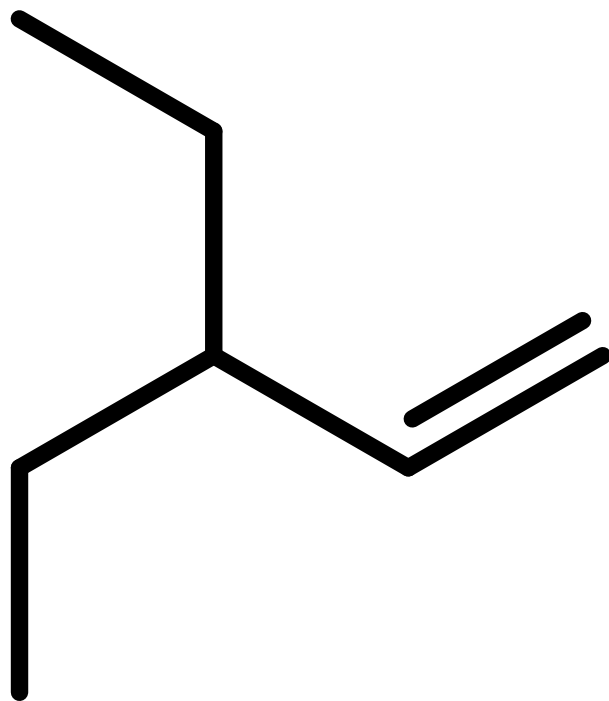
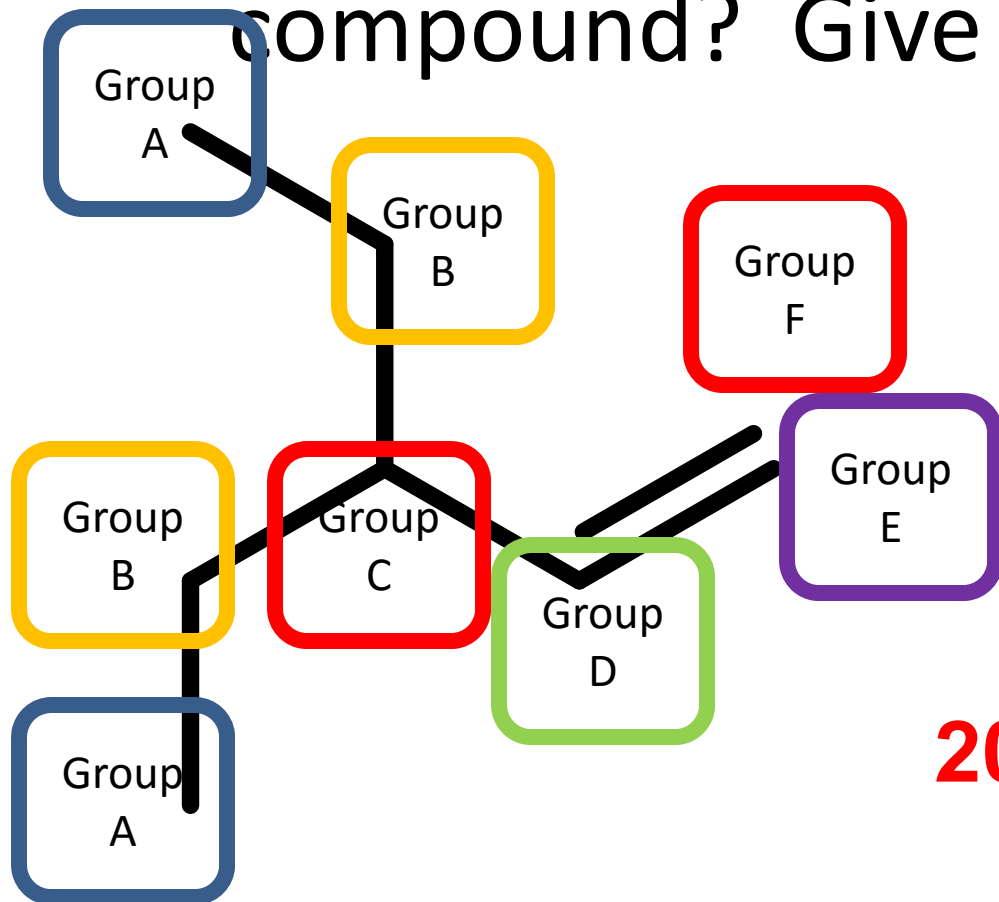


How many different groups of chemically equivalent hydrogen atoms are in the following compound? Give a number.



**2016-08-26 Q1**

How many different groups of chemically equivalent hydrogen atoms are in the following compound? Give a number.



**Answer = 6**

**2016-08-26 Q1**

# Order of Coverage (Exam 1)

	Homework Assignment	Due Date
1	B4-11-01 IR Functional Groups (wDeadline)	Tuesday, August 23
2	B7-14-02 Mass Spec - Molecular Ion (wDeadline)	Wednesday, August 24
3	B7-14-03 Mass Spec - Isotope Effects (wDeadline)	Thursday, August 25
4	B7-15-01 Number of Peaks 1H NMR Spectra (wDeadline)	Friday, August 26
5	B7-15-06 Number of Peaks 13C NMR (wDeadline)	Saturday, August 27
6	B7-15-02 Theoretical NMR Chemical Shift (wDeadline)	Sunday, August 28
7	B7-15-03 Theoretical NMR Integration (wDeadline)	Monday, August 29
8	B7-15-04 Theor. NMR Spin-Spin Splitting (wDeadline)	Tuesday, August 30
9	B7-15-05 NMR Spectroscopy Problems (wDeadline)	Wednesday, August 31
10	B7-15-07 13C NMR Structure ID (wDeadline)	Thursday, September 1
11	B7-13-01A Nomenclature Alkyl Halides (wDeadline)	Friday, September 2
12	B7-13-01B Alkyl Halide Nomenclature (wDeadline)	Saturday, September 3
13	B7-13-02A Halogenation of Alkanes (wDeadline)	Sunday, September 4
14	B7-13-02B Halogenation of Alkanes (wDeadline)	Monday, September 5

