Package Title: Brown/Poon Test Bank
Course Title: Brown/Poon 6e
Chapter Number: 2

Question type: Multiple Choice

Section 2.1
Difficulty Level: Easy
1. Identify the Arrhenius acids:

I. HCl II. NaOH III. HNO_3 IV. $Ca(OH)_2$

a) I, II
b) I, III, IV
c) II, IV
d) I, III

Answer: d

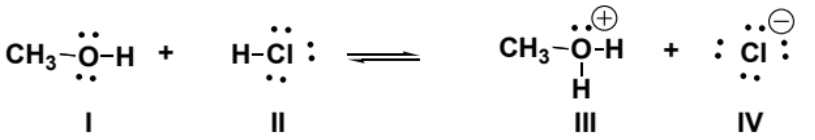
Section 2.1
Difficulty Level: Easy
2. Identify the Arrhenius bases:

I. NH_3 II. NaOH III. HI IV. $Ca(OH)_2$

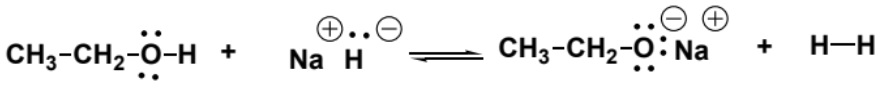
a) I, II
b) II, IV
c) I, III
d) I, II, IV

Answer: b

Section 2.2
Difficulty Level: Easy
3. Identify the Brønsted-Lowry acids in the following reactions.



I II III IV

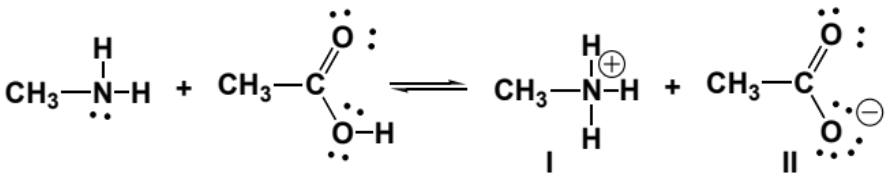


V VI VII VIII

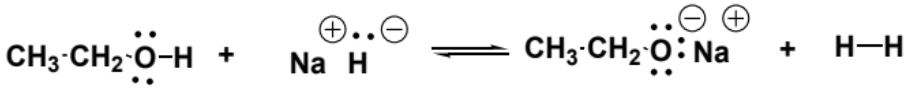
a) I, III,VI, VII
b) II, VI
c) I, IV, V, VIII
d) II, III, V, VIII

Answer: d

Section 2.2
Difficulty Level: Easy
4. Identify the conjugate bases in the following reactions.



