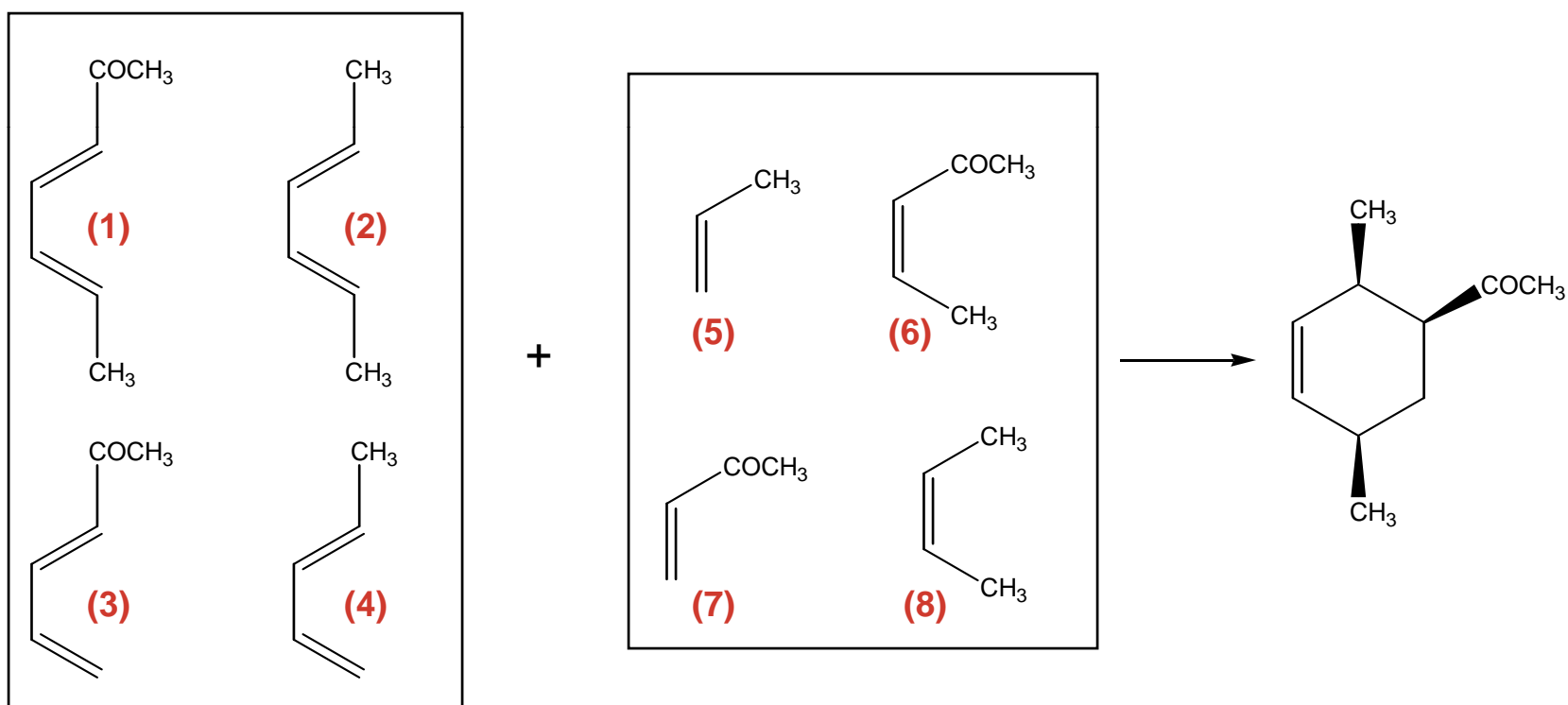
[‡] Schuwirth, L.W.T.; Van der Vleuten, C.P.M. *Medical Education* **2004**, 38, 974-979.