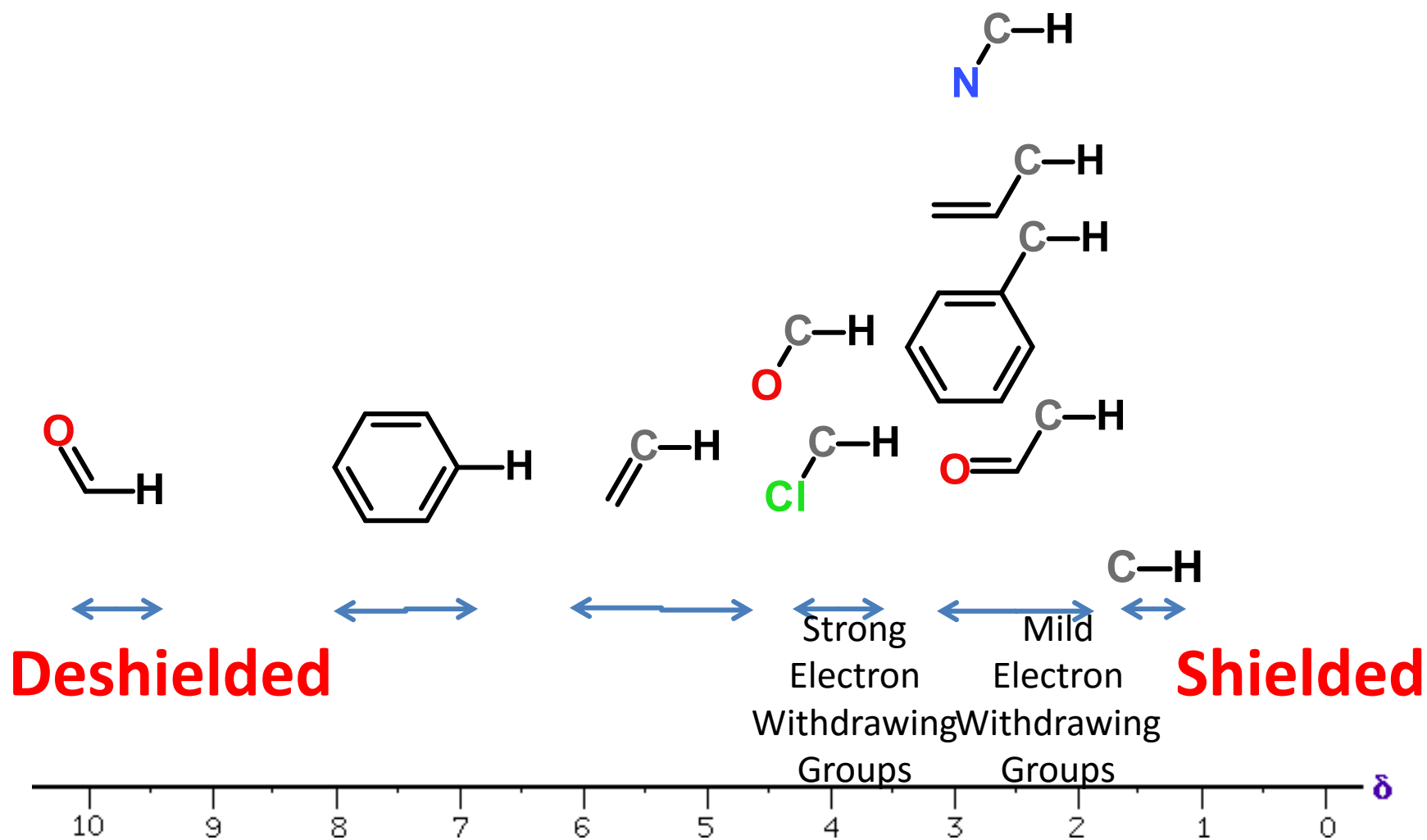
# Order of Coverage (Exam 1)

	Homework Assignment	Due Date
15	B7-13-03A Oxidation and Anti-oxidants (wDeadline)	Tuesday, September 6
16	B7-19-01 Aromaticity (wDeadline)	Wednesday, September 7
17	B7-19-02B Arene Nomenclature (wDeadline)	Thursday, September 8
18	B7-19-03A Halogenation of Arenes (wDeadline)	Friday, September 9
19	B7-19-03B Halogenation of Arenes (wDeadline)	Friday, September 9
20	B7-19-04A Arene Rxns Inorganic Acids (wDeadline)	Saturday, September 10
21	B7-19-04B Arene Rxns Inorganic Acids (wDeadline)	Saturday, September 10
22	B7-19-05A Friedel-Crafts (wDeadline)	Sunday, September 11
23	B7-19-05B Friedel-Crafts (wDeadline)	Sunday, September 11
24	B7-19-06 Arene Mechanistic Issues (wDeadline)	Wednesday, September 12
25	B7-19-06B Arene Mechanisms (wDeadline)	Wednesday, September 12
26	B7-19-07A Nucleophilic Aromatic Subs (wDeadline)	Thursday, September 13
27	B7-19-07B Nucleophilic Aromatic Subs (wDeadline)	Friday, September 14
	<b>Exam 1</b>	<b>September 18, 19, 20</b>

# Exam 1

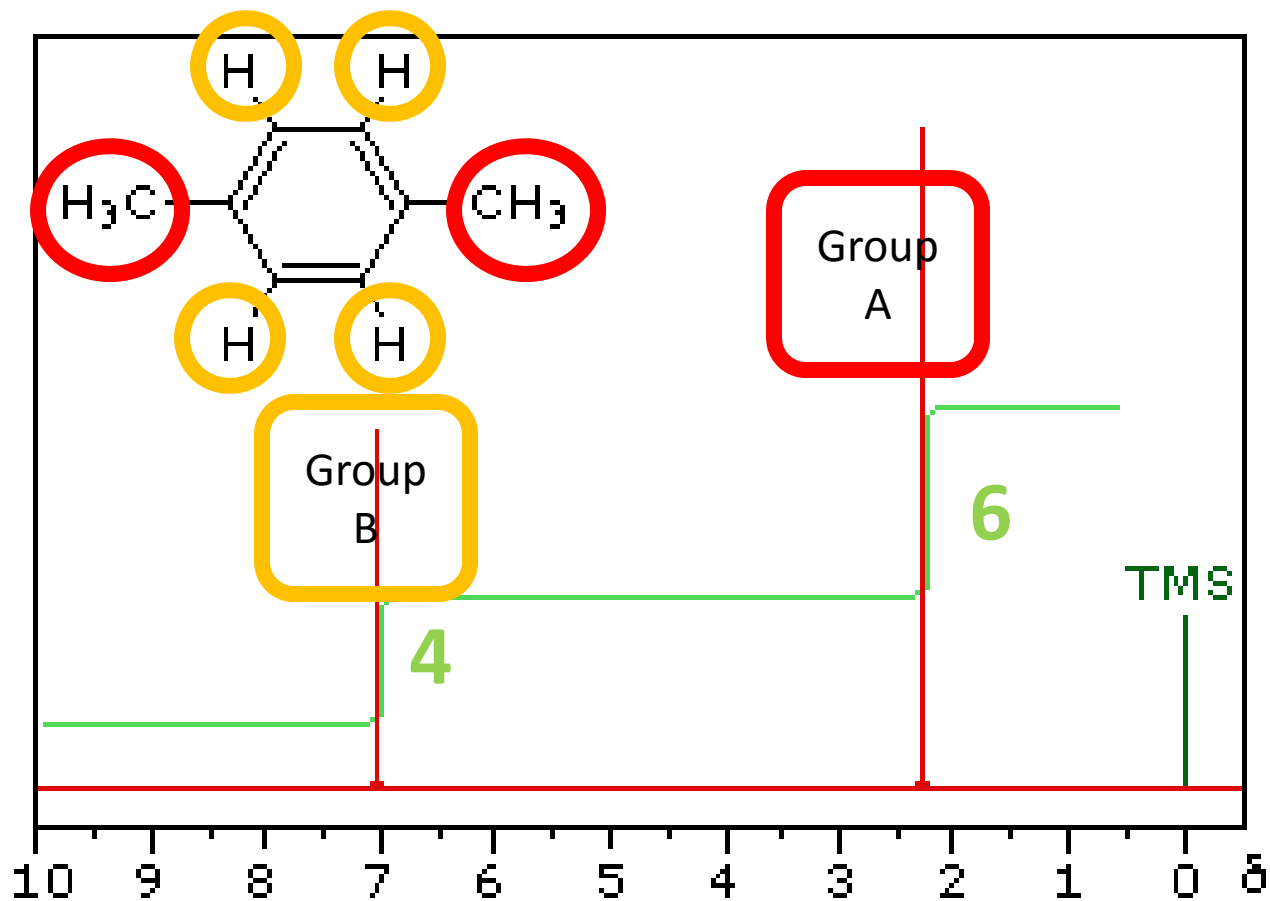
- **Time:**
  - Tuesday, September 20: 7:00 – 9:00PM
  - Wednesday, September 21: 7:00 – 9:00PM OR
  - Thursday, September 22: 7:00 – 10:00PM
- **Location – Soc/Anthro Testing Center**
  - Chapters will be covered in this order: Chapter 11, 14, 15, 19, 13
- **Practice Exams are Posted**
  - B7-19-98A Practice Exam 1A
  - B7-19-98B Practice Exam 1B
- **Deadline for alternate arrangements is Monday, 9/19/2016 at 4:30 PM (i.e., close of business)**
  - An oral make-up exam will be required for making up the exam for all students not taking the exam on the above dates or having already made prior arrangements

