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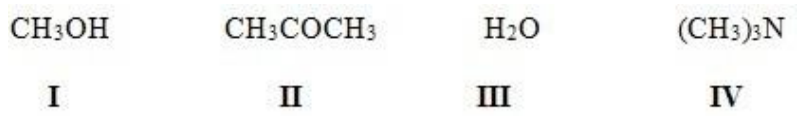
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Organic Chemistry, 6e **(Smith)**
Chapter 2 Acids and Bases

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

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.

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



A) I, II
B) I, III
C) II, IV
D) I, IV

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) $H_2PO_4^-$

5) Which of the following species is not a Brønsted-Lowry base?
A) BF_3
B) NH_3
C) H_2O
D) PO_4^{3-}

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.

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7) Which of the following species is the conjugate base of methanol, CH_3OH?

A) $CH_3OH_2^+$

B) CH_3O^-

C) CH_3^-

D) CH_4

8) Which of the following species is the conjugate base of the hydronium ion, H_3O^+?

A) H_3O

B) H_2O^-

C) H_2O

D) HO^-

9) Which of the following species is the conjugate acid of ammonia, NH_3?

A) H_4N

B) H_3N^+

C) H_2N^-

D) H_4N^+

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



A) I

B) II

C) III

D) IV

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



A) I

B) II

C) III

D) IV

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



A) I
B) II
C) III
D) IV

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



A) I
B) II
C) III
D) IV

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.

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



A) I
B) II
C) III
D) IV

16) Which of the following compounds is the strongest acid?
A) CH_3OH
B) $BrCH_2OH$
C) CH_3NH_2
D) CH_3Cl

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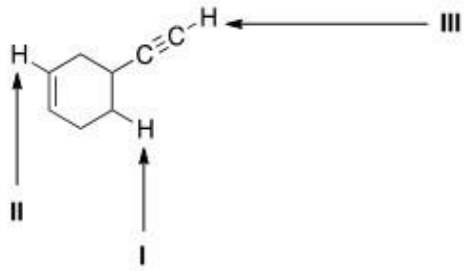
17) Which of the following compounds is the weakest acid?
A) HF
B) HCl
C) HBr
D) HI

18) Which of the following compounds is the weakest acid?
A) H_2S
B) PH_3
C) HCl
D) SiH_4

19) Which of the following species is the strongest base?
A) HO^-
B) H_2N^-
C) CH_3COO^-
D) Cl^-

20) Which of the following ranks the compounds in order of increasing basicity, putting the least basic first?
A) $CH_3NH_2 < CH_3OH < CH_4$
B) $CH_3OH < CH_3NH_2 < CH_4$
C) $CH_4 < CH_3NH_2 < CH_3OH$
D) $CH_4 < CH_3OH < CH_3NH_2$

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

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



A) III < I < IV < II
B) III < IV < I < II
C) II < I < IV < III
D) III < I < II < IV

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



A) I < IV < III < II
B) I < III < IV < II
C) II < III < IV < I
D) II < IV < III < I

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



A) IV > II > III > I
B) III > II > IV > I
C) I > II > IV > III
D) III > IV > II > I

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

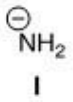


A) IV > II > III > I
B) IV > III > II > I
C) III > IV > II > I
D) III > IV > I > II

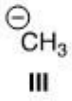
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26) Rank the following conjugate bases in order of increasing basicity, putting the least basic first.

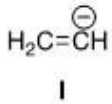

I

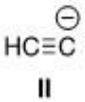

II


III

A) II < I < III
B) II < III < I
C) I < II < III
D) I < III < II

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


I


II


III

A) II > I > III
B) I > II > III
C) III > I > II
D) III > II > I

28) Which of the following is the strongest base?
A) CH_3COCH_3
B) CH_3COOH
C) NH_3
D) H_2O

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

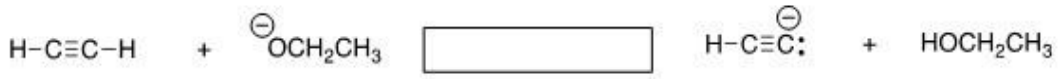


A) Left
B) Right
C) Neither
D) Cannot be determined

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30) What is the direction of equilibrium when acetylene (C_2H_2) reacts with ethoxide ($CH_3CH_2O^-$) in an acid-base reaction?