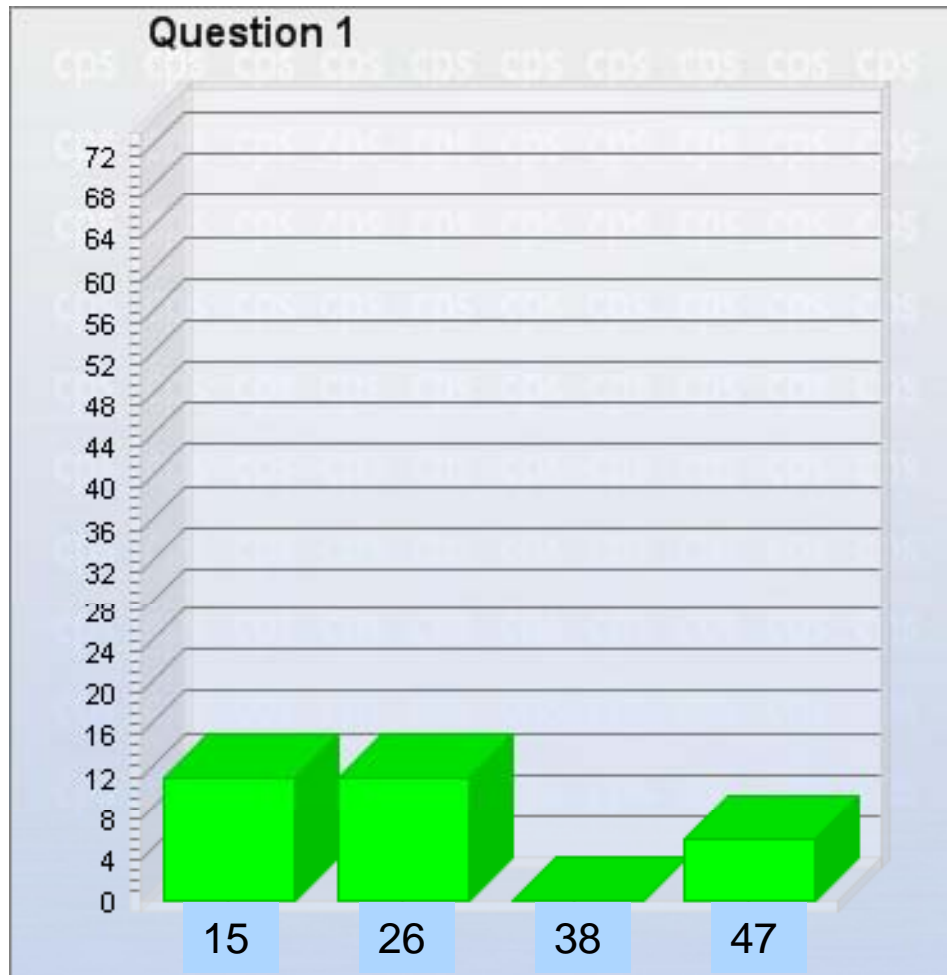
Example Concept Test

“Series Response” Single Concept Question

Q: Choose the diene and dienophile Diels Alder reaction partners that will form the product shown:



Question 1



Example Concept Test

“Series Response” Multiple Concept Question

Q: From the reagent pool shown, list the series of reagents (**in order**) that will yield the following transformation.