# Penn's View of $^1\text{H}$ Chemical Shifts

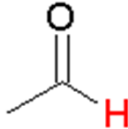
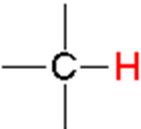
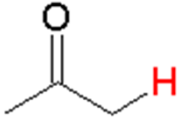


# Chemical Shift and Integration

## Examples

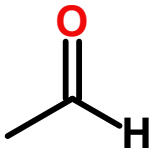
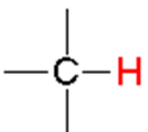
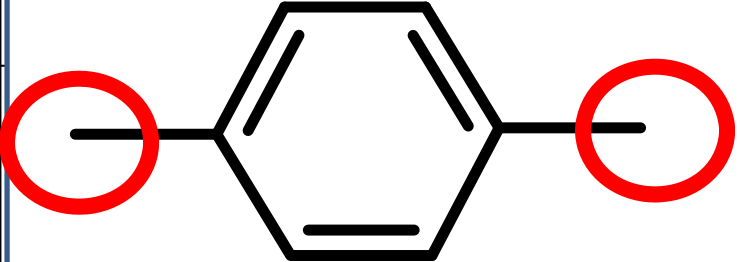
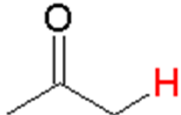


## Approximate Values of Chemical Shifts for $^1\text{H}$ NMR

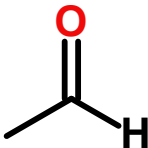
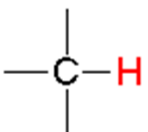
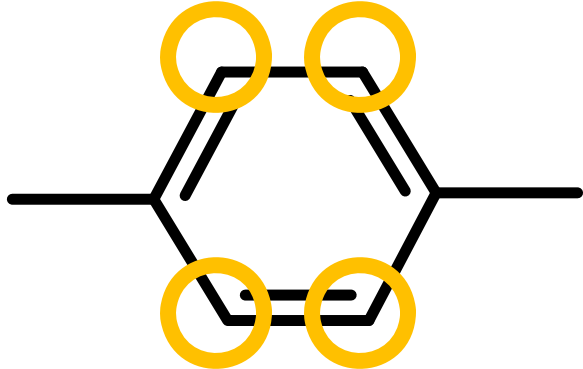
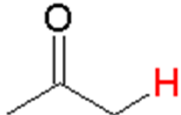
Type of Proton	Approximate Chemical Shift ( $\delta$ )	Type of Proton	Approximate Chemical Shift ( $\delta$ )
$-\text{CH}_3$	0.9	Ar-H	6.8-8.0
$-\text{CH}_2-$	1.2-1.3		9.7-10.5
	1.4	I-C-H	3.1-3.3
$\text{C}=\text{C}-\text{CH}_3$	1.5-2.5	Br-C-H	3.4-3.6
	2.1-2.6	Cl-C-H	3.6-3.8
Ar- $\text{CH}_3$	2.3-2.6	$\text{RNH}_2$	Variable
$-\text{C}\equiv\text{C}-\text{H}$	2.5-3.0	R-O-H	Variable
R-O-CH	3.3-4.0	ArOH	Variable
$\text{R}_2\text{C}=\text{CHR}$	4.5-6.5	$\text{RCO}_2\text{H}$	Variable



## Approximate Values of Chemical Shifts for $^1\text{H}$ NMR

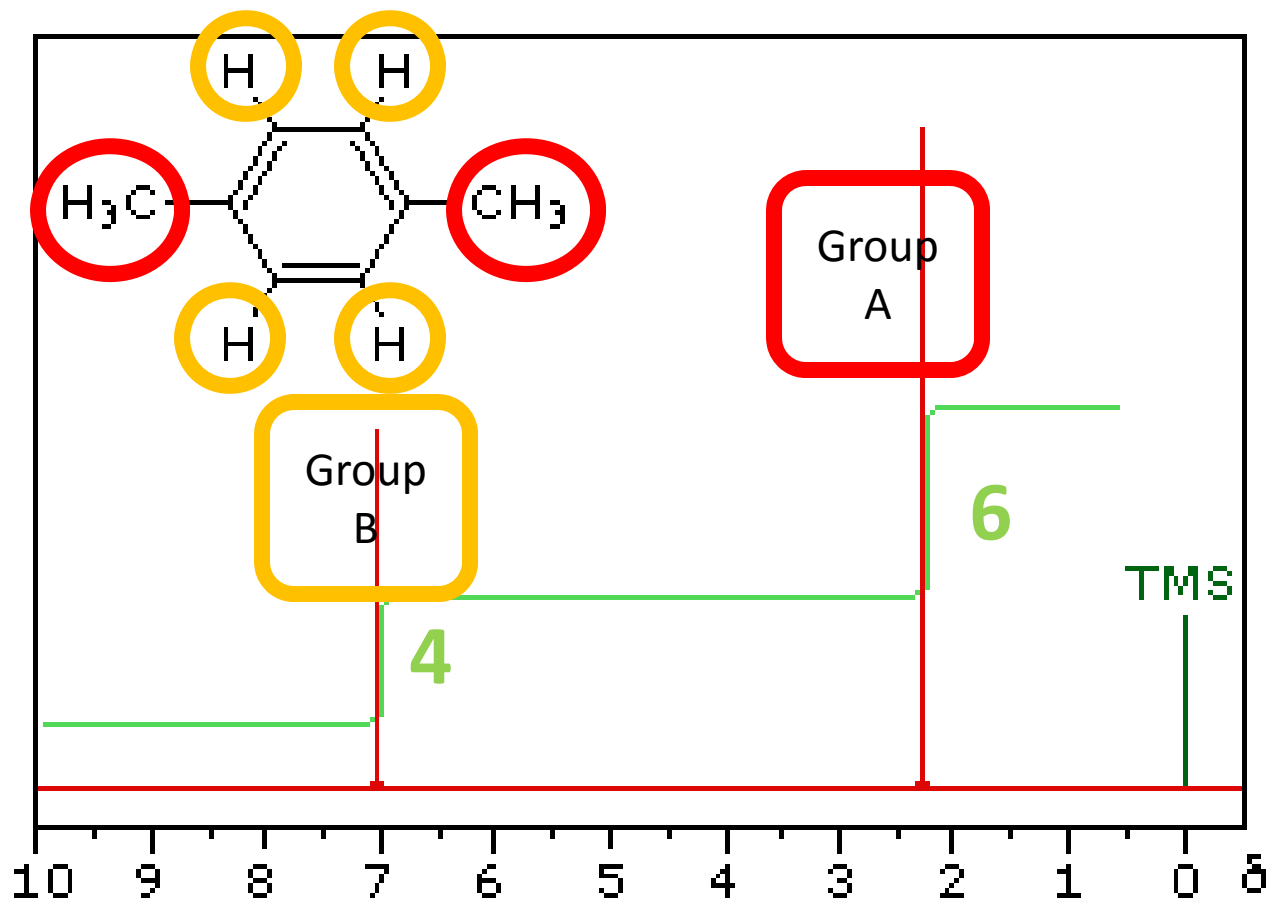
Type of Proton	Approximate Chemical Shift ( $\delta$ )	Type of Proton	Approximate Chemical Shift ( $\delta$ )
$-\text{CH}_3$	0.9	Ar-H	6.8-8.0
$-\text{CH}_2-$	1.2-1.3		9.7-10.5
	1.4		
$\text{C}=\text{C}-\text{CH}_3$	1.5-2.5		
	2.1-2.6		
Ar- $\text{CH}_3$	2.3-2.6		
$-\text{C}\equiv\text{C}-\text{H}$	2.5-3.0		
R-O-CH	3.3-4.0		
$\text{R}_2\text{C}=\text{CHR}$	4.5-6.5		

