CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (ENGLISH)

IONIC EQUILIBRIUM

Solved Examples

1. Write the conjugate bases for the following Bronsted acids

(a) HF (b) H_2SO_4 (c) HCO_3^{Θ}

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2. Wirte the conjugate bases for the following :

a. $\overset{\Theta}{N}H_2$ b. NH_3 c. HCO_3^{Θ}

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3. The species $H_2O, HCO_3^{\Theta}, HSO_4^{\Theta}, NH_3$ can act both as Bronsted acids and bases. For each case write the corresponding conjugate acid.

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4. Classify the following species into Lewis acids and Lewis bases and show how these act as such:

(a) HO^- , (b) F^- , (c) H^+ , (d) BCl_3

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5. In the reaction of BeF_2 with $2F^{\Theta}$ to form BeF_4^{-2}, which reactant is the Lewis acid and which is the Lewis base?

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6. Write the conjugate bases of the following acids:

a. $\overset{\oplus}{N}_2H_5$ b. C_2H_5OH

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7. Write the conjugate base of the following acid:

$\overset{\oplus}{N}_2H_5$

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8. Liquid NH_3, like water, is an amphiprotic solvent. Write the equaiton for the auto-ionisation of NH_3.

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9. Aniline $\left(C_6H_5NH_2\right)$ is a weak organic base in aqueous solution. Suggest a solvent in which aniline would become a strong base.

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10. The concentration of hydrogen ion in a sample of soft drink is $2.8 \times 10^{-4}M$. What is its pH?

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11. Calculate the pH of the following solutions:

a $10^{-2}MHCl$

b $10^{-3}MH_2SO_4$

c $0.2 \times 10^{-2}MNaOH$

d $0.3 \times 10^{-3}MCa(OH)_2$

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12. Calculate the concentration of hydrogen ion in the acidic solution with pH

a. 4.3

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13. Calculate the concentration of $\overset{\Theta}{OH}$ in the solution of base with pH

a. 10.4771

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14. Calculate the pH of the following mixtires of strong acids, strong bases, and combination of both:

a. $500mL$ of $0.1MHCI + 200mL$ of $0.1MH_2SO_4 + 300mL$ of $0.2MHNO_3$

b. $100mL$ of $0.1MHCI + 100mL$ of $0.2MH_2SO_4 + 100mL$ of $0.1MHNO_3$ and $700mL$ of H_2O

c. $500mL$ of $0.1MNaOH + 100mL$ of $0.1MCa(OH)_2 + 400mL$ of $0.2MKOH$

d. $100mL$ of $0.1MNaOH + 200mL$ of $0.1NCa(OH)_2 + 200mL$ of $0.1MKOH$ and $500mL$ of H_2O

e. $100mL$ of $0.1MHCI + 300mL$ of $0.1MH_2SO_4 + 100mL$ of $0.3MBa(OH)_2$ and volume was made to $1L$ by adding water

f $500mL$ of $0.1MHCI + 100mL$ of $0.1NH_2SO_4 + 400mL$ of $0.1MCa(OH)_2$

g $8g$ of $NaOH + 680mL$ of $MHCI + 10mL$ of H_2SO_4, (specific gravity $1.2, 49\% H_2SO_4$ bu mass). The total volume of the solution was made to $1L$ with water.

h. $37.0g$ of $Ca(OH)_2 + 360mL$ of $1MHCI + 10mL$ of H_2SO_4 (density $= 1.4, 49\% H_2SO_4$ by mass). The total volume of the solution was made to $1L$ with water.

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15. a. What amount of H_2SO_4 must be dissolved in $500mL$ of solution to have a pH of 2.15?

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16. Calculate the pH of solution made by mixing equal volume of three solutions having $pH = 2, 4$, and 6.

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17. While calculating the pH of $10^{-7}MHCl$, the common ion effect of HCl on water is considered. Why the common ion effect of HCl on water is considered?

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18. What is the pH of the following solutions:

a. $10^{-8}MHCl$ b. $5 \times 10^{-8}MHCl$

c. $5 \times 10^{-10}MHCl$ d. $10^{-3}MHCl$

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19. What is the pH of the following solutions:

$10^{-2}MNaOH$

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20. Calculate the percent error in the $\left[H_3O^{\oplus}\right]$ made by neglecting the ionisation of water in $10^{-6} MNaOH$ solution.