1. $\text{CrO}_3, \text{H}_3\text{O}^+$

4. H_2, Pt

7. $\text{CH}_3\text{CH}_2\text{MgBr}$

2. $\text{Mg}, \text{Et}_2\text{O}$

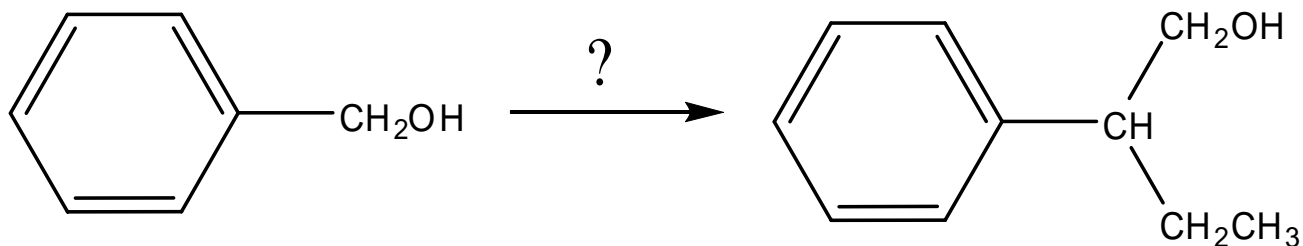
5. PBr_3

8. $\text{LiAlH}_4, \text{THF}$

3. H_2CO

6. $\text{PCC}, \text{CH}_2\text{Cl}_2$

9. H_3O^+



Example Concept Test

“Series Response” Multiple Concept Question

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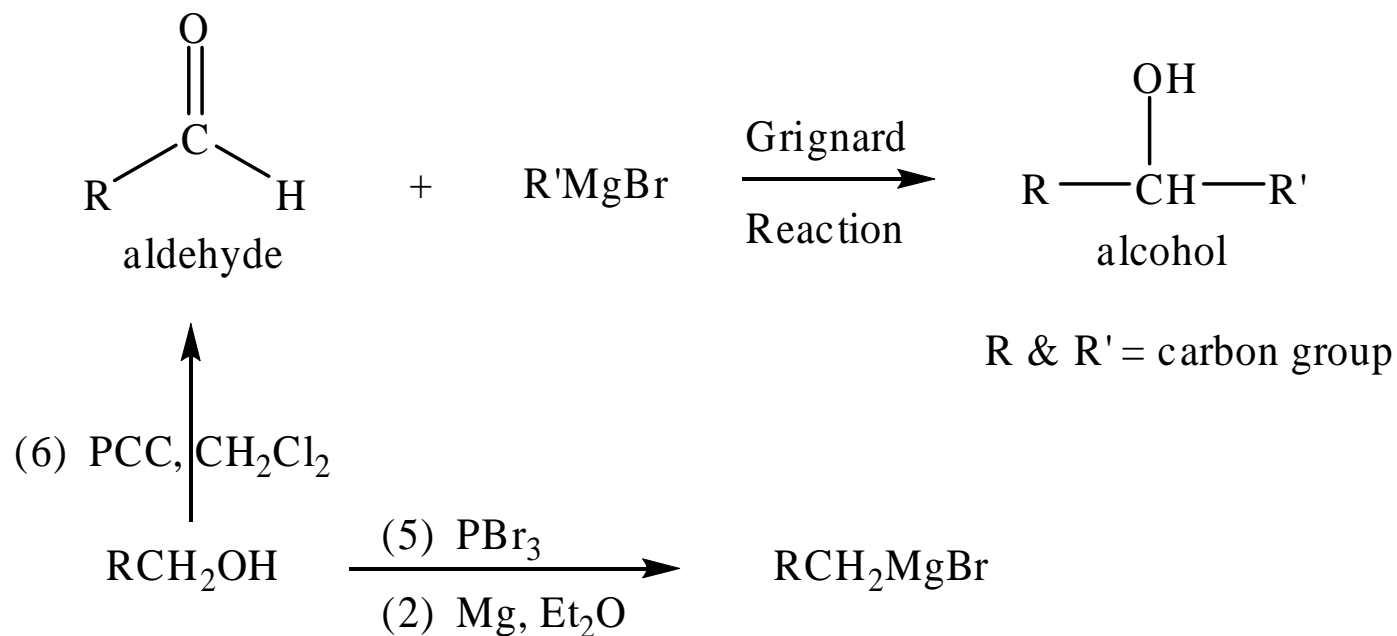
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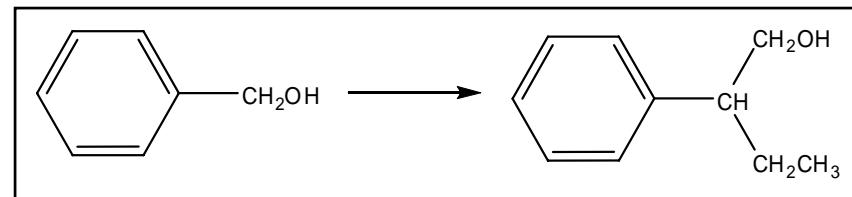
6. $\text{PCC}, \text{CH}_2\text{Cl}_2$

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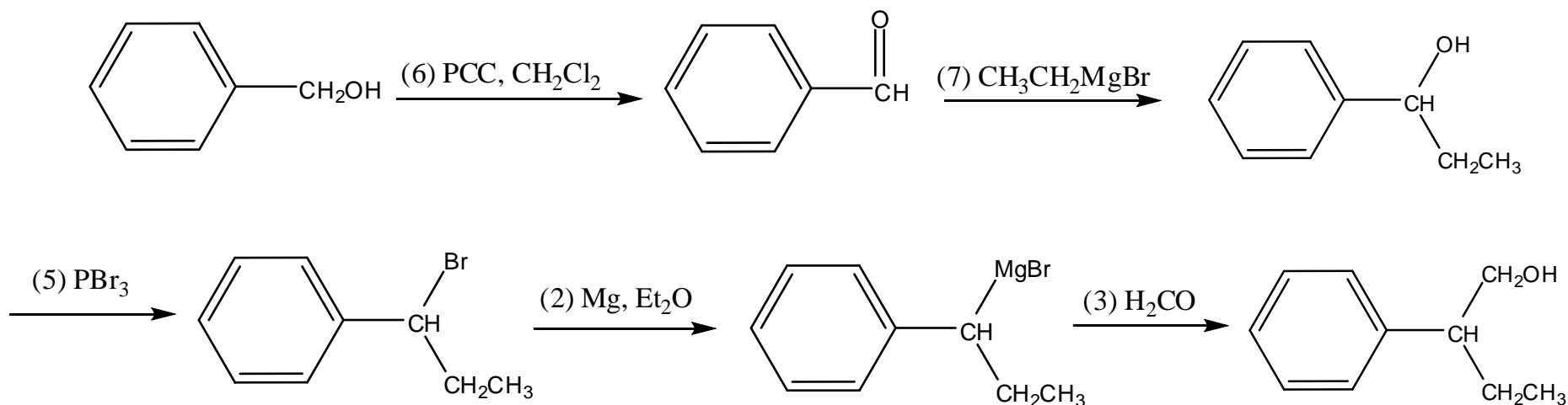


