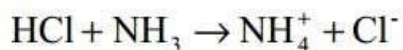


## **Chapter 14/ acids and bases**

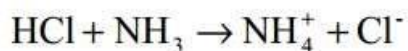
### **Q1) Multiple Choice**

- \_\_\_\_\_ 1. A strong acid
- ionizes completely in solution.
  - produces hydronium ions in solution.
  - reacts with metals that are more active than hydrogen.
  - All of the above
- \_\_\_\_\_ 2. Which of the following substances is a weak base?
- NH<sub>3</sub>
  - KOH
  - K<sub>2</sub>O
  - NaOH
- \_\_\_\_\_ 3. Hydroxides of Group 1 metals
- are all strong bases
  - are all weak bases
  - are all acids.
  - do not dissociate in solution.
- \_\_\_\_\_ 4. Strong bases are
- strong electrolytes.
  - weak electrolytes.
  - nonelectrolytes.
  - also strong acids.
- \_\_\_\_\_ 5. A highly polar molecule that contains a weak bond between a hydrogen atom and another element would be
- a weak acid.
  - unable to ionize completely.
  - a nonelectrolyte.
  - a strong acid.
- \_\_\_\_\_ 6. Which of the following substances is both a Brønsted-Lowry base and an Arrhenius base?
- NH<sub>3</sub>(s)
  - NH<sub>3</sub>(aq)
  - HCl(g)
  - HCl(aq)
- \_\_\_\_\_ 7. In the following reaction, which substance acts as a Brønsted-Lowry acid?



- HCl
- NH<sub>3</sub>
- NH<sub>4</sub><sup>+</sup>
- Cl<sup>-</sup>

- \_\_\_\_\_ 8. In the following reaction, which substance acts as a Brønsted-Lowry base?



- HCl
- NH<sub>3</sub>
- NH<sub>4</sub><sup>+</sup>
- Cl<sup>-</sup>

- \_\_\_\_ 9. Which stage of ionization of  $\text{H}_3\text{PO}_4$  produces the most ions in solution?
- $\text{H}_3\text{PO}_4(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{H}_2\text{PO}_4^-(aq)$
  - $\text{H}_2\text{PO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{HPO}_4^{2-}(aq)$
  - $\text{HPO}_4^{2-}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{PO}_4^{3-}(aq)$
  - All stages produce the same number of ions in solution.
- \_\_\_\_ 10. Acetic acid is found in
- vinegar
  - the stomach.
  - antacids.
  - oranges
- \_\_\_\_ 11. A characteristic of an Arrhenius base is that it
- is an electrolyte
  - tastes bitter.
  - dissociates to form  $\text{OH}^-$  ions.
  - All of the above
- \_\_\_\_ 12. Which of the following is a Brønsted- Lowry base?
- $\text{HCl}$
  - $\text{HCO}_3^-$
  - $\text{H}_3\text{O}^+$
  - $\text{H}_3\text{PO}_4$
- \_\_\_\_ 13. What is the correct acid name for an aqueous solution of  $\text{HClO}_4$ ?
- hypochlorous acid
  - chlorous acid
  - chloric acid
  - perchloric acid
- \_\_\_\_ 14. An Arrhenius acid in an aqueous solution
- attracts negatively charged anions.
  - attracts positively charged cations.
  - gives up one or more of its hydrogen ions to water molecules.
  - forms ionic bonds with water molecules.
- \_\_\_\_ 15. Which of the following is an indication of acid strength?
- the number of hydrogen atoms in the formula of the acid
  - how strongly an aqueous solution of the acid conducts an electric current
  - how quickly the acid dissolves in water
  - the number of total atoms in one molecule of the acid
- \_\_\_\_ 16. A strong base in an aqueous solution
- is a weak electrolyte.
  - produces many  $\text{H}^+$  ions.
  - will not dissolve.
  - completely dissociates into ions.

\_\_\_17. In a Brønsted-Lowry acid-base reaction, what are transferred from one reactant to another?

- a. electrons
- b. water molecules
- c. protons
- d.  $\text{OH}^-$  ions

\_\_\_18. How many protons per molecule can a monoprotic acid donate?

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

\_\_\_19. How many stages of ionization does phosphoric acid go through?

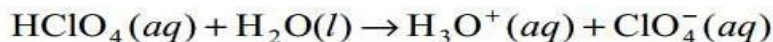
- a. one
- b. two
- c. three
- d. four

\_\_\_20. Which is the stronger base in the reaction represented by the following equation?



