THEORIES OF ACIDS & BASES

1. Which of the following acids is monoprotic :

(A) H_2S (B) H_3PO_2 (C) H_3PO_3 (D) H_3PO_4

2. The weakest Bronsted base among the following is :

(A) Cl^- (B) HS^- (C) ClO_4^- (D) NH_3

3. Several acids are listed below with their respective equilibrium constants :

$HF(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + F^-(aq)$ $K_a = 7.2 \times 10^{-4}$

$HS^-(aq) + H_2O(\ell) \rightleftharpoons H_3O+(aq) + S^{2-}(aq)$ $K_a = 1.3 \times 10^{-11}$

$CH_3COOH(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + CH_3COO(aq)$ $K_a = 1.8 \times 10^{-5}$

Which is the strongest acid and which acid has the strongest conjugate base ?

(A) HF and HF (B) HF and HS^- (C) HS^- and HF (D) HS^- and CH_3COOH

4. Several bases are listed below with their respective K_b values :

$NH_3(aq) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$. $K_b = 1.8 \times 10^{-5}$

$C_5H_5N(aq) + H_2O(\ell) \rightleftharpoons C_5H_5NH^+(aq) + OH^-(aq)$. $K_b = 1.5 \times 10^{-9}$

$N_2H_4(aq) + H_2O(\ell) \rightleftharpoons N_2H_5^+(aq) + OH^-(aq)$. $K_b = 8.5 \times 10^{-7}$

Which is the weakest base and which base has the weakest conjugate acid ?

(A) C_5H_5N and C_5H_5N (B) NH_3 and NH_3 (C) C_5H_5N and NH_3 (D) NH_3 and N_2H_4

5. Which of the following can act both as a Bronsted acid & a Bronsted base (amphiprotic species) in aq. solution

(A) NH_3 (B) $H_2PO_3^-$ (C) HCO_3^- (D) OH^-

6. How many of the following species behave as a strong acid or as a strong base in aqueous solution ?

(a) HNO_2 (b) HNO_3 (c) NH_4^+ (d) Cl^- (e) H^- (f) O^{2-} (g) H_2SO_4 (h) 3

(i) 4 (j) 5 (k) 6

7. Consider following reactions

(a) $H_2CO_3(aq) + HSO_4^-(aq) \rightleftharpoons H_2SO_4(aq) + HCO_3^-(aq)$

(b) $HF(aq) + Cl^-(aq) \rightleftharpoons HCl(aq) + F^-(aq)$

(c) $HF(aq) + NH_3(aq) \rightleftharpoons NH_4^+(aq) + F^-(aq)$

(d) $HSO_4^-(aq) + CN^-(aq) \rightleftharpoons HCN(aq) + SO_4^{2-}(aq)$

Reactions proceeding to the right are :

(A) a, b (B) c, d (C) a, c (D) b, d

8. What are the conjugate bases of each of the following Bronsted Lowry acids ?

(a) HOCl (b) HPO_4^{2-} (c) H_2O (d) $CH_3NH_3^+$

(e) H_2CO_3 (f) H_2 (g) H_2O_2 (h) HO_2^-

9. Given : $HF + H_2O \xrightarrow{K_a} H_3O^+ + F^-$; $F^- + H_2O \xrightarrow{K_b} HF + OH^-$.

Which relation is correct :

(A) $\frac{K_b}{K_a} = K_w$ (B) $K_a \times K_b \times K_w = 1$ (C) $K_b \times K_w = K_a$ (D) $\frac{K_w}{K_a} = K_b$

10. For the following equilibrium at 25°C : $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$, equilibrium constant is 1.8×10^{-5}.

Calculate equilibrium constant for the equilibrium at 25°C : $NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+$

(A) 1.8×10^{-19} (B) 5.55×10^{-10} (C) 1.8×10^{-9} (D) data insufficient

11. If equilibrium constant of $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$ is 5.55×10^{-10} at 25°C, calculate equilibrium constant of $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$ at 25°C.

