

1. Which of the following does NOT represent an acid followed by its conjugate base?

- a) $\text{H}_3\text{O}^+ / \text{H}_2\text{O}$
- b) HCN / CN^-
- c) HCl / Cl^-
- d) $\text{HC}_2\text{H}_3\text{O}_2 / \text{OH}^-$
- e) All are acids followed by their conjugate base

2. According to the Bronsted-Lowry definition, a base is

- a) a substance that increases the hydroxide ion concentration of a solution
- b) a substance that can accept a proton from an acid
- c) a substance that can donate an electron pair to the formation of a covalent bond
- d) a substance that increases the anion formed by the autoionization of the solvent
- e) a substance that donates a proton

3. The equilibrium constant for the reaction

$\text{A}^- + \text{H}^+ \rightleftharpoons \text{HA}$ is called:

- a) K_a
- b) K_b
- c) $1/K_a$
- d) K_w/K_b
- e) K_wK_a

4. At 0 degrees Celsius, the K_w for water is 1.2×10^{-15} . The pH of pure water at this temperature is

- a) 7.00
- b) 6.88
- c) 7.56
- d) 7.46

e) none of these

5. Given $\text{HCN}(\text{aq}) + \text{HCO}_3^-(\text{aq}) \rightleftharpoons \text{CN}^-(\text{aq}) + \text{H}_2\text{CO}_3(\text{aq})$

If $K < 1$, what is the strongest base in this system?

- a) HCN
- b) HCO_3^-
- c) CN^-
- d) H_2CO_3
- e) H_2O

6. The following acids are listed in order of decreasing acid strength in water.

$\text{HI} > \text{HNO}_2 > \text{CH}_3\text{COOH} > \text{HClO} > \text{HCN}$

According to Bronsted-Lowry theory, which of the following ions is the weakest base?

- a) I^-
- b) NO_2^-
- c) CH_3COO^-
- d) ClO^-
- e) CN^-

7. Which of the following is an acid?

- a) HCOOH
- b) CH_3OH
- c) KOH
- d) NH_3
- e) CH_3NH_2

8. What is the strongest acid?

- a) HClO_2
- b) HClO_3
- c) HClO_4
- d) HF

e) HOCl

9. Which of the following reactions does not proceed significantly to the right in aqueous solution?

- a) $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{Cl}^-$
- b) $\text{H}_3\text{O}^+ + \text{OH}^- \rightleftharpoons 2\text{H}_2\text{O}$
- c) $\text{H}_2\text{O} + \text{HSO}_4^- \rightleftharpoons \text{H}_2\text{SO}_4 + \text{OH}^-$
- d) $\text{HCN} + \text{OH}^- \rightleftharpoons \text{H}_2\text{O} + \text{CN}^-$
- e) $\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{HSO}_4^-$

10. What is the $[\text{H}^+]$ in a solution which shows a pH of 2.30?

- a) 2.3M
- b) 11.7M
- c) $5.0 \times 10^{-3}\text{M}$
- d) $2.0 \times 10^{-12}\text{M}$
- e) none of these

11. What is the pH of a solution at 25 degrees Celsius in which $[\text{OH}^-] = 3.4 \times 10^{-5}\text{M}$.

- a) 4.5
- b) 10.5
- c) 9.5
- d) 6.3
- e) none of these

12. What is the pH of a 10.0 M solution of HNO_3 ?

- a) 10
- b) 1.0
- c) 0
- d) -1.0
- e) none of these

13. Nitrous acid, HNO_2 , has an ionization constant $K_a = 4.0 \times 10^{-4}$. The pH of a 0.25 M HNO_2 solution is:

- a) 2.00
- b) 2.30
- c) 2.70
- d) 3.70
- e) none of these

14. In a solution prepared by dissolving 0.10 mole of an acid HX in enough water to make 1.00 L of solution, the pH is observed to 1.35. What is the K_a for this acid?

- a) 2.0×10^{-2}
- b) 3.6×10^{-2}
- c) 4.5×10^{-2}
- d) 5.0×10^{-12}
- e) None of these

15. A 0.05 M aqueous solution of a weak monoprotic acid is 1.2% ionized at equilibrium at 25 degrees celsius. K_a for this acid is:

- a) 0.034
- b) 6.4×10^{-8}
- c) 7.3×10^{-33}
- d) 29
- e) none of these

16. What is the pOH of a 0.10 M solution of $\text{Ba}(\text{OH})_2$?

- a) 13.30
- b) 0.70
- c) 1.00
- d) 13.00
- e) none of these

17. The $[\text{OH}^-]$ in a 0.50 M pyridine solution ($\text{C}_5\text{H}_5\text{N}$; $K_b = 1.7 \times 10^{-9}$) is:

- a) 0.50 M
- b) 2.9×10^{-5} M
- c) 1.8×10^{-9} M
- d) 3.3×10^{-10} M
- e) none of these

18. The equilibrium constant for the reaction

$\text{NH}_4^+ + \text{OH}^- \rightleftharpoons \text{NH}_3 + \text{H}_2\text{O}$ is:

- a) $1/K_b$ for NH_3
- b) $1/K_a$ for NH_4^+
- c) K_w/K_a for NH_4^+
- d) K_w/K_b for NH_3
- e) K_b for NH_3/K_w

19. What is the pH of a 0.05 M solution of ascorbic acid, Vitamin C ($K_{a1} = 7.9 \times 10^{-5}$; $K_{a2} = 1.6 \times 10^{-12}$)

- a) 1.3
- b) 2.7
- c) 3.1
- d) 5.4
- e) 6.5

20. Given: HAc $K_a = 1.8 \times 10^{-5}$

H_2CO_3 $K_{a1} = 4.3 \times 10^{-7}$

$K_{a2} = 5.6 \times 10^{-11}$

Which of the following 0.01M solutions will have the highest pH?

- a) HAc
- b) NaAc
- c) Na_2CO_3
- d) H_2CO_3
- e) NaHCO_3

21. If K_a for HCN is 6.2×10^{-10} , what is K_b for CN^- ?

- a) 6.2×10^{-24}
- b) 6.2×10^4
- c) 1.6×10^{-5}
- d) 1.6×10^{-23}
- e) none of these

22. Which of the following substances can be dissolved in water to give a basic solution?

- a) NH_4Cl
- b) NaBr
- c) KF
- d) NaHSO_4
- e) KNO_3

23. What is the pH of a 1.0 M aqueous solution of NaCl ?

- a) 7.0
- b) greater than 7.0
- c) less than 7.0
- d) not enough information
- e) too tired to answer

24. What is the pH of a 1.0 M aqueous solution of KNO_2 ?

- a) 7.0
- b) greater than 7.0
- c) less than 7.0
- d) not enough information

25. Which of the following is the STRONGEST Lewis acid?

- a) Na^+
- b) Al^{3+}

- c) CH_3COO^-
- d) Mg^{2+}
- e) Cl^-

26. All of the following species can function as Bronsted-Lowry bases in solution EXCEPT:

- a) H_2O
- b) NH_3
- c) S^{2-}
- d) NH_4^+
- e) HCO_3^-

27. What is the pH of a 0.36M solution of sodium acetate?

- a) 9.15
- b) 4.85
- c) 2.59
- d) 11.41
- e) 7.00

28. Which of the following will NOT give an acid solution when dissolved in water?

Hint : Check section 14.10 in your book.

- a) K_2O
- b) P_2O_5
- c) CO_2
- d) NO_2
- e) SO_3

29. HCN is a weak acid ($K_a = 6.2 \times 10^{-10}$) NH_3 is a weak base ($K_b = 1.8 \times 10^{-5}$). A 1.0 M solution of NH_4CN would be

- a) strongly acidic
- b) weakly acidic
- c) neutral

d) weakly basic

30. The equilibrium constant for this reaction is approximately 0.001.



Which is the strongest conjugate base in this reaction?

- a) $\text{HPO}_4^{2-}(\text{aq})$
- b) $\text{HCO}_3^{-}(\text{aq})$
- c) $\text{H}_2\text{PO}_4^{-}(\text{aq})$
- d) $\text{CO}_3^{2-}(\text{aq})$
- e) there is no base in this reaction

31. The equilibrium constant for this reaction is 3.6×10^{-7}



What is K_a for HOCl?

- a) 2.8×10^{-8}
- b) 3.6×10^{-7}
- c) 6.0×10^{-4}
- d) 2.8×10^6