## Approximate Values of Chemical Shifts for $^1\text{H}$ NMR

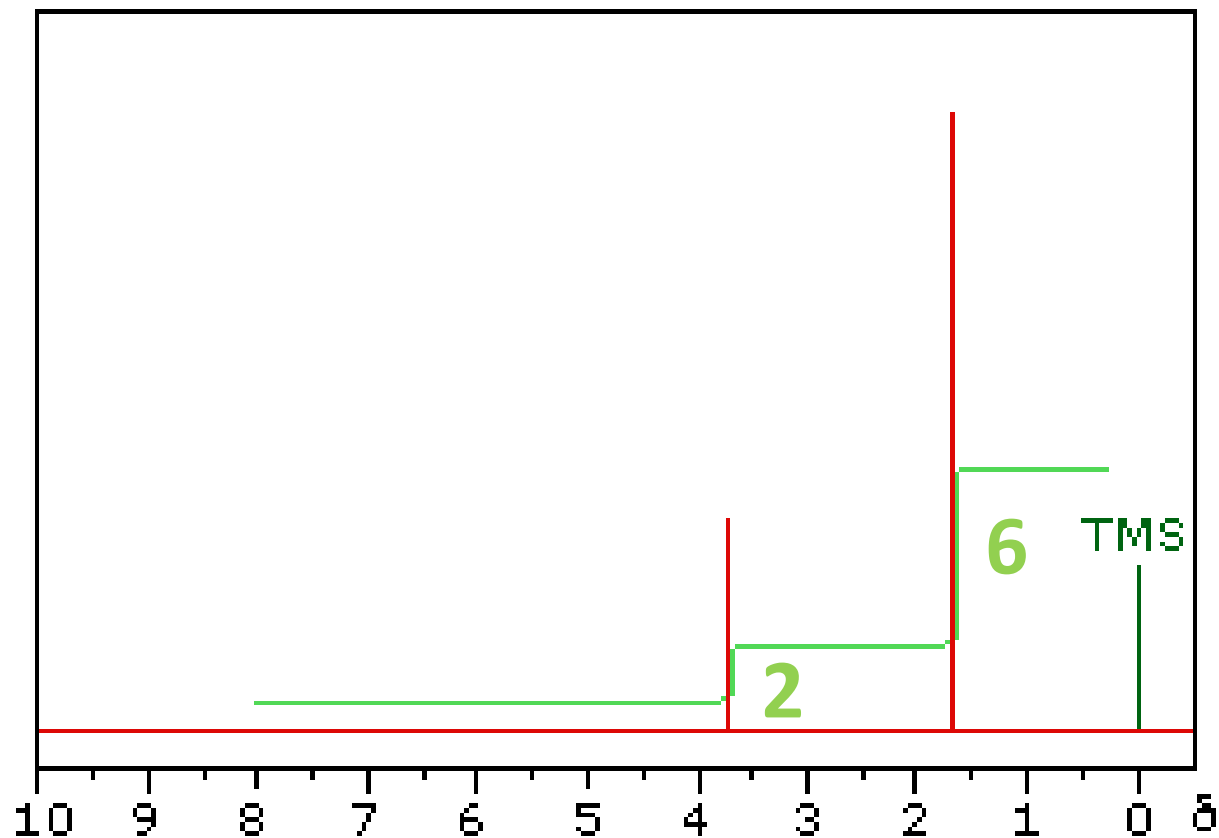
Type of Proton	Approximate Chemical Shift ( $\delta$ )	Type of Proton	Approximate Chemical Shift ( $\delta$ )
$-\text{CH}_3$	0.9	Ar-H	6.8-8.0
$-\text{CH}_2-$	1.2-1.3		9.7-10.5
	1.4		
$\text{C}=\text{C}-\text{CH}_3$	1.5-2.5		
	2.1-2.6		
Ar- $\text{CH}_3$	2.3-2.6		
$-\text{C}\equiv\text{C}-\text{H}$	2.5-3.0		
R-O-CH	3.3-4.0		
$\text{R}_2\text{C}=\text{CHR}$	4.5-6.5		

