

Test Bank for Organic Chemistry 5th Smith

Chapter 2 - Acids and Bases (test bank) KEY

1. Which of the following statements is a correct definition for a Brønsted-Lowry acid?

- A. Proton acceptor
- B. Electron pair donor
- C. Electron pair acceptor
- D. Proton donor

Accessibility: Keyboard Navigation
Bloom's Level: 1. Remember
Difficulty: Easy Gradable: automatic Section: 02.01

Subtopic: Acid/Base definitions
Topic: Acids and Bases

2. Which of the following statements about a Brønsted-Lowry base is true?

- A. The net charge may be zero, positive, or negative.
- B. All Brønsted-Lowry bases contain a lone pair of electrons or a π bond.
- C. All Brønsted-Lowry bases contain a proton.
- D. The net charge may be zero or positive.

Accessibility: Keyboard Navigation
Bloom's Level: 1. Remember
Difficulty: Easy Gradable: automatic Section: 02.01

Subtopic: Acid/Base definitions
Topic: Acids and Bases

3. Which of the following compounds is both a Brønsted-Lowry acid and base?



I

II

III

IV

- A. I, II
- B. I, III
- C. II, IV
- D. I, IV

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.01

Subtopic: Acid/Base definitions
Topic: Acids and Bases

4. Which of the following species cannot act as both a Brønsted-Lowry acid and base?

- A. HCO_3^-
- B. HSO_4^-
- C. HO^-
- D. H_2PO_4^-

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply Difficulty: Easy
Gradable: automatic Section: 02.01

Subtopic: Acid/Base definitions
Topic: Acids and Bases

5. Which of the following species is not a Brønsted-Lowry base?

- A. BF_3
- B. NH_3
- C. H_2O^{3-}
- D. PO_4^{3-}

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply Difficulty: Easy
Gradable: automatic Section: 02.01

Subtopic: Acid/Base definitions
Topic: Acids and Bases

6. Which of the following statements about Brønsted-Lowry acids and bases is true?

- A. Loss of a proton from a base forms its conjugate acid.
- B. Loss of a proton from an acid forms its conjugate base.
- C. Gain of a proton by an acid forms its conjugate base.
- D. Brønsted-Lowry acid-base reactions always result in the transfer of a proton from a base to an acid.

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply Difficulty: Easy
Gradable: automatic Section: 02.01

Subtopic: Acid/Base definitions
Topic: Acids and Bases

7. Which of the following species is the conjugate base of methanol, CH₃OH?

- A. CH₃OH²⁺
- B. CH₃O⁻**
- C. CH₃⁻
- D. CH₄

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.01
Subtopic: Acid/Base definitions
Topic: Acids and Bases

8. Which of the following species is the conjugate base of the hydronium ion, H₃O⁺?

- A. H₃O
- B. H₂O⁻**
- C. H₂O
- D. HO⁻

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.01
Subtopic: Acid/Base definitions
Topic: Acids and Bases

9. Which of the following species is the conjugate acid of ammonia, NH₃?

- A. H₄N
- B. H₃N⁺**
- C. H₂N⁻
- D. H₄N⁺

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.01
Subtopic: Acid/Base definitions
Topic: Acids and Bases

10. Which is the conjugate acid in the following reaction?



- A. I
- B. II
- C. III**
- D. IV

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.02
Subtopic: Acid/Base definitions
Topic: Acids and Bases

11. Which is the conjugate base in the following reaction?



- A. I
- B. II
- C. III
- D. IV**

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.02
Subtopic: Acid/Base definitions
Topic: Acids and Bases

12. Which is the conjugate acid in the following reaction?



- A. I
B. II
C. III
D. IV

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.02
Subtopic: Acid/Base definitions
Topic: Acids and Bases

13. Which is the conjugate base in the following reaction?



- A. I
B. II
C. III
D. IV

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.02
Subtopic: Acid/Base definitions
Topic: Acids and Bases

14. Which of the following statements about acid strength is true?

- A. The stronger the acid, the further the equilibrium lies to the left.
B. The stronger the acid, the smaller the K_a .
C. The stronger the acid, the larger the pK_a .
D. The stronger the acid, the smaller the pK_a .