I II



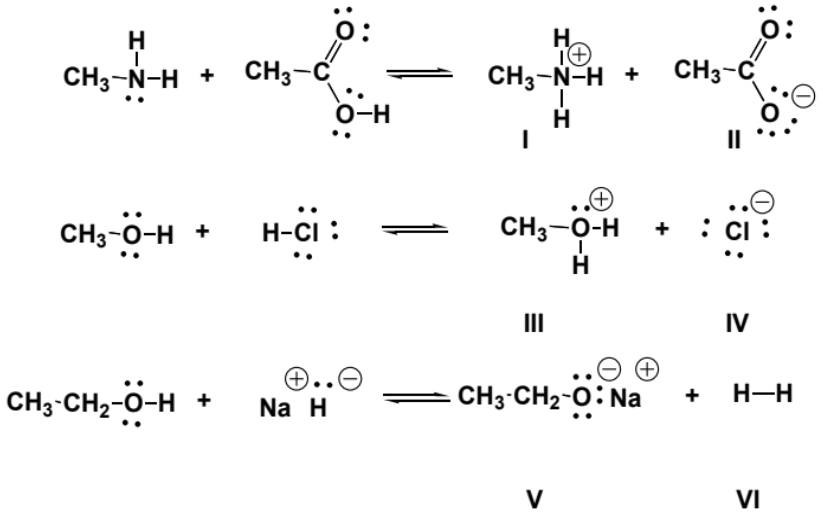
III IV

V VI

a) II, III, VI
b) I, IV, V
c) I, III, V
d) II, IV

Answer: a

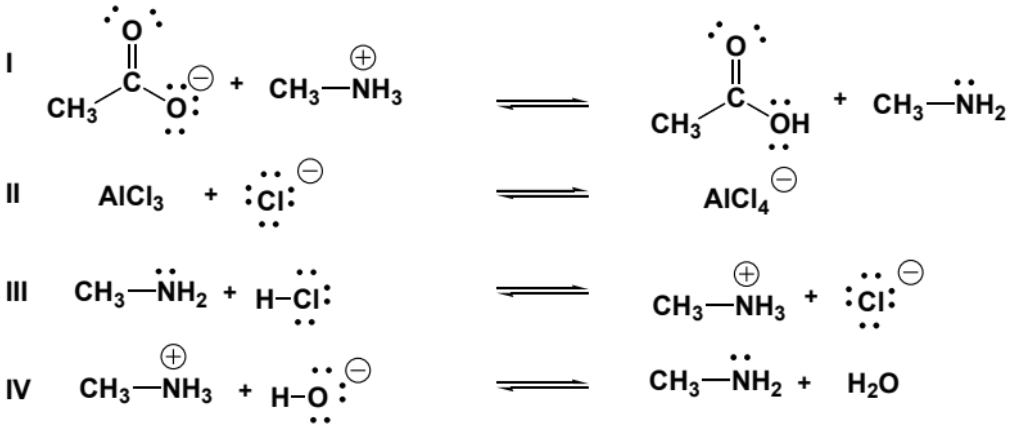
Section 2.2
Difficulty Level: Medium
5. Identify the conjugate acids in the following reactions.



a) I, IV, VI
b) I, III, VI
c) II, IV, V
d) I, III, V

Answer: b

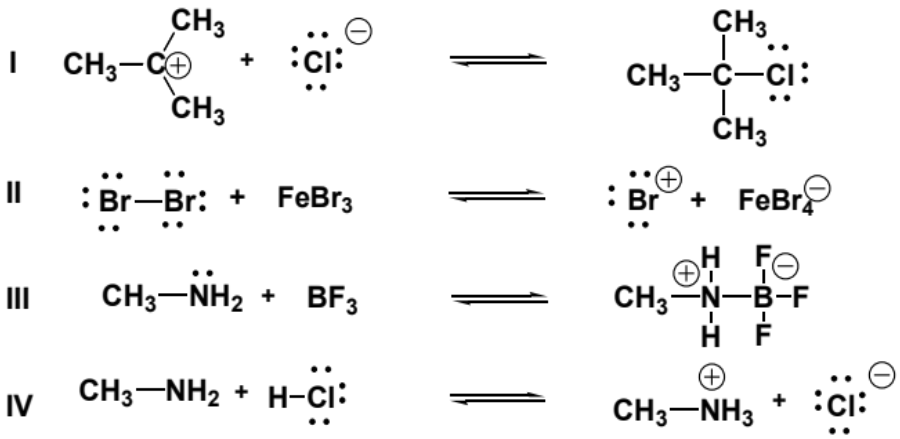
Section 2.2
Difficulty Level: Medium
6. Which are acid-base reactions according to Brønsted-Lowry theory?



a) I, III
b) I, II, II, IV
c) I, II, III
d) I, III, IV

Answer: d

Section 2.2
Difficulty Level: Hard
7. Which are acid-base reactions according to the Brønsted-Lowry theory?



a) IV
b) I, III, IV
c) II, III
d) I, IV

Answer: a

Section 2.3
Difficulty Level: Easy
8. Which of these has the lowest numerical value of pKa and is therefore the strongest acid?

a) CH_3COOH
b) H_2O
c) NH_4^+
d) HCl

Answer: d

Section 2.3
Difficulty Level: Medium
9. Arrange the following species in order of increasing basicity (weakest to strongest).

