

Student name: _____

MULTIPLE CHOICE - Choose the one alternative that best completes the statement or answers the question.

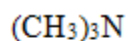
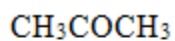
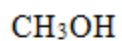
1) Which of the following statements is a correct definition for a Brønsted-Lowry acid?

- 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?



I

II

III

IV

- 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.

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

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 $\text{p}K_a$.
- D) The stronger the acid, the smaller the $\text{p}K_a$.

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

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

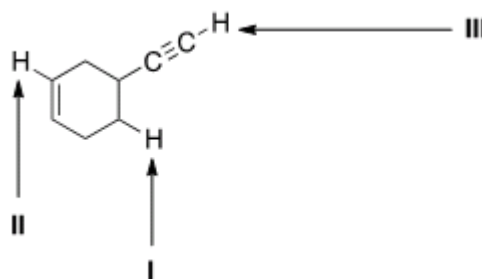
19) Which of the following species is the strongest base?

- 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) $\text{CH}_3\text{NH}_2 < \text{CH}_3\text{OH} < \text{CH}_4$
- B) $\text{CH}_3\text{OH} < \text{CH}_3\text{NH}_2 < \text{CH}_4$
- C) $\text{CH}_4 < \text{CH}_3\text{NH}_2 < \text{CH}_3\text{OH}$
- D) $\text{CH}_4 < \text{CH}_3\text{OH} < \text{CH}_3\text{NH}_2$

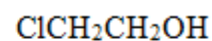
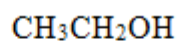
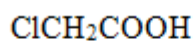
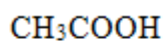
21) Consider the following molecule with protons labeled, I-III. Rank these protons in order



of decreasing acidity, putting the most acidic first.

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

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



first.

I

II

III

IV

- 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



	I	II	III	IV
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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



	I	II	III	IV
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first.

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

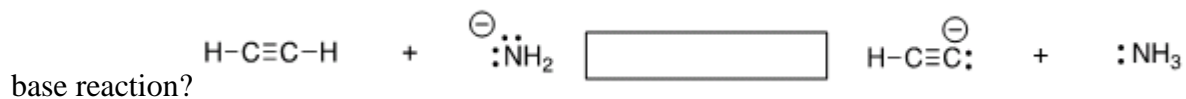
25) Rank the following compounds in order of decreasing acidity, putting the most acidic



	I	II	III	IV
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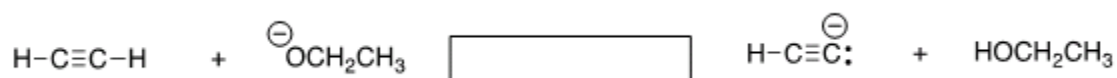
first.

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



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

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 ($\text{CH}_3\text{CH}_2\text{OH}$)?

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

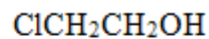
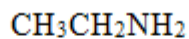
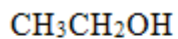
35) Which of the following concepts can be used to explain the difference in acidity between acetylene (C_2H_2) and ethylene (C_2H_4)?

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

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

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) $\text{III} > \text{I} > \text{II}$

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.

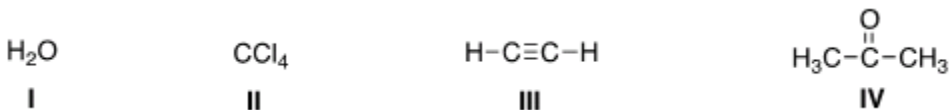
39) Which of the following statements about Lewis bases is true?

- 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?

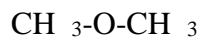
- A) CH₃OH
- B) H₂O
- C) CH₃COOH
- D) BF₃

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



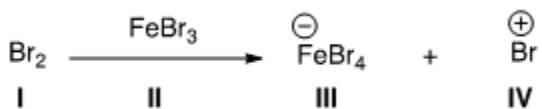
- A) I, III, IV
- B) I, II, IV
- C) II, III, IV
- D) I, II, III

42) What is the correct classification of the following compound?

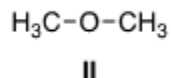


- A) Brønsted-Lowry acid and Lewis acid
- B) Brønsted-Lowry base and Lewis base
- C) Brønsted-Lowry base
- D) Lewis base

43) Identify the Lewis acid in the following reaction.

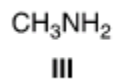
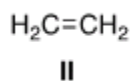
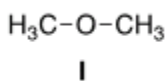


47) What is the electrophilic site in the following compounds?



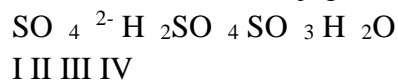
- A) I = Carbon; II = carbon; III = boron.
- B) I = Chlorine; II = carbon; III = boron.
- C) I = Carbon; II = oxygen; III = boron.
- D) I = Carbon; II = carbon; III = fluorine.