Example Concept Test

Answer: 6,7,5,2,3

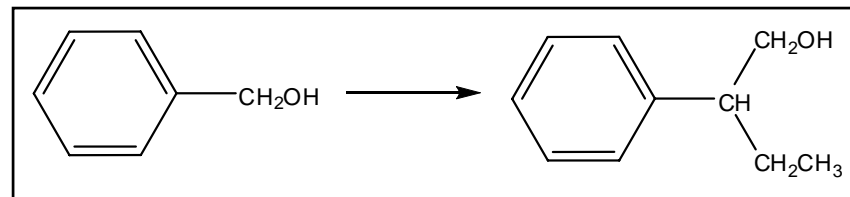


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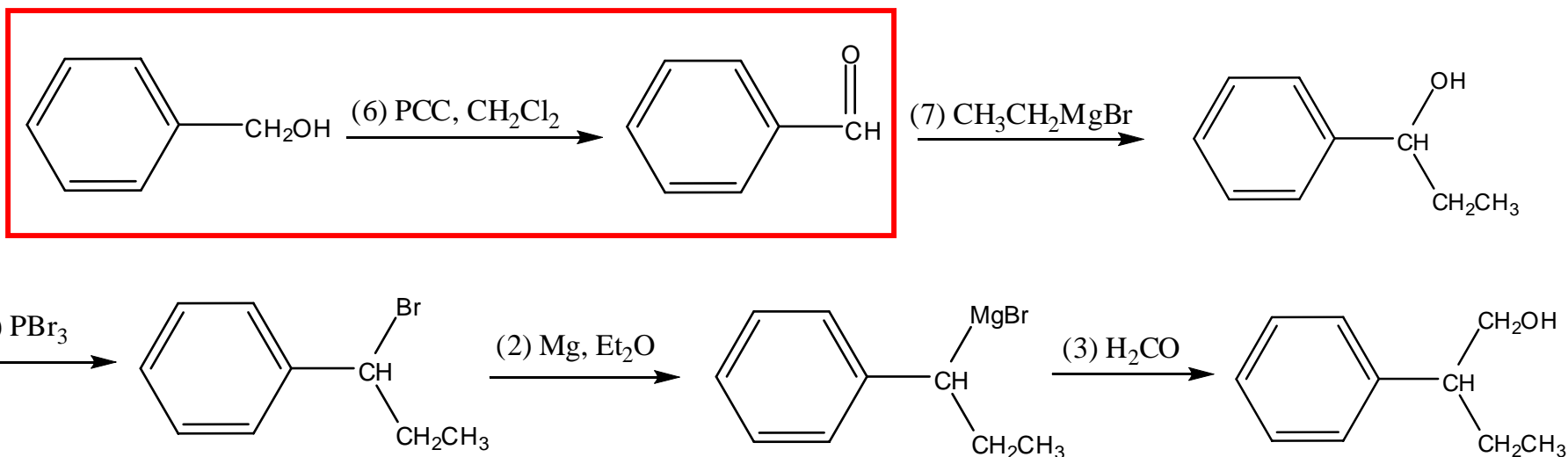


