

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

[TP] Ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, and dimethyl ether, CH_3OCH_3 , are constitutional isomers. This means that their mass spectra ...

20% 1. must have the same molecular ion peak

20% 2. must contain the same number of peaks at the same places (m/z), but with different heights

20% 3. must contain the same number of peaks but at different places (m/z)

20% 4. 1 and 2

20% 5. 1 and 3

BOSTON UNIVERSITY

Response Counter 10 1

Lecture 5 CH101 A1 (MWF 9:05 am)
Friday, September 14, 2017

- Begin ch3: Naming things
- Molecular mass spectra

Next lecture: Mass spectra of compounds with Br (or Cl); light; infrared (IR) spectra

BOSTON UNIVERSITY

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

Common monoatomic ions and patterns

Figure 3.7 (p 57)

Legend:

- Metals
- Transition metals
- Metalloids
- Non-metals

BOSTON UNIVERSITY

3

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

Common monoatomic ions

Figure 3.8 (p 59)

Legend:

- Metals
- Transition metals
- Metalloids
- Non-metals

BOSTON UNIVERSITY

4

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

Common polyatomic ions, Table 3.2 (p 59)

Formula	Name	Formula	Name
CATIONS: Positive Ion			
NH_4^+	ammonium ion		
ANIONS: Negative Ions			
Based on a Group 14 element		Based on a Group 17 element	
CN^-	cyanide ion	ClO^-	hypochlorite ion
CH_3COO^-	acetate ion	ClO_2^-	chlorite ion
CO_3^{2-}	carbonate ion	ClO_3^-	chlorate ion
HCO_3^-	hydrogencarbonate ion (or bicarbonate ion)	ClO_4^-	perchlorate ion
Based on a Group 15 element		Based on a transition metal	
NO_2^-	nitrite ion	CrO_4^{2-}	chromate ion
NO_3^-	nitrate ion	$\text{Cr}_2\text{O}_7^{2-}$	dichromate ion
PO_4^{3-}	phosphate ion	MnO_4^-	permanganate ion
HPO_4^{2-}	hydrogenphosphate ion		
H_2PO_4^-	dihydrogenphosphate ion		
Based on a Group 16 element			
OH^-	hydroxide ion		
SO_3^{2-}	sulfite ion		
SO_4^{2-}	sulfate ion		
HSO_4^-	hydrogensulfate ion (or bisulfate ion)		

BOSTON UNIVERSITY

5

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

[Group Quiz] When ionic compounds are dissolved in water, they dissociate into their component ions completely. Which of the following ionic compounds, when dissolved in water, will result in an aqueous solution that contains the greatest number of ions?

25% 1. 1 mol of sodium chloride
 25% 2. 1 mol of ammonium carbonate
 25% 3. 1 mol of potassium phosphate
 25% 4. 1 mol of ammonium acetate

BOSTON UNIVERSITY

6

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

Molecular mass spectra

BOSTON UNIVERSITY

7

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

[TP] The mass spectrum of ethane, C_2H_6 , has peaks at $m/z = 14, 15, 27, 28, 29,$ and 30 . The peak with the highest relative intensity is at $m/z = 28$, and the peak with the lowest relative intensity is at $m/z = 14$. Which peak is due to the molecular ion?

13% 1. The peak at $m/z = 14$
 13% 2. The peak at $m/z = 15$
 13% 3. The peak at $m/z = 27$
 13% 4. The peak at $m/z = 28$
 13% 5. The peak at $m/z = 29$
 13% 6. The peak at $m/z = 30$
 13% 7. None of the above
 13% 8. All of the above

BOSTON UNIVERSITY

Response Counter 10 8

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018

Copyright © 2018 Dan Dill dan@bu.edu

Sketch mass spectrum of ethane

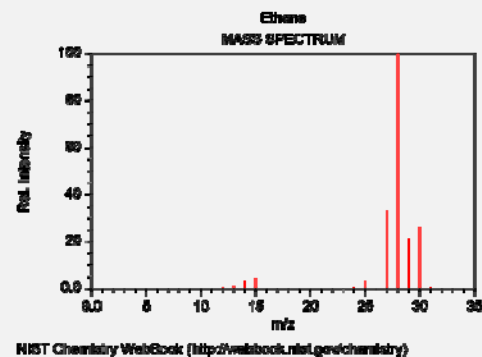


9

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018

Copyright © 2018 Dan Dill dan@bu.edu

Sketch mass spectrum of ethane

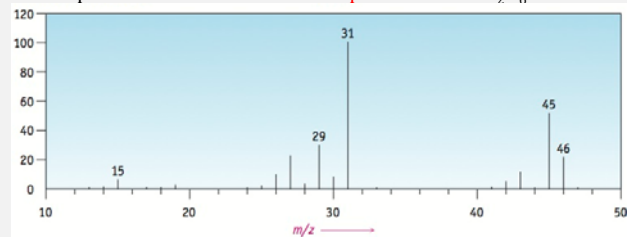


10

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018

Copyright © 2018 Dan Dill dan@bu.edu

Use the molecular ion to analyze mass spectrum

Here is the spectrum of a molecule with empirical formula C_2H_6X .

What element is X?



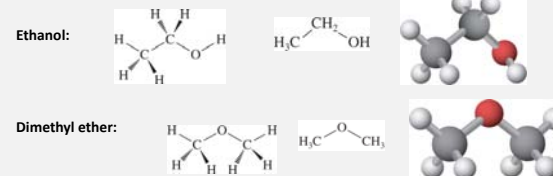
12

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018

Copyright © 2018 Dan Dill dan@bu.edu

Important terms to distinguish

- **Constitutional isomers:** Ethanol and dimethyl ether
- **Empirical formula:** C_2H_6O
- **Condensed formula:** CH_3CH_2OH and CH_3OCH_3
- **Structural formula**



14

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018

Copyright © 2018 Dan Dill dan@bu.edu

[TP] Ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, and dimethyl ether, CH_3OCH_3 , are constitutional isomers. This means that their mass spectra ...

- 20% 1. must have the same molecular ion peak
 20% 2. must contain the same number of peaks at the same places (m/z), but with different heights
 20% 3. must contain the same number of peaks but at different places (m/z)
 20% 4. 1 and 2
 20% 5. 1 and 3

Response
Counter

10

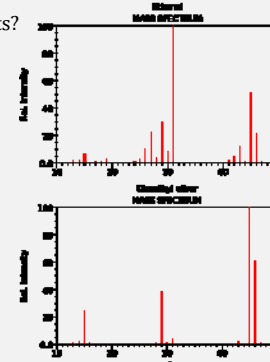
15

Lecture 5 CH101 A1 (MWF 9:05 am) Fall 2018

Copyright © 2018 Dan Dill dan@bu.edu

Ethanol and dimethyl ether, $\text{C}_2\text{H}_6\text{O}^+$

What are the fragments?



16