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



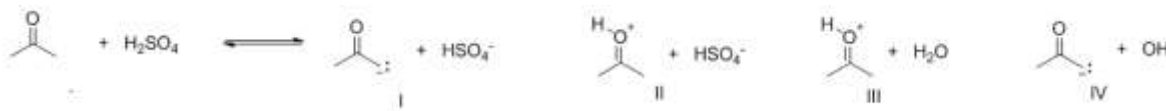
- A) I = Hydrogen; II = π electrons in bond; III = nitrogen.
- B) I = Oxygen; II = carbon; III = nitrogen.
- C) I = Hydrogen; II = carbon; III = carbon.
- D) I = Oxygen; II = π electrons in bond; III = nitrogen.

49) What is the conjugate base of HSO₄⁻?



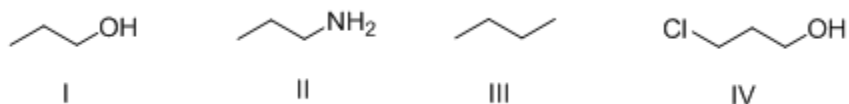
- A) I
- B) II
- C) III
- D) IV

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



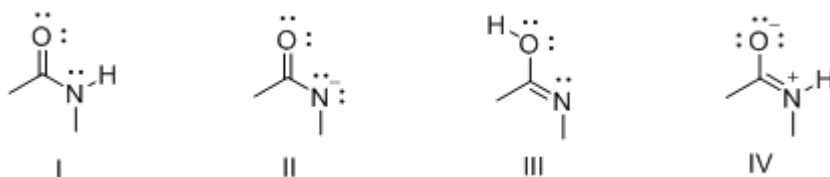
- A) I
- B) II
- C) III
- D) IV

51) What is the correct rank of the following compounds in order of decreasing acidity?



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

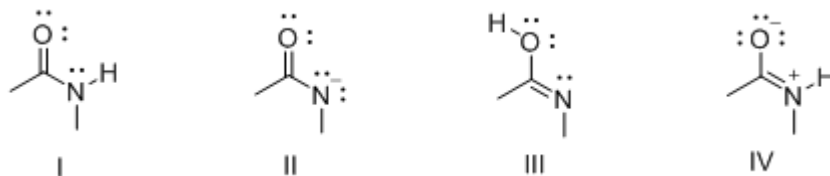
52) Consider the following structures I-IV. Which two species represent a conjugate acid-



base pair?

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

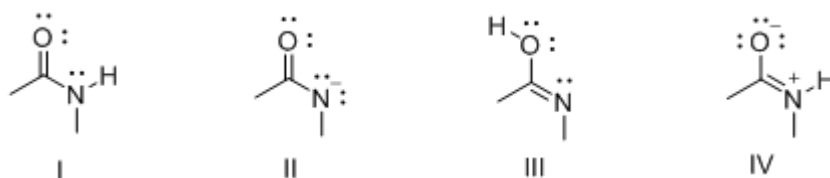
53) Consider the following structures I-IV. Which two species represent resonance



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

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) $\text{CH}_4 < \text{H}_2\text{O} < \text{NH}_3$
- B) $\text{H}_2\text{O} < \text{NH}_3 < \text{CH}_4$
- C) $\text{NH}_3 < \text{CH}_4 < \text{H}_2\text{O}$
- D) $\text{CH}_4 < \text{NH}_3 < \text{H}_2\text{O}$

58) Which of the following will proceed as written?

- A) $\text{CH}_3\text{ONa} + \text{HCl} \rightarrow \text{CH}_3\text{OH} + \text{NaCl}$
- B) $\text{CH}_3\text{OH} + \text{NaCl} \rightarrow \text{NaOEt} + \text{HCl}$
- C) $\text{CH}_3\text{OH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{O}^- + \text{H}_3\text{O}^+$
- D) $\text{CH}_3\text{OH} + \text{NH}_3 \rightarrow \text{CH}_3\text{O}^- + \text{NH}_4^+$

59) Which of the following would have the lowest pKa?

- A) $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
- B) $\text{CH}_3\text{CHClCH}_2\text{CH}_2\text{COOH}$
- C) $\text{CH}_3\text{CH}_2\text{CHClCH}_2\text{COOH}$
- D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHClCOOH}$

Answer Key

Test name: 002

- 1) D
- 2) B
- 3) B
- 4) C
- 5) A
- 6) B
- 7) B
- 8) C
- 9) D
- 10) C
- 11) D
- 12) D
- 13) C
- 14) D
- 15) D
- 16) B
- 17) A
- 18) D
- 19) B
- 20) D
- 21) C
- 22) B
- 23) A
- 24) D
- 25) B
- 26) A

- 27) C
- 28) C
- 29) B
- 30) A
- 31) D
- 32) A
- 33) B
- 34) C
- 35) D
- 36) B
- 37) D
- 38) D
- 39) B
- 40) D
- 41) A
- 42) B
- 43) B
- 44) A
- 45) D
- 46) B
- 47) A
- 48) D
- 49) A
- 50) B
- 51) C
- 52) A
- 53) C
- 54) B
- 55) C
- 56) B

57) D

58) A

59) D