Chapter 14/ acids and bases

Q1) Multiple Choice

__d__1. A strong acid
a. ionizes completely in solution.
b. produces hydronium ions in solution.
c. reacts with metals that are more active than hydrogen.
d. All of the above

__a__2. Which of the following substances is a weak base?
a. NH_3
b. KOH
c. K_2O
d. NaOH

__a__3. Hydroxides of Group 1 metals
a. are all strong bases
b. are all weak bases
c. are all acids.
d. do not dissociate in solution.

__a__4. Strong bases are
a. strong electrolytes.
b. weak electrolytes.
c. nonelectrolytes.
d. also strong acids.

_d___5. A highly polar molecule that contains a weak bond between a hydrogen atom and another element would be
a. a weak acid.
b. unable to ionize completely.
c. a nonelectrolyte.
d. a strong acid.

__b__6. Which of the following substances is both a Brønsted-Lowry base and an Arrhenius base?
a. $NH_3(s)$
b. $NH_3(aq)$
c. HCl(g)
d. HCl(aq)

__a__7. In the following reaction, which substance acts as a Brønsted-Lowry acid?

$$HCl + NH_3 \rightarrow NH_4^+ + Cl^-$$

a. HCl
b. NH_3
c. NH_4^+
d. Cl^-

__b__8. In the following reaction, which substance acts as a Brønsted-Lowry base?

$$HCl + NH_3 \rightarrow NH_4^+ + Cl^-$$

a. HCl
b. NH_3
c. NH_4^+
d. Cl^-

__a___9. Which stage of ionization of H_3PO_4 produces the most ions in solution?

a. $H_3PO_4(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + H_2PO_4^-(aq)$

b. $H_2PO_4^-(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + HPO_4^{2-}(aq)$

c. $HPO_4^{2-}(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + PO_4^{3-}(aq)$

d. All stages produce the same number of ions in solution.

__a_10. Acetic acid is found in

a. vinegar
b. the stomach.
c. antacids.
d. oranges

___d_11. A characteristic of an Arrhenius base is that it

a. is an electrolyte
b. tastes bitter.
c. dissociates to form OH- ions.
d. All of the above

_b___12. Which of the following is a Brønsted- Lowry base?

a. HCl
b. HCO_3^-
c. H_3O^+
d. H_3PO_4

__d_13. What is the correct acid name for an aqueous solution of $HClO_4$?

a. hypochlorous acid
b. chlorous acid
c. chloric acid
d. perchloric acid

_c___14. An Arrhenius acid in an aqueous solution

a. attracts negatively charged anions.
b. attracts positively charged cations.
c. gives up one or more of its hydrogen ions to water molecules.
d. forms ionic bonds with water molecules.

__b_15. Which of the following is an indication of acid strength?

a. the number of hydrogen atoms in the formula of the acid
b. how strongly an aqueous solution of the acid conducts an electric current
c. how quickly the acid dissolves in water
d. the number of total atoms in one molecule of the acid

__d_16. A strong base in an aqueous solution

a. is a weak electrolyte.
b. produces many H+ ions.
c. will not dissolve.
d. completely dissociates into ions.

__c_17. In a Brønsted-Lowry acid-base reaction, what are transferred from one reactant to another?

a. electrons
b. water molecules
c. protons
d. OH^- ions

__a_18. How many protons per molecule can a monoprotic acid donate?

a. one
b. two
c. three
d. zero

__c_19. How many stages of ionization does phosphoric acid go through?

a. one
b. two
c. three
d. four

__d_20. Which is the stronger base in the reaction represented by the following equation?

$$CH_3COOH(aq) + H_2O(l) \leftrightarrows H_3O^+(aq) + CH_3COO^-(aq)$$

a. CH_3COOH
b. CH_3COO^-
c. H_3O^+
d. H_2O

__c_21. Consider the reaction represented by the equation below.

$$HClO_4(aq) + H_2O(l) \rightarrow H_3O^+(aq) + ClO_4^-(aq)$$

Which substances are present in the greatest concentrations'

a. $HClO_4$ and H_2O
b. $HClO_4$ and ClO_4^-
c. H_3O^+ and ClO_4^-
d. H_2O and H_3O^+

__b_22. Acid strength increases with

a. increasing polarity and increasing bond strength.
b. increasing polarity and decreasing bond strength.
c. decreasing polarity and increasing bond strength.
d. decreasing polarity and decreasing bond strength.