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pK_a
Topic: Acids and Bases

15. Which of the following compounds is the strongest acid?



- A. I
B. II
C. III
D. IV

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pK_a
Topic: Acids and Bases

16. Which of the following compounds is the strongest acid?

- A. CH_3OH
B. BrCH_2OH
C. CH_3NH_2
D. CH_3Cl

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pK_a
Topic: Acids and Bases

17. Which of the following compounds is the weakest acid?

- A. HF
- B. HCl
- C. HBr
- D. HI

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pKa
Topic: Acids and Bases

18. Which of the following compounds is the weakest acid?

- A. H₂S
- B. PH₃
- C. HCl
- D. SiH₄

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pKa
Topic: Acids and Bases

19. Which of the following species is the strongest base?

- A. HO⁻
- B. H₂N⁻
- C. CH₃COO⁻
- D. Cl⁻

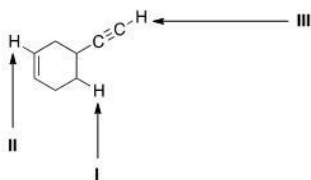
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Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pKa
Topic: Acids and Bases

20. Which of the following ranks the compounds in order of increasing basicity, putting the least basic first?

- A. CH₃NH₂ < CH₃OH < CH₄
- B. CH₃OH < CH₃NH₂ < CH₄
- C. CH₄ < CH₃NH₂ < CH₃OH
- D. CH₄ < CH₃OH < CH₃NH₂

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply
Difficulty: Medium
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pKa
Topic: Acids and Bases

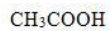
21. Consider the following molecule with protons labeled, I-III. Rank these protons in order of decreasing acidity, putting the most acidic first.



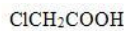
- A. I > II > III
- B. I > III > II
- C. III > II > I
- D. III > I > II

Bloom's Level: 3. Apply
Difficulty: Medium
Gradable: automatic
Section: 02.03
Subtopic: Acid strength of functional groups
Subtopic: Factors affecting acid strength
Subtopic: pKa
Topic: Acids and Bases

22. Rank the following compounds in order of increasing acidity, putting the least acidic first.



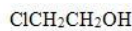
I



II



III



IV

- A. $\text{III} < \text{I} < \text{IV} < \text{II}$
B. $\text{III} < \text{IV} < \text{I} < \text{II}$
C. $\text{II} < \text{I} < \text{IV} < \text{III}$
D. $\text{III} < \text{I} < \text{II} < \text{IV}$

Bloom's Level: 3. Apply

Difficulty: Medium

Gradable: automatic

Section: 02.03

Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa

Topic: Acids and Bases

23. Rank the following compounds in order of increasing acidity, putting the least acidic first.



I



II



III



IV

- A. $\text{I} < \text{IV} < \text{III} < \text{II}$
B. $\text{I} < \text{III} < \text{IV} < \text{II}$
C. $\text{II} < \text{III} < \text{IV} < \text{I}$
D. $\text{II} < \text{IV} < \text{III} < \text{I}$

Bloom's Level: 3. Apply

Difficulty: Medium

Gradable: automatic

Section: 02.03

Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa

Topic: Acids and Bases

24. Rank the following compounds in order of decreasing acidity, putting the most acidic first.



I



II



III



IV

- A. $\text{IV} > \text{II} > \text{III} > \text{I}$
B. $\text{III} > \text{II} > \text{IV} > \text{I}$
C. $\text{I} > \text{II} > \text{IV} > \text{III}$
D. $\text{III} > \text{IV} > \text{II} > \text{I}$

Bloom's Level: 3. Apply

Difficulty: Medium

Gradable: automatic

Section: 02.03

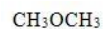
Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa

Topic: Acids and Bases

25. Rank the following compounds in order of decreasing acidity, putting the most acidic first.



I



II



III



IV

- A. $\text{IV} > \text{II} > \text{III} > \text{I}$
B. $\text{IV} > \text{III} > \text{II} > \text{I}$
C. $\text{III} > \text{IV} > \text{II} > \text{I}$
D. $\text{III} > \text{IV} > \text{I} > \text{II}$

Bloom's Level: 3. Apply

Difficulty: Medium

Gradable: automatic

Section: 02.03

Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa

Topic: Acids and Bases

26. Rank the following conjugate bases in order of increasing basicity, putting the least basic first.



- A. $\text{II} < \text{I} < \text{III}$
 B. $\text{II} < \text{III} < \text{I}$
 C. $\text{I} < \text{II} < \text{III}$
 D. $\text{I} < \text{III} < \text{II}$