- a.  $\text{CH}_3\text{COOH}$
- b.  $\text{CH}_3\text{COO}^-$
- c.  $\text{H}_3\text{O}^+$
- d.  $\text{H}_2\text{O}$

\_\_\_21. Consider the reaction represented by the equation below.



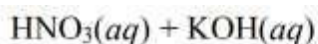
Which substances are present in the greatest concentrations?

- a.  $\text{HClO}_4$  and  $\text{H}_2\text{O}$
- b.  $\text{HClO}_4$  and  $\text{ClO}_4^-$
- c.  $\text{H}_3\text{O}^+$  and  $\text{ClO}_4^-$
- d.  $\text{H}_2\text{O}$  and  $\text{H}_3\text{O}^+$

\_\_\_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.

\_\_\_23. What is the correct net ionic equation for the neutralization reaction between the substances below?

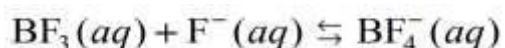


- a.  $\text{NO}_3^-(aq) + \text{K}^+(aq) \rightarrow \text{KNO}_3(aq)$
- b.  $\text{H}_3\text{O}^+(aq) + \text{OH}^-(aq) \rightarrow 2\text{H}_2\text{O}(l)$
- c.  $\text{H}_3\text{O}^+(aq) + \text{NO}_3^-(aq) + \text{K}^+(aq) + \text{OH}^-(aq) \rightarrow \text{NO}_3^-(aq) + \text{K}^+(aq) + 2\text{H}_2\text{O}(l)$
- d.  $\text{HNO}_3(aq) + \text{KOH}(aq) \rightarrow \text{KNO}_3(aq) + \text{H}_2\text{O}(l)$

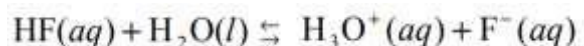
- \_\_\_24. Which of the following characteristics describes a base?
- reacts with oils in the skin and converts them to acids.
  - forms alkaline solutions.
  - is a nonelectrolyte.
  - None of the above.
- \_\_\_25. Which of the following is not a strong acid?
- HCl
  - H<sub>2</sub>SO<sub>4</sub>
  - CH<sub>3</sub>COOH
  - HBr
- \_\_\_26. All Brønsted- Lowry acids
- are aqueous solutions.
  - can act as Arrhenius acids.
  - donate protons
  - All of the above
- \_\_\_27. Which of the following is a polyprotic acid?
- HCl
  - H<sub>2</sub>SO<sub>4</sub>
  - HNO<sub>3</sub>
  - HF.
- \_\_\_28. Which of the following can act as a Lewis acid?
- NH<sub>3</sub>(aq)
  - Cl<sup>-</sup> (aq)
  - BF<sub>4</sub><sup>-</sup> (aq)
  - Ag<sup>+</sup> (aq)
- \_\_\_29. A Lewis acid
- is an anion.
  - donates an electron pair to form a covalent bond.
  - can be a substance that does not contain a hydrogen atom.
  - All of the above.
- \_\_\_30. Which of the following substances can act as an Arrhenius base, a Brønsted- Lowry base, and a Lewis base?
- F<sup>-</sup> (aq)
  - NH<sub>3</sub>(aq)
  - H<sup>+</sup> (aq)
  - NaOH(aq)
- \_\_\_31. Which of the following will be present in an aqueous solution of H<sub>2</sub>SO<sub>4</sub>?
- H<sub>3</sub>O<sup>+</sup> (aq)
  - HSO<sub>4</sub><sup>-</sup> (aq)
  - SO<sub>4</sub><sup>2-</sup> (aq)
  - All of the above
- \_\_\_32. What is the conjugate base of the hydronium ion, H<sub>3</sub>O<sup>+</sup>?
- OH<sup>-</sup>
  - H<sup>+</sup>
  - H<sub>2</sub>O
  - H<sub>3</sub>O<sup>2+</sup>
- \_\_\_33. The conjugate acid of the chloride ion, Cl<sup>-</sup>, is
- Cl<sub>2</sub>.
  - H<sup>+</sup>.
  - HCl.
  - ClO.

