

## THEORIES OF ACIDS &amp; BASES

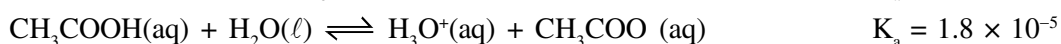
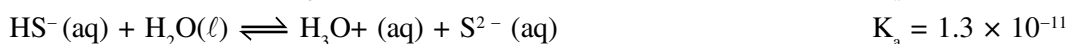
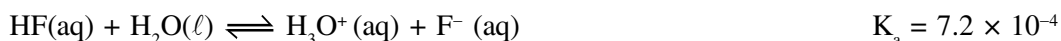
1. Which of the following acids is monoprotic :

(A)  $\text{H}_2\text{S}$  (B)  $\text{H}_3\text{PO}_2$  (C)  $\text{H}_3\text{PO}_3$  (D)  $\text{H}_3\text{PO}_4$ 

2. The weakest Bronsted base among the following is :

(A)  $\text{Cl}^-$  (B)  $\text{HS}^-$  (C)  $\text{ClO}_4^-$  (D)  $\text{NH}_3$ 

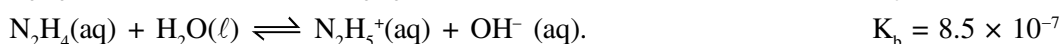
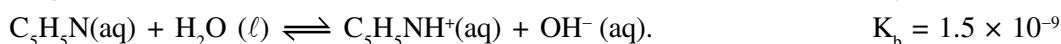
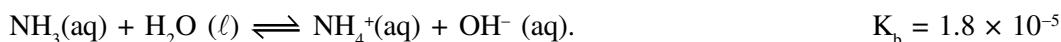
3. Several acids are listed below with their respective equilibrium constants :



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

(A) HF and HF (B) HF and  $\text{HS}^-$  (C)  $\text{HS}^-$  and HF (D)  $\text{HS}^-$  and  $\text{CH}_3\text{COOH}$ 

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



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

(A)  $\text{C}_5\text{H}_5\text{N}$  and  $\text{C}_5\text{H}_5\text{N}$  (B)  $\text{NH}_3$  and  $\text{NH}_3$  (C)  $\text{C}_5\text{H}_5\text{N}$  and  $\text{NH}_3$  (D)  $\text{NH}_3$  and  $\text{N}_2\text{H}_4$ 

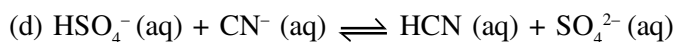
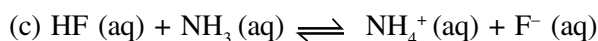
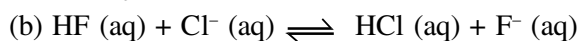
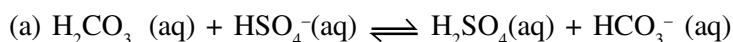
5. Which of the following can act both as a Bronsted acid & a Bronsted base (amphiprotic species) in aq. solution

(A)  $\text{NH}_3$  (B)  $\text{H}_2\text{PO}_3^-$  (C)  $\text{HCO}_3^-$  (D)  $\text{OH}^-$ 

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

(a)  $\text{HNO}_2$  (b)  $\text{HNO}_3$  (c)  $\text{NH}_4^+$  (d)  $\text{Cl}^-$  (e)  $\text{H}^-$  (f)  $\text{O}^{2-}$  (g)  $\text{H}_2\text{SO}_4$  (h) 3  
(i) 4 (j) 5 (k) 6

7. Consider following reactions



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)  $\text{HOCl}$  (b)  $\text{HPO}_4^{2-}$  (c)  $\text{H}_2\text{O}$  (d)  $\text{CH}_3\text{NH}_3^+$ (e)  $\text{H}_2\text{CO}_3$  (f)  $\text{H}_2$  (g)  $\text{H}_2\text{O}_2$  (h)  $\text{HO}_2^-$ 

9. Given :
- $\text{HF} + \text{H}_2\text{O} \xrightarrow{K_a} \text{H}_3\text{O}^+ + \text{F}^-$
- ;
- $\text{F}^- + \text{H}_2\text{O} \xrightarrow{K_b} \text{HF} + \text{OH}^-$
- .

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
- $25^\circ\text{C}$
- :
- $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$
- , equilibrium constant is
- $1.8 \times 10^{-5}$
- .

