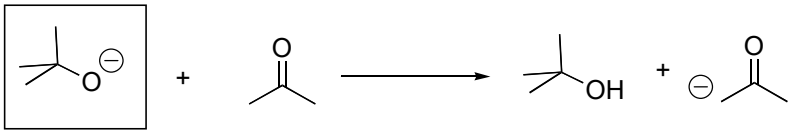
Chapter 3

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

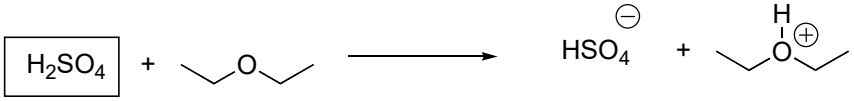
1. Is the indicated compound acting an acid or a base in the following reaction?



A. Acid
B. Base
C. Neither
Ans: B

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

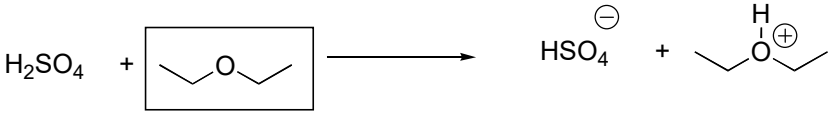
2. Is the indicated compound acting an acid or a base in the following reaction?



A. Acid
B. Base
C. Neither
Ans: A

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

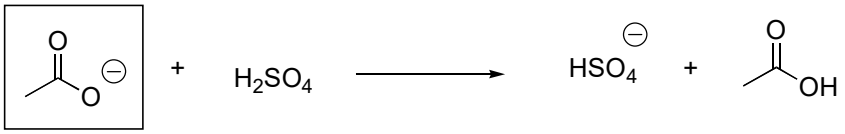
3. Is the indicated compound acting an acid or a base in the following reaction?



A. Acid
B. Base
C. Neither
Ans: B

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

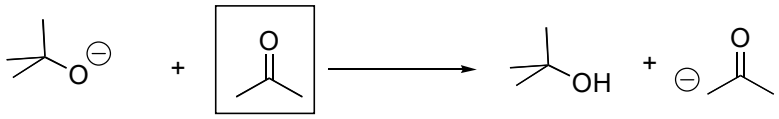
4. Is the indicated compound acting an acid or a base in the following reaction?



A. Acid
B. Base
C. Neither
Ans: B

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

5. Is the indicated compound acting an acid or a base in the following reaction?



A. Acid
B. Base
C. Neither
Ans: A

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Medium

6. Provide a definition of a Bronsted-Lowry acid.
Ans: A Bronsted-Lowry acid is a proton donor

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Medium

7. What is the conjugate base of the following acid?
H_2O
Ans: HO^-

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Medium

8. What is the conjugate base of the following acid?
NH_4^+
Ans: NH_3

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

9. Which of the following is the conjugate base of the following acid?

A.  B.  C.  D. 

Ans: A

Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Easy

10. Which of the following is the conjugate acid of the following base?

A.  B.  C.  D. 

Ans: C

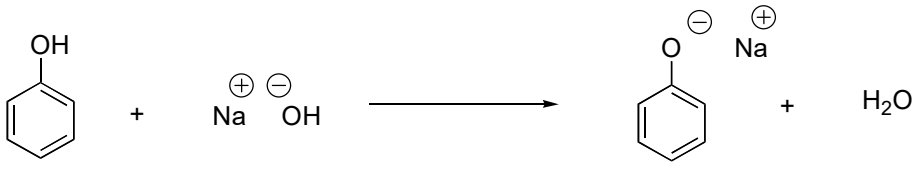
Topic: Introduction to Bronsted-Lowry Acids and Bases
Section 3.1
Difficulty Level: Medium

11. What is an ionic reaction?

Ans: It is a reaction in which ions participate as the reactants.

Topic: Curved Arrow Notation
Section 3.2
Difficulty Level: Hard

12. In the following reaction, identify the acid and base as well as the conjugate acid and base.

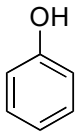


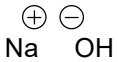
Ans: Acid, Base, Conjugate Base, Conjugate Acid

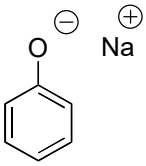
Topic: Curved Arrow Notation

Section 2
Difficulty Level: Easy

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

A. 