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21. The value of K_w, at the physiological temperature $37^{\circ} C$ is 2.56×10^{-14}. What is the pH at the neutral point of water at this temperature where there are equal numbers of $H^{\oplus}$ and $\overset{\Theta}{OH}$ ions?

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22. Solution of a monobasic acid has a pH=5. If one mL of it is diluted to 1 litre, what will be the pH of the resulting solution ?

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23. The ionisation constant of HF is 3.2×10^{-4}.

a. Calculate the degree of dissociation of HF present in its 1M solution.

b. Calculate the concentration of all species present $\left(H_3O^{\oplus}, F^{\Theta}\right.$ and $\left.HF\right)$ in the solution.

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24. The pH of $0.1M$ monobasic acid is 4.50. Calculate the concentration of species, $H^{\oplus}, A^{\Theta}$, and HA at equilibrium. Also determine the value of K_a and pK_a of the monobasic acid.

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25. Calculate the pH of $0.08M$ solution of hypochlorous acid, HOCl. The ionization constant of the acid is 2.5×10^{-5}. Determine the percent dissociation of HOCl.

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26. The pH of $0.004M$ hydrazine solution is 9.7. Calculate its ionization constant K_b and pK_b.

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27. Determine the dergee of dissociation of $0.05MNH_3$ at $25^{\circ}C$ in a solution of $pH = 11$

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28. Calculate the ionic constant of the conjugate acid of NH_3. given k_(b) is 1.77 x 10^-5

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29. Prove that the dergee of dissociation of weak acid is given by:

$$\alpha = \frac{1}{1 + 10^{pK_a - pH}}$$

where K_a is its dissociation constant of the weak acid.

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30. Calculate $\left[H^{\oplus}\right]$ in a soluton that is $0.1MHCOOH$ and $0.1MHOCN. K_a(HCOOH)=1.8\times10^{-4}, K_a(HoCN)=3.3\times10^{-4}$.

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31. Calculate $\left[H^{\oplus}\right], \left[C_3H_5O_3^{\Theta}\right]$, and $\left[PhO^{\Theta}\right]$ in a solution that is $0.03M\left(C_2H_5\overset{O}{\overset{||}{C}}-O-O-H\right)$ and $0.1MPhOH?K_a$ values for $C_3H_5O_3H$ and $PhOH$ are 1.48×10^{-4} and 1.05×10^{-10} respectively.

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32. What is pH of $7.0 \times 10^{-8}M$ acetic acid. What is the concentration of un-ionsed acetic acid. K_a of $CH_3COOH = 1.8 \times 10^{-5}$.

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33. The K_a for formic acid and acetic acid are 2.1×10^{-4} and 1.1×10^{-5}, respectively. Calculate relative strength of acids

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34. What is the pH of the solution when $100mL$ of $0.1MHCl$ is mixed with $100mL$ of $0.1MCH_3COOH$.

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35. Calculate $\left[H^{\oplus}\right]$ and $\left[\overset{\Theta}{OH}\right]$ in $10^{-3}M$ solution of monobasic acid which is 4.0% ionised. What is the pH, K_a and pK_a of the acid.

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36. calculate $\left[H^{\oplus}\right]$ and $\left[\overset{\Theta}{OH}\right]$ in a $0.1M$ solution of weak monoacitic base which is 2.0% ionised. What is the pH of solution.

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37. The pH of pure water at $25^{\circ}C$ and $35^{\circ}C$ are 7 and 6, respectively. Calculate the heat of formation of water from $H^{\oplus}$ and $\overset{\Theta}{OH}$.

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38. The pH of $0.05M$ aqueous solution of diethy1 amine is 12.0 . Caluclate K_b.

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39. What is the pH of 1 M solution of acetic acid ? To what volume one litre of this solution be diluted so that pH of the resulting solution will be twice of the original value ? $\left(K_a = 1.8 \times 10^{-5}\right)$

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40. Calculate the pH of $0.1MNH_3$ solution. $K_b = 1.8 \ast 10^{-5}$

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41. Calculate the pH after $50.0mL$ of 0.1M NH_(3) this solution is treated with $25.0mL$ of $0.1MHCI$

K_b for $NH_3 = 1.77 \times 10^{-5}\left(pK_b \approx 4.76\right)$.

