1. K_b of an acid-base indicator H In is 10^{-9}. The pH at which its 10^{-3} (M) solution shows the colour change
(a)9 (b)7 (c)5 (d)3

2. K_{sp} of SrF_2 (s) in water is 3.2×10^{-11}. The solubility of SrF_2 (s) in 0.1 (M) NaCl solution is
(a)3.2×10^{-9} (M) (b)2×10^{-4} (M)
(c)4×10^{-4} (M) (d)slightly higher than 2×10^{-4} (M)

3. A solution contains 0.05 (M) each of NaCl and Na_2CrO_4. Solid $AgNO_3$ is gradually added to it. K_{sp} (AgCl) = 1.7×10^{-10} and K_{sp} (Ag_2CrO_4) =1.9×10^{-12}
Which of the following would occur ?
(a)Cl^- ions are precipitated first
(b)CrO_4^{2-} ions are precipitated first
(c)Both Cl^- and CrO_4^{2-} ions are precipitated together
(d)The second ion starts precipitating when half of the first ion is precipitated

4. How many minimum moles of NH_3 is required to be added to 1L solution so as to dissolve 0.1 moles of AgCl (s) ?
Given :K_{sp} of AgCl = 10^{-10}&K_{form} of $Ag(NH_3)_2^+ = 10^8$
(a)0.5 mol (b)1.0 mol (c)1.1 mol (d)1.2 mol

5. Equal volume of 1 M HCl and 1 M H_2SO_4 are neutralized by dilute NaOH solution and x and y kcal of heat are liberated respectively. Which of the following is true ?
(a)x = y (b)x =0.5 y (c)x = 0.4 y (d)None of these

6. When 100 ml $Ca(OH)_2$ solution of 0.01 M is diluted with water, the pH of the resulting solution changes to 12. Volume of water added is –
(a)10 ml (b)50 ml (c)100 ml (d)200 ml

7. Which of the following solutions has pH = 11 -
(a)1×10^{-11} M NaOH (b)1×10^{-3} M HCl
(c)1×10^{-3} M NaOH (d)1×10^{-11} M HCl

8. At a certain temperature, pure water has hydronium ion concentration equal to $10^{-6.5}$mol L^{-1}. The value of K_w at this temperature will be –
(a)$10^{-6.5}$ (b)10^{-13} (c)$10^{-1.4}$ (d)$10^{-13.5}$

9. When 100 ml of N/10 NaOH are added to 50 ml of N/5 HCl, the pH of the resulting solution is -
(a)7 (b)greater than 7 (c)less than 7 (d)Zero

10. Which of the following solution will have pH close to 1.0 ?
(a)100 ml of M/100 HCl + 100 ml of M/10 NaOH
(b)55 ml of M/10 HCl + 45 ml of M/10 NaOH
(c)10 ml of M/10 HCl + 90 ml of M/10 NaOH
(d)75 ml of M/5 HCl + 25 ml of M/5 NaOH

11. The pH of 0.5 M aqueous solution of HF
($K_a = 2 \times 10^{-4}$) is -
(a) 2 (b) 4 (c)6 (d)10

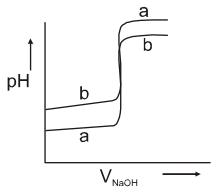
12. Solubility of calcium phosphate (molecular mass, M) in water is W g per 100 mL at 25ºC. Its solubility product at 25ºC will be approximately -
(a) $10^9\left(\frac{W}{M}\right)^5$ (b) $10^7\left(\frac{W}{M}\right)^5$ (c)$10^5\left(\frac{W}{M}\right)^5$ (d)$10^3\left(\frac{W}{M}\right)^5$

13. A solution is prepared by mixing equal volumes of 0.4 M CH_3COOH and 0.2 M CH_3COONa. K_a for $CH_3COOH = 10^{-6}$. The pH of the resulting solution would be –
(a)6 (b)5.69 (c)6.69 (d)6.5

14. Buffer capacity of a buffer solution is x, the volume of 1 M NaOH added to 100 mL of this solution if change the pH by 1 is
(a) 0.1 x Ml (b) 10 x mL (c) 100 x mL (d)xmL

15. The best indicator for the detection of end point in titration of a weak acid and a strong base is :
(a) Methyl orange (3 to 4)
(b) Methyl red (5 to 6)
(c)Bromothymol blue (6 to 7.5)
(d) Phenolphthalein (8 to 9.6).