B. 

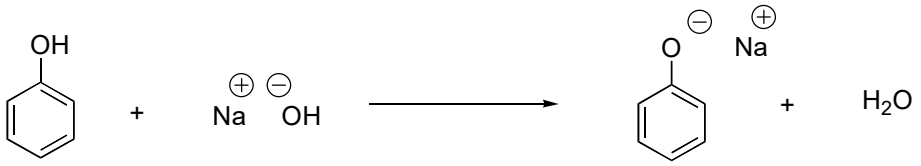
C. 

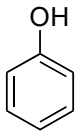
D. H_2O

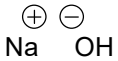
Ans: D

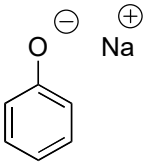
Topic: Curved Arrow Notation
Section 2
Difficulty Level: Easy

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



A. 

B. 

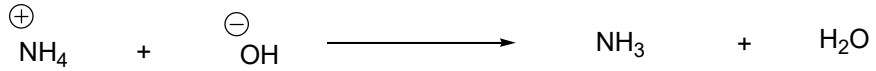
C. 

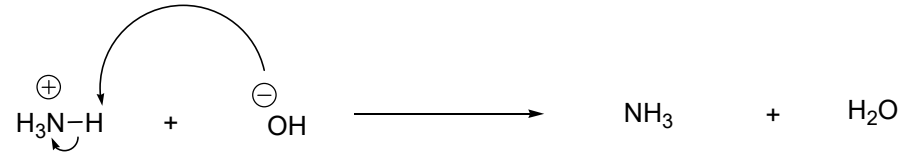
D. H_2O

Ans: C

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Medium

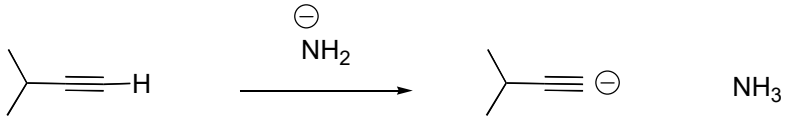
15. Draw arrows to indicate the movement of electrons in the following reaction.

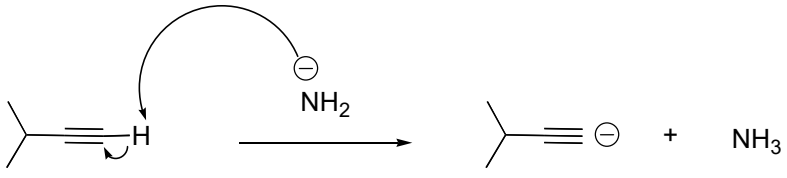


Ans: 

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Medium

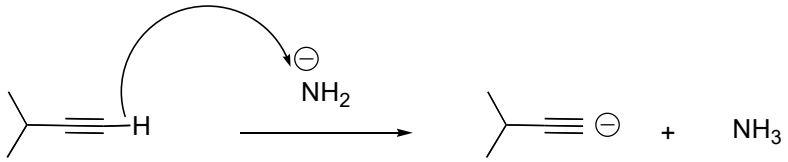
16. Draw arrows to indicate the movement of electrons in the following reaction.



Ans: 

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Easy

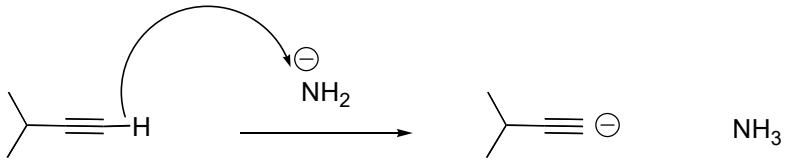
17. What is wrong with the following arrow?