Example Concept Test

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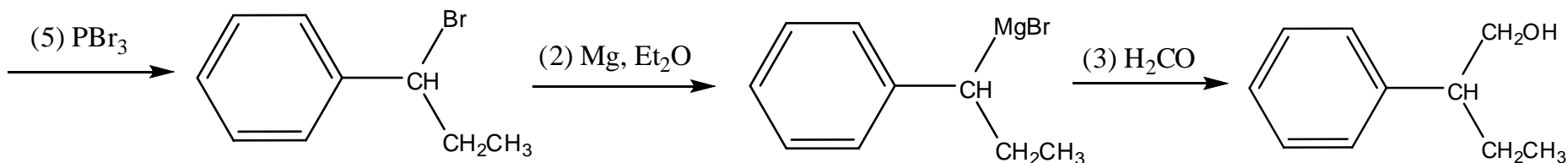
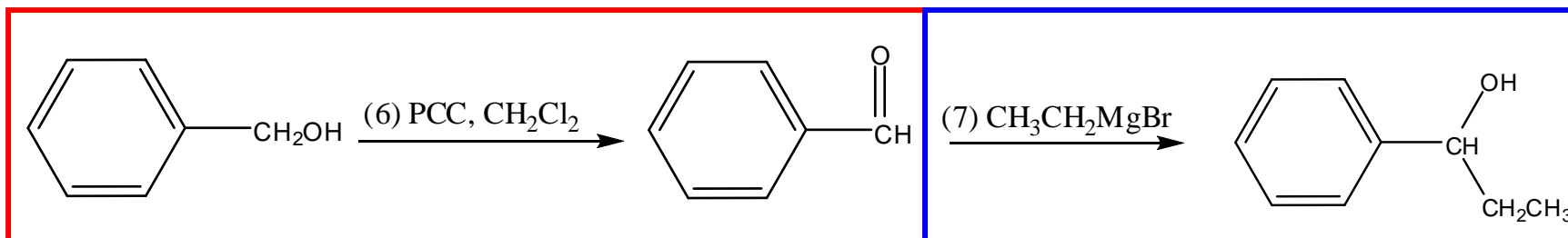
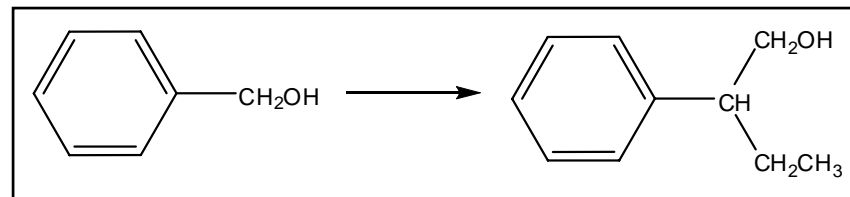
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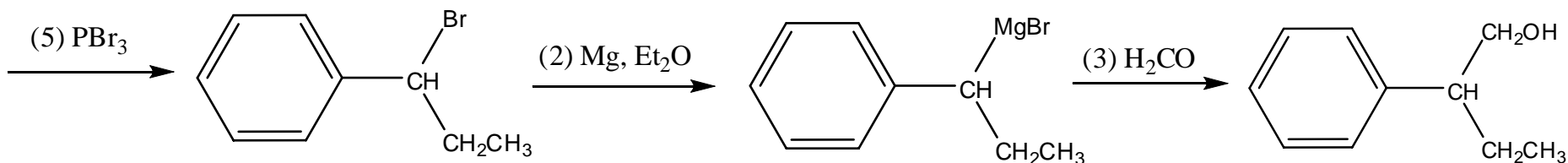
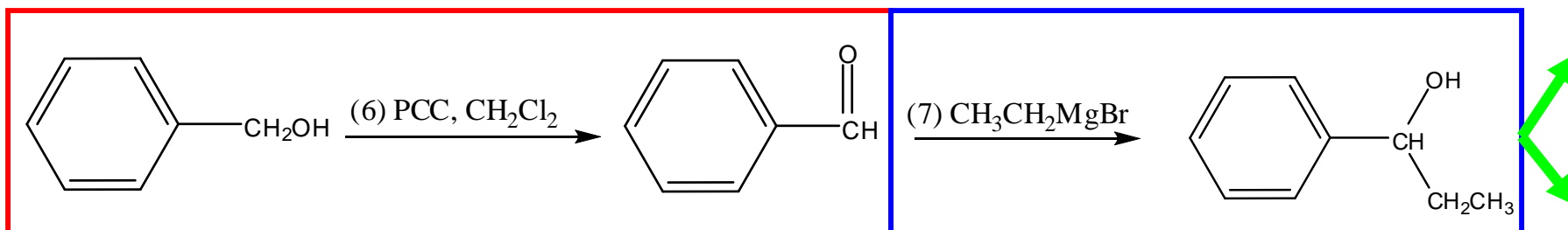
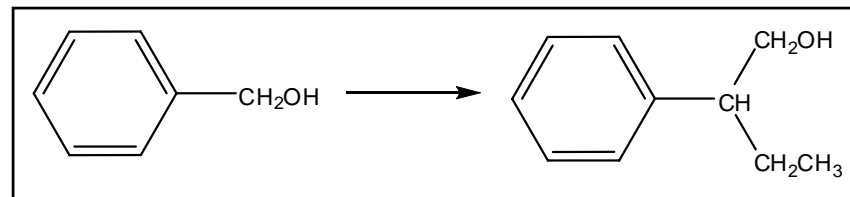
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4. H_2, Pt
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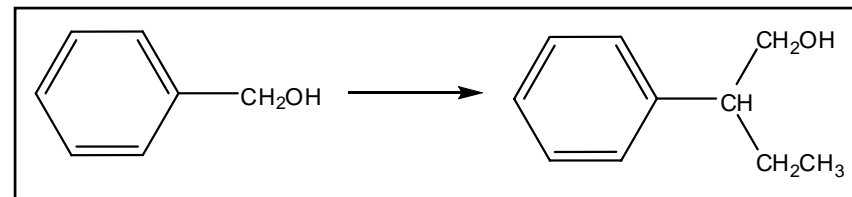