Bloom's Level: 3. Apply

Difficulty: Medium

Gradable: automatic

Section: 02.03

Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa Topic: Acids and Bases

27. Rank the following conjugate bases in order of decreasing basicity, putting the most basic first.



- A. $\text{II} > \text{I} > \text{III}$
 B. $\text{I} > \text{II} > \text{III}$
 C. $\text{III} > \text{I} > \text{II}$
 D. $\text{III} > \text{II} > \text{I}$

Bloom's Level: 3. Apply

Difficulty: Medium

Gradable: automatic

Section: 02.03

Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa Topic: Acids and Bases

28. Which of the following is the strongest base?

- A. CH_3COCH_3
 B. CH_3COOH
 C. NH_3
 D. H_2O

Accessibility: Keyboard Navigation

Bloom's Level: 3. Apply Difficulty:

Medium Gradable: automatic

Section: 02.03

Subtopic: Acid strength of functional groups

Subtopic: Factors affecting acid strength

Subtopic: pKa Topic: Acids and Bases

29. What is the direction of equilibrium when acetylene (C_2H_2) reacts with H_2N^- in an acid-base reaction?



- A. Left
 B. Right
 C. Neither
 D. Cannot be determined

Bloom's Level: 3. Apply

Difficulty: Easy

Gradable: automatic

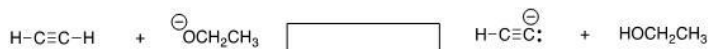
Section: 02.04

Subtopic: Factors affecting acid strength Subtopic:

Predicting acid/base reaction equilibrium Topic:

Acids and Bases

30. What is the direction of equilibrium when acetylene (C_2H_2) reacts with ethoxide ($\text{CH}_3\text{CH}_2\text{O}^-$) in an acid-base reaction?



- A. Left
B. Right
C. Neither
D. Cannot be determined

Bloom's Level: 3. Apply

Difficulty: Easy

Gradable: automatic

Section: 02.04

Subtopic: Factors affecting acid strength

Predicting acid/base reaction equilibrium

Topic: Acids and Bases

31. Which of the following statements explains why H_2O is a stronger acid than CH_4 ?

- A. H_2O can form hydrogen bonds while CH_4 cannot.
B. H_2O forms a less stable conjugate base, HO^- .
C. CH_4 forms a more stable conjugate base, CH_3^- .
D. H_2O forms a more stable conjugate base, HO^- .

Accessibility: Keyboard Navigation

Bloom's Level: 3. Apply Difficulty:

Easy Gradable: automatic Section:

02.05

Subtopic: Factors affecting acid strength

Topic: Acids and Bases

32. Which of the following statements explain why HBr is a stronger acid than HF ?

- A. Br^- is more stable than F^- because Br^- is larger than F^- .
B. Br^- is less stable than F^- because Br^- is larger than F^- .
C. Br^- is more stable than F^- because Br^- is less electronegative than F^- .
D. Br^- is less stable than F^- because Br^- is less electronegative than F^- .

Accessibility: Keyboard Navigation

Bloom's Level: 3. Apply Difficulty:

Easy Gradable: automatic Section:

02.05

Subtopic: Factors affecting acid strength

Topic: Acids and Bases

33. Which of the following compounds has the lowest pK_a ?

- A. H_2O
B. H_2S
C. NH_3
D. CH_4

Accessibility: Keyboard Navigation

Bloom's Level: 3. Apply

Difficulty: Easy

Gradable: automatic

Section: 02.03

Subtopic: pK_a

Topic: Acids and Bases

34. Which of the following concepts can be used to explain the difference in acidity between acetic acid (CH_3COOH) and ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)?

- A. Hybridization
B. Electronegativity
C. Resonance
D. Size

Accessibility: Keyboard Navigation

Bloom's Level: 3. Apply Difficulty:

Easy Gradable: automatic Section:

02.05

Subtopic: Factors affecting acid strength

Topic: Acids and Bases

35. Which of the following concepts can be used to explain the difference in acidity between acetylene (C_2H_2) and ethylene (C_2H_4)?

- A. Size
B. Resonance
C. Inductive effect
D. Hybridization

Accessibility: Keyboard Navigation

Bloom's Level: 3. Apply Difficulty:

Easy Gradable: automatic Section:

02.05

Subtopic: Factors affecting acid strength

Topic: Acids and Bases

36. Which of the following concepts can be used to explain the difference in acidity between ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) and 2-fluoroethanol ($\text{FCH}_2\text{CH}_2\text{OH}$)?