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42. What is the pH of a solution containing $0.01MHCl$?

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43. What is $\left[H^{+}\right]$ in mol/L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH ? $\left(K_a \text{ for } CH_3COOH = 1.8 \times 10^{-5}\right)$

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44. $0.1MNH_3$ solution is found to have a $\left[\overset{\Theta}{O}H\right]$ of $.133 \times 10^{-3}M.$

a. What is the pH of the solution?

b. What will be the pH of the solution after $0.1MNaOh$ is added to it?

c. Calculate K_b and pK_b for NH_3?

d. How will $NaOh$ added to the solution affect the extent of dissociation of NH_3?

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45. The self ionisation constant for pure $HCOOH, K = \left[HCOO\overset{\oplus}{H}_2\right]\left[HCOO^{\Theta}\right]$ is 10^{-6} at room temperature. What percentage of $HCOOH$ molecules are converted to $HCOO^{\Theta}$ ions. The density of $HCOOH$ iws $1.22gcm^{-3}$.

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46. Liquid NH_3 dissociation to a slight extent, At a certain temp. its self dissociation constant $K_{SDC}\left(NH_3\right)$=10^{-30}. The number of NH_4^+ ions are present per $100cm^3$ of pure liquid are :

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47. Find the concentration of $H^{\oplus}$, HCO_3^{Θ}, and CO_3^{-2} in a $0.01M$ solution of carbonic acid if the pH of solution is 4.18.

$K_1 = 4.45 \times 10^{-7}, K_2 = 4.69 \times 10^{-11}$

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48. K_1 and K_2 for dissociation of H_2A are 4×10^{-3} and 1×10^{-5}. Calculate concentration of A^{2-} ion in $0.1 MH_2A$ solution. Also report $\left[H^+\right]$ and pH.

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49. Calculate the concentration of all species of significant concentrations presents in $0.1 MH_3PO_4$ solution. If $K_1 = 7.5 \times 10^{-3}, K_2 = 6.2 \times 10^{-8}, K_3 = 3.6 \times 10^{-13}$

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50. A solution contains $0.10 MH_2S$ and $0.3 HCl$ Calculate the concentration of S^{2-} and HS^- ions in the solution . For $H_2S, K_{a_1} = 1 \times 10^{-7}$ and $K_{a_2} = 1.3 \times 10^{-13}$

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51. Which of the following combinations of solute would result in the formation of a buffer solution.

a. $CH_3COOH + NaOH$ in

i. $1:1$ mol ratio

ii. $2:1$ mol ratio

iii. $1:2$ mol ratio

b. $NH_4CI = NH_3$in

i. $1:1$ mol ratio

ii. $2:1$ mol ratio

iii. $1:2$mol ratio

c. $HCI + NaCI$

d. $HCI + CH_3COOH$

e. $NaH + HCI$

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52. Calculate the pH of a solution made by mixing $0.1MNH_3$ and $0.1M\left(NH_4\right)_2SO_4$. $\left(pK_b \text{ of } NH_3 = 4.76\right)$

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53. How much volume of $0.1 M Hac$ should be added to $50 mL$ of $0.2 M NaAc$ solution to have a $pH 4.91$?

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54. i At what pH will the mixture of $HCOOH$ and $HCOONa$ given buffer solution of higher capacity?

$\left(K_a of HCOOH = 1.8 \times 10^{-4}\right)$

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55. How much ml of $0.3 M NH_4OH$ should be mixed with $30 mL$ of $0.2 M$ solution of NH_4Cl to given buffer solution of $pH 8.65$? (pKb =4.74)

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56. Calculate the pH of the following mixtures given $K_a = 1.8 \times 10^{-5}$ and $K_b = 1.8 \times 10^{-5}\left(pK_a = pK_b = 4.7447\right)$.