I. OH^- II. Cl^- III. H_2O IV. NH_3

a) II, III, IV, I
b) III, I, IV, II
c) IV, I, II, III
d) III, IV, I, II

Answer: a

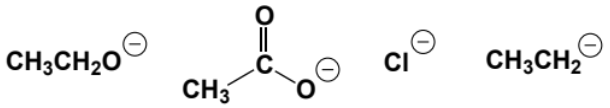
Section 2.3
Difficulty Level: Medium
10. Arrange the following species in the order of increasing acidity (weakest to strongest).

I. H_2O II. H_3O^+ III. NH_4^+

a) II, III, I
b) I, II, III
c) III, II, I
d) I, III, II

Answer: d

Section 2.3
Difficulty Level: Hard
11. Which ion is the strongest base?



I II III IV

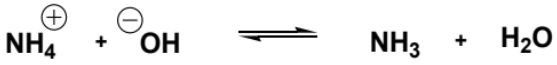
a) I
b) II
c) III
d) IV

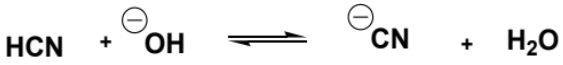
Answer: d

Section 2.4
Difficulty Level: Medium
12. Which equilibria have equilibrium constants greater than 1.0?

I 

II 

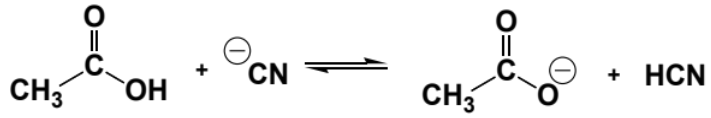
III 

IV 

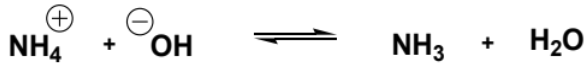
a) II, III
b) I, III, IV
c) III, IV
d) I, II, III

Answer: b

Section 2.3
Difficulty Level: Medium
13. Which equilibria have equilibrium constants smaller than 1.0?

I 

II 

III 

IV 

a) II
b) I, IV
c) III, IV
d) I

Answer: a

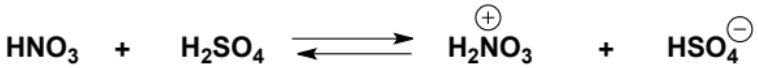
Section 2.4
Difficulty Level: Medium
14. What is the stronger acid in the following reaction if the equilibrium constant is approximately 10^8.

I II III IV

a) I
b) II
c) III
d) IV

Answer: a

Section 2.4
Difficulty Level: Medium
15. What is the strongest acid in the following reaction if the equilibrium constant is much less than 0.01?



I II III IV

a) I
b) II
c) III
d) IV

Answer: c

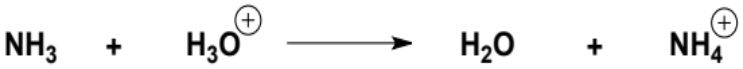
Section 2.4
Difficulty Level: Medium
16. Which statements about acid-base equilibria are true?

I. The pKa is the negative $\log_{10}$ of the acid equilibrium constant.
II. A stronger acid has a pKa with a smaller value than a weaker acid.
III. The stronger the base, the smaller the pKa of its conjugate acid.
IV. The Ka = K [HA].

a) I, III
b) I, II
c) I, II, III
d) II, III, IV

Answer: b

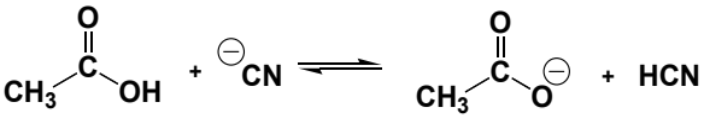
Section 2.2 and 2.4
Difficulty Level: Medium
17. What is the role of water in the following reaction?



a) acid
b) base
c) conjugate acid
d) conjugate base

Answer: d

Section 2.4
Difficulty Level: Hard
18. Which is the stronger base if the equilibrium lies to the right? (Sec. 2.4, HARD)



I II III IV

a) I
b) II
c) III
d) IV

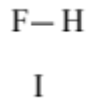
Answer: b

Section 2.5
Difficulty Level: Medium
19. List the bonds in order of increasing acidity (least to most).

