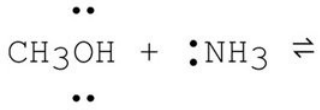
Organic Chemistry 8th edition Bruice Test Bank

SKU: 9780134042282-TEST-BANK

Organic Chemistry, 8e **(Bruice)**
Chapter 2 Acids and Bases: Central to Understanding Organic Chemistry

1) Which of the following is <u>not</u> a conjugate acid-base pair?
A) H_2O, HO^-
B) H_2O, H_3O^+
C) HSO_4^-, H_2SO_4
D) ^-OH, O^{2-}
E) NO_3^-, NO_2^-
Answer: E
Section: 2-1
MCAT: 1.4

2) What is the product formed from the following acid-base reaction when ammonia functions as a base? The equilibrium lies far to the reactants.



A) $CH_3O^- + {}^+NH_4$
B) $CH_2OH + {}^+NH_3$
C) $CH_3OH_2^+ + {}^-NH_2$
D) $CH_3NH_2 + H_2O$
E) $CH_4 + NH_2OH$
Answer: A
Section: 2-1
MCAT: 1.4

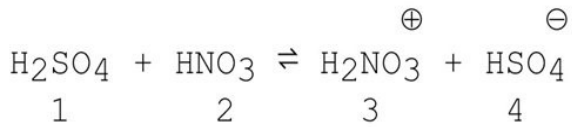
3) The conjugate acid of H_2O is
A) H_3O^-.
B) H_3O.
C) H_3O^+.
D) HO^-.
E) H_2O^+.
Answer: C
Section: 2-1
MCAT: 1.4

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank

4) Which of the following ions is the strongest acid?
A) H^-
B) HO^-
C) HSO_4^-
D) H_2O
E) H_3O^+
Answer: E
Section: 2-1
MCAT: 1.4

5) Which species act as bases in the following reaction?



A) 1 and 2
B) 3 and 4
C) 2 and 4
D) 1 and 3
E) 2 and 3
Answer: C
Section: 2-1
MCAT: 1.4

6) What is the conjugate acid of NH_3?
A) $^+NH_3$
B) ^-NH
C) $^+NH_4$
D) $^-NH_2$
E) $^+NH_2$
Answer: C
Section: 2-1
MCAT: 1.4

7) What is the conjugate acid of CH_3NH_2?
A) $CH_3NH_3^+$
B) CH_3NH^-
C) NH_4^+
D) NH_2^-
Answer: A
Section: 2-1
MCAT: 1.4

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank

8) What is the conjugate base of CH_3NH_2?

A) $CH_3NH_3^+$

B) CH_3NH^-

C) NH_4^+

D) NH_2^-

Answer: B
Section: 2-1

9) Give the conjugate acid and the conjugate base for $HSO4^-$:
Answer: conjugate acid: H_2SO_4

conjugate base: SO_4^{2-}

Section: 2-1
MCAT: 1.4

10) Write a completed equation for the acid-base pair shown below.
$HCO_2H + {}^-NH_2 \rightarrow$

Answer: $HCO_2H + {}^-NH_2 \rightarrow HCO_2^- + NH_3$
Section: 2-1
MCAT: 1.4

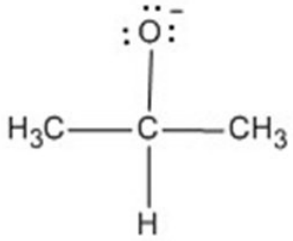
11) What is the pH of a 0.1 M solution of HCl? (Note: pK_a for HCl is -6.)
A) 6
B) -6
C) 1
D) -8
E) -1
Answer: C
Section: 2-2
MCAT: 1.4
GLO: G2, G4

12) If H_2O has a pK_a value of 15.7 and HF has a pK_a value of 3.2, which is a stronger base, HO^- or F^-? Explain.
Answer: HO^- is a stronger base than F^- because HF is a stronger acid than H_2O, and the stronger the acid the weaker its conjugate base.
Section: 2-2
MCAT: 1.4
GLO: G2

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank

13) 2-Propanol is shown below. Draw the structure of its conjugate base.
$(CH_3)_2CHOH$
Answer:



Section: 2-3

14) Which of the following is the strongest acid?
A) CH_3OH
B) $CH_3OH_2^+$
C) H_2N^-
D) CH_3NH_2
E) $CH_3NH_3^+$
Answer: B
Section: 2-6
GLO: G2