a. $50mL0.05MNaOH + 50mL$ of $0.1MCH_3COOH$

b. $50mL0.1MNH_4OH + 50mL$ of $0.05MHCI$

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57. What volume of strong monobasic acid of normality 10 is needed to prepare $1L$ of a butter solution of $pH9$, using $1mol$ of NH_3 and as much of strong acid needed. $\left(K_b \text{ for } NH_3 = 1.8 \times 10^{-5}\right)\left(pK_b = 4.7477\right)$

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58. $40mL$ sample of $0.1M$ solution of nitric acid is added to $20mL$ of $0.3M$ aqueous ammonia. What is the pH of the resulting solution? $\left(pK_b = 4.7447\right)$

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59. The base imidazole has a K_b of 8.1×10^{-8}.

a. In what amounts should $0.02 MHCI$ and $0.02M$ imidazole be mixted to make $100mL$ of a buffer at $pH7$?

b. If the resulting solution is diluted to $1L$, what is the pH of the diluted solution?

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60. In the titration of solution of a weak acid HA and NaOH, the pH is 5.0 after 10 mL of NaOH solution has been added and 5.60 after 20 mL NaOH has been added.

What is the value of pK_a for HA?

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61. A definite volume of an aqueous $N/20$ acetic acid $\left(pK_a = 4.74\right)$ is titrated with a strongs base. It is found that 75 equal-sized drops of

$NaOH$ added from a burette effect the complete neutralisation. Find the pH when an acid solution is neutralised to the extent of 20%, 40%, and 90%, respectively.

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62. How many moles of $NaOH$ can be added to $0.1L$ of solution of $0.1MNH_3$ and $0.1MNH_4CI$ without changing pOH by more than pne unit $\left(pK_a\text{of}NH_3 = 4.75\right)$?

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63. How many moles of HCI can be added to $1.0L$ of solution of $0.1MNH_3$ and $0.1MNH_4CI$ without changing pOH by more than one unit? $\left(pK_bofNH_3 = 4.75\right)$

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64. A buffer solution of pH value 4 is to be prepared, using CH_3COOH and CH_3COONa.How much amount of sodium acetate is to be added to $1.0L$ of $M/10$ acetic acid? $\left(K_a = 2.0 \times 10^{-5}\right)$

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65. What will be the pH if $0.01 mol$ of HCl is dissolved in the above buffer solution? Find the change in pH value.

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66. How will the pH be affected if $1.5L$ of H_2O is added to the above buffer?

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67. Calculate the pH of a buffer by mixing 0.15 mole of NH_4OH and 0.25 mole of NH_4Cl in a $1000mL$ solution K_b for $NH_4OH = 2.0 \times 10^{-5}$

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68. To $0.1L$ of a decimolar solution of acetic acid, how much dry sodium acetate be added (in moles) so as to decrease the concentration of $H^{\oplus}$ ion to $1/10th$ of its previous value? $K_a = 2.0 \times 10^{-5}$.

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69. The equivalent point in a titration of $40.0mL$ of a sodium of a weak monoprotic acid occurs when $35.0mL$ of a $0.10MNaOH$ solutio has been added. The pH of the solution is 5.5 after the addition of $20.0mL$ of $NaOH$ solution. What is the dissociation constant of the acid ?

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70. Consider a buffer solution containing $0.1 mol$ each of acetic and sodium acetate in $1.0 L$ of solution, $0.01 mol$ of $NaOH$ is gradually added to this buffer solution. Calculate the average buffer capacity of the solution and as well as initial and final buffer capacity. $\left[K_a = 2 \times 10^{-5}\right] pK_a = 4.7$

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71. The ph of blood stream is maintained by a proper balance of H_2CO_3 and $NaHCO_3$ concentrations. What volume of $5 M NaHCO_3$ solution, should be mixed with $10 mL$ sample of blood which is $2M$ in H_2CO_3 in order to maintain a pH of 7.4. K_a for H_2CO_3 in blood is 7.8×10^{-7}?

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72. Calculate the degree of hydrolysis of a mixture of aniline and acetic acid each of them being $0.01M$. K_a of acetic acid $= 1.8 \times 10^{-5}$ and $K_b(\text{aniline}) = 4.5 \times 10^{-10}$. Also calculate pH of the mixture.