LOGIC BIFURCATION

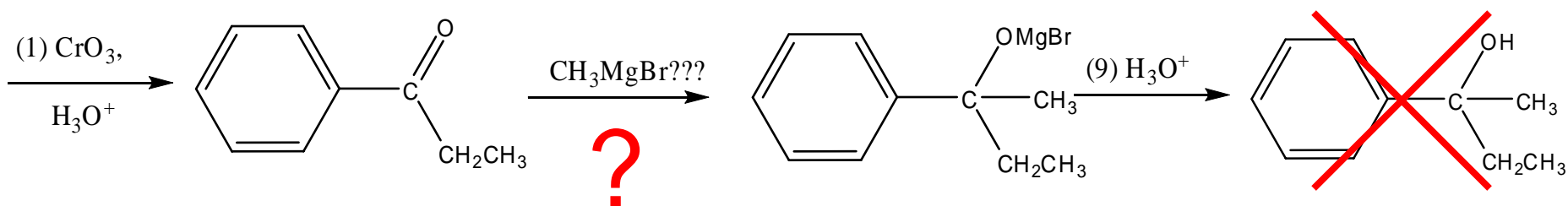
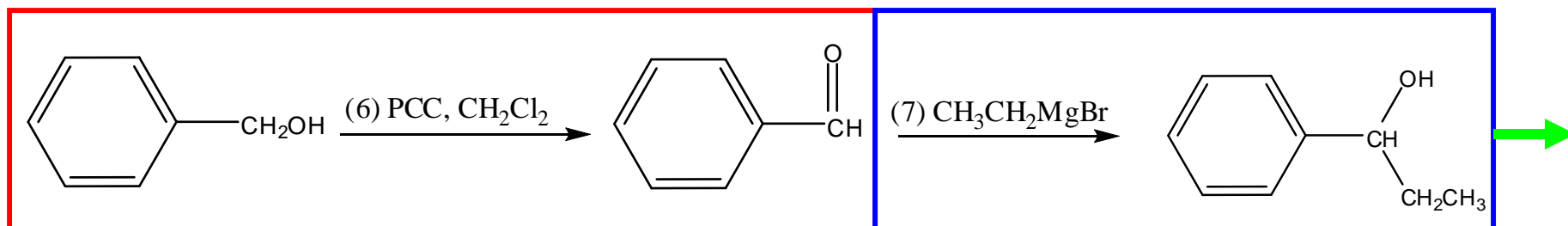


Example Concept Test

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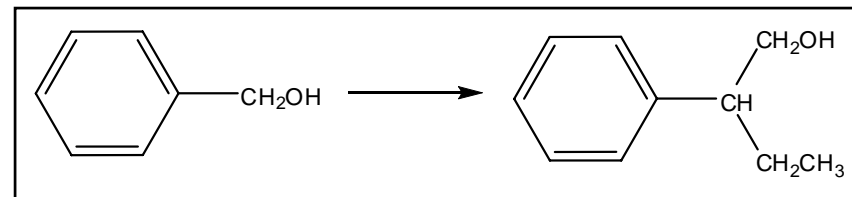


INCORRECT PATH

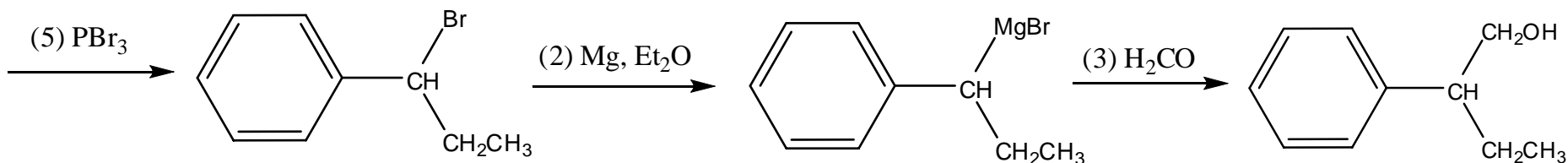
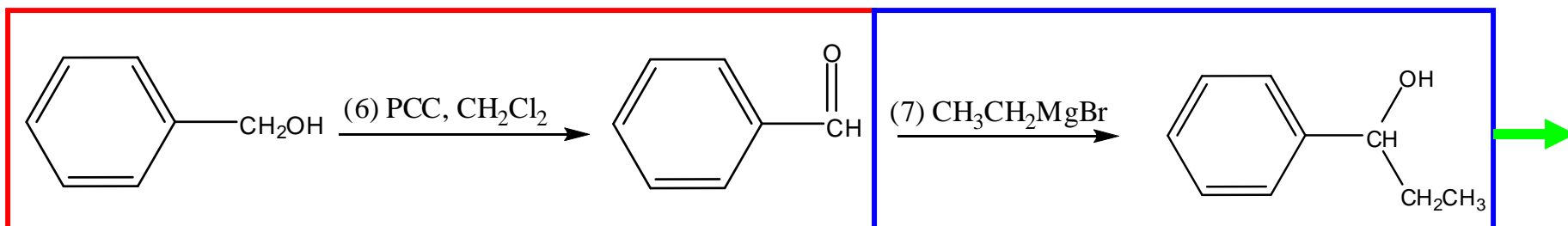