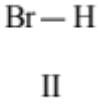
a) II, III, IV, I
b) III, I, II, IV
c) I, IV, II, III
d) IV, III, II, I

Answer: c

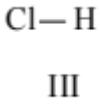
Section 2.5
Difficulty Level: Medium
20. List the bonds in order of decreasing acidity (most to least).



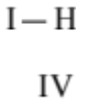
I



II



III

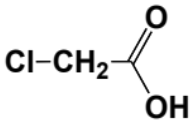


IV

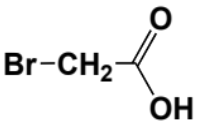
a) I, III, II, IV
b) IV, II, III, I
c) II, III, IV, I
d) I, II, III, IV

Answer: b

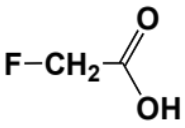
Section 2.5
Difficulty Level: Hard
21. Which is the order of decreasing acid strength of the following compounds (greatest first)?



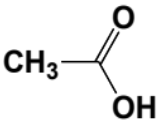
I



II



III

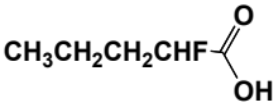


IV

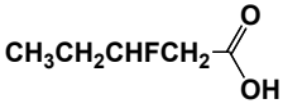
a) II, I, III, IV
b) III, IV, I, II
c) III, I, II, IV
d) IV, II, I, III

Answer: c

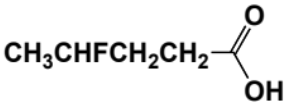
Section 2.5
Difficulty Level: Hard
22. Which is the order of increasing acid strength of the following compounds (least first)?



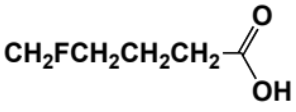
I



II



III

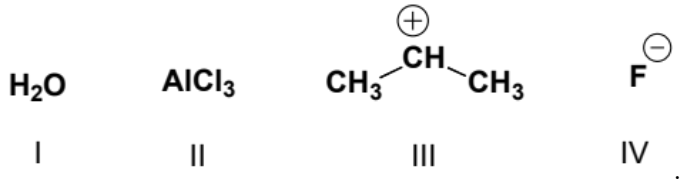


IV

a) I, III, II, IV
b) IV, III, II, I
c) II, I, III, IV
d) IV, III, I, II

Answer: b

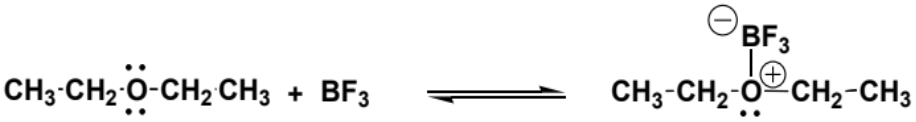
Section 2.6
Difficulty Level: Easy
23. Which substances are Lewis bases?



a) I, II
b) I, III
c) III, IV
d) I, IV

Answer: d

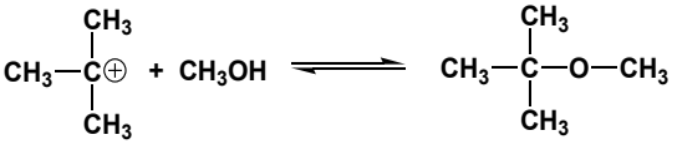
Section 2.6
Difficulty Level: Medium
24. What is the role of diethyl ether in the following reaction?