Calculate equilibrium constant for the equilibrium at  $25^\circ\text{C}$  :  $\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4\text{OH} + \text{H}^+$ (A)  $1.8 \times 10^{-19}$  (B)  $5.55 \times 10^{-10}$  (C)  $1.8 \times 10^{-9}$  (D) data insufficient

11. If equilibrium constant of  $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$  is  $5.55 \times 10^{-10}$  at  $25^\circ\text{C}$ , calculate equilibrium constant of  $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$  at  $25^\circ\text{C}$ .  
 (A)  $1.8 \times 10^{-4}$  (B)  $1.8 \times 10^9$  (C)  $5.55 \times 10^4$  (D)  $1.8 \times 10^{-5}$

### PH OF SOLUTION

12.  $K_b$  for trimethylamine at  $25^\circ\text{C}$  is  $6.667 \times 10^{-5}$ . Calculate  $\text{p}K_a$  for trimethyl ammonium ion  $(\text{CH}_3)_3\text{NH}^+$  at  $25^\circ\text{C}$ .  
 (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)  $45^\circ\text{C}$  (B)  $25^\circ\text{C}$  (C)  $15^\circ\text{C}$  (D)  $35^\circ\text{C}$
14. For pure water at  $25^\circ\text{C}$  and  $50^\circ\text{C}$ , the correct relation is :  
 (A)  $\text{pH}_{25^\circ\text{C}} = \text{pH}_{50^\circ\text{C}}$  (B)  $\text{pH}_{25^\circ\text{C}} > \text{pH}_{50^\circ\text{C}}$  (C)  $\text{pH}_{50^\circ\text{C}} > \text{pH}_{25^\circ\text{C}}$  (D) Can't say
15. The ionic product of water at  $65^\circ\text{C}$  is  $16 \times 10^{-14}$ . 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  $10^\circ\text{C}$  and  $60^\circ\text{C}$ , the correct relation is :  
 (A)  $\text{pOH}_{10^\circ\text{C}} = \text{pOH}_{60^\circ\text{C}}$  (B)  $\text{pOH}_{10^\circ\text{C}} > \text{pOH}_{60^\circ\text{C}}$  (C)  $\text{pOH}_{60^\circ\text{C}} > \text{pOH}_{10^\circ\text{C}}$  (D) Can't say
17. At  $-50^\circ\text{C}$ , autoprotolysis of  $\text{NH}_3$  gives  $[\text{NH}_4^+] = 1 \times 10^{-15}$  M. Hence, autoprotolysis constant of  $\text{NH}_3$  is :  
 (A)  $\sqrt{1 \times 10^{-15}}$  (B)  $1 \times 10^{-30}$  (C)  $2 \times 10^{-30}$  (D)  $2 \times 10^{-15}$
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  $\text{OH}^-$  ion per molecule, if its 0.04 M solution is 2.5% ionized:  
 (A)  $2.5 \times 10^{-4}$  (B)  $2.5 \times 10^{-6}$  (C)  $2.5 \times 10^{-5}$  (D)  $2.5 \times 10^{-7}$
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.  $\text{CO}_2$  in aqueous solution shows following ionic equilibrium :  $2\text{H}_2\text{O} + \text{CO}_2 \rightleftharpoons \text{HCO}_3^- + \text{H}_3\text{O}^+$   
 If hydronium ion ( $\text{H}_3\text{O}^+$ ) concentration at  $25^\circ\text{C}$  is  $2 \times 10^{-6}$  M, what is hydroxide ion ( $\text{OH}^-$ ) concentration ?  
 (A)  $5 \times 10^{-8}$  M (B)  $2 \times 10^8$  M (C)  $5 \times 10^{-9}$  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)  $8 \times 10^{-4}$  % (B) 0.08 % (C)  $8 \times 10^{-3}$  % (D) 0.8 %
23. Which solution has maximum pH :  
 (A) 0.01 M  $\text{H}_2\text{SO}_4$  (B) 0.01 M HCl (C) 0.01 M  $\text{Ba}(\text{OH})_2$  (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  $\text{Sr}(\text{OH})_2$  if its solution has pH of 12 ?  
 (A)  $[\text{NaOH}] = 2 \times 10^{-4}\text{M}$  (B)  $[\text{Sr}(\text{OH})_2] = 5 \times 10^{-3}$  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)  $3.75 \times 10^{-5}$  (B)  $7.5 \times 10^{-4}$  (C)  $3.75 \times 10^{-4}$  (D)  $7.5 \times 10^{-5}$
26. pH of  $10^{-8}$  N NaOH solution is  
 (A) 7.2 (B) 6.8 (C) 6.98 (D) 7.02

# Answers

## RACE # 39

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)