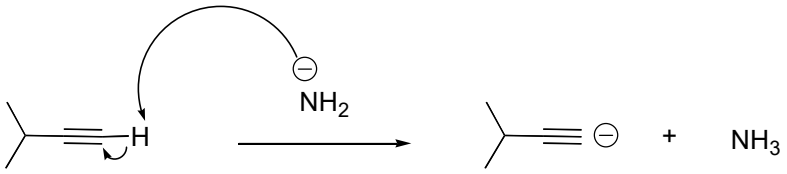
A. It should start on the alkyne carbon.
B. It should start on a hydrogen attached to the nitrogen.
C. It should start on the anion on nitrogen, end at the H on the alkyne, and a second arrow should start at the bond between the C and H on the alkyne and end on the terminal carbon of the alkyne.
D. There should be two arrows – one from nitrogen and one from the alkyne carbon.
Ans: C

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Hard

18. What is wrong with the following arrow? Please draw the correct mechanism.

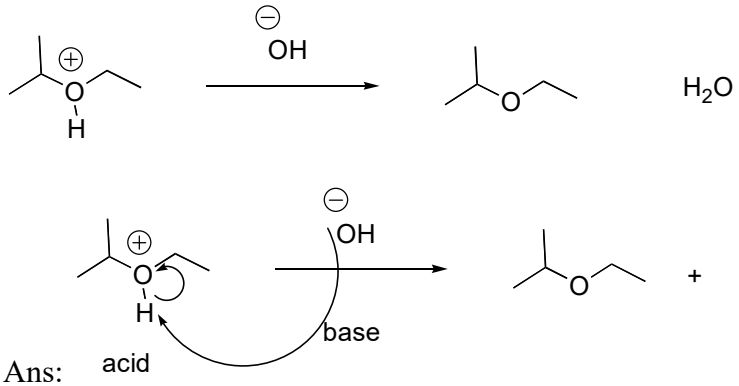


Ans: The arrow is going the wrong direction. It should start at the source of electron density, as in the following:



Topic: Curved Arrow Notation
Section 2
Difficulty Level: Medium

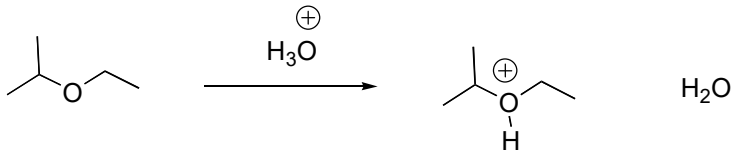
19. Identify the acid and the base and draw the mechanism.

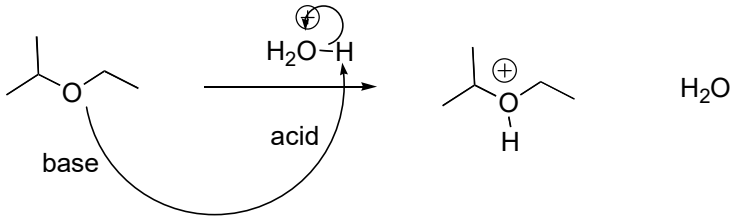


Ans:

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Medium

20. Identify the acid and the base and draw the mechanism.

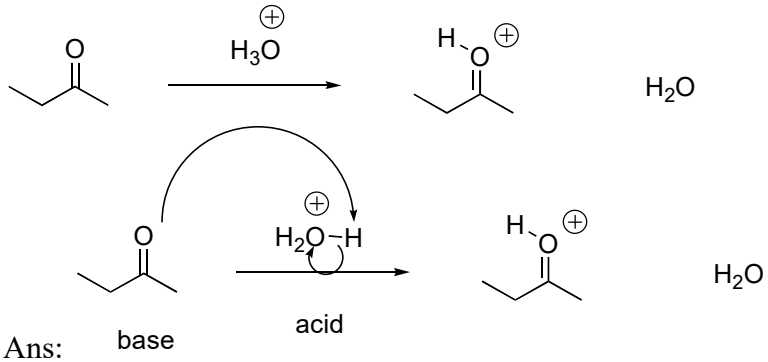




Ans:

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Medium

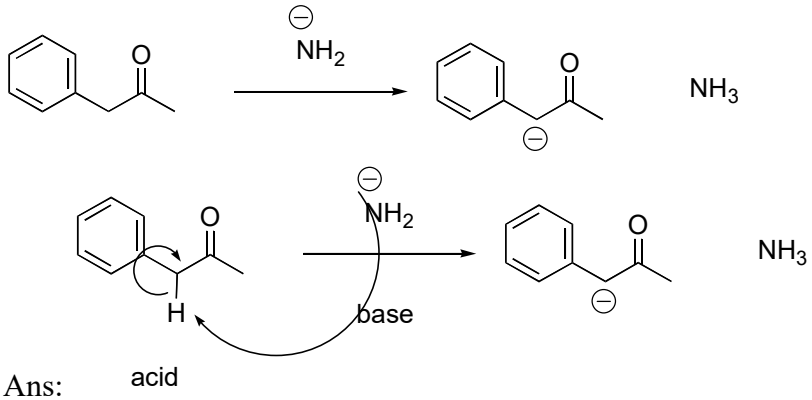
21. Identify the acid and the base and draw the mechanism.



Ans:

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Hard

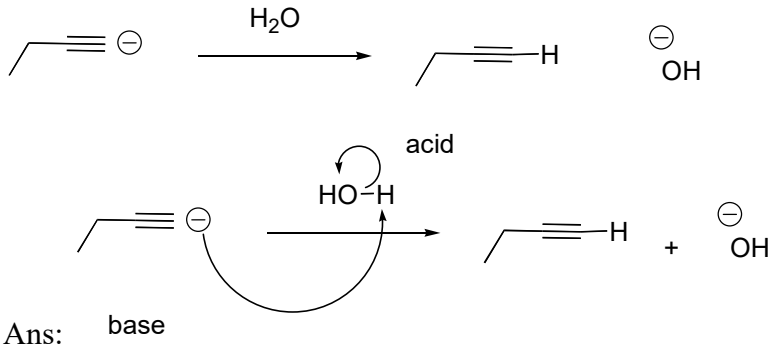
22. Identify the acid and the base and draw the mechanism.



Ans:

Topic: Curved Arrow Notation
Section 2
Difficulty Level: Medium

23. Identify the acid and the base and draw the mechanism.



Ans:

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Easy

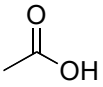
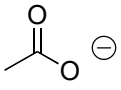
24. Which of the following is the most acidic?

A. HCl B.  C. H_2O D. NH_3

Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Easy

25. Which of the following is the most acidic?

A.  B.  C.  D. NH_3

Ans: B

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Easy

26. Which of the following is most basic?

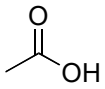
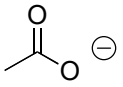
A. HCl B.  C. H_2O D. NH_3

Ans: D

Topic: Quantitative Bronsted-Lowry Acidity
Section 3

Difficulty Level: Easy

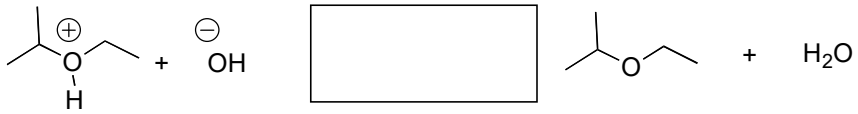
27. Which of the following is the most basic?

A. 
B. 
C. 
D. NH_3

Ans: D

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

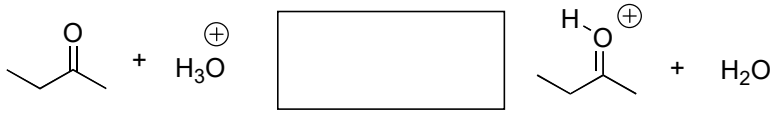
28. Which side will the following acid-base reaction favor?