16. Which is/are correct statements:
(i) In any strong acid's solution, the concentration of $[OH^-]$ will be zero.
(ii) If DG^0 of a reaction is positive, then the reaction will not proceed at all, in the forward direction for any concentrations of reactants and products.
(iii) Titration curves are drawn for (about the figure shown)
(a) 1M HCl (50 mL) with 1 M NaOH and
(b) 0.01 M HCl (50 mL) with 0.01 M NaOH on the same graph paper they look like:



(a)i& ii (b) iii only (c) ii only (d) i & iii

17. Which one of the following statements is not true?
(a) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}.
(b)pH + pOH = 14 for all aqueous solutions at 25^0C.
(c) The pH of 1×10^{-8} M HCl is 8.
(d) 96, 500 coulombs of electricity when passed through a $CuSO_4$ solution deposits 1 gram equivalent of copper at the cathode.

18. When rain is accompanied by a thunderstorm, the collected rain water will have a pH value.
(a) Slightly lower than that of rain water without thunderstorm
(b) Slightly higher than that when the thunderstorm is not there
(c) Uninfluenced by occurrence of thunderstorm
(d) Which depends on the amount of dust in in air.

19. Three reactions involving $H_2PO_4^-$ are given below :
(i) $H_3PO_4 + H_2O \rightarrow H_3O^+ + H_2PO^{4-}$
(ii) $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$
(iii) $H_2PO_4^- + OH^- \rightarrow H_3PO_4 + O^{2-}$
In which of the above does $H_2PO_4^-$ act as an acid ?
(a) (ii) only (b) (i) and (ii) (c) (iii) only (d) (i) only

20. In aqueous solution the ionization constants for carbonic acid are
$K_1 = 4.2 \times 10^{-7}$ and $K_2 = 4.8 \times 10^{-11}$
Select the correct statement for a saturated 0.034 M solution of the carbonic acid.
(a) The concentration of CO_3^{2-} is 0.034 M.
(b) The concentration of CO_3^{2-} is greater than that of HCO_3^-.
(c) The concentration of H^+ and HCO_3^- are approximately equal.
(d) The concentration of H^+ is double that of CO_3^{2-}.

21. The following equilibrium is established when hydrogen chloride is dissolved in acetic acid
$HCl\ (aq) + CH_3COOH\ (aq) \rightleftharpoons Cl^-\ (aq) + CH_3\ COOH_2^+ (aq)$.
The set that characterises the conjugate acid-base pairs is
(a) (HCl, CH_3COOH) and ($CH_3COOH_2^+$, Cl^-)

(b) (HCl, $CH_3COOH_2^+$) and (CH_3COOH, Cl^-)

(c) ($CH_2COOH_2^+$, HCl) and (Cl^-, CH_3COOH)

(d) (HCl, Cl^-) and ($CH_3COOH_2^+$, CH_3COOH).

22. K_a for the acid HA is 1×10^{-6}. The value of K for the reaction $A^- + H_3O^+ \rightleftharpoons HA + H_2O$ is

(a) 1×10^{-6} (b) 1×10^{12} (c) 1×10^{-12} (d) 1×10^{6}

23. The pK_a value of NH_4^+ is 9. The pK_b value of NH_4OH would be :

(a) 9 (b) 5 (c) 7 (d) 8

24. K_{b_1} of N_2H_4 is 4.0×10^{-6}. Then what is the acid dissociation constant of $N_2H_5^+$ and $N_2H_6^{+2}$respectively.

(a)data insufficient, 4×10^{-6}

(b)data insufficient, 2.5×10^{-8}

(c) 2.5×10^{-9} ,data insufficient

(d) 2.5×10^{-9} , 4×10^{-6}

25. The pH of a solution obtained by mixing 50 ml of 0.4 N HCl and 50 ml of 0.2 N NaOH is :

(a) 13 (b) 12 (c) 1.0 (d) 2.0

26. Which of the following has the highest degree of ionisation ?

(a) 1 M NH_3 (b) 0.001 M NH_3

(c) 0.1 M NH_3 (d) 0.0001 M NH_3.

27. At infinite dilution the percentage dissociation of both weak acid and weak base is:

(a) 1% (b) 20%

(c) 50% (d) 100%

28. Concentration of the anion will be 3c. α for the following weak electrolytes.

(a) AB_2 (b) AB

(c) AB_3 (d) A_3B_4

29. Which statement/relationship is correct?

(a)pH of 0.1 M HNO_3, 0.1M HCl, 0.1M HI is not equal.

(b)pH $= -\log \dfrac{1}{[H^+]}$

(c) At 25^0C the pH of pure water is 7.

(d) The value of pK_w at 25^0C is 7.