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73. $2.5mL$of $2/5M$ weak mono-acidic base $\left(K_b = 1 \times 10^{-12} \text{ at } 25^{\circ} C\right)$ is titrated with $2/15MHCI$ in water at $25^{\circ} C$. Find the concentration of $H^{\oplus}$ ions at equivalence point. $\left(K_w = 1 \times 10^{-14} at 25^{\circ} C\right)$

a. $3.7 \times 10^{-13}M$ b. $3.2 \times 10^{-7}M$

c. $3.2 \times 10^{-2}M$ d. $2.7 \times 10^{-2}M$

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74. The pK_a of CH_3COOH and pK_a of nH_4OH is 4.76 and 4.75, respectively. Calculate the hydrolysis constant of ammonium acetate $\left(CH_3COONH_4\right)$ at $298K$ and also the drgree of hydrolysis and pH of its (a) $0.01M$ and (b) $0.04M$ solutions.

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75. Calculate the dergee of hydrolysis and pH of $0.02M$ ammonium cyanide $\left(NH_4CN\right)$ at $298K$. $\left(K_a \text{ of } HCN = 4.99 \times 10^{-9}, K_b\right.$ for

$NH_4OH = 1.77 \times 10^{-5}\big)$

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76. Calculate the pH of the solutions when following conditions are provided:

a. $20mL$ of $M/10CH_3COOH$ solution is titrated with $M/10$ solution of $NaOH$.

i. No titration is carried out.

$\left(pK_a \text{ of } CH_3COOH = 4.74\right)$

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77. Calculate the pH of the following mixtures given $\left(pK_a = pK_b = 4.7447\right)$:

a. $50mL0.1MNaOH + 50mL0.1MCH_3COOH$

b. $50mL0.1mNaOH + 50mL0.05MCH_3COOH$

c. $50mL0.05MNaOH + 50mL0.1MCH_3COOH$

d. $50mL0.1MNH_4OH + 50mL0.05MHCI$

e. $50mL0.05MNH_4OH + 50mL0.1MHCI$

f. $50mL0.05MNH_4OH + 50mL0.05MCH_3COOH$

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78. Which of the following ions or compounds in a solutions tends to produe an acidic, a basic, or a neutral solution.

a. i. $C_2H_3O_2^{\Theta}$ ii. $Na^{\oplus}$ iii. So_3^{2-} iv. F^{Θ} v. $NH_4^{\oplus}$

b. i. CH_3COONa ii. $ZnCI_2$ iii. KNO_3 iv. NH_4CI

c. i. $NaCN$ ii. K_2CO_3 iii. H_3PO_4 iv. NaF

d. i. NH_4NO_3 ii. Ba_2CO_3 iii. $NaHSO_4$ iv. $NaOCI$ v. $HOCI$ vi. $AI\left(NO_3\right)_3$

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79. Arrange the following bases in order of decreasing basicity:

$S^{2-}, CH_3COO^{\Theta}, CN^{\Theta}, NH_3, F^{\Theta}$

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80. Classify each of the folowing as a strong acid, string base, weak acid, and weak base:

i. $NaOH$ ii. HF iii. $NH_4^{\oplus}$ iv. NH_3 v. $F^{\ominus}$ vi. HI

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81. Arrange the following $0.1M$ solutions in order of increasing pH:

$H_2CO_3, HBr, HI, NH_3, KCN, NaOH, NH_4Br$

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82. Why the following compounds will produce acidic solution in water

i. H_3PO_4

ii. CO_2

iii. HNO_2

iv. $AlCl_3$

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83. Write equations & explain why the following species act as weak bases in water solution.

i. CH_3NH_2 ii. NO_2^{Θ} iii. HPO_4^{2-} iv. CHO_2^{Θ}

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84. Which equilibrium constant(s) or ratio of equilibrium constants should be used to calculate the pH of $1.00L$ of each of the following solutions?

a. KOH b. NH_3 c. $HC_2H_3O_2$

d. $HC_2H_3O_2 + NaC_2H_3O_2$ e. $KC_2H_3O_2$

f. $0.01molHC_2H_3O_2 + 0.050molNaOh$

g. H_2S h. $0.01NH_4CI + 0.50molNaOH$

i. $0.010molHC_2H_3O_2 + 0.10molNaOH$

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85. The salt of which one of the follwing five weak acid will be the most hydrolysed?