a) Lewis acid
b) Lewis base
c) Brønsted acid
d) Brønsted base

Answer: b

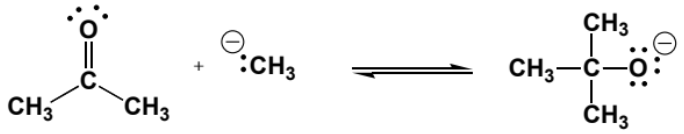
Section 2.6
Difficulty Level: Medium
25. What is the role of methanol (CH_3OH) in the following reaction?

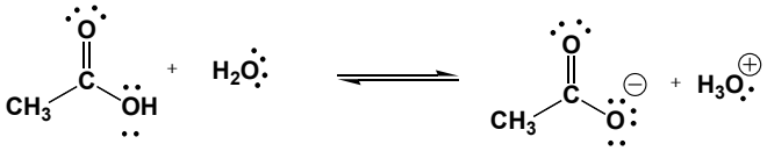


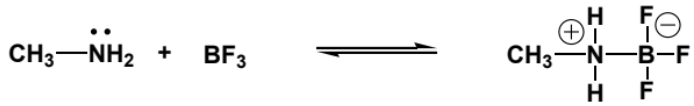
a) Lewis acid
b) Lewis base
c) Brønsted acid
d) Brønsted base

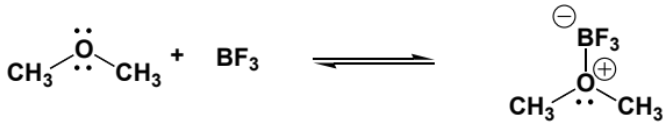
Answer: b

Section 2.6
Difficulty Level: Hard
26. Which are acid-base reactions according to Lewis theory but not according to the Brønsted-Lowry theory?

I 

II 

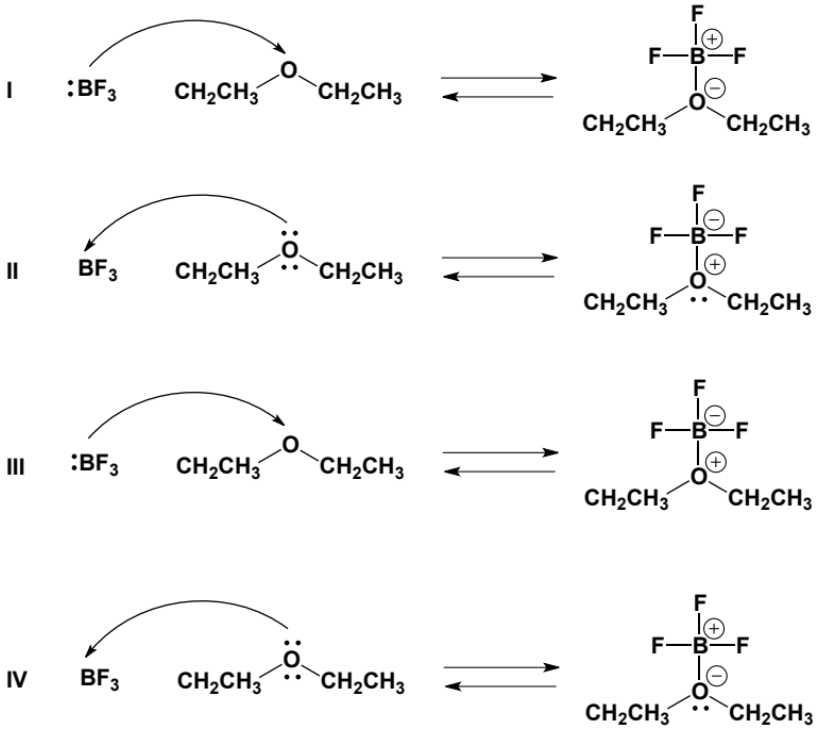
III 

IV 

a) I, II
b) III, IV
c) I, III, IV
d) I, II, III, IV

Answer: c

Section 2.6
Difficulty Level: Hard
27. Which is the proper reaction mechanism for the reaction of boron trifluoride and diethyl ether?
Assume that the charges are correct and add electron pairs, if needed. Also consider how many electrons should be in the outer shell of boron trifluoride to make it neutral.