30. At 25^0C, the solubility product values of AgCl and AgCNS are 1.8×10^{-10} and 1.6×10^{-11} respectively. When a solution is saturated with both solids, calculate the ratio $[Cl^-]/[CNS^-]$ and also $[Ag^+]$ in the solution.

(a) 1.125, 4×10^{-6} M (b) 11.25, 1.4×10^{-5} M

(c) 1.25, 4×10^{-5} M (d) 1.25, 4×10^{-6} M

1. (c)

$K_aK_b = 10^{-14}$

or $K_a = K_{in} = 10^{-5}$

$\therefore [H^+] = 10^{-5}$

or pH = 5

2. (d)

SrF_2 (s) $\rightleftharpoons$ $Sr^{2+} + 2F^-$ s 2s

where s is the solubility

$\therefore 4s^3 = 32 \times 10^{-12}$

or $s = 2 \times 10^{-4}$ (M)

But practically the solubility of SrF_2 (s) in NaCl solution is slightly greater than 2×10^{-4} because NaCl increases ionic strength of the solution

3. (a)

To precipitate Cl^-, required $[Ag^+] = \frac{(K_{sp})_{AgCl}}{0.05}$

To precipitate CrO_4^{2-}, required $[Ag^+] = \left\{\frac{(K_{sp})_{Ag_2CrO_4}}{0.05}\right\}^{1/2}$

Since for the precipitation of Ag_2CrO_4 required concentration of Ag^+ is greater, hence Cl^- ions precipitate first in the form of AgCl (s).

4. (d)

AgCl (s) $\rightleftharpoons$ Ag^+ + Cl^- 0.1(M)

$Ag^+ + 2NH_3 \xrightleftharpoons{K_{form}} Ag(NH_3)_2^+$,

$\frac{K_{sp}}{0.1}$ x 0.1(M)

$\therefore K_{form} = \frac{[Ag(NH_3)_2^+]}{[Ag^+][NH_3]^2} = \frac{0.1}{10^{-9} \times [NH_3]^2} = 10^8$

or $[NH_3] = 1$ (M)

Total moles of NH_3 required = 1 + 0.1 × 2 = 1.2 moles

5. (b)

1 M H_2SO_4 = 2 equivalent H_2SO_4

1 M Hcl = 1 equivalent HCl

Thus, for equal volume of two acids to be neutralized separately with NaOH, heat evolved will be twice in case of H_2SO_4 to that of HCl.

6. (c)

Molarity of $[OH^-]_{Ca(OH)_2}$ = 0.02 M (M_1)

V_1 = 100 ml

V_2 = ?

$M_2 = 10^{-2}$ (pH = 12, pOH = 2, $[OH^-] = 10^{-2}$)

$\Rightarrow 0.02 \times 100 = V_2 \times 10^{-2}$

$\Rightarrow V_2$ = 200 ml

$\Rightarrow$ So volume of H_2O added = $V_2 - V_1$ = 100 mL

7. (c)

10^{-3} M NaOH has $[OH^-] = 10^{-3}$

or $[H^+] = 10^{-11}$. Hence pH = 11.

8. (b)

$K_w = 10^{-6.5} \times 10^{-6.5} = 10^{-13}$

9. (a)

100 ml of N/10 NaOH = 50 ml of N/5 HCl.They exactly neutralise 50 ml of N/5 HCl. Hence pH of resulting solution = 7.

10. (d)

(a) is exact neutralisation. Hence pH = 7

(b) After neutralisation, $\frac{M}{10}$ HCl left = 10 ml.

Total volume = 100 ml.

Dilution = 10 times $\therefore$ $[H^+] = 10^{-2}$

or pH = 2.

(c) After neutralisation, $\frac{M}{10}$ NaOH left = 80 ml.

Total volume = 100 ml. pH > 7

(d) After neutralisation, $\frac{M}{5}$ HCl left = 50 ml

Total volume = 100 ml

Dilution = 2 times.

11. (a)

$[H^+] = \sqrt{CK_a} = \sqrt{0.5 \times 2 \times 10^{-4}} = 10^{-2}$ M

$pH = -\log_{10}[H^+] = -\log 10^{-2} = 2$

12. (b)

$S = \frac{10W}{M}$ mol litre

K_{sp} of $Ca_3(PO_4)_2 = 108\ S^5$

$= 108 \left(\frac{10W}{M}\right)^5$

$= 10^7 \left(\frac{W}{M}\right)^5$ (approximately)

13. (b)

$pH = pK_a + \log \frac{[Salt]}{[Acid]}$

14. (c)

Mole of NaOH is required for 1 lit solution = x

$\therefore$ Mole of NaOH is required for 100 ml of solution = 0.1 x

Now, $0.1x = 1 \times V \Rightarrow V = 0.1x$ lt = 100x ml.