- A. Size
- B. Inductive effect**
- C. Resonance
- D. Hybridization

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply Difficulty:
Easy Gradable: automatic Section:
02.05

Subtopic: Factors affecting acid strength
Topic: Acids and Bases

37. Rank the following compounds in order of decreasing acidity, putting the most acidic first.



I



II



III

- A. $\text{I} > \text{II} > \text{III}$
- B. $\text{III} > \text{II} > \text{I}$**
- C. $\text{II} > \text{III} > \text{I}$
- D. $\text{III} > \text{I} > \text{II}$

Bloom's Level: 3. Apply
Difficulty: Medium
Gradable: automatic
Section: 02.05
Subtopic: Factors affecting acid strength
Topic: Acids and Bases

38. Which of the following statements about Lewis acids is true?

- A. Lewis acids are proton donors.
- B. Lewis acids are proton acceptors.
- C. Lewis acids are electron pair donors.
- D. Lewis acids are electron pair acceptors.**

Accessibility: Keyboard Navigation
Bloom's Level: 2. Understand
Difficulty: Easy Gradable:
automatic Section: 02.06

Subtopic: Acid/Base definitions
Topic: Acids and Bases

39. Which of the following statements about Lewis bases is true?

- A. Lewis bases are electron pair acceptors.
- B. Lewis bases are electron pair donors.**
- C. Lewis bases are proton donors.
- D. Lewis bases are proton acceptors.

Accessibility: Keyboard Navigation
Bloom's Level: 2. Understand
Difficulty: Easy Gradable:
automatic Section: 02.06

Subtopic: Acid/Base definitions
Topic: Acids and Bases

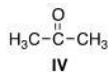
40. Which of the following is a Lewis acid but not a Brønsted-Lowry acid?

- A. CH_3OH
- B. H_2O
- C. CH_3COOH
- D. BF_3**

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply Difficulty:
Easy Gradable: automatic Section:
02.06

Subtopic: Acid/Base definitions
Topic: Acids and Bases

41. Which of the following species can be both Lewis acid and Lewis base?



- A. I, III, IV
 B. I, II, IV
 C. II, III, IV
 D. I, II, III

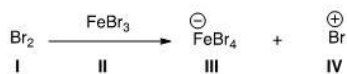
Bloom's Level: 3. Apply
 Difficulty: Easy
 Gradable: automatic
 Section: 02.06
 Subtopic: Acid/Base definitions
 Topic: Acids and Bases

42. What is the correct classification of the following compound?
 $\text{CH}_3\text{-O-CH}_3$

- A. Brønsted-Lowry acid and Lewis acid
 B. Brønsted-Lowry base and Lewis base
 C. Brønsted-Lowry base
 D. Lewis base

Accessibility: Keyboard Navigation
 Bloom's Level: 3. Apply
 Difficulty: Easy
 Gradable: automatic
 Section: 02.06
 Subtopic: Acid/Base definitions
 Topic: Acids and Bases

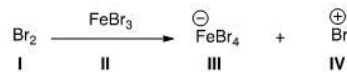
43. Identify the Lewis acid in the following reaction.



- A. I
 B. II
 C. III
 D. IV

Bloom's Level: 3. Apply
 Difficulty: Easy
 Gradable: automatic
 Section: 02.06
 Subtopic: Acid/Base definitions
 Topic: Acids and Bases

44. Identify the Lewis base in the following reaction.



- A. I
 B. II
 C. III
 D. IV

Bloom's Level: 3. Apply
 Difficulty: Easy
 Gradable: automatic
 Section: 02.06
 Subtopic: Acid/Base definitions
 Topic: Acids and Bases

45. Which of the following compounds is *not* a Lewis acid?

- A. AlCl_3
- B. HCl
- C. H_2O
- D. CBr_4

Accessibility: Keyboard Navigation
Bloom's Level: 3. Apply Difficulty:
Easy Gradable: automatic Section:
02.06

Subtopic: Acid/Base definitions
Topic: Acids and Bases

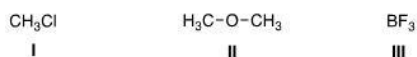
46. What is the role of methylchloride (CH_3Cl) in the following reaction?



- A. Lewis acid
- B. Lewis base
- C. Brønsted-Lowry acid
- D. Brønsted-Lowry base

Bloom's Level: 3. Apply
Difficulty: Easy
Gradable: automatic
Section: 02.06
Subtopic: Acid/Base definitions
Topic: Acids and Bases

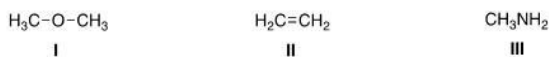
47. What is the electrophilic site in the following compounds?