# Chemical Shift and Integration

## Examples

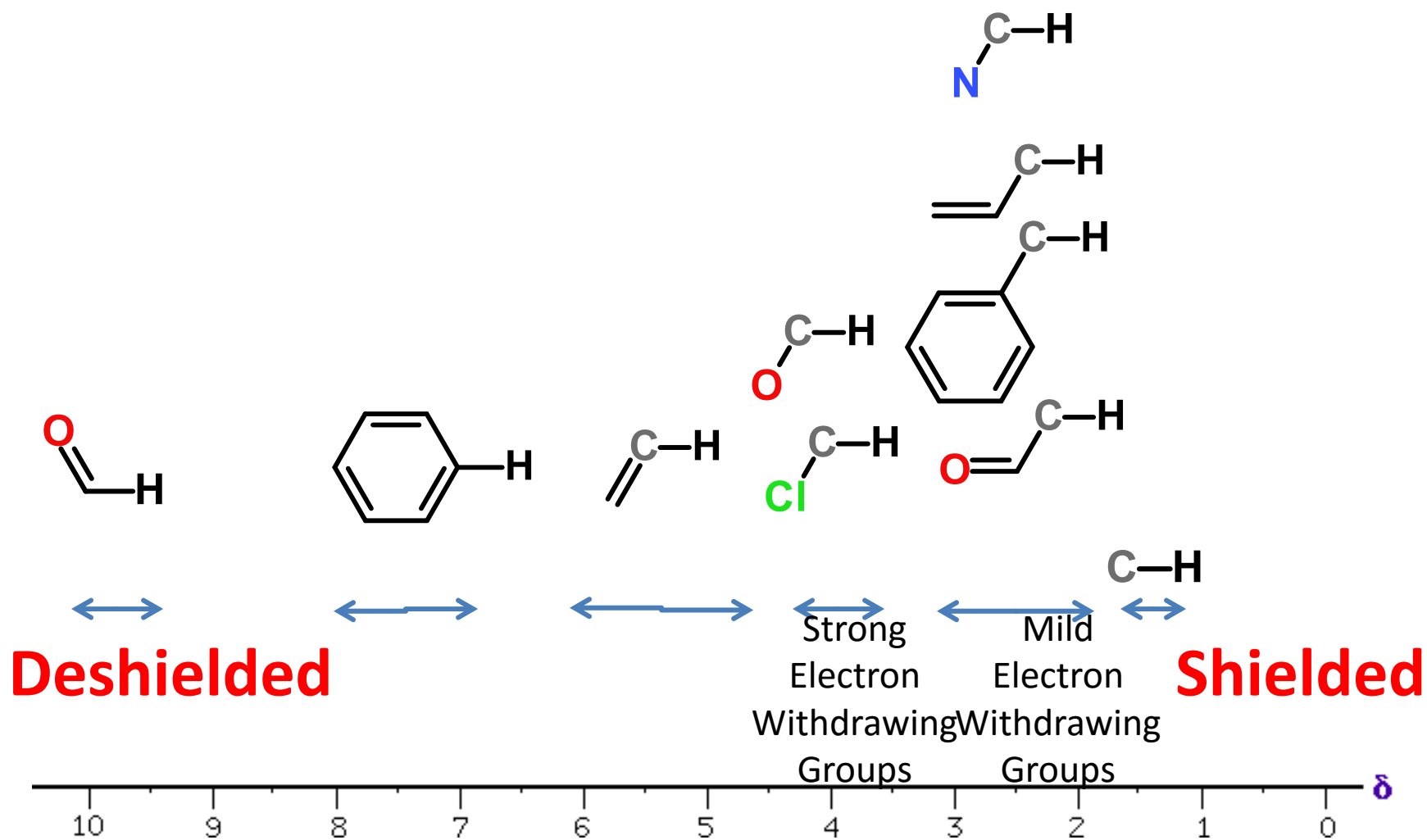


# Chemical Shift and Integration Examples



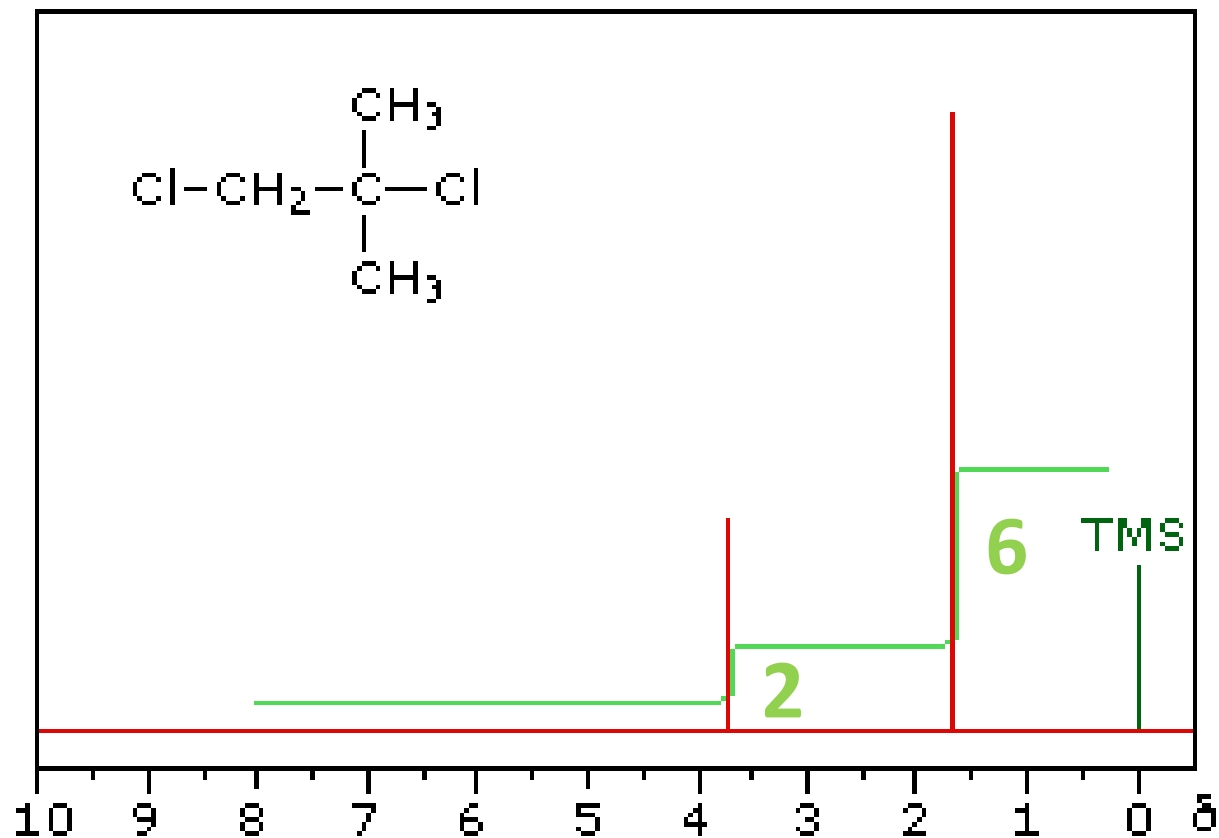
**What information is here in this spectrum?**