A. The right
B. The left
C. Neither
Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

29. Which side will the following acid-base reaction favor?



A. The right
B. The left
C. Neither
Ans: B

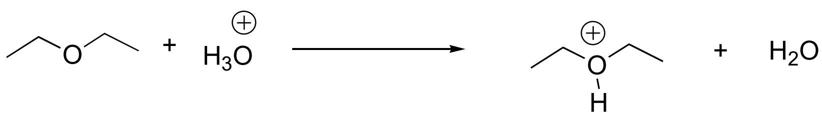
Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

30. Which side will the following acid-base reaction favor?

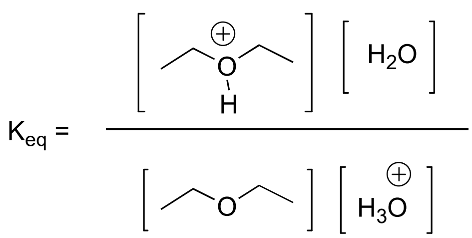
A. The right
B. The left
C. Neither
Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Hard

31. Provide the correct K_{eq} for the following reaction.

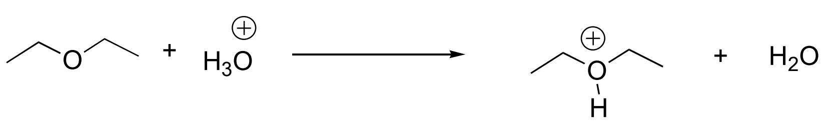


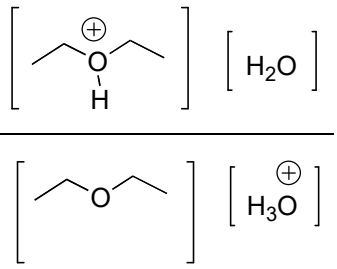
Ans:

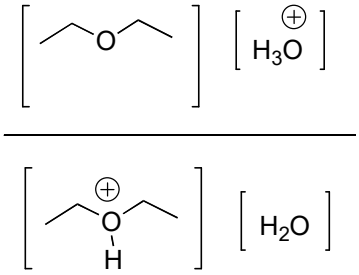


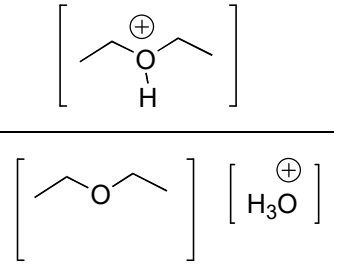
Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

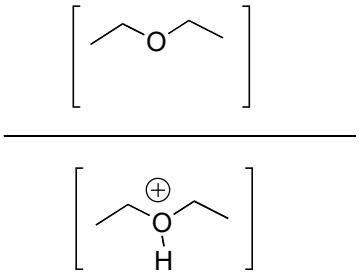
32. Which of the following is the correct K_{eq} for the following reaction?



A. 

B. 

C. 

D. 

Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

33. What is the difference between Ka and pKa?
Ans: pKa = -logKa

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

34. Which side will the following acid-base reaction favor?

A. The right
B. The left
C. Neither
Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

35. Which side will the following acid-base reaction favor?

A. The right
B. The left
C. Neither
Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

36. Which side will the following acid-base reaction favor?

A. The right
B. The left
C. Neither
Ans: A

Topic: Quantitative Bronsted-Lowry Acidity
Section 3
Difficulty Level: Medium

37. Which side will the following acid-base reaction favor?

A. The right
B. The left
C. Neither
Ans: A

Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

38. Which of the following is the strongest acid?

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

Ans: D

Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

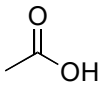
39. Which of the following is the strongest acid?

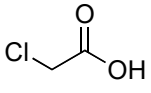
A. HOMe
B. HSMe
C. HSeMe
D. HTeMe

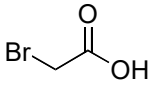
Ans: D

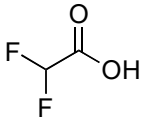
Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

40. Which of the following is the strongest acid?

A. 

B. 

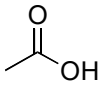
C. 

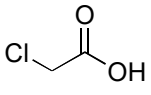
D. 

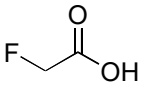
Ans: D

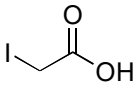
Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

41. Which of the following is the strongest acid?

A. 

B. 

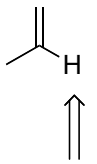
C. 

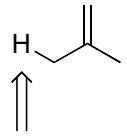
D. 

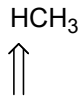
Ans: C

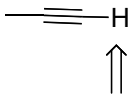
Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

42. Which of the following indicated H's is the most acidic?

A. 