- A. I = Carbon; II = carbon; III = boron.
- B. I = Chlorine; II = carbon; III = boron.
- C. I = Carbon; II = oxygen; III = boron.
- D. I = Carbon; II = carbon; III = fluorine.

Bloom's Level: 3. Apply
Difficulty: Medium
Gradable: automatic
Section: 02.06
Subtopic: Acid/Base definitions
Topic: Acids and Bases

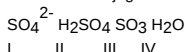
48. What is the nucleophilic site in the following compounds?



- A. I = Hydrogen; II = π electrons in bond; III = nitrogen.
- B. I = Oxygen; II = carbon; III = nitrogen.
- C. I = Hydrogen; II = carbon; III = carbon.
- D. I = Oxygen; II = π electrons in bond; III = nitrogen.

Bloom's Level: 3. Apply
Difficulty: Medium
Gradable: automatic
Section: 02.06
Subtopic: Acid/Base definitions
Topic: Acids and Bases

49. What is the conjugate base of HSO_4^- ?

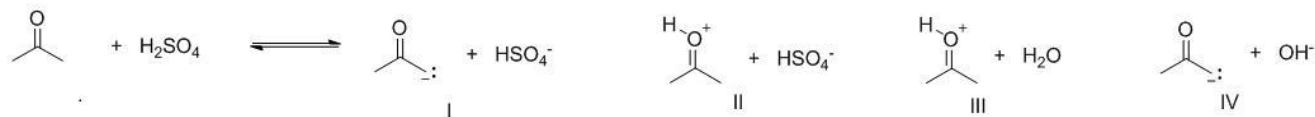


- A. I
- B. II
- C. III
- D. IV

Accessibility: Keyboard Navigation
Bloom's Level: 4. Analyze
Difficulty: Medium Gradable:
automatic Section: 02.06

Subtopic: Acid/Base definitions
Topic: Acids and Bases

50. What are the products of the following proton transfer reaction?



- A. I
B. II
C. III
D. IV

Bloom's Level: 4. Analyze

Difficulty: Medium

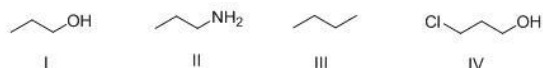
Gradable: automatic

Section: 02.04

Subtopic: Predicting acid/base reaction equilibrium

Topic: Acids and Bases

51. What is the correct rank of the following compounds in order of increasing acidity?



- A. I > II > III > IV
B. IV > III > II > I
C. IV > I > II > III
D. III > I > IV > II

Bloom's Level: 4. Analyze

Difficulty: Hard

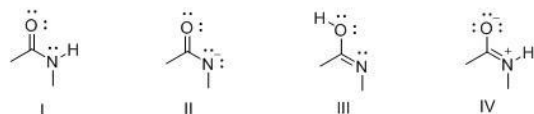
Gradable: automatic

Section: 02.05

Subtopic: Factors affecting acid strength

Topic: Acids and Bases

52. Consider the following structures I-IV. Which two species represent a conjugate acid-base pair?



- A. I and II
B. I and III
C. I and IV
D. II and III

Bloom's Level: 4. Analyze

Difficulty: Medium

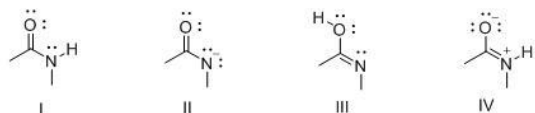
Gradable: automatic

Section: 02.02

Subtopic: Acid/Base definitions

Topic: Acids and Bases

53. Consider the following structures I-IV. Which two species represent resonance structures?



- A. I and II
B. I and III
C. I and IV
D. II and IV

Bloom's Level: 4. Analyze

Difficulty: Medium

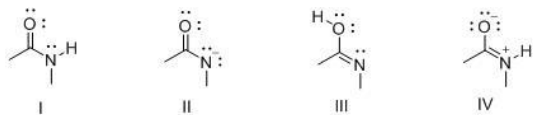
Gradable: automatic

Section: 02.02

Subtopic: Acid/Base definitions

Topic: Acids and Bases

54. Consider the following structures I-IV. Which two species represent constitutional isomers?



- A. I and II
- B. I and III**
- C. I and IV
- D. II and IV

Bloom's Level: 4. Analyze
 Difficulty: Medium
 Gradable: automatic
 Section: 02.02
 Subtopic: Acid/Base definitions
 Topic: Acids and Bases