# Penn's View of $^1\text{H}$ Chemical Shifts



# Chemical Shift and Integration

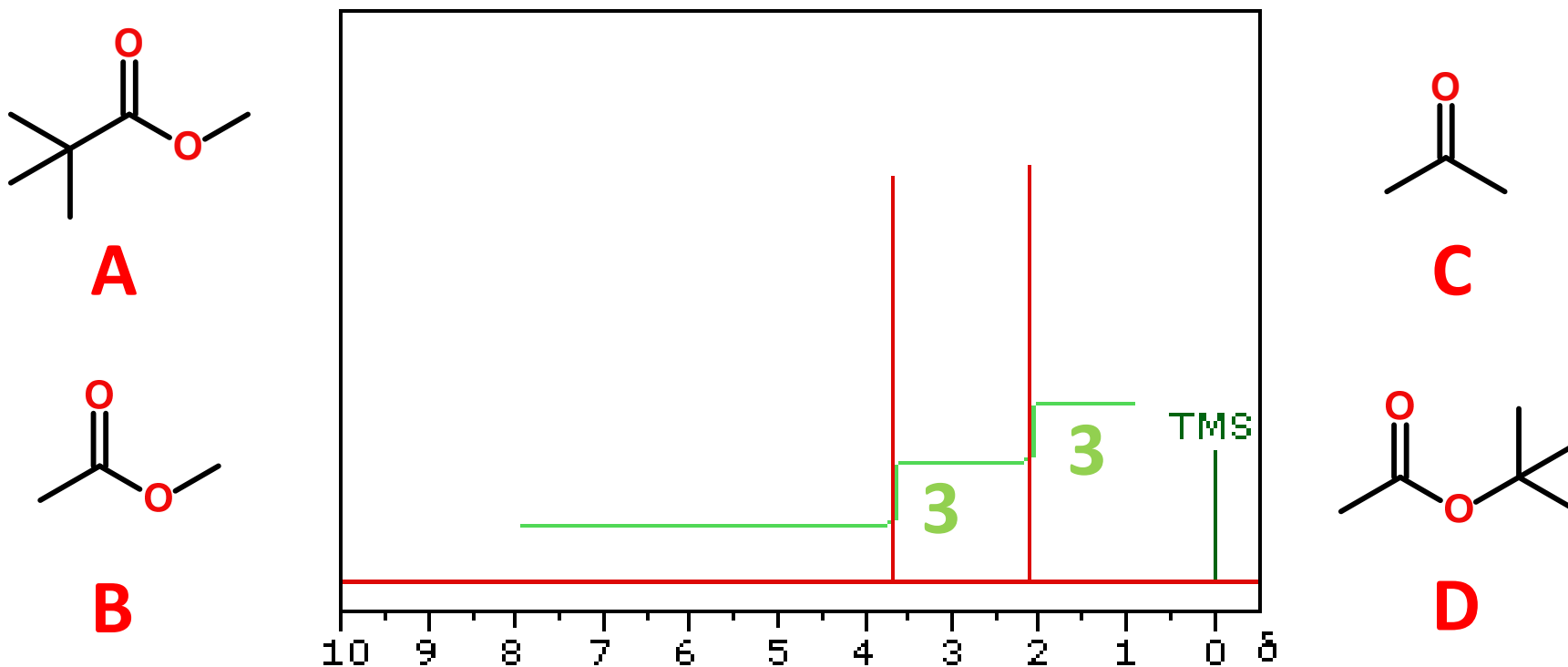
## Examples



# Chemical Shift and Integration

## Examples

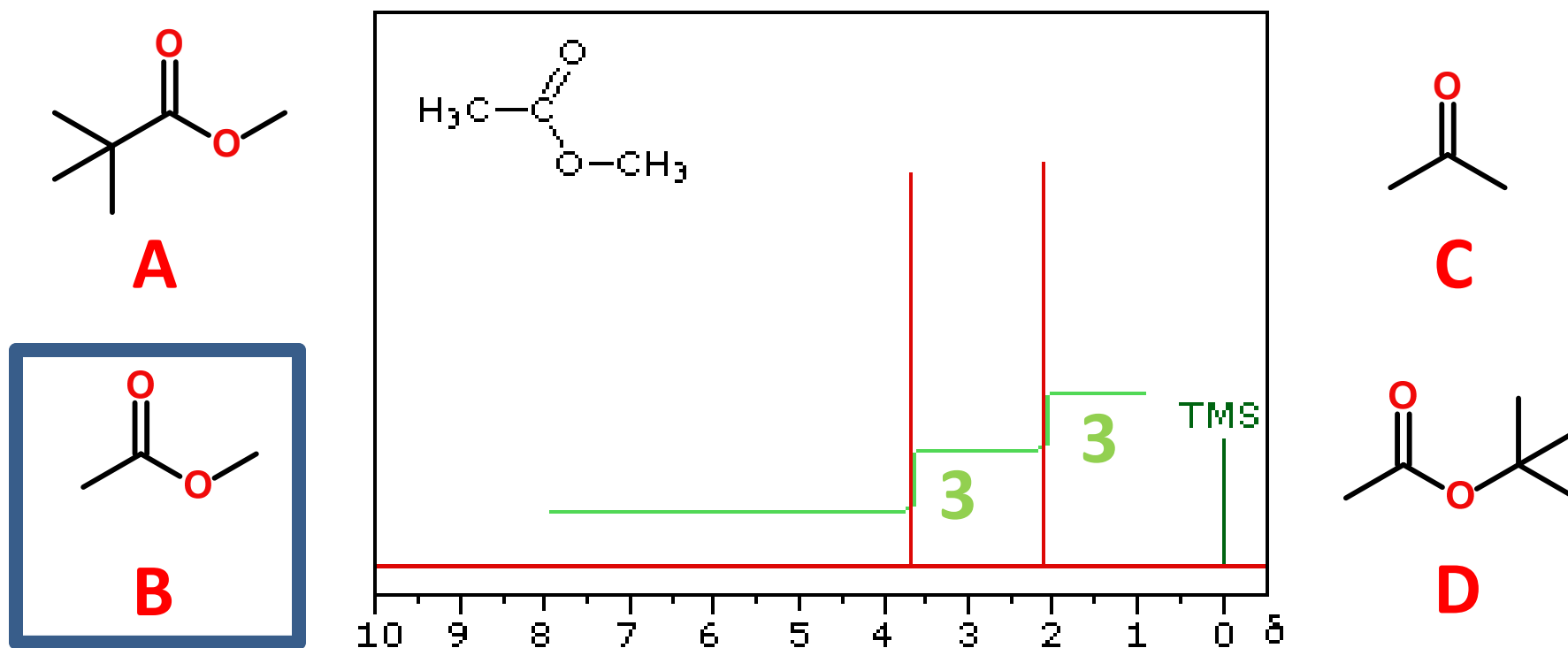
2016-08-26 Q2



Which of the following structures is consistent with the observed spectrum?