a. $HA : K_a = 1 \times 10^{-8}$ b. $HB : K_a = 2 \times 10^{-6}$

c. $HC : K_a = 3 \times 10^{-8}$ d. $HD : K_a = 4 \times 10^{-10}$

e. $HE : K_a = 1 \times 10^{-7}$

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86. $500mL$ of $0.2M$ aqueous solution of acetic acid is mixed with $500mL$ of $0.2HCI$ at $25^{\circ}C$.

a. Calculate the degree of dissociation of acetic acid in the resulting solution and pH of the folution.

b. If $6g$ of $NaOH$ is added to the above solution determine the final pH. $\left[K_a\right.$ of $CH_3COOH = 2 \times 10^{-5}$.

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87. $0.1MNaOH$ is titrated with $0.1M, 20mLHA$ till the point. $K_a(HA) = 6 \times 10^{-6}$ and degree of dissociation of HA is neglible (small) as compared to unity. Calculate the pH of the resulting solution at the end point [Use $\log 6 \approx 0.8$]

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88. A hydrogen electrode placed in a solution containing sodium acetate and acetic acid in the ratio of $x:y$ and $y:x$, ahs electrode potential values of -1.5 and $-0.5V$, respectively. What is the pK_a value of acetic acid?

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89. The emf of the following cell is observed to be $0.118V$ at $25^{\circ}C$.

$$\left[Pt, H_2(1atm) \mid HA\left(100mL0.1M\right|\left|H^{\oplus}(0.1M)\right|H_2(1atm)\left|Pt\right]$$

a. If $30mL$ of $0.2MNaOH$ is added to the negative terminal of battery, find the emf of the cell.

b. If $50mL$ of $0.2MNaOH$ is added to the negative terminal of battery, find the emf of teh cell.

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90. The freezing point of $0.20M$ solution of weak acid HA is $272.5K$. The molality of the solution is $0.263 molKg^{-1}$.

Find the pH of the solution on adding $0.20M$ solution of $NaOH$. Given: K_f of water $= 1.86Km^{-1}$

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91. Methy1 red has a $K_a = 10^{-5}$. The acid form Hin is red and its conjugate base, Ind^{Θ} is yellow. Complete the following table:

pH	3	5	7
$\left[\mathrm{Ind}^{\Theta}\right]/[\mathrm{HIn}]$	-	-	-
Colour	-	-	-

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92. There are three acid-base indicators. Methyl orange (end point at $pH = 4$), bromothymol blue (end point at $pH - 7$), phenolphthalein (end point at $pH = 9$). Which is the most suitable indicator for the following titrations?

(a). H_2SO_4 with KOH

(b). KCn with HCl

(c). NH_3 with HNO_3

(d). HF with NaOH

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93. A solution gives the following colours with different indicators:

a. Methyl orange ⇒ Yellow

b. Methyl red ⇒ Yellow

c. Bromthymol blue ⇒ Orange

What is the pH of the solution?

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94. What indicators will be suitable for the following acid-base titrations:

a. $HCOOH$ against $NaOH$

b. HBr against KOH

c. NH_4OH with HNO_3

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95. Calculate the pH at which an acid indicator with $K_a = 1.0 \times 10^{-5}$ changes colour when the indicator is $1.00 \times 10^{-3}M$.

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96. At what pH will a $1.0 \times 10^{-3}M$ solution of an indicator with $K_b = 1.0 \times 10^{-10}$ changes colour?

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97. What indicator should be used for the titration of $1.0 M KBO_2$ with $1.10 M HCl$?

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98. Calcualte the pH at which an indicator with $pK_b = 4$ changes colour.

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99. Bromophenol blue is an indicator with a K_a value of 5.84×10^{-5}. What is the percentage of this indicator in its basic form at a pH of 4.84?

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100. An acid-base indicator has $K_{HIn} = 3.0 \times 10^{-5}$. The acid form of the indicator is red and the basic form is blue. The change in $\left[H^{+}\right]$ required to change the indicator from 75% red to 75% blue is :

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101. Determine the solubility of (a) $AgCI$, (b) $Fe(OH)_3$, (c) Hg_2Br_2, and (d) Ag_2SO_4 from their solubility product constants give in table. Calculate the molarities of the individual ions and also the soubities of salts in gL^{-1}.

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102. Calcualte the solubility of M_2X_3 in pure water, assuming that neither kind of ion reacts with H_2O. The solubility product of $M_2X_3, K_{sp} = 1.1 \times 10^{-23}$.

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103. The values of K_{sp} of two sparingly soluble salts $Ni(OH)$ an d $AgCN$ are 2.0×10^{-15} and 6×10^{-17} respectively. Which salt is more soluble? Explain.

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104. A solution of caF_2 is found to contain $10^{-4}MF^{\Theta}$ ions. What is the K_{sp} of caF_2?

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105. Let the solubilities of $AgBr$ in water and in $0.01MCaBr_2, 0.01MKBr$, and $0.05MAgNO_3$be S_1, S_2, S_3 and S_4, respectively. Give the decreasing order of the solubilities.

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106. The K_{sp} of $AgCl$ at $25^{\circ}C$ is 1.5×10^{-10}. Find the solubility (in gL^{-1}) in an aqueous solution containing $0.01MAgNO_3$.

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107. The solubility of $BaSO_4$ in water is $2.33g100mL^{-1}$. Calculate the percentage loss in weight when $0.2g$ of $BaSO_4$ is washed with

a. $1L$ of water

b. $1L$ of $0.01NH_2SO_4$. $\left[Mw_{BaSO_4} = 233gmol^{-1}\right]$

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108. When $15mL$ of $0.05MAgNO_3$ is mixed with $45.0mL$ of $0.03MK_2CrO_4$, predict whether precipitation of Ag_2CrO_4 occurs or not? K_{sp} of $Ag_2CrO_4 = 1.9 \times 10^{-12}$

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109. The concentration of Ni^{+2} ions in a given NiS solution is $2.0 \times 10^{-6}M$. Find the minimum S^{2-} ions necessary to cause precipitation of NiS. K_{sp} of $NiS = 1.4 \times 10^{-14}$.

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110. A solution contains $0.1M$ each of $CaCI_2$ and $SrCI_2$. $A0.005M$ solution of SO_4^{2-} is slowly added to the given solution.

a. Which substance beings to precipitate first?

b. If H_2SO_4 is continuosult added, determine when will other salt be precipitated?

c. When second salt starts to precipitate, find the concentration of cation of first salt. Assume that $CaCI_2$ and $SrCI_2$ are 100% ionised and volume of the solution remains constant.

$K_{sp} of SrSO_4 = 3.2 \times 10^{-7}$ and $K_{sp} of CaSO_4 = 1.3 \times 10^{-4}$

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111. How much the concentration of $Ag^{\oplus}$ ions in a saturated solution of $AgCI$ diminish if such an amount of HCI is added to it that the concentration of $CI^{\ominus}$ ions in the solution becomes equal to $0.03M$? Also find the amount of $AgCI$ precipitated at the given concentration. K_{sp} of $AgCI = 1.8 \times 10^{-10}$.

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112. Calculate the maximum possible concentration of Mn^{2+} in water that is saturated with H_2S (which is $0.1M$ at $300K$) and maintained at $pH = 3$ with HCI. The equilibrium constant (s) for dissociation of H_sS are:

$H_2S \Leftrightarrow H^{\oplus} + HS^{\Theta}, K_1 = 9 \times 10^{-8}$

$HS^{\Theta} \Leftrightarrow H^{\oplus} + S^{2-}, K_2 = 1 \times 10^{-12}$ and

K_{sp} of $MnS = 3 \times 10^{-22}$

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113. Two weak monobasic organic acids HA and HB have dissociation constants as 3.0×10^{-5} and 1.5×10^{-5}, respectively, at $25^{\circ} C$. If $500mL$ of $1M$ solutions of each of these two acids are mixed to produce$1L$ of mixed acid solution, what is the pH of the resulting solutions?

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114. Calculate the simultaneous solubility of AgSCN and AgBr. K_{sp} for AgSCN and AgBr are1×10^{-12} and 5×10^{-13} respectively.

