

Solution

31. **(C)** Correct option is (c) since for strong acids (completely ionised) only concentration is the measure of strength but for weak (incompletely ionised) acids both degree of ionisation (or K_a) and concentration will be required.
32. **(A)** Correct answer is (A) as one can conclude from the increasing values of K_a .
33. **(B)** In the following reaction, NH_3 changes to NaNH_2 which contains NH_2^- ion. This means that NH_3 has donated a proton to Na and hence acts as an acid.

34. **(B)** HCl is 100% ionised so

$$[\text{H}_3\text{O}^+] = 1.2 \times 10^{-3} \text{ M}$$

$$\text{pH} = -\log (1.2 \times 10^{-3} \text{ M})$$

$$\text{or pH} = 2.92$$

35. **(B)** $\text{pH} = \text{p}K_a - \log \frac{[\text{acid}]}{[\text{salt}]}$

0.1 M NaOH will react with acid to form 0.1 M CH_3COONa and therefore CH_3COOH concentration will be reduced to 0.2 M.

$$\text{pH} = 4.76 - \log \frac{0.2}{0.1} = 4.45$$

36. **(C)** For amphiprotic species

$$\text{pH} = \frac{\text{p}K_1 + \text{p}K_2}{2}$$

37. **(D)** $[\text{Ba}^{2+}] [\text{SO}_4^{2-}]$

$$= 1.5 \times 10^{-9} (K_{\text{sp}}) \text{ and } [\text{Ba}^{2+}] = 0.01 \text{ M}$$

$$\text{so Required } [\text{SO}_4^{2-}] = \frac{1.5 \times 10^{-9}}{0.01}$$

$$= 1.5 \times 10^{-7}$$

$$\text{so } [\text{H}_2\text{SO}_4] > 1.5 \times 10^{-7}$$

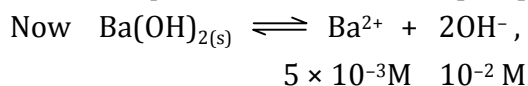
for precipitation of BaSO_4

38. **(A)** Solubility of $\text{CaCO}_3 = \sqrt{K_{\text{sp}}} = \sqrt{2.5 \times 10^{-9}}$

$$\text{solubility of } \text{CaCO}_3 \text{ in g L}^{-1} = 5 \times 10^{-5} \times 128$$

$$= 6.4 \times 10^{-3} \text{ g L}^{-1}$$

39. **(C)** $\text{pH} = 12$ so $[\text{OH}^-] = 10^{-2} \text{ M}$



$$\text{so } K_{\text{sp}} = [\text{Ba}^{2+}] [\text{OH}^-]^2$$

$$= (5 \times 10^{-3}) (10^{-2})^2$$

$$= 5 \times 10^{-7}$$

40. (D)
$$\text{pH} = \text{pK}_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$5 = 5 + \log \left[\frac{N_2 V_2}{N_1 V_1 - N_2 V_2} \right]$$

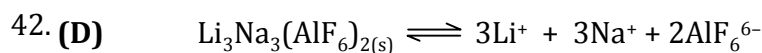
$$1 = \frac{0.1 \times V_2}{0.1 \times 100 - 0.1 \times V_2}$$
or $10 - 0.1 V_2 = 0.1 V_2$ or $V_2 = 50 \text{ mL}$

41. (B)
$$[\text{CH}_3\text{COOH}] = \frac{6.0}{60} \times 1 = 0.1 \text{ M}$$

$$[\text{CH}_3\text{COONa}] = \frac{8.2}{82} \times 1 = 0.1 \text{ M}$$

so
$$\text{pH} = \text{pK}_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

or
$$\text{pH} = 4.5 + \log \left(\frac{0.1}{0.1} \right) = 4.5$$



Let solubility of salt is 's' mol L⁻¹

so $[\text{Li}^+] = 3s = [\text{Na}^+]$

$$[\text{AlF}_6^{6-}] = 2s$$

so
$$K_{\text{sp}} = [\text{Li}^+]^3 [\text{Na}^+]^3 [\text{AlF}_6^{6-}]^2$$

$$= (3s)^3 (3s)^3 (2s)^2$$

$$= 2916 s^8$$

43. (B)
$$K_h = \frac{K_w}{K_b} = \frac{10^{-14}}{1 \times 10^{-5}} = 10^{-19}$$

44. (C)
$$\text{pH} = 7 + \frac{1}{2} \text{pK}_a - \frac{1}{2} \text{pK}_b$$

$$= 7 + 2 - 3 = 6$$

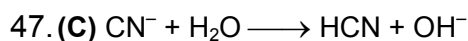
45. (B) AgBr forms soluble complex with NH₄OH i.e. [Ag(NH₃)₂]⁺.