15) The pKa of CH_3COOH is 4.8 and the pKa of HCOOH is 3.8. Given this information, one knows that
A) CH_3COOH completely ionizes in water.
B) HCOOH is a weaker acid than CH_3COOH.
C) $HCOO^-$ is a weaker base than CH_3COO^-.
D) CH_3COOH reacts with HO^- while HCOOH does not.
E) HCOOH reacts with HO^- while CH_3COOH does not.
Answer: C
Section: 2-6
MCAT: 20.2

16) Which of the following is the strongest acid?
A) HF
B) H_2O
C) **:** NH_3
D) CH_4
E) CH_3OH
Answer: A
Section: 2-6
MCAT: 1.4

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank

17) Which of the following is the strongest acid?
A) CH_3CH_2OH
B) CH_3OCH_3
C) $CH_3—NH—CH_3$
D) $CH_3—C{\equiv}CH$
E) $CH_3—CH{=}CH_2$
Answer: A
Section: 2-6
MCAT: 1.4

18) Consider the set of compounds, NH_3, HF, and H_2O. Rank these compounds in order of increasing acidity and discuss your rationale.
Answer: $NH_3 < H_2O < HF$
When determining relative acidity, it is often useful to look at the relative basicity of the conjugate bases. The stronger the acid, the weaker (more stable, less reactive) the conjugate base. In this case, one would look at the relative basicity of F^-, OH^-, and NH_2^-. The relative strengths of these species can be gauged based on the electronegativity of the charged atom in each base. Since fluorine is the most electronegative, F^- is the most stable, least reactive base in the group. This means that its conjugate acid, HF, is the strongest.
Section: 2-6
MCAT: 1.4
GLO: G2

19) Identify the compound with the highest pK_a.
A) CH_3NH_2
B) CH_3OH
C) CH_3COOH
D) H_2O
E) $CH_3NH_3^+$
Answer: A
Section: 2-6
MCAT: 1.4
GLO: G2

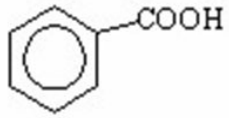
20) Identify the compound with the highest pK_a.
A) CH_3CH_3
B) HCCH
C) CH_2CH_2
D) CH_3OH
E) CH_3NH_2
Answer: A
Section: 2-6
MCAT: 1.4

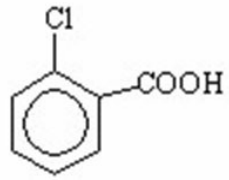
Copyright © 2017 Pearson Education, Inc.

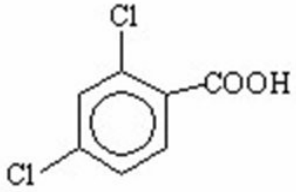
Organic Chemistry 8th edition Bruice Test Bank

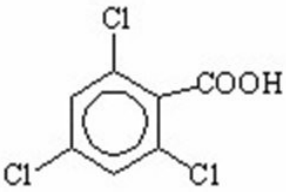
21) Identify the most acidic carboxylic acid.
A) ICH_2COOH
B) $BrCH_2COOH$
C) CH_3COOH
D) FCH_2COOH
E) $ClCH_2COOH$
Answer: D
Section: 2-7
MCAT: 1.4, 20.2

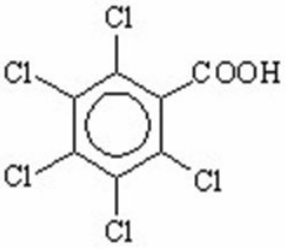
22) Which of the following is the strongest acid?

I. 

II. 

III. 

IV. 

V. 

A) I
B) II
C) III
D) IV
E) V
Answer: E
Section: 2-7
MCAT: 1.4, 20.2

23) Explain why **:** NF_3 is a weaker base than **:** NH_3.
Answer: Fluorine has an electron withdrawing effect that reduces the availability of the pair of electrons on nitrogen. Thus the basicity of **:** NF_3 is less than that of **:** NH_3.
Section: 2-7
MCAT: 1.4
GLO: G2

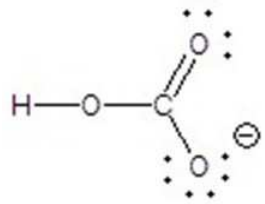
Copyright © 2017 Pearson Education, Inc.