15. (d)

WA Vs SB end point > 7 Phenolphthalein

16. (b)

(i) False, $[OH^-] = \dfrac{10^{-14}}{[H^+]}$ at 25^0C

$= \dfrac{K_w}{[H^+]}$ at any other temperature

(ii) False, $\Delta G^0 = 0 = -RT \ln K_{eq}$

so, $K_{eq} = 1$

Hence reaction will proceed significantly in the forward direction.

17. (c)

We know for acids, pH must be less than 7.

18. (a)

When rain is accompanied by a thunderstorm,

$N_2 + O_2 \quad NO \longrightarrow NO_2 \xrightarrow{H_2O} HNO_2 + HNO_3$

19. (a)

In IInd equation $H_2PO_4^-$ give H^+ ion to the H_2O therefore in the IInd equation it act as an acid.

20. (c)

$H_2CO_3 \rightleftharpoons H^+ + HCO_3^- \quad K_1 = 4.2 \times 10^{-7}$

$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-} \quad K_2 = 4.8 \times 10^{-11} \quad K_1 >> K_2$

$\therefore [H^+] = [HCO_3^-]K_2 = \dfrac{[H^+][CO_3^{2-}]}{[HCO_3^-]}$

but $[H^+] = [HCO_3^-]$

$[CO_3^{2-}] = K_2 = 4.8 \times 10^{-11}$

21. (d)

$HCl\ (aq) + CH_3COOH\ (aq) \rightleftharpoons Cl^-\ (aq) + CH_3\ COOH_2^+(aq).$

Acid-1 base-2 base-1 acid-2

22. (d)

$K_a = 10^{-6}$ for $HA + H_2O \rightleftharpoons H_3O^+ + A^-$ Thus K for reverse reaction is $\dfrac{1}{10^{-6}} = 10^6$

23. (b)

$pK_a + pK_b = 14.$

24. (c)

$$K_{a_1} = \frac{K_W}{K_{b_1}} = \frac{10^{-14}}{4\times10^{-6}} = 2.5\times10^{-9}$$

25. (c)

HCI	NaOH
N = 0.4N = 0.2	
V = 50 ml	V = 50 ml
No. of milieq =0.4 × 50= 20	0.2 × 50 = 10

$[H^+] = 0.1$ M, pH = 1

26. (d)
As concentration of solution decreases, degree of dissociation of weak electrolyte increases.

27. (d)
At infinite weak electrolytes are 100% dissociated.

28. (c)

$AB_3 \rightleftharpoons A^{3+} + 3B^-$

Initial mole 1		0	0
Mole at. Eq.	$1-\alpha$	α	3α
	$\frac{1-\alpha}{v}$	$\frac{\alpha}{v}$	$\frac{3\alpha}{v}$

If volume is v, Therefore, $3c.\alpha$

29. (c)
Factual.

30. (b)

$AgCI \longrightarrow Ag^+ + CI^-$ $AgCNS \longrightarrow Ag^+ + CNS^-$

$(x + y)$ x $(x + y)$ y

$$\frac{K_{SP}(AgCl)}{K_{SP}(AgCNS)} = \frac{x}{y} = \frac{[Cl^-]}{[CNS^-]}$$

$$\text{So } \frac{[Cl^-]}{[CNS^-]} = \frac{x}{y} = \frac{1.8\times10^{-10}}{1.6\times10^{-11}}$$

$= 1.125 \times 10 = 11.25$

$\Rightarrow \frac{x}{y} = 11.25$ $x = 11.25$

$K_{SP}(AgCI) = [Ag^+][CI^-] = (x + y)\,x = 1.8 \times 10^{-10}$

$12.25\,y \times 11.25\,y = 1.8 \times 10^{-10}$

$$y^2 = \frac{1.8\times10^{-10}}{12.25\times11.25}$$

$$y^2 = \frac{180\times10^{-12}}{12.25\times11.25}$$

$y^2 = 1.3 \times 10^{-12}$

$y = 1.14 \times 10^{-6}$

$x = 11.25 \times 1.14 \times 10^{-6} = 12.83 \times 10^{-6}$

$[Ag^+] = [x + y] = 12.83 \times 10^{-6} + 1.14 \times 10^{-6} = 13.97 \times 10^{-6} = 1.4 \times 10^{-5}$ M