# Chemical Shift and Integration Examples

2016-08-26 Q2

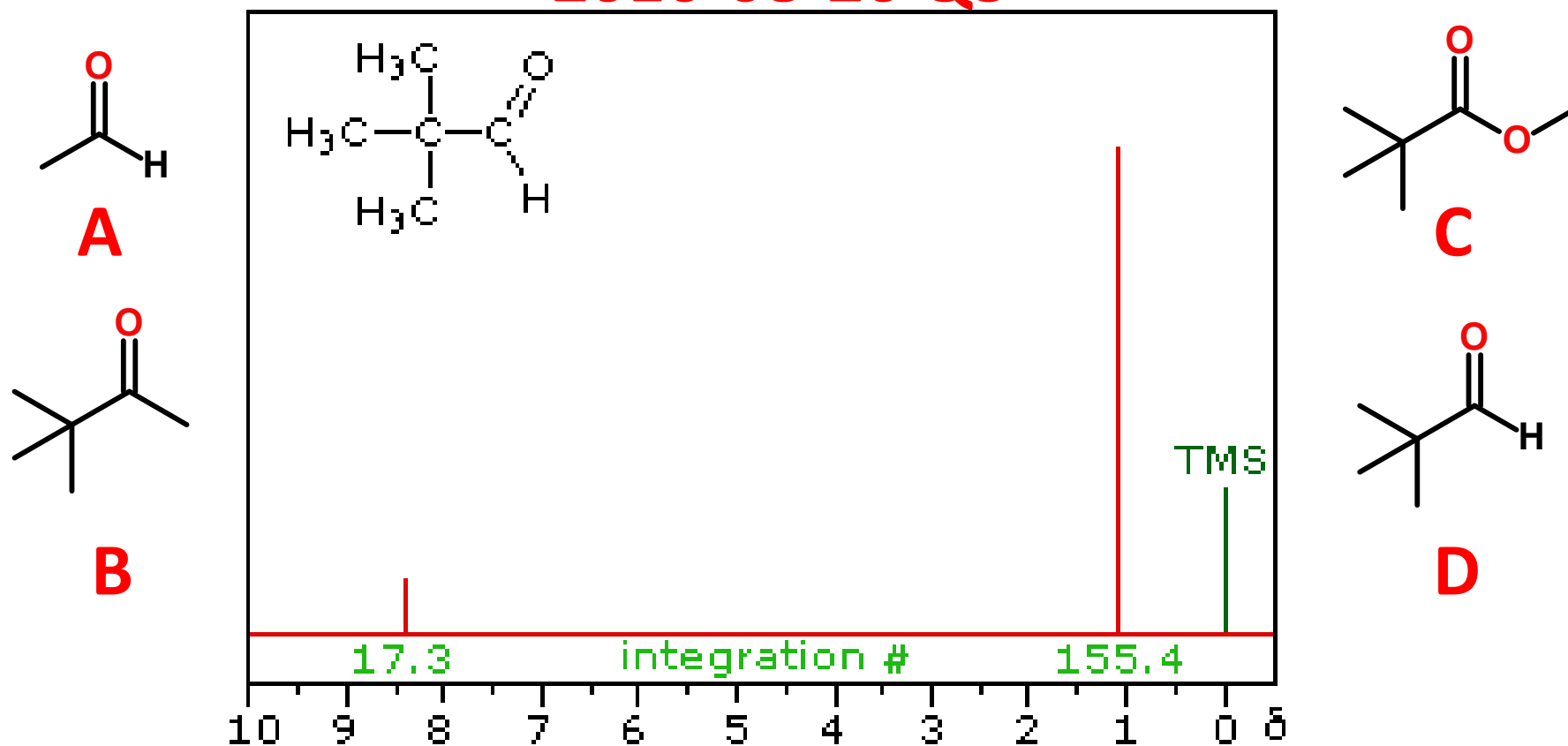


Which of the following structures is  
consistent with the observed spectrum?



# Chemical Shift and Integration Examples

2016-08-26 Q3



Which of the following structures is  
consistent with the observed spectrum?

# 2016-08-26 Q4

Click on the "Next Question" button to start your assignment.

2 of 5

Which of these choices best describes the interpretation of the following peak that may be recorded in a  $^1\text{H}$  NMR spectrum? 0.90  $\delta$  (3H, s). The underlined hydrogen atom is intended to be the one producing the peak that we are interpreting. More than one choice may describe the peak very well.

A  
B  
C  
D  
E  
F  
G

$\text{CH}_3\text{-C=O}$

$\text{CH}_3\text{-N}$

$\text{CH}_3\text{-O}$

$\text{CH}_3\text{-C}$

$\text{CH}_3\text{-Ar}$

$\text{CH}_3\text{-C=C}$

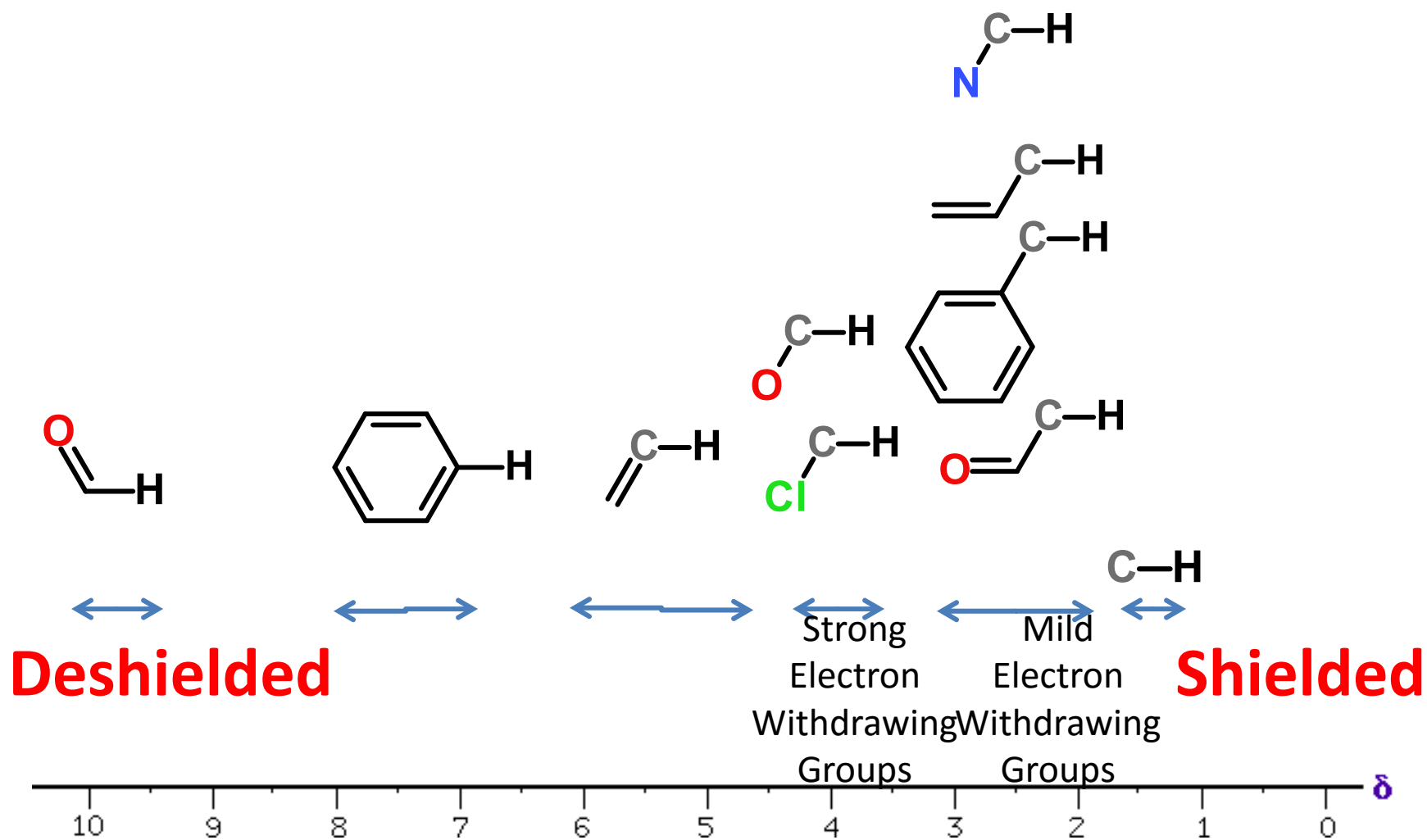
None of these interpretations describes this peak.

Previous

Next

Submit

# Penn's View of $^1\text{H}$ Chemical Shifts



AT&T 8:56 AM 80%

B7-15-02 Theoretical NMR C X

← → ↻ <https://ondemand.questionmark.com/delivery/perception.php?customerid=399959> ☆ 🔊 📶 ⋮

Progress: 0%

## 2016-08-26 Q4

Click on the "Next Question" button to start your assignment.