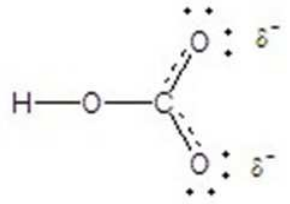
Organic Chemistry 8th edition Bruice Test Bank

24) Would you predict trifluoromethanesulfonic acid, CF_3SO_3H, to be a stronger or weaker acid than methanesulfonic acid, CH_3SO_3H? Explain your reasoning.
Answer: Trifluoromethanesulfonic acid is a stronger acid. Compare the strengths of the conjugate bases and remember that the weaker the base, the stronger the conjugate acid. In the case of the trifluoro derivative, the presence of the highly electronegative fluorine atoms serves to delocalize the negative charge to a greater extent. This additional delocalization makes trifluoromethanesulfonate a weaker base.
Section: 2-7
MCAT: 1.4

25) Which of the following anions, $CH_3CHBrCO_2^-$ or $CH_3CHFCO_2^-$ is the stronger base? Explain your choice.
Answer: $CH_3CHBrCO_2^-$ is the stronger base. The more electronegative F atom can more effectively delocalize the negative charge via induction. This greater delocalization stabilizes $CH_3CHFCO_2^-$ relative to $CH_3CHBrCO_2^-$ and makes it a weaker base.
Section: 2-7
MCAT: 1.4, 20.2
GLO: G2

26) Draw a resonance contributor and the resonance hybrid for $HOCO_2^-$.
Answer: resonance contributor: resonance hybrid:





Section: 2-8
MCAT: 20.8

27) The pKa of CH_3COOH is 4.8. If the pH of an aqueous solution of CH_3COOH and CH_3COO^- is 4.8, then one knows
A) CH_3COOH is completely ionized.
B) $[CH_3COOH] > [CH_3COO^-]$.
C) $[CH_3COOH] = [CH_3COO^-]$.
D) $[CH_3COOH] < [CH_3COO^-]$.
E) CH_3COOH is completely unionized.
Answer: C
Section: 2-10
GLO: G2, G4

Copyright © 2017 Pearson Education, Inc.

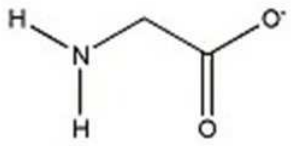
Organic Chemistry 8th edition Bruice Test Bank

28) When a small amount of hexanoic acid [$CH_3(CH_2)_4CO_2H$, pKa~4.8], is added to a separatory funnel which contains the organic solvent diethyl ether and water with a pH of 2.0, it is found mainly in the _____ phase as _____.
A) ether; $CH_3(CH_2)_4CO_2^-$
B) water; $CH_3(CH_2)_4CO_2^-$
C) ether; $CH_3(CH_2)_4CO_2H$
D) water; $CH_3(CH_2)_4CO_2H$
E) none of the above
Answer: C
Section: 2-10
GLO: G2, G4

29) When a small amount of hexanoic acid [$CH_3(CH_2)_4CO_2H$, pK_a~4.8], is added to a separatory funnel which contains the organic solvent diethyl ether and water with a pH of 12.0, it is found mainly in the _____ phase as _____.
A) ether; $CH_3(CH_2)_4CO_2^-$
B) water; $CH_3(CH_2)_4CO_2^-$
C) ether; $CH_3(CH_2)_4CO_2H$
D) water; $CH_3(CH_2)_4CO_2H$
E) none of the above
Answer: B
Section: 2-10
GLO: G2, G4

30) At what pH will 25% of a compound with a pKa of 5.3 be in its basic form?
Answer: 4.8
Section: 2-10
GLO: G2, G4

31) The amino acid glycine ($H_3N^+CH_2CO_2H$) has two acidic Hs, one with pKa = 2.34 and the other with pKa=9.60. Draw the structure of the form of glycine that predominates at a pH of 12.
Answer:



Section: 2-10
MCAT: 24.3
GLO: G2, G4

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank

32) H-A is an acid with a pKa of 4.5. Which of the following statements about an aqueous solution of H-A is true?

A) At pH = 4.5, the solution contains much more H-A than. A^-.

B) At pH = 4.5, the solution contains much more A^- than H-A.

C) At pH- 3.5, the solution contains about 90% A^- and 10% H-A.

D) At pH = 6.5, the solution contains about 80% A^- and 20% H-A.