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CORRECT PATH



Conclusions

- *In-lecture* guided inquiry just as important as out-of-lecture (labs)!
- Where demonstrations not feasible (large class sizes, organic chemistry), **Class Response Systems** for guided inquiry
- **Guided**: beyond multiple choice for in-class concept tests (step-wise, “series-response” question format)



Acknowledgements

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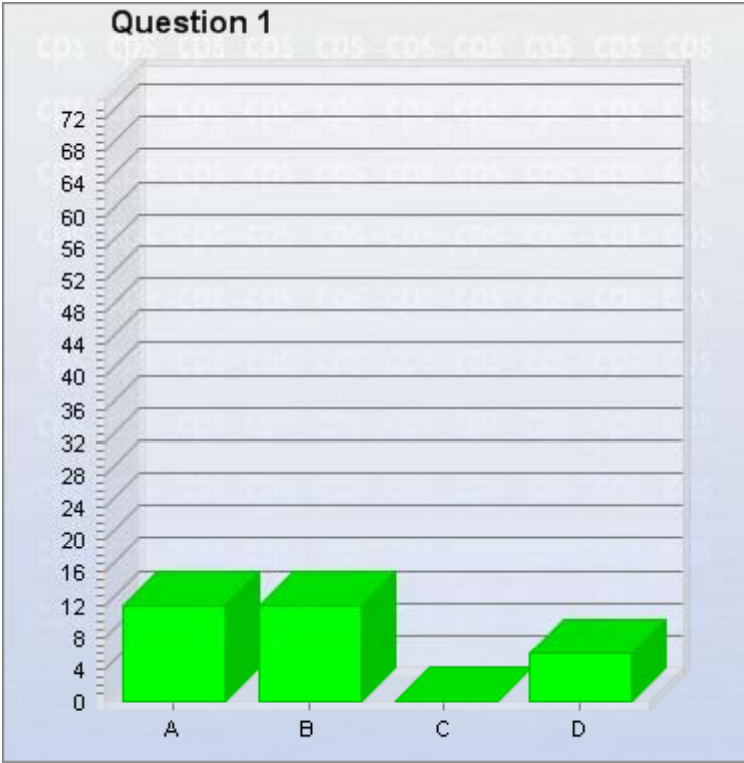


“Guided Inquiry”

NSES

- Scientific *inquiry*: “The diverse ways in which scientists **study** the natural world and **propose** explanations based on **evidence** derived from their work”
- Recognize questions that *guide* investigations
- Devise and perform investigations
- Create and revise rationale and paradigms using logic and evidence
- Identify and analyze alternative rationalizations and models
- Communicate and justify a scientific argument





Guided Inquiry: Implementation

In-Lecture

1. Demonstrations

- Cognitive dissonance, relevant examples (**Engage**)
- Dr. Kathryn Wagner, Princeton University
- Limitations: not feasible for large classes

2. Classroom Response Systems

- Interactive, problem-solving (**Engage**)
- Anonymity
- “Live” feedback
- **Guide: Beyond Multiple Choice**



†Mattox, A.C.; Reisner, B.A.; Rickey, D. *J. Chem. Ed.* **2006**, 83 (4), 622-624.

‡Mait Jones.