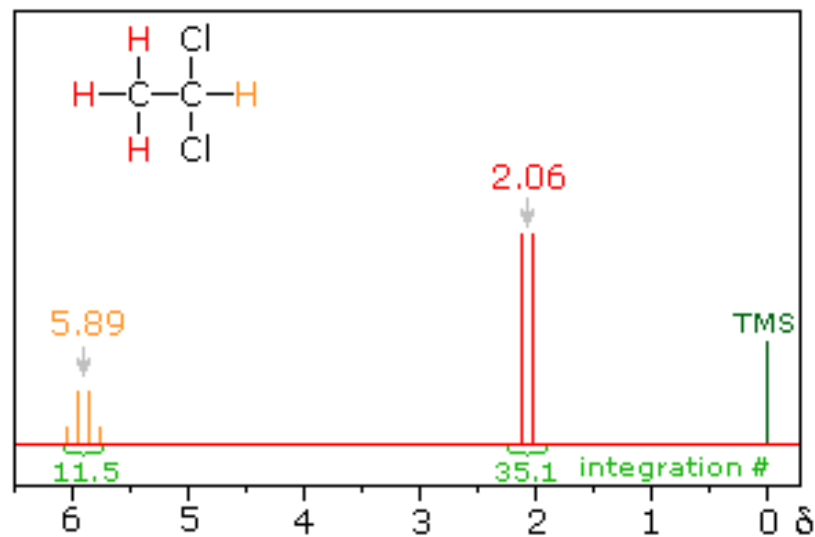
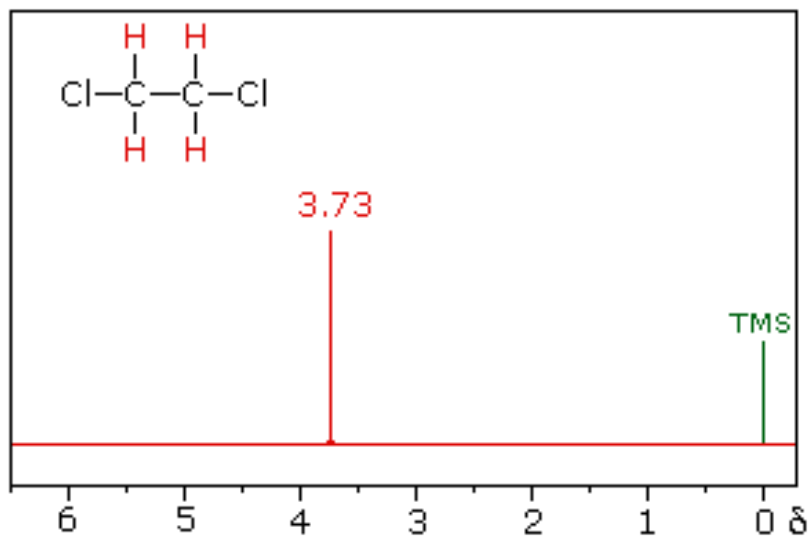
**2 of 5**

Which of these choices best describes the interpretation of the following peak that may be recorded in a  $^1\text{H}$  NMR spectrum? 0.90  $\delta$  (3H, s). The underlined hydrogen atom is intended to be the one producing the peak that we are interpreting. More than one choice may describe the peak very well.

- A**   $\text{CH}_3\text{-C=O}$       **MEG – Predicted Chemical Shift ~ 1.5 – 3.0**
- B**   $\text{CH}_3\text{-N}$       **MEG – Predicted Chemical Shift ~ 1.5 – 3.0**
- C**   $\text{CH}_3\text{-O}$       **SEG – Predicted Chemical Shift ~ 3.5 – 4.0**
- D**   $\text{CH}_3\text{-C}$       **Shielded – Predicted Chemical Shift ~ 0.9 – 1.5**
- E**   $\text{CH}_3\text{-Ar}$       **MEG – Predicted Chemical Shift ~ 1.5 – 3.0**
- F**   $\text{CH}_3\text{-C=C}$       **MEG – Predicted Chemical Shift ~ 1.5 – 3.0**
- G**  None of these interpretations describes this peak.

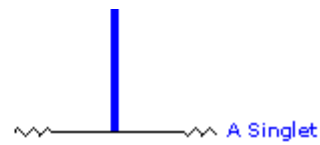
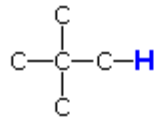
⏪ Previous    ⏩ Next    ✓ Submit

# Spin-Spin Splitting

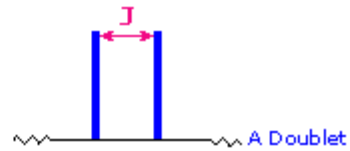
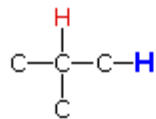


# Splitting Patterns

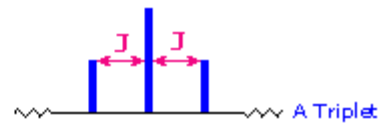
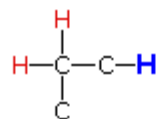
No Coupled  
Hydrogens



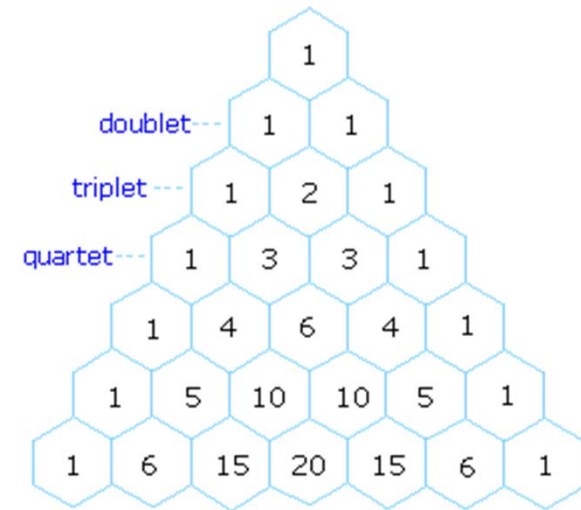
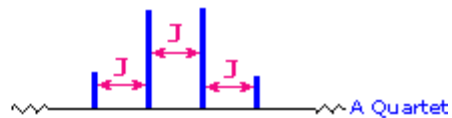
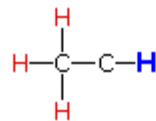
One Coupled  
Hydrogen



Two Coupled  
Hydrogens



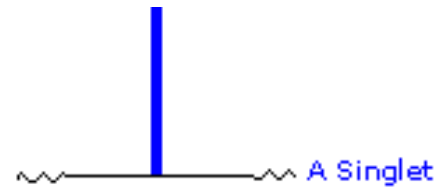
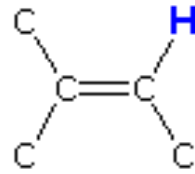
Three Coupled  
Hydrogens



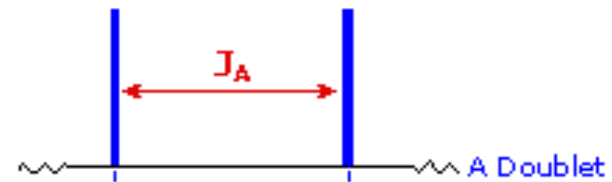
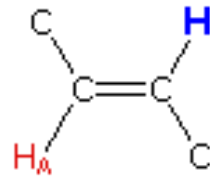
Pascal's Triangle

# Splitting Patterns

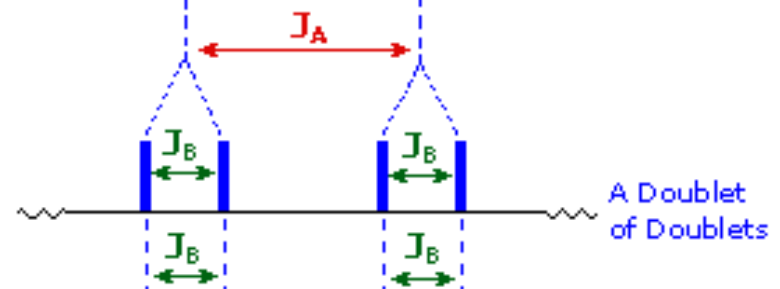
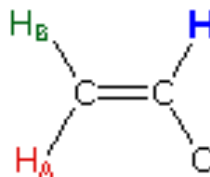
No Coupled  
Hydrogens



One Coupled  
Hydrogen



Two Coupled  
Hydrogens



Three Coupled  
Hydrogens