46. (A) When NH₄OH is half neutralized

$$[\text{NH}_4\text{OH}] = [\text{NH}_4\text{Cl}]$$

$$\text{pOH} = \text{pK}_b + \log \frac{[\text{salt}]}{[\text{Base}]} = \text{pK}_b = 4.75$$

$$\therefore \text{pH} = 14 - 4.75 = 9.25$$



$$pK_b = 4.7$$

$$\therefore pK_a = 9.3$$

$$[\text{OH}^-] = Ch = C \sqrt{\frac{K_b}{C}} = \sqrt{K_b C} = \sqrt{\frac{K_w C}{K_a}} = \sqrt{\frac{10^{-14} \times 0.5}{10^{-9.3}}}$$

$$\therefore [\text{OH}^-] = \sqrt{10^{4.7} \times 0.5}$$

$$\therefore \text{pOH} = 11.4$$

48. (C) $[\text{H}^+] = C\alpha = 0.1 \times 0.013 = 1.3 \times 10^{-3}$

$$\text{pH} = -\log(1.3 \times 10^{-3}) = 3 - 0.11 = 2.89$$

49. (A) $\text{NH}_4\text{OH} + \text{HCl}$ for NH_4Cl which gives acidic solution with $\text{pH} < 7$

50. (C) $\text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{acid}]}$

$$\Rightarrow 9 = -\log(5 \times 10^{-5}) + \log \frac{[\text{salt}]}{[\text{acid}]}$$

$$\therefore \frac{[\text{salt}]}{[\text{acid}]} = 0.5$$

Let volume of KCN to be added is = v

Total volume of HCN + KCN = (10 + v)

$$[\text{KCN}] = \frac{5V}{(10 + v)}, [\text{HCN}] = \frac{10 + 2}{(10 + v)}$$

$$\therefore \frac{[\text{salt}]}{[\text{acid}]} = \frac{5v/(10 + v)}{20/(10 + v)} = 0.5$$

$$\therefore \frac{v}{4} = 0.5 \therefore v = 2\text{cc}$$

51. (D) Mixture of sodium acetate and acetic acid is a buffer of pH value equal to $\text{p}K_a$ so its buffer capacity is very high and hence its pH will not change significantly while $\text{CH}_3\text{COONH}_4$ is a salt of weak acid CH_3COOH and weak base NH_4OH whose magnitude of K_a and K_b are equal. So its pH does not depend upon concentration. Further more, NaH_2PO_4 is, in fact, a single solute buffer

52. (C) $\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$

$$\therefore 4.5 = 4.2 + \log \frac{[\text{Salt}]}{[\text{Acid}]} = \log \frac{[\text{Salt}]}{[\text{Acid}]} = 0.3$$

(since $\log 2 = 0.3$)

$$\therefore \frac{[\text{Salt}]}{[\text{Acid}]} = 2$$

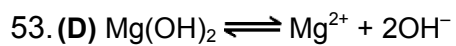
Let V ml 1M $\text{C}_6\text{H}_5\text{COOH}$ solution and (300 - V) 1M $\text{C}_6\text{H}_5\text{COONa}$ solution be mixed together

$$[\text{Acid}] = \frac{V \times 1}{1000} \times \frac{1000}{300}; [\text{Salt}] = \frac{(300 - V)}{1000} \times \frac{1000}{300}$$

$$[\text{Acid}] = \frac{V}{300}; [\text{Salt}] = \frac{300 - V}{300}$$

$$\therefore \frac{300 - V/300}{V/300} = 2$$

$$= 300 - V = 2V \therefore V = 100 \text{ ml}$$



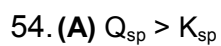
$$K_{\text{sp}} = [\text{Mg}^{2+}][\text{OH}^-]^2$$

$$\Rightarrow 1.2 \times 10^{-11} = 0.1 \times [\text{OH}^-]^2 \Rightarrow [\text{OH}^-] = 1.2 \times 10^{-10}$$

$$\therefore [\text{OH}^-] = 1.1 \times 10^{-5}$$

$$\therefore [\text{H}^+] = \frac{10^{-14}}{1.1 \times 10^{-5}} = 9.09 \times 10^{-9} \text{ M}$$

$$\therefore \text{pH} = -\log(9.09 \times 10^{-9}) = 10 - 0.9586 = 9.04$$



55. (D) at equivalence point solution will be basic in nature

56. (B)

57. (B)

58. (D)

59. (B)

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