B. 

C. 

D. 

Ans: D

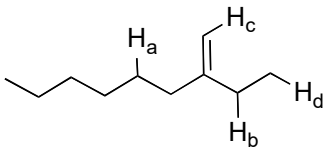
Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Medium

43. What are two factors that influence the acidity of a compound?

Ans: 1. Type of atom charge is on, 2. Resonance of the conjugate base anion, 3. Inductive effect, 4. Hybridization of the orbital

Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

44. Identify the most acidic proton on the following compound.

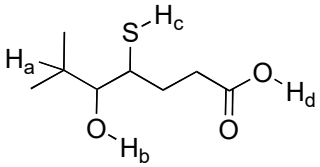


A. Ha
B. Hb
C. Hc
D. Hd

Ans: B

Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Easy

45. Identify the most acidic proton on the following compound.



A. Ha
B. Hb
C. Hc
D. Hd

Ans: D

Topic: Qualitative Bronsted-Lowry Acidity
Section 4
Difficulty Level: Hard

46. Why is acetic acid more acidic than ethanol when the acidic proton in both cases is attached to oxygen?

Ans: The conjugate base of acetic acid has resonance delocalization of the anion, which is not the case in the conjugate base of ethanol.

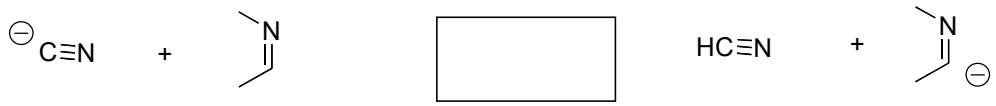
Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

47. Predict the position of equilibrium for the following reaction.

A. To the left
B. To the right
C. No reaction
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

48. Predict the position of equilibrium for the following reaction.



A. To the left
B. To the right
C. No reaction
Ans: A

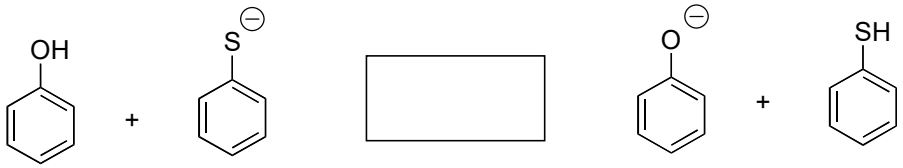
Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

49. Predict the position of equilibrium for the following reaction.

A. To the left
B. To the right
C. No reaction
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

50. Predict the position of equilibrium for the following reaction.



A. To the left
B. To the right
C. No reaction
Ans: A

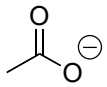
Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

51. Could water protonate the following compound?

A. Yes
B. No
Ans: A

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

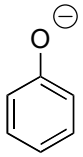
52. Could water protonate the following compound?



A. Yes
B. No
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

53. Could water protonate the following compound?



A. Yes
B. No
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

54. Could water protonate the following compound?
$HOSO_3^-$

A. Yes
B. No
Ans: A

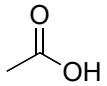
Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

55. Could hydroxide deprotonate CH_4?

A. Yes
B. No
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

56. Could hydroxide deprotonate the following compound?



A. Yes
B. No
Ans: A

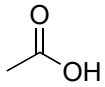
Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

57. Could ammonia (NH_3) deprotonate CH_4?

A. Yes
B. No
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

58. Could ammonia (NH_3) deprotonate the following compound?



A. Yes
B. No
Ans: A

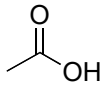
Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

59. Could the amide anion ($^-NH_2$) deprotonate CH_4?

A. Yes
B. No
Ans: B

Topic: Position of Equilibrium
Section 5
Difficulty Level: Easy

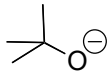
60. Could the amide anion ($^-NH_2$) deprotonate the following compound?



A. Yes
B. No
Ans: A

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

61. Can this base exist in water?



A. Yes
B. No
Ans: B

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

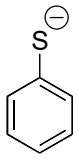
62. Can this base exist in water?