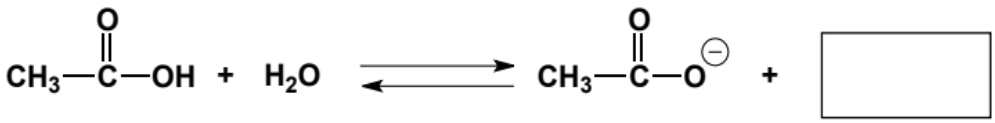


a) I
b) II
c) III
d) IV

Answer: b

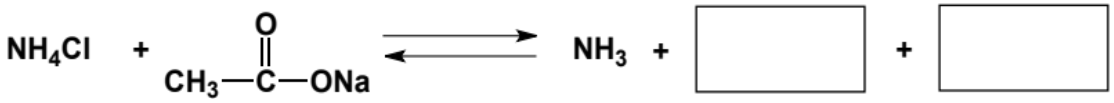
Question type: Fill-in-the-Blank

Section 2.2
Difficulty Level: Easy
28. Complete the following reaction.



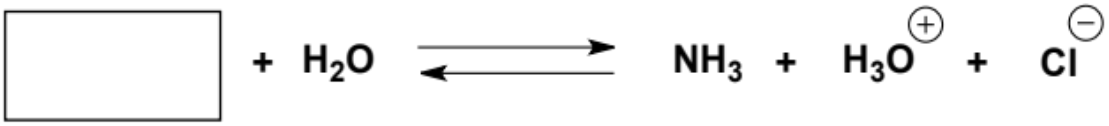
Answer: H_3O^+

Section 2.2
Difficulty Level: Easy
29. Complete the following reaction.



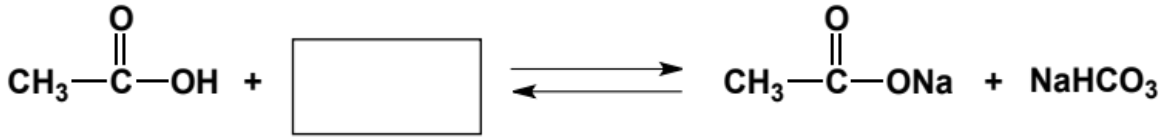
Answer: $CH_3COOH + NaCl$

Section 2.2
Difficulty Level: Easy
30. Complete the following reaction.



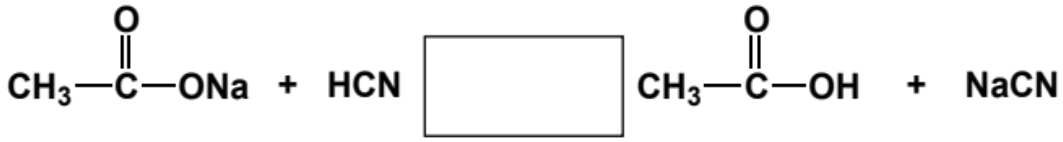
Answer: NH_4Cl

Section 2.2
Difficulty Level: Easy
31. Complete the following reaction.



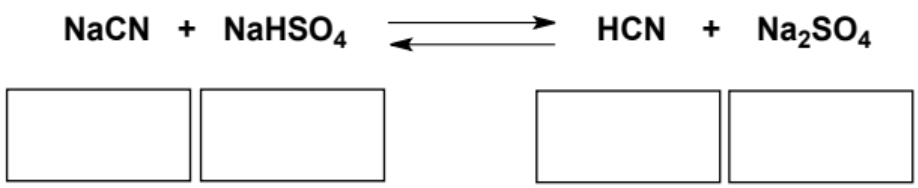
Answer: Na_2CO_3

Section 2.2
Difficulty Level: Medium
32. Complete the following reaction scheme with the appropriate equilibrium arrow (indicating the higher concentrations at equilibrium).