__b_23. What is the correct net ionic equation for the neutralization reaction between the substances below?

$$HNO_3(aq) + KOH(aq)$$

a. $NO_3^-(aq) + K^+(aq) \rightarrow KNO_3(aq)$
b. $H_3O^+(aq) + OH^-(aq) \rightarrow 2H_2O(l)$
c. $H_3O^+(aq) + NO_3^-(aq) + K^+(aq) + OH^-(aq) \rightarrow NO_3^-(aq) + K^+(aq) + 2H_2O(l)$
d. $HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(l)$

__b_24. Which of the following characteristics describes a base?
a. reacts with oils in the skin and converts them to acids.
b. forms alkaline solutions.
c. is a nonelectrolyte.
d. None of the above.

__c_25. Which of the following is not a strong acid?
a. HCl
b. H_2SO_4
c. CH_3COOH
d. HBr

__c_26. All Brønsted- Lowry acids
a. are aqueous solutions.
b. can act as Arrhenius acids.
c. donate protons
d. All of the above

__c_27. Which of the following is a polyprotic acid?
a. HCl
b. H_2SO_4
c. HNO_3
d. HF.

___d_ 28. Which of the following can act as a Lewis acid?
a. $NH_3(aq)$
b. Cl^- (aq)
c. BF_4^- (aq)
d. Ag^+ (aq)

___c_ 29. A Lewis acid
a. is an anion.
b. donates an electron pair to form a covalent bond.
c. can be a substance that does not contain a hydrogen atom.
d. All of the above.

___b_ 30. Which of the following substances can act as an Arrhenius base, a Brønsted-Lowry base, and a Lewis base?
a. F^- (aq)
b. $NH_3(aq)$
c. H^+ (aq)
d. NaOH(aq)

___d_ 31. Which of the following will be present in an aqueous solution of H_2SO_4?
a. H_3O^+ (aq)
b. HSO_4^- (aq)
c. SO_4^{2-} (aq)
d. All of the above

___c___32. What is the conjugate base of the hydronium ion, H_3O^+?
a. OH^-
b. H^+
c. H_2O
d. H_3O^{2+}

___c___33. The conjugate acid of the chloride ion, Cl^-, is
a. Cl_2.
b. H^+.
c. HCl.
d. ClO.

___c___34. A conjugate acid is an acid that forms when
a. the acid gains a proton.
b. a base loses a proton.
c. a base gains a proton.
d. an atom accepts an electron pair.

__d____35. Ions that are present before and after a neutralization reaction are
a. nonelectrolytes.
b. metal ions.
c. neutral ions.
d. spectator ions.

___b___36. In an acid- base reaction, the conjugate base of the weaker acid is the
a. stronger acid.
b. stronger base.
c. weaker base.
d. None of the above.

___d___37. A conjugate base is the species that
a. remains after a base has given up a proton.
b. is formed by the addition of a proton.
c. is formed by the addition of a proton to a base.
d. remains after an acid has given up a proton.

___c_ 38. In the following reaction, which substance is the conjugate base of $HClO_4$?

$$HClO_4\ (aq) + H_2O(l) \longrightarrow H_3O^+(aq) + ClO_4^-\ (aq\ )$$

a. $H_2O(l)$
b. $H_3O^+(aq)$
c. $ClO_4^-\ (aq\ )$
d. Both (a) and (b)

___b___39. Which of the properties listed below is not characteristic of an acid?
a. a sour taste
b. a slippery feel
c. the ability to conduct an electric current
d. reactivity with metals

___c___40. In the reaction represented by the equation

$$H_2C_2O_4(aq) + CH_3NH_2(aq) \rightleftharpoons HC_2O_4^-(aq) + CH_3NH_3^+(aq)$$

Which of these is a conjugate acid-base pair?
a. $H_2C_2O_4(aq)$ and $CH_3NH_2(aq)$
b. $H_2C_2O_4(aq)$ and $CH_3NH_3^+(aq)$
c. $CH_3NH_2(aq)$ and $CH_3NH_3^+(aq)$
d. $HC_2O_4^-(aq)$ and $CH_3NH_3^+(aq)$

__b____41. A substance that increases the concentration of OH^- ions in an aqueous solution is known as a(n)
a. Arrhenius acid.
b. Arrhenius base.
c. Lewis acid.
d. Lewis base.

___d___42. A strong base in an aqueous solution
a. is a weak electrolyte.
b. produces many H^+ ions
c. will not dissolve.
d. completely dissociates into ions.