(A) 1.8×10^{-4} (B) 1.8×10^{9} (C) 5.55×10^{4} (D) 1.8×10^{-5}

PH OF SOLUTION

12. K_b for trimethylamine at 25°C is 6.667×10^{-5}. Calculate pK_a for trimethyl ammonium ion $(CH_3)_3NH^+$ at 25°C.

(A) 9.82 (B) 10.18 (C) 8.82 (D) – 9.82

13. For which temperature, the pOH of pure water can be greater than 7 :

(A) 45ºC (B) 25ºC (C) 15ºC (D) 35ºC

14. For pure water at 25ºC and 50ºC, the correct relation is :

(A) $pH_{25ºC} = pH_{50ºC}$ (B) $pH_{25ºC} > pH_{50ºC}$ (C) $pH_{50ºC} > pH_{25ºC}$ (D) Can't say

15. The ionic product of water at 65ºC is 16×10^{-14}. What is pH of pure water at this temperature : ?

(A) 6.7 (B) 7 (C) 7.6 (D) 6.4

16. For pure water at 10ºC and 60ºC, the correct relation is :

(A) $pOH_{10ºC} = pOH_{60ºC}$ (B) $pOH_{10ºC} > pOH_{60ºC}$ (C) $pOH_{60ºC} > pOH_{10ºC}$ (D) Can't say

17. At – 50ºC, autoprotolysis of NH_3 gives $[NH_4^+] = 1 \times 10^{-15}$ M. Hence, autoprotolysis constant of NH_3 is :

(A) $\sqrt{1\times10^{-15}}$ (B) 1×10^{-30} (C) 2×10^{-30} (D) 2×10^{-15}

18. For a 10^{-3} M solution of a weak monoacidic base ($K_b = 5 \times 10^{-4}$), calculate the % ionisation of base.
Report your answer rounding it off to the nearest whole number.

19. What is the K_b of a weak base that can produce one OH^- ion per molecule, if its 0.04 M solution is 2.5% ionized:

(A) 2.5×10^{-4} (B) 2.5×10^{-6} (C) 2.5×10^{-5} (D) 2.5×10^{-7}

20. The degree of dissociation of 0.04 M HA solution is 0.01. What would be the degree of dissociation of 0.01 M solution of the acid at the same temperature ?

(A) 0.02 (B) 0.16 (C) 0.005 (D) 0.04

21. CO_2 in aqueous solution shows following ionic equilibrium : $2H_2O + CO_2 \rightleftharpoons HCO_3^- + H_3O^+$
If hydronium ion (H_3O^+) concentration at 25°C is 2 x 10^{-6} M, what is hydroxide ion (OH^-) concentration ?

(A) 5×10^{-8} M (B) 2×10^{8} M (C) 5×10^{-9} M (D) 0.05 M

22. What is the percent ionization of a 0.01 M HCN solution : Given $K_a = 6.4 \times 10^{-9}$.

(A) 8×10^{-4} % (B) 0.08 % (C) 8×10^{-3} % (D) 0.8 %

23. Which solution has maximum pH :

(A) 0.01 M H_2SO_4 (B) 0.01 M HCl (C) 0.01 M $Ba(OH)_2$ (D) 0.01 M NaOH

24. (a) pH of a NaOH solution is 10.3. What is concentration of NaOH solution ?
(b) What is molar concentration of $Sr(OH)_2$ if its solution has pH of 12 ?

(A) [NaOH] = 2×10^{-4}M (B) $[Sr(OH)_2] = 5 \times 10^{-3}$ M
(C) Both (A) and (B) (D) None of these

25. How many moles of sulphuric acid must be dissolved to produce 250 ml of an aqueous solution of pH = 3.52? Assume complete dissociation.

(A) 3.75×10^{-5} (B) 7.5×10^{-4} (C) 3.75×10^{-4} (D) 7.5×10^{-5}

26. pH of 10^{-8} N NaOH solution is

(A) 7.2 (B) 6.8 (C) 6.98 (D) 7.02

Answers

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1. (AB) **2.** (C) **3.** (B) **4.** (B) **5.** (BC) **6.** (B) **7.** (B) **9.** (D) **10.** (B) **11.** (D)
12. (A) **13.** (C) **14.** (B) **15.** (D) **16.** (B) **17.** (B) **18.** 50 **19.** (C) **20.** (D) **21.** (C)
22. (B) **23.** (C) **24.** (C) **25.** (A) **26.** (D)