E) At pH = 5.5, the solution contains about 90% A^- and 10% H-A.

Answer: E
Section: 2-10
GLO: G2, G4

33) At what pH will the concentration of a compound with a pKa of 5.7 be 100 times greater in its acidic form than in its basic form?

Answer: 3.7
Section: 2-10
GLO: G2, G4

34) HCN has a pKa = 9.1. What form of the compound, HCN or CN^-, will predominate in a solution of pH = 7.0

Answer: HCN
Section: 2-10
GLO: G2, G4

35) Propanoic acid, CH_3CH_2COOH, has a pKa =4.9. Draw the structure of the conjugate base of propanoic acid and give the pH above which 90% of the compound will be in this conjugate base form.

Answer: $CH_3CH_2COO^-$; 5.9

Section: 2-10
GLO: G2, G4

36) Buffering is used to maintain the pH of human blood in the relatively narrow 7.3 - 7.4 range. What acid/base pair serves to buffer the blood?

A) H_2O / HO^-

B) H_3O^+ / H_2O

C) H_2CO_3 / HCO_3^-

D) NH_4^+ / NH_3

E) HCl / Cl^-

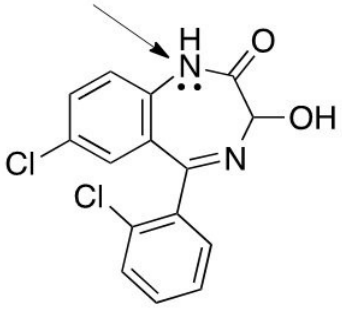
Answer: C
Section: 2-11
GLO: G2, G7

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank

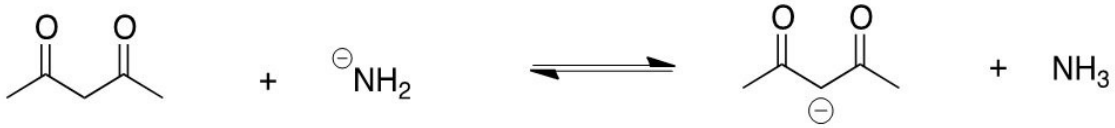
37) Explain why $AlCl_3$ is a Lewis acid.
Answer: A Lewis acid is an electron pair acceptor. Aluminum in $AlCl_3$ has an empty p orbital that can accommodate the pair of electrons provided by a Lewis base.
Section: 2-12
MCAT: 1.4

38) Structure of Lorazepam, a widely known drug for short-term anxiety is shown below. Is the indicated lone pair localized or delocalized?



Answer: Delocalized
Section: 2-8
MCAT: 2.3

39) Predict the direction of equilibrium in the following reaction. Explain your answer.



Answer: Right
Conjugate base on the right is more stable due to resonance that puts negative charge on the oxygen atom.
Section: 2-9
MCAT: 1.3
GLO: G2

40) What would be the conjugate base in the following acid base reaction?

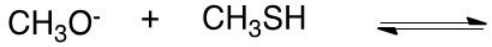
CH_3O^- + CH_3SH ⇌

A) CH_2O
B) CH_3OH
C) $CH_3SH_2^+$
D) CH_3S^-
E) H_2O
Answer: D
Section: 2-3
MCAT: 1.4

Copyright © 2017 Pearson Education, Inc.

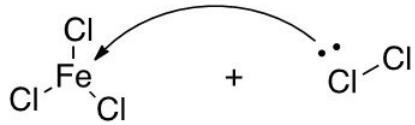
Organic Chemistry 8th edition Bruice Test Bank

41) What would be the conjugate acid in the following acid base reaction?

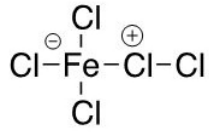


A) CH_2O
B) CH_3OH
C) $CH_3SH_2^+$
D) CH_3S^-
E) H_2O
Answer: B
Section: 2-3
MCAT: 1.4

42) What is the product of the following Lewis acid-base reaction?



Answer:



Section: 2-2
MCAT: 1.4

43) Which of the following species cannot function as a Lewis acid?
A) H^+
B) $TiCl_4$
C) $AlCl_3$
D) NH_4^+
E) H_2O
Answer: E
Section: 2-12
MCAT: 1.4

Copyright © 2017 Pearson Education, Inc.

Organic Chemistry 8th edition Bruice Test Bank