___b___43. Which of the following is an indication of acid strength?
a. the number of hydrogen atoms in the formula of the acid
b. how strongly an aqueous solution of the acid conducts an electric current
c. how quickly the acid dissolves in water
d. the number of total atoms in one molecule of the acid

___a_ 44. The neutralization of any strong acid and strong base produces
a. H_2O molecules.
b. H_3O^+ ions
c. OH^- ions
d. Both (b) and (c)

___a_ 45. Which substance is a Lewis acid in the reaction shown by the equation below?

$$BF_3(aq) + F^-(aq) \leftrightarrows BF_4^-(aq)$$

a. BF_3.
b. F^-
c. BF_4^-
d. None of the above

___c___46. What is the conjugate acid of the water?
a. OH^-
b. H^+
c. H_3O^+
d. H_3O^{2+}

___a___47. Sulfur trioxide gas dissolves in atmospheric water. The product of the reaction, which falls to the ground as a component of acid rain or snow, is
a. H_2SO_4 (aq).
b. H_2S(aq).
c. H_3O^+ (aq).
d. SO_4^{2-} (aq)

___d___48. Which of the following is an oxyacid?
a. HCl
b. H_2S
c. H_2O
d. H_2SO_4 (aq).

___c___49. In the reaction represented by the equation

$$HF(aq) + H_2O(l) \leftrightarrows H_3O^+(aq) + F^-(aq)$$

Which of these is a conjugate acid-base pair?
a. F^- and H_2O.
b. H_3O^+ and HF.
c. HF and F^-
d. HF and H_2O.

___b___50. Proton-transfer reactions favor production of the
a. stronger acid and stronger base.
b. weaker acid and weaker base.
c. stronger acid and weaker base.
d. weaker acid and stronger base.

____a_ 51. Aqueous solutions of most bases contain
a. hydroxide ions and cations.
b. hydroxide ions and anions.
c. hydrogen ions and anions.
d. hydrogen ions and cations

Q2) Completion

1. A substance that ionizes almost completely in aqueous solutions, producing H_3O^+ ions, is a(n)_____strong_____acid.

2. An acid that can donate two protons per molecule is called a(n)____diprotic_____acid.

3.Bases are said to be neutralized when they react with____acid_____to yield_ water_____ and a(n)____salt_____.

4.Write the name of each of the following acids in the space provided.

a. __nitrous acid_____HNO_2

b. __hydrochloric acid_____HCl

c. ___carbonic acid_____H_2CO_3

d. _____sulfuric acid_____H_2SO_4

e. _____hydriodic acid_____HI

f. _____hypobromous acid_____HBrO

5.Write the formula for each of the following acids in the space provided.

a. _____H_2S_____hydrosulfuric acid

b. _____HNO_3_____nitric acid

c. _____H_3PO_3_____phosphorous acid

d. _____$HClO_4$_____perchloric acid.

6. An acid that contains hydrogen and only one other element is called a(n) __ binary____acid.

7. The species that forms when an acid has given up a proton is called the acid's _conjugate base_.

8. Barium carbonate will react with hydrochloric acid to produce____carbon dioxide____, __Barium Chloride_____, and____water_____.

Q3) Short Answer

1. Explain the difference between strong acids and weak acids.

A strong acid ionizes completely in an aqueous solution. A weak acid does not ionize completely in aqueous solution. Its aqueous solution contains hydronium ions, anions, and dissolved acid molecules.

2. List five properties of aqueous acids.

Have a sour taste; change the color of acid-base indicators; some react with active metals to release hydrogen gas; react with bases to produce salts and water; conduct electric current

3. Refer to the equation below to answer (a) and (b).

$$HCl(g) + NH_3(l) \leftrightharpoons NH_4^+(aq) + Cl^-(aq)$$

a. List the conjugate acid-base pairs.

HCl and Cl^-

NH_3 and NH_4^+

b. Identify each reactant and product as acidic or basic.

Acidic HCl and NH_4^+

Basic Cl^- and NH_3

4. Refer to the statement below to answer (a), (b), and (c).

Dilute HCl(aq) and NaOH(aq) are mixed in chemically equivalent quantities.

a. Write the chemical equation for the reaction.

$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$

b. Write the overall ionic equation for the reaction.

$H_3O^+(aq) + Cl^-(aq) + Na^+(aq) + OH^-(aq) \longrightarrow Na^+(aq) + Cl^-(aq) + 2H_2O(l)$

c. Write the net ionic equation.

$H_3O^+(aq) + OH^-(aq) \longrightarrow 2H_2O(l)$

5. Explain how the production of sulfur trioxide, SO3, in industrial processes can result in acid rain. Write an equation for the reaction.

Sulfur trioxide, SO3, is produced as a gas and dissolves in atmospheric water to produce a sulfuric acid solution that falls to the ground as rain or snow.

$$SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$$