Guided Inquiry: Implementation

Out-of-Lecture

1. Laboratories

- Experiential Learning (**Engaged**)
- Step-wise investigation of a chemical principle (**Guided**)

2. “Lecture-less” Courses

- Problem-Solving (**Engaged**)
- Peer Discussion (**Guided**)



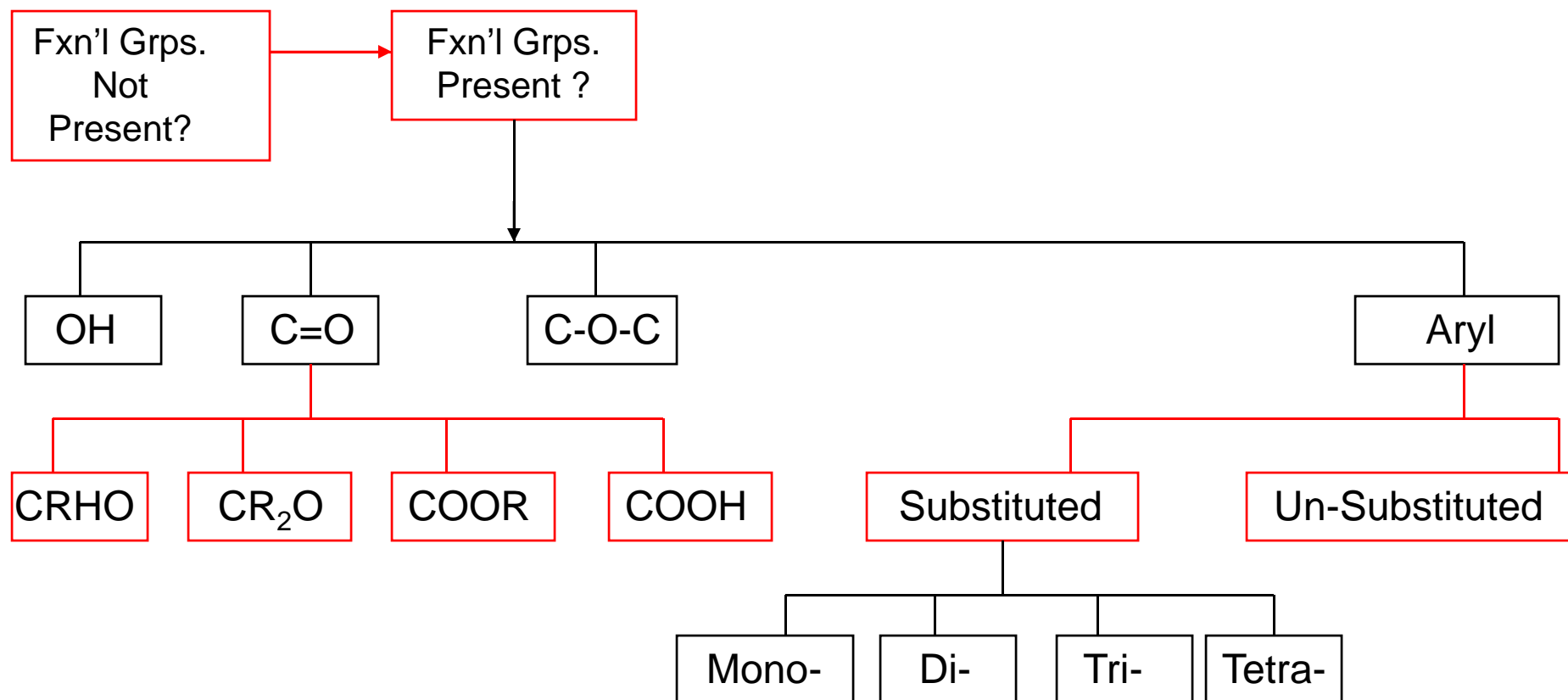
Example Concept Test

Guided Concept Question

- Ex. IR Spectroscopy
- “Decision Tree”
- **Guide** step-wise through problem-solving strategy (multiple questions in sequence)



“Decision Tree”



Example Concept Test

Guided Concept Question

Q1: The molecular formula of a compound is C_3H_6O . Based on the IR spectrum shown, which functional group(s) are **not** present in the molecule?

-OH

(1)

-C=O

(2)

-C-O-C

(3)

-CN

(4)

-NR₂

(5)

-Aryl

(6)



Example Concept Test

Guided Concept Question

Q2: The molecular formula of a compound is C_3H_6O . Based on the IR spectrum shown, which functional group(s) **are** present in the molecule?

-OH

(1)

-C=O

(2)

-C-O-C

(3)

-CN

(4)

-NR₂

(5)

-Aryl

(6)



Example Concept Test

Guided Concept Question

Q3: (If there was a carbonyl group present)

What type of carbonyl-containing functional group is in the molecule?

Aldehyde
(RCHO)

(1)

Ketone
(R₂CO)

(2)

Ester
(RCO₂R)

(3)

Carboxylic
Acid
(RCO₂H)

(4)

Amide
(RCONR₂)

(5)