Na_2CO_3

A. Yes
B. No
Ans: B

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

63. Can this base exist in water?



A. Yes
B. No
Ans: A

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

64. Can this base exist in water?

Et_3N

A. Yes
B. No
Ans: A

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

65. Can this base exist in water?

A. Yes
B. No
Ans: B

Topic: Choice of Solvent
Section 6
Difficulty Level: Hard

66. Explain the leveling effect.

Ans: The leveling effect says that the strongest acid or base you can have in a given solvent is the protonated version of that solvent (for acids) or the deprotonated version of that solvent (for bases).

Topic: Choice of Solvent
Section 6
Difficulty Level: Medium

67. What is the strongest base that can exist in water?

Ans: Hydroxide

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

68. Can this base exist in hexane?

A. Yes
B. No
Ans: A

Topic: Choice of Solvent
Section 6
Difficulty Level: Easy

69. Can this base exist in liquid ammonia?

A. Yes
B. No
Ans: B

Topic: Counterions

Section 8
Difficulty Level: Medium

70. What is a cation?

Ans: A positively charged ion.

Topic: Counterions
Section 8
Difficulty Level: Easy

71. What is the counterion to methoxide in the following compound?
NaOMe
A. Na^+
B. O
C. Me
D. OMe
Ans: A

Topic: Counterions
Section 8
Difficulty Level: Easy

72. What is the counterion of iodide in the following compound?
AgI
A. I
B. Ag^+
C. gI
D. AI
Ans: B

Topic: Counterions
Section 8
Difficulty Level: Easy

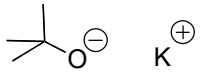
73. What is the counterion of the t-butyl carbanion in the following compound?

A. tert-butyl
B. C
C. Li^+
D. H
Ans: C

Topic: Counterions
Section 8

Difficulty Level: Easy

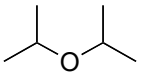
74. What is the counterion of t-butoxide in the following compound?



A. K^+
B. O
C. tert-butoxide
D. tert-butyl
Ans: A

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

75. Into which of the following categories does the following compound belong?



A. Bronsted-Lowry Acid
B. Bronsted-Lowry Base
C. Lewis Acid
D. Lewis Base

Ans: D and B

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

76. Into which of the following categories does the following compound belong?
BF_3

A. Bronsted-Lowry Acid
B. Bronsted-Lowry Base
C. Lewis Acid
D. Lewis Base

Ans: C

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

77. Into which of the following categories does the following compound belong?
GaF_3

A. Bronsted-Lowry Acid
B. Bronsted-Lowry Base
C. Lewis Acid
D. Lewis Base

Ans: C

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

78. Into which of the following categories does the following compound belong?

A. Bronsted-Lowry Acid
B. Bronsted-Lowry Base
C. Lewis Acid
D. Lewis Base

Ans: D and B

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

79. Into which of the following categories does the following compound belong?

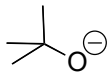
Me_3P

A. Bronsted-Lowry Acid
B. Bronsted-Lowry Base
C. Lewis Acid
D. Lewis Base

Ans: D

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

80. Which is the best descriptor for the following compound?

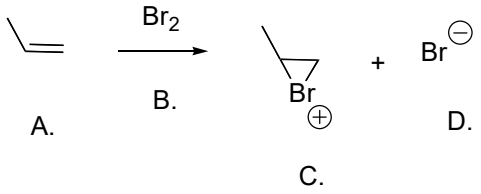


A. Bronsted-Lowry Acid
B. Bronsted-Lowry Base
C. Lewis Acid
D. Lewis Base

Ans: B

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

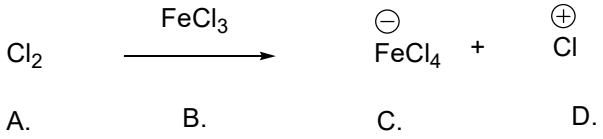
81. Identify the Lewis acid in the following reaction.



Ans: B

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

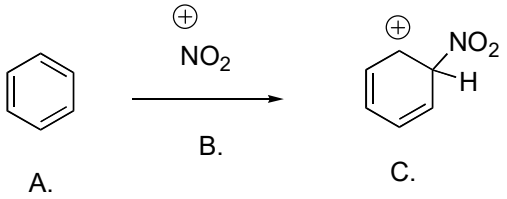
82. Identify the Lewis acid in the following reaction.