A) Left
B) Right
C) Neither
D) Cannot be determined

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^-.

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^-.

33) Which of the following compounds has the lowest pK_a?
A) H_2O
B) H_2S
C) NH_3
D) CH_4

34) Which of the following concepts can be used to explain the difference in acidity between acetic acid (CH_3COOH) and ethanol (CH_3CH_2OH)?
A) Hybridization
B) Electronegativity
C) Resonance
D) Size

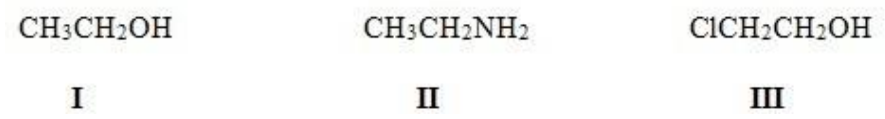
35) Which of the following concepts can be used to explain the difference in acidity between acetylene (C_2H_2) and ethylene (C_2H_4)?
A) Size
B) Resonance
C) Inductive effect
D) Hybridization

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36) Which of the following concepts can be used to explain the difference in acidity between ethanol (CH_3CH_2OH) and 2-fluoroethanol (FCH_2CH_2OH)?
A) Size
B) Inductive effect
C) Resonance
D) Hybridization

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



A) I > II > III
B) III > II > I
C) II > III > I
D) III > I > II

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.

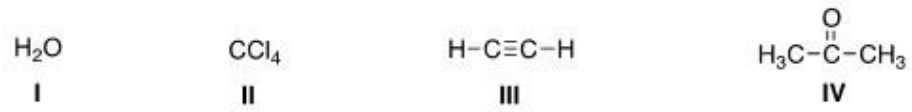
39) Which of the following statements about Lewis bases is true?
A) Lewis bases are electron pair acceptors.
B) Lewis bases are electron pair donors.
C) Lewis bases are proton donors.
D) Lewis bases are proton acceptors.

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

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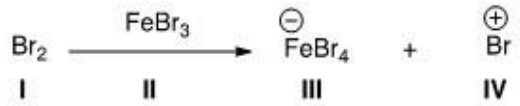
41) Which of the following species can be both Lewis acid and Lewis base?



A) I, III, IV
B) I, II, IV
C) II, III, IV
D) I, II, III

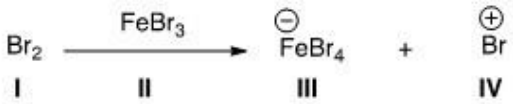
42) What is the correct classification of the following compound?
CH_3-O-CH_3
A) Brønsted-Lowry acid and Lewis acid
B) Brønsted-Lowry base and Lewis base
C) Brønsted-Lowry base
D) Lewis base

43) Identify the Lewis acid in the following reaction.



A) I
B) II
C) III
D) IV

44) Identify the Lewis base in the following reaction.



A) I
B) II
C) III
D) IV

45) Which of the following compounds is *not* a Lewis acid?
A) $AlCl_3$
B) HCl
C) H_2O
D) CBr_4

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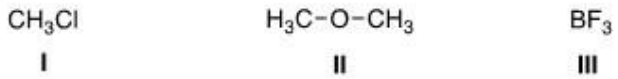
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46) What is the role of methylchloride (CH_3Cl) in the following reaction?



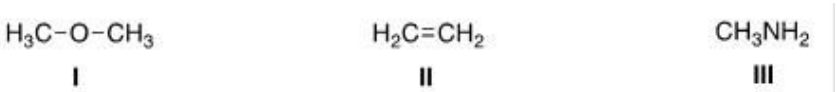
A) Lewis acid
B) Lewis base
C) Brønsted-Lowry acid
D) Brønsted-Lowry base

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.