- \_\_\_\_\_ 34. A conjugate acid is an acid that forms when  
a. the acid gains a proton. c. a base gains a proton.  
b. a base loses a proton. d. an atom accepts an electron pair.
- \_\_\_\_\_ 35. Ions that are present before and after a neutralization reaction are  
a. nonelectrolytes. c. neutral ions.  
b. metal ions. d. spectator ions.
- \_\_\_\_\_ 36. In an acid- base reaction, the conjugate base of the weaker acid is the  
a. stronger acid. c. weaker base.  
b. stronger base. d. None of the above.
- \_\_\_\_\_ 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.
- \_\_\_\_\_ 38. In the following reaction, which substance is the conjugate base of  $\text{HClO}_4$ ?  
$$\text{HClO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) \longrightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{ClO}_4^-(\text{aq})$$
  
a.  $\text{H}_2\text{O}(\text{l})$  c.  $\text{ClO}_4^-(\text{aq})$   
b.  $\text{H}_3\text{O}^+(\text{aq})$  d. Both (a) and (b)
- \_\_\_\_\_ 39. Which of the properties listed below is not characteristic of an acid?  
a. a sour taste c. the ability to conduct an electric current  
b. a slippery feel d. reactivity with metals
- \_\_\_\_\_ 40. In the reaction represented by the equation  
$$\text{H}_2\text{C}_2\text{O}_4(\text{aq}) + \text{CH}_3\text{NH}_2(\text{aq}) \rightleftharpoons \text{HC}_2\text{O}_4^-(\text{aq}) + \text{CH}_3\text{NH}_3^+(\text{aq})$$
  
Which of these is a conjugate acid-base pair?  
a.  $\text{H}_2\text{C}_2\text{O}_4(\text{aq})$  and  $\text{CH}_3\text{NH}_2(\text{aq})$   
b.  $\text{H}_2\text{C}_2\text{O}_4(\text{aq})$  and  $\text{CH}_3\text{NH}_3^+(\text{aq})$   
c.  $\text{CH}_3\text{NH}_2(\text{aq})$  and  $\text{CH}_3\text{NH}_3^+(\text{aq})$   
d.  $\text{HC}_2\text{O}_4^-(\text{aq})$  and  $\text{CH}_3\text{NH}_3^+(\text{aq})$
- \_\_\_\_\_ 41. A substance that increases the concentration of  $\text{OH}^-$  ions in an aqueous solution is known as a(n)  
a. Arrhenius acid. c. Lewis acid.  
b. Arrhenius base. d. Lewis base.
- \_\_\_\_\_ 42. A strong base in an aqueous solution  
a. is a weak electrolyte. c. will not dissolve.  
b. produces many  $\text{H}^+$  ions d. completely dissociates into ions.

- \_\_\_\_\_ 43. Which of the following is an indication of acid strength?
- the number of hydrogen atoms in the formula of the acid
  - how strongly an aqueous solution of the acid conducts an electric current
  - how quickly the acid dissolves in water
  - the number of total atoms in one molecule of the acid
- \_\_\_\_\_ 44. The neutralization of any strong acid and strong base produces
- $\text{H}_2\text{O}$  molecules.
  - $\text{H}_3\text{O}^+$  ions
  - $\text{OH}^-$  ions
  - Both (b) and (c)
- \_\_\_\_\_ 45. Which substance is a Lewis acid in the reaction shown by the equation below?



- $\text{BF}_3$ .
  - $\text{F}^-$
  - $\text{BF}_4^-$
  - None of the above
- \_\_\_\_\_ 46. What is the conjugate acid of the water?
- $\text{OH}^-$
  - $\text{H}^+$
  - $\text{H}_3\text{O}^+$
  - $\text{H}_3\text{O}^{2+}$
- \_\_\_\_\_ 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
- $\text{H}_2\text{SO}_4(aq)$ .
  - $\text{H}_2\text{S}(aq)$ .
  - $\text{H}_3\text{O}^+(aq)$ .
  - $\text{SO}_4^{2-}(aq)$
- \_\_\_\_\_ 48. Which of the following is an oxyacid?
- $\text{HCl}$
  - $\text{H}_2\text{S}$
  - $\text{H}_2\text{O}$
  - $\text{H}_2\text{SO}_4(aq)$ .
- \_\_\_\_\_ 49. In the reaction represented by the equation



Which of these is a conjugate acid-base pair?

- $\text{F}^-$  and  $\text{H}_2\text{O}$ .
  - $\text{H}_3\text{O}^+$  and  $\text{HF}$ .
  - $\text{HF}$  and  $\text{F}^-$
  - $\text{HF}$  and  $\text{H}_2\text{O}$ .
- \_\_\_\_\_ 50. Proton-transfer reactions favor production of the
- stronger acid and stronger base.
  - weaker acid and weaker base.
  - stronger acid and weaker base.
  - weaker acid and stronger base.
- \_\_\_\_\_ 51. Aqueous solutions of most bases contain
- hydroxide ions and cations.
  - hydroxide ions and anions.
  - hydrogen ions and anions.
  - hydrogen ions and cations

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