Chapter 14 TEST: Acids and Bases

1. For the equilibrium that exists in an aqueous solution of nitrous acid (HNO_2, a weak acid), the equilibrium constant expression is:
   A) $K = \frac{[H^+][NO_2^-]}{[HNO_2]}$
   B) $K = \frac{[H^+][N^{3+}][O^{2-}]^2}{[HNO_2]}$
   C) $K = [H^+][NO_2^-]$
   D) $K = \frac{[H^+]^2[NO_2^-]}{[HNO_2]}$
   E) none of these

2. Which of the following is a conjugate acid/base pair?
   A) HCl/OCl^-
   B) H_2SO_4/SO_4^{2-}
   C) NH_4^+/NH_3
   D) H_3O^+/OH^-
   E) more than one of these

3. The hydrogen sulfate or bisulfate ion HSO_4^- can act as either an acid or a base in water solution. In which of the following equations does HSO_4^- act as an acid?
   A) $HSO_4^- + H_2O \rightarrow H_2SO_4 + OH^-$
   B) $HSO_4^- + H_3O^+ \rightarrow SO_3 + 2H_2O$
   C) $HSO_4^- + OH^- \rightarrow H_2SO_4 + O^{2-}$
   D) $HSO_4^- + H_2O \rightarrow SO_4^{2-} + H_3O^+$
   E) none of these

4. Which of the following is the equilibrium constant expression for the dissociation of the weak acid HOCl?
   A) $K = \frac{[H^+][OCl^-]}{[HOCl]}$
   B) $K = [H^+][OCl^-]$
   C) $K = \frac{[HOCl]}{[H^+][OCl^-]}$
   D) $K = \frac{[H^+][O^{2-}][Cl^-]}{[HOCl]}$
   E) none of these

5. Consider the reaction $HNO_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$. Which species is a conjugate base?
   A) $HNO_2(aq)$
   B) $H_2O(l)$
   C) $H_3O^+(aq)$
   D) $NO_2^-(aq)$
   E) two of these

6. In which of the following reactions does the $H_2PO_4^-$ ion act as an acid?
   A) $H_3PO_4 + H_2O \rightarrow H_3O^+ + H_2PO_4^-$
   B) $H_2PO_4^- + H_2O \rightarrow H_3O^+ + HPO_4^{2-}$
   C) $H_2PO_4^- + OH^- \rightarrow H_3PO_4 + O^{2-}$
   D) The ion cannot act as an acid.
   E) Two of these.

7. Which of the following is *not* true for a solution at 25°C that has a hydroxide concentration of 2.5×10^{-6} *M*?
   A) $K_w = 1 \times 10^{-14}$
   B) The solution is acidic.
   C) The solution is basic.
   D) The $[H^+]$ is 4.0×10^{-9} *M*.
   E) The K_w is independent of what the solution contains.

8. A solution in which the pOH is 13.1 would be described as
   A) very acidic
   B) slightly acidic
   C) neutral
   D) very basic
   E) slightly basic

9. Calculate the $[H^+]$ in a solution that has a pH of 2.73.
   A) 2.7 *M*
   B) 11.3 *M*
   C) 1.9×10^{-3} *M*
   D) 5.4×10^{-12} *M*
   E) none of these

10. The pH of a solution at 25°C in which $[OH^-] = 3.9 \times 10^{-5}$ *M* is:
   A) 4.41
   B) 3.90
   C) 9.59
   D) 4.80
   E) none of these

11. What is the pOH of pure water at 65°C? (K_w at 65°C = 1.20×10^{-13})
    A) 7.540
    B) 7.000
    C) 14.000
    D) 12.921
    E) 6.460

12. Which of the following indicates the most basic solution?
    A) $[H^+] = 1 \times 10^{-10}\ M$
    B) pOH = 6.7
    C) $[OH^-] = 7 \times 10^{-5}\ M$
    D) pH = 4.2
    E) At least two of the solutions are equally basic.

13. Calculate the pH of 0.203 *M* $HNO_3(aq)$.
    A) 0.693
    B) 2.030
    C) –1.140
    D) 13.797
    E) 1.595

14. Calculate the pH of a 0.031 *M* strong acid solution.
    A) –1.51
    B) 1.51
    C) 12.49
    D) 15.51
    E) none of these

15. Calculate the pH of a 0.13 *M* solution of HOCl, $K_a = 3.5 \times 10^{-8}$.
    A) 4.17
    B) 8.34
    C) 9.83
    D) 1.00
    E) 3.76

16. Acetic acid, ($HC_2H_3O_2$) is a weak acid ($K_a = 1.8 \times 10^{-5}$). Calculate the pH of a 15.1 *M* $HC_2H_3O_2$ solution.
    A) –1.18
    B) 3.57
    C) 1.78
    D) 1.18
    E) 12.22

17. Calculate the $[H^+]$ in a 0.068 *M* solution of HCN, $K_a = 6.2 \times 10^{-10}$.
    A) 1.0×10^{-7} *M*
    B) 6.5×10^{-6} *M*
    C) 4.2×10^{-11} *M*
    D) 1.3×10^{-5} *M*
    E) none of these

18. Determine the concentration of a solution of the weak acid $HClO_2$ ($K_a = 1.10 \times 10^{-2}$) if it has a pH of 1.075.
    A) 0.644 *M*
    B) 0.0841 *M*
    C) 7.65 *M*
    D) 12.9 *M*
    E) 1.287 *M*

19. When 2.5×10^{-2} mol of nicotinic acid (a monoprotic acid) is dissolved in 350 mL of water, the pH is 3.05. Calculate the K_a of nicotinic acid.
    A) 1.3×10^{-2}
    B) 1.1×10^{-5}
    C) 7.1×10^{-2}
    D) 3.3×10^{-5}
    E) none of these

20. Calculate the pH of a 0.02 *M* solution of KOH.
    A) 1.7
    B) 15.7
    C) 14.0
    D) 12.3
    E) cannot calculate answer unless a volume is given

21. A 0.372-g sample of NaOH(s) is added to enough water to make 250.0 mL of solution. The pH of this solution is:
    A) 1.429
    B) 0.429
    C) 11.968
    D) 12.571
    E) none of these

22. Calculate the pOH of a 0.32 *M* solution of $Ba(OH)_2$.
    A) 0.49
    B) 0.19
    C) 13.81
    D) 13.51
    E) none of these

23. The conjugate acid and conjugate base of bicarbonate ion, HCO_3^-, are, respectively:
A) H_3O^+ and OH^-
B) H_3O^+ and CO_3^{2-}
C) H_2CO_3 and OH^-
D) H_2CO_3 and CO_3^{2-}
E) CO_3^{2-} and OH^-

24. The pH of a 1.0 *M* aqueous solution of NaCl is:
A) 7.0
B) greater than 7.0
C) less than 7.0
D) not enough information given
E) none of these (A-D)

25. The equilibrium constant for the reaction $A^- + H^+ \rightleftharpoons HA$ is called:
A) K_a
B) K_b
C) $\frac{1}{K_a}$
D) $\frac{K_w}{K_b}$
E) K_wK_a

26. What is the equilibrium constant for the following reaction? $N_3^- + H_3O^+ \rightleftharpoons HN_3 + H_2O$
The K_a value for $HN_3 = 1.9 \times 10^{-5}$.
A) 5.3×10^{-10}
B) 1.9×10^{-9}
C) 1.9×10^{-5}
D) 5.3×10^{4}
E) 1.9×10^{9}

27. At 65°C, the ion-product constant of water, K_w, is 1.20×10^{-13}. The pH of pure water at 65°C is:
A) 7.000
B) 6.560
C) 5.880
D) 6.460
E) none of these

28. For weak acid, HX, $K_a = 6.9 \times 10^{-6}$. Calculate the pH of a 0.13 *M* solution of HX.
A) 0.89
B) 3.02
C) 6.05
D) 10.98
E) none of these

29. Which of the following solutions contains the strongest acid?

A) 5.00 *M* HCN ($K_a = 6.2 \times 10^{-10}$)
B) 3.50 *M* $H_2C_6H_6O_6$ ($K_{a1} = 7.9 \times 10^{-5}$, $K_{a2} = 1.6 \times 10^{-12}$).
C) 2.50 *M* $HC_2H_3O_2$ ($K_a = 1.8 \times 10^{-5}$)
D) 4.00 *M* HOCl ($K_a = 3.5 \times 10^{-8}$)
E) 1.00 *M* HF ($K_a = 7.2 \times 10^{-4}$)

30. The conjugate acid and conjugate base of bicarbonate ion, HCO_3^-, are, respectively:

A) H_3O^+ and OH^-
B) H_3O^+ and CO_3^{2-}
C) H_2CO_3 and OH^-
D) H_2CO_3 and CO_3^{2-}
E) CO_3^{2-} and OH^-

31. The products of a strong acid a strong base are:

a) acidic

b) basic

c) amphoteric

d) water and salt

32. Which would be a useful pH range for an indicator used for a neutralization reaction?

a) 0-4 b) 8-12 c) 6-8 d) not enough information e) too much information

33. Find the concentration of HCl if it takes 12.5 mL of HCl to neutralize 144 mL of 3.00M NaOH.

a) 34.6 M b) 64.3 M c) 17.3 M d) 43.6 M

Go Vikings!!