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.

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

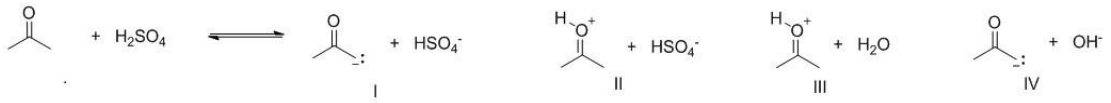
SO_4^{2-} H_2SO_4 SO_3 H_2O
I II III IV

A) I
B) II
C) III
D) IV

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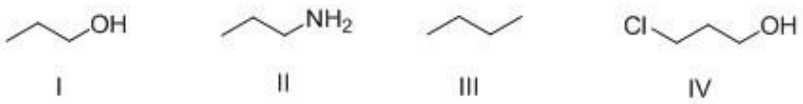
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50) What are the products of the following proton transfer reaction?



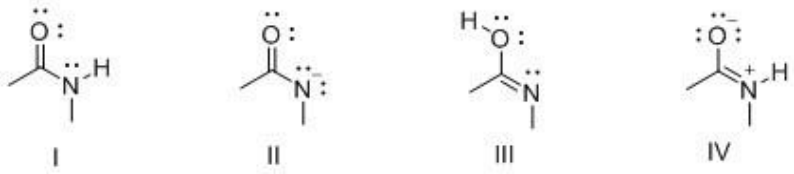
A) I
B) II
C) III
D) IV

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

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

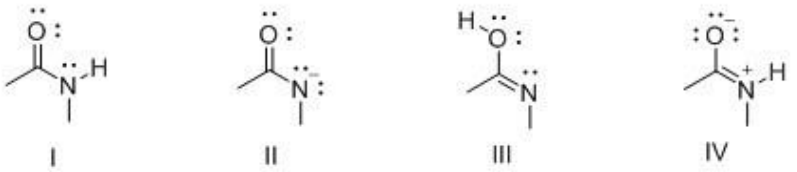


A) I and II
B) I and III
C) I and IV
D) II and III

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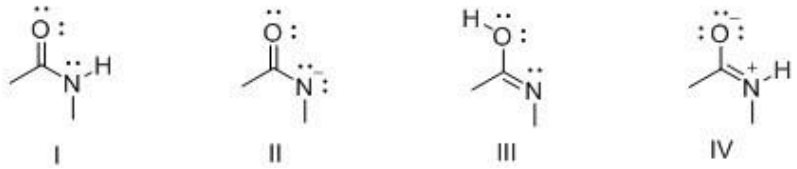
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53) Consider the following structures I-IV. Which two species represent resonance structures?



A) I and II
B) I and III
C) I and IV
D) II and IV

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

55) Identify the acid/conjugate acid (in that order) in the following reaction:



A) I, III
B) I, IV
C) II, III
D) II, IV

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56) Identify the base/conjugate base (in that order) in the following reaction:



A) I, III
B) I, IV
C) II, III
D) II, IV

57) Which of the following ranks the compounds in order of increasing acidity, putting the least acidic first?
A) $CH_4 < H_2O < NH_3$
B) $H_2O < NH_3 < CH_4$
C) $NH_3 < CH_4 < H_2O$
D) $CH_4 < NH_3 < H_2O$

58) Which of the following will proceed as written?
A) $CH_3ONa + HCl \rightarrow CH_3OH + NaCl$
B) $CH_3OH + NaCl \rightarrow NaOEt + HCl$
C) $CH_3OH + H_2O \rightarrow CH_3O^- + H_3O+$
D) $CH_3OH + NH_3 \rightarrow CH_3O^- + NH_4^{\pm}$

59) Which of the following would have the lowest pKa?
A) $ClCH_2CH_2CH_2CH_2COOH$
B) $CH_3CHClCH_2CH_2COOH$
C) $CH_3CH_2CHClCH_2COOH$
D) $CH_3CH_2CH_2CHClCOOH$

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