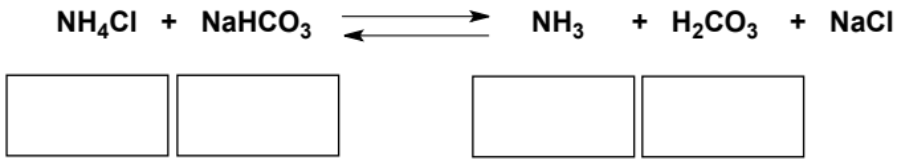
Answer: 

Section 2.2
Difficulty Level: Medium
33. Identify the acid, base, conjugate acid, conjugate base in the following reaction.



Answer: base, acid, conjugate acid, conjugate base

Section 2.2
Difficulty Level: Medium
34. Identify the acid, base, conjugate acid, conjugate base in the following reaction.



Answer: acid, base, conjugate base, conjugate acid

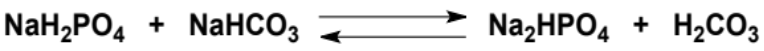
Section 2.3
Difficulty Level: Easy
35. The weaker the acid, the _____ the conjugate base.

Answer: stronger

Section 2.4
Difficulty Level: Easy
36. The higher concentration (reactants or products) at equilibrium will lie on the side of the _____ acid.

Answer: weaker

Section 2.4
Difficulty Level: Medium
37. Complete the following reaction scheme with the appropriate equilibrium arrow (indicating the higher concentrations at equilibrium).



Answer: 

Question type: True/False

Section 2.2
Difficulty Level: Easy
38. Brønsted-Lowry acids accept protons when reacting.

Answer: False

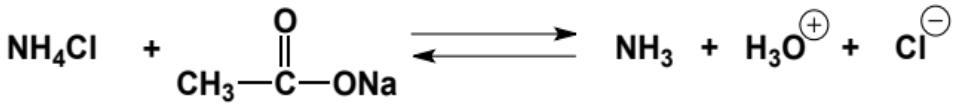
Section 2.3
Difficulty Level: Easy
39. The stronger acid has the larger (more positive) pK_a.

Answer: False

Section 2.3
Difficulty Level: Easy
40. Strong acids have weak conjugate bases.

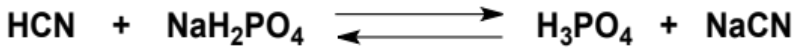
Answer: True

Section 2.4
Difficulty Level: Medium
41. The equilibrium constant will be greater than 1.0 for the following reaction



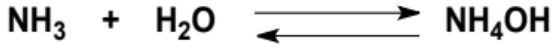
Answer: False

Section 2.4
Difficulty Level: Medium
42. The equilibrium constant will be greater than 1.0 for the following reaction



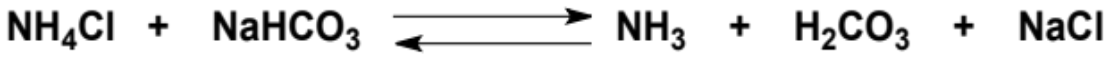
Answer: False

Section 2.2
Difficulty Level: Medium
43. Water acts as a Brønsted-Lowry base in the following reaction.



Answer: False

Section 2.2
Difficulty Level: Hard
44. Ammonia acts as a Brønsted-Lowry base in the following reaction.



Answer: True

Section 2.3
Difficulty Level: Medium
45. The strongest acid in the following list is sodium bicarbonate.

Answer: False

Section 2.5
Difficulty Level: Hard
46. The weakest acid in the following list is acetic acid.

Answer: True

Section 2.6
Difficulty Level: Easy
47. Lewis bases donate electrons when reacting.

Answer: True