Ans: B

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

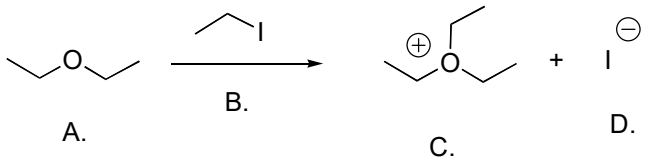
83. Identify the Lewis acid in the following reaction.



Ans: B

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

84. Identify the Lewis base in the following reaction.

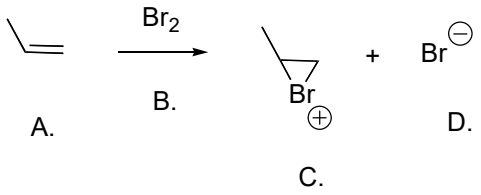


Ans: A

Topic: Lewis Acids and Bases

Section 9
Difficulty Level: Easy

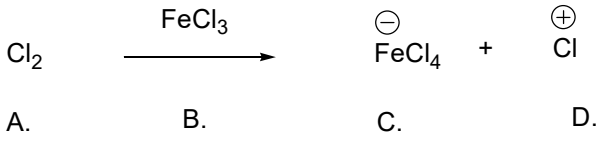
85. Identify the Lewis base in the following reaction.



Ans: A

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

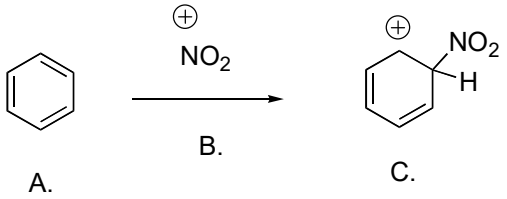
86. Identify the Lewis base in the following reaction.



Ans: A

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Easy

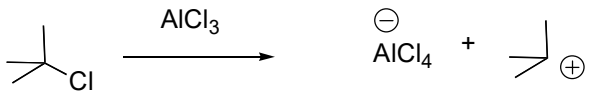
87. Identify the Lewis base in the following reaction.

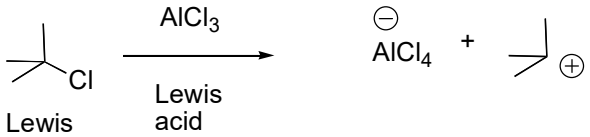


Ans: A

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Medium

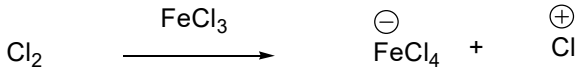
88. In the following reaction, identify the Lewis acid and the Lewis base.

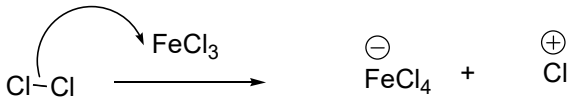


Ans: 

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Hard

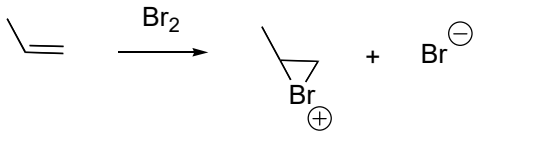
89. For the following reaction, draw the mechanism.

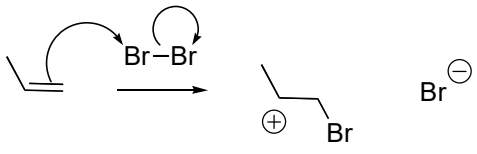


Ans: 

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Hard

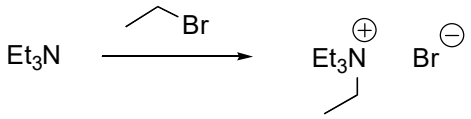
90. For the following reaction, draw the mechanism.



Ans: 

Topic: Lewis Acids and Bases
Section 9
Difficulty Level: Hard

91. For the following reaction, draw the mechanism.



Ans: