Chem12 Acids : Exam Questions M.C.-100

1) Given : HPO_4^{2-}(aq) + NH_4^+(aq) <-> $H_2PO_4^-$(aq) + NH_3(aq) , the strongest acid in the above equation is :

a) NH_4^+ b) HPO_4^{2-} c) NH_3 d) $H_2PO_4^-$

2) Which is the correct expression for pH ?

a) log $[H_3O^+]$ b) - log $[H_3O^+]$ c) - log $[H_3O^+]^2$ d) - log $1/[H_3O^+]$

3) What is the hydronium ion concentration of a 0.00100 M sodium hydroxide (NaOH) solution ?

a) 1.00×10^{-3} M   b) 11.0 M   c) 1.00×10^{-11} M   d) 3.00 M

4) What is the pH of a 0.00100 M perchloric ($HClO_4$) acid solution ?

a) 11.0   b) 1.00×10^{-3} c) 3.00   d) 1.00×10^{-11}

5) The $[H_3O^+]$ in a hydrochloric acid solution is 1.00×10^{-3} M. What is the pOH of the solution ?

a) 3.00   b) 11.0   c) 0.00100   d) 1.00×10^{-3}

6) Given that $K_a = \{[NH_3][H_3O^+]\}/[NH_4^+]$; $K_b = \{[NH_4^+][OH^-]\}/[NH_3]$ and $K_w = [H_3O^+][OH^-]$.

a) $K_w = K_a \times K_b$;   b) $K_w = K_a/K_b$;   c) $K_w = 1/(K_a \times K_b)$;   d) $K_w = K_b / K_a$

7) Given K_a of $HC_2H_3O_2$ (acetic acid) = 1.80×10^{-5}. The initial concentration of an acetic acid solution is 0.0100 M. The percentage dissociation of the acid when equilibrium has been reached is :

a) 4.24×10^{-4} %   b) 1.80×10^{-3} %   c) 1.00 %   d) 4.24 %

8) What is the pH of a 0.0100 M hydrochloric acid (HCl) solution ?

a) 1.00×10^{-2} b) 0.0100   c) 2.00   d) 12.0

9) Which one of the expressions given below is the correct expression for calculating pOH ?

a) - $\log[OH^-]$ b) - $\log[OH^-]^2$ c) - $\log\{1/[OH^-]\}$ d) $\log[OH^-]$

10) What is the hydronium ion concentration, $[H_3O^+]$ of an aqueous solution with a pH of 12.00 ?

a) 1.0×10^{-12} M   b) 1.0×10^{-2} M   c) 2.00 M   d) 12.0 M

11) Data : $HClO(aq) + H_2O(l) <-> H_3O^+(aq) + OCl^-(aq)$: $K_a = 3.00 \times 10^{-8}$
When the equilibrium concentration of a hypochlorous acid solution is 1.00×10^{-2} M, what is the pH of the solution ?

a) 2.00   b) 4.76   c) 9.24   d) 9.52

12) What is the K_a of a 0.200 M solution of a weak acid which is found to have a pH of 5.62 ?

a) 5.8×10^{-12} b) 8.7×10^{-11} c) 2.9×10^{-11} d) 1.2×10^{-5}

13) Which one of the following statements about HNO_3 and HNO_2 is true given that HNO_3 is a stronger acid than HNO_2 ?

a) NO_2^- ion is a stronger base than NO_3^- ion ?
b) NO_3^- ion is a better proton acceptor than NO_2^- ion ?
c) The bond between H and O in undissociated HNO_3 is stronger than the bond between H and O in undissociated HNO_2.
d) A solution of 1.0 M HNO_3 contains fewer particles than a solution of 1.0 M HNO_2 if equal volumes are compared.

14) What is the hydronium ion concentration, $[H_3O^+]$, of a solution with a pH of 6.00 ?

a) 1.0×10^{-8} M   b) 1.0×10^{-6} M   c) 6.0 M   d) 1.0×10^6 M

15) What is the pOH of a 0.012 M solution of sodium hydroxide, NaOH ?

a) 1.03   b) 1.9   c) 1.92   d) 12.08

16) What is the pH of a 0.0025 M solution of lime water, $Ba(OH)_2$?

a) 2.30   b) 2.60   c) 11.40   d) 11.7

17) Which one of the following orders is correct for the Bronsted acids and bases in the equation : $C_6H_5NH_2(aq) + H_2O(l) <-> C_6H_5NH_3^+(aq) + OH^-(aq)$?

a) acid + base <-> acid + base   b) acid + base <-> base + acid
c) base + acid <-> acid + base   d) base + acid <-> base + acid

18) Which one of the following statements best describes a Bronsted base ?

a) It will accept an H^+ b) It will donate an H^+
c) It will accept an OH^- d) It will donate an OH^-

19) Which one of the following K_a expressions for the dissociation of hydrogen sulfide in water is correct given that the equation for the dissociation is :

$$H_2S(aq) + H_2O(l) <-> HS^-(aq) + H_3O^+(aq) ?$$
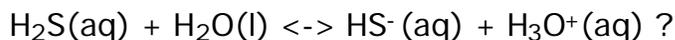
a) $K_a = \{[HS^-][H_3O^+]\}/\{[H_2S][H_2O]\}$ b) $K_a = \{[H_2S][H_2O]\}/\{[HS^-][H_3O^+]\}$
c) $K_a = [H_2S]/\{[HS^-][H_3O^+]\}$ d) $K_a = \{[HS^-][H_3O^+]\}/[H_2S]$

20) Which one of the following expressions is the correct expression for pKw ?

a) $pKw = 1/Kw$; b) $pKw = (pH)(pOH)$; c) $pKw = pH + pOH$; d) $pKw = 10^{Kw}$

21) An aqueous solution of the base hydrazine N_2H_4 is in equilibrium with its conjugate acid, $N_2H_5^+$. If the K_b for N_2H_4 is 1.70×10^{-6} at 20°C, what is the K_a for $N_2H_5^+$?

a) 5.88×10^{-9} b) 1.70×10^{-6} c) 5.88×10^5 d) 1.70×10^8

22) Water at 25°C has a pH of 7 and the equation for the dissociation is $2H_2O(l) + 57.3$ kJ $<-> H_3O^+(aq) + OH^-(aq)$. Water at 80°C could best be described as :

a) basic   b) acidic   c) neutral with a pH < 7
d) neutral with pH > 7

23) What is the pH of a 2.0 M solution of benzoic acid C_6H_5COOH ?

a) 1.94   b) 2.24   c) 3.88   d) 4.48

24) Calculate the percentage ionization of a 0.20 M acid solution that has a pH of 2.50.

25) The K_a and K_b values for HPO_4^{-2} ion in water are given. K_a = $4.4x10^{-13}$ and K_b = $1.6x10^{-7}$. Indicate whether an aqueous solution of Na_2HPO_4 is basic or acidic, and explain your answer with reference to the above K_a and K_b values.

26) The equation for dissolving formic acid in water is :

$$HCOOH(aq) + H_2O(l) <-> H_3O^+(aq) + HCOO^-(aq)$$
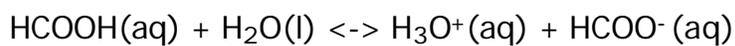
Which of the following is the correct K_a expression for HCOOH(aq) ?

a) $[HCOOH]/\{[H_3O^+][HCOO^-]\}$ b) $\{[H_3O^+][HCOO^-]\}/[HCOOH]$
c) $\{[HCOOH][H_2O]\}/\{[H_3O^+][HCOO^-]\}$ d) $\{[H_3O^+][HCOO^-]\}/\{[HCOOH][H_2O]\}$

27) The K_a value for nitrous acid is $5.1x10^{-4}$. Which of the following is the K_b value for the conjugate base of nitrous acid ?

a) $2.0x10^{-11}$ b) $5.1x10^{-4}$ c) $2.0x10^3$ d) $5.1x10^{10}$

28) Which is the stronger acid in the reaction :

$$HNO_2(aq) + NH_3(aq) <-> NH_4^+(aq) + NO_2^-(aq)$$
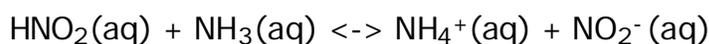
a) $NH_3(aq)$ b) $NH_4^+(aq)$ c) $NO_2^-(aq)$ d) $HNO_2(aq)$

29) What is the $[H_3O^+]$ for a solution with a pH of 2.5 ?

a) $3.2x10^{-3}$ M   b) $3.9x10^{-1}$ M   c) 2.5 M   d) $3.2x10^2$ M

30) A solution of a strong acid has a pH of 3.0. What is the resulting pH if 1.0 L of the solution is diluted to 2.0 L with distilled water ?

a) 1.5   b) 2.7   c) 3.3   d) 6.0

31) What is the pH of a 2.00 M solution of KOH ?

a) 14.3   b) 13.7   c) 0.300   d) -0.300

32) Which one of the following solutions would have the largest [H_3O^+(aq)] ?

a) 1.0 M HA K_a = 1.0x10^{-6} b) 1.0 M HB K_a = 1.0x10^{-3}
c) 1.0 M HC K_a = 1.0x10^{-8} d) 1.0 M HD K_a = 1.0x10^{-12}

33) As the strengths of acids decrease, the strengths of their conjugate bases :
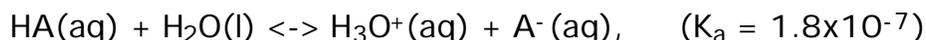
a) decrease   b) increase   c) remain the same
d) approach the strength of the acids

34) Methylamine CH_3NH_2 is a weak base. Give the K_b expression for this base, given :

$$CH_3NH_2(aq) + H_2O(l) <-> CH_3NH_3^+(aq) + OH^-(aq)$$
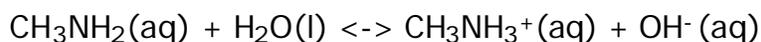
a) {[$CH_3NH_3^+$][OH^-]}/{[CH_3NH_2][H_2O]}   b) {[$CH_3NH_3^+$][OH^-]}/[CH_3NH_2]
c) {[CH_3NH_2][H_2O]}/{[$CH_3NH_3^+$][OH^-]}   d) [CH_3NH_2]/{[$CH_3NH_3^+$][OH^-]}

35) Give the [H_3O^+] of a 2.0 M solution of a weak acid HA :

$$HA(aq) + H_2O(l) <-> H_3O^+(aq) + A^-(aq), \quad (K_a = 1.8x10^{-7})$$

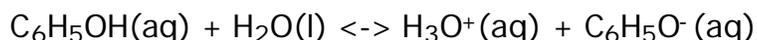a) 9.0x10^{-8} M   b) 7.2x10^{-5} M   c) 4.2x10^{-4} M   d) 6.0x10^{-4} M

36) A 0.60 M solution of the weak acid HX is found to have a pH = 4.30. Determine K_a for this acid.

37) Calculate the [H_3O^+] of a solution with a pOH of 3.86.

38) A sample of peach juice has a pH of 3.50. What is the [H_3O^+] in this sample of juice ?

a) 2.9x10^{-15} M   b) 3.2x10^{-4} M   c) 5.4x10^{-1} M   d) 3.2x10^3 M

39) What is the K_a expression for the following reaction ?

$$C_6H_5OH(aq) + H_2O(l) <-> H_3O^+(aq) + C_6H_5O^-(aq)$$

a) $[H_3O^+][C_6H_5O^-]$

b) $[C_6H_5OH]/\{[C_6H_5O^-][H_2O]\}$

c) $\{[H_3O^+][C_6H_5O^-]\}/\{[C_6H_5OH][H_2O]\}$

d) $\{[C_6H_5O^-][H_3O^+]\}/[C_6H_5OH]$

40) Which of the following solutions would have the lowest $[H_3O^+]$?

a) 1.0 M HF   b) 1.0 M HCl   c) 1.0 M HNO_2 d) 1.0 M CH_3COOH

41) What is the $[OH^-]$ in a solution that has a pH of 4.60 ?

a) $4.0x10^{-10}$ M   b) $2.5x10^{-5}$ M   c) $4.0x10^4$ M   d) $2.5x10^9$ M

42) Determine the $[H_3O^+]$ in 2.4 M HF. ($K_a = 3.5x10^{-4}$)

43) H_3BO_3 normally acts as a monoprotic acid. What is the K_a expression for the ionization of H_3BO_3 ?

a) $[H_3BO_3]/\{[H_3O^+][H_2BO_3^-]\}$

b) $\{[H_3O^+][H_2BO_3^-]\}/[H_3BO_3]$

c) $[H_3O^+]/\{[H_2BO_3^-][H_3BO_3]\}$

d) $[H_2BO_3^-]/\{[H_3O^+][H_3BO_3]\}$

44) Which one of the following K_a values is associated with the strongest acid ?

a) $1.3x10^{-2}$ b) $6.7x10^{-5}$ c) $5.7x10^{-10}$ d) $1.8x10^{-16}$

45) Which one of the following expressions is true for the constant of dissociation of pure water ?

a) $K_w = [H_3O^+]/[OH^-]$ b) $K_w = [H_3O^+] - [OH^-]$ c) $K_w = [H_3O^+][OH^-]$

d) $K_w = [H_3O^+] + [OH^-]$

46) Which one of the following solutions has the highest pH ?

a) 0.10 M acetic acid CH_3COOH
b) 0.10 M sodium hydroxide NaOH
b) 0.10 M ammonia NH_3
d) 0.10 M sodium acetate $NaCH_3COO$

47) The K_b for NH_3 is $1.8x10^{-5}$. In a 0.010 M ammonia solution, the $[OH^-]$ is :

a) $1.8x10^{-7}$ M   b) $4.2x10^{-4}$ M   c) $1.8x10^{-3}$ M   d) $4.2x10^{-3}$ M

48) In a solution with pOH = 8.90, the $[H_3O^+]$ is :

a) 5.1×10^{-6} M   b) 7.9×10^{-6} M   c) 1.3×10^{-9} M   d) 8.9×10^{-9} M

49) In which of the following acid-base systems are the reactants favored ?

a) $HCO_3^- + SO_4^{2-} \leftrightarrow HSO_4^- + CO_3^{2-}$
b) $HCl + SO_4^{2-} \leftrightarrow HSO_4^- + Cl^-$
c) $HNO_3 + H_2O \leftrightarrow H_3O^+ + NO_3^-$
d) $H_3PO_4 + CH_3COO^- \leftrightarrow CH_3COOH + H_2PO_4^-$

50) In the equation, $ClO_4^- + HNO_3 \leftrightarrow HClO_4 + NO_3^-$, the order, from left to right, for the Bronsted acids and bases is :

a) acid + base <-> base + acid   b) acid + base <-> acid + base
c) base + acid <-> base + acid   d) base + acid <-> acid + base

51) The process of removing hydrogen ions from solution by adding hydroxide ions is called :

a) hydrolysis; b) ionization; c) neutralization; d) precipitation

52) The weak acid, HClO, has a K_a of 3.24×10^{-8}. Calculate the pH of a 0.076 M solution of HClO.

Answers : 1) d, 2) b, 3) c, 4) c, 5) b, 6) a, 7) d, 8) c, 9) a, 10) a, 11) b, 12) c, 13) a, 14) b, 15) c, 16) d, 17) c, 18) a, 19) d, 20) c, 21) a, 22) c, 23) a, 24) 1.6%, 25) Base $K_b > K_a$, 26) b, 27) a, 28) d, 29) a, 30) c, 31) a, 32) b, 33) b, 34) b, 35) d, 36) 4.2×10^{-9}, 37) 7.2×10^{-11}, 38) b, 39) d, 40) d, 41) a, 42) 0.029 M, 43) b, 44) a, 45) c, 46) b, 47) b, 48) b, 49) a, 50) d, 51) c, 52) 4.3.