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115. The following equilibria are given by

rho$N_2 + 3H_2 \Leftrightarrow 2NH_3 : K_1$

$N_2 + O_2 \Leftrightarrow 2NO, K_2$

$H_2 + \frac{1}{2}O_2 \Leftrightarrow H_2O, K_3$

The equlibrium constant of the reaction

$2NH_3 + \frac{5}{2}O_2 \Leftrightarrow 2NO + 3H_2O$

in terms of K_1 and K_3 is

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116. The solubility of silver benozate $(PhCOOAg)$ in H_2O and in a buffer solution of $pH = 4, 5$ and 6 are S_1, S_2, S_3, and S_4, respectively. Given the decreasing order of their solubilities.

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117. The ionization contant of benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-13}. How many times is silver benzoate more soluble in abuffer of pH=3.19 compared to its solubility in pure water ?

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118. Write equations showing all of the equilibrium reactions occurring in aqueous solution containing following reagent:

$NaCI$

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119. Calculate the solubility of CoS in $0.1MH_2S$ and $0.15MH_3O^{\oplus}$ $\left(K_{sp} \text{ of } CoS = 3 \times 10^{-26}\right)$.

$\left(K_1 \times K_2\left(H_2S\right) = 10^{-21}\right)$

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120. Explain why CoS is more soluble than predicted by the K_{sp}.

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121. The solubility of CuS in pure water at $25^\circ C$ is $3.3 \times 10^{-4} gL^{-1}$. Calculate K_{sp} of CuS. The accurate value of K_{sp} of CuS was found to be 8.5×10^{-36} at $25^\circ C$.

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122. Explain why CuS is more soluble than predicted by the K_{sp}.

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123. The solubility of TI_2S in pure CO_2 -free water is $6.3 \times 10^{-6}M$. Assume that the dissolved S^{2-} ion hydrolyses almost completely to HS^{Θ} and that the further hydrolysis to H_2S is neglected. What is the K_{sp}. $\left(K_2\left(H_2S\right) = 10^{-14}\right)$.

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124. When solid $SrCO_3$ is equilibrated with a $pH8.60$ buffer, the solution was found to have $\left[Sr^{2+}\right] = 2.2 \times 10^{-4}$. What is the K_{sp} of $SrCO_3$.

$\left(K_2 \text{ of } H_2CO_3 = 4.7 \times 10^{-11}\right)$

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125. Calculate the solubility at $25^\circ C$ of $CaCO_3$ in a closed container containing a solution of $pH8.60$. $\left[K_{sp}\left(CaCO_3\right) = 10^{-8}, K_a = 4.7 \times 10^{-11}\right]$

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126. For the galvanic cell: $Ag|AgCI(s)|KCI(0.2M)||KBr(0.001M)|AgBr(s)|Ag$, calculate the EMF generated for a spontaneous process after taking into account the cell reaction at $25\,^{\circ}C$.

$\left[K_{sp(AgCI)} = 2.8 \times 10^{-10}, K_{sp(AgBr)} = 3.3 \times 10^{-13}\right]$

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127. At $25\,^{\circ}C$, after the addition of $110mL$ of $0.1NaCI$ solution to $100mL$ of $0.1NAgNO_3$ solution, the reduction potentilal of a silver electrode placed in it is $0.36V$. Calculate the $K_{sp}$of $AgCI$. (Given: $\left.E^{\Theta}Ag/Ag^{\oplus} = -0.799V\right)$.

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128. Calculate the entropy of $\overset{\Theta}{OH}$ ion at $298K$. Given:

a. $H_2O \Leftrightarrow H^{\oplus} + \overset{\Theta}{OH}(\Delta H = 13.4kcal)$

b. K_{eq} for the reaction $= 10^{-14}$.

c. $S^{\Theta}\left(H^{\oplus}\right) = 0.0$

d. $S^{\Theta}\left(H_2O\right) = 16.7cal/molk.$

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129. Calculate K_{sp} for $AgCI$. Given:

$\Delta_f H^{\Theta} Ag^{\oplus} = 25.3kcalmol^{-1}$

$\Delta_f H^{\Theta} C1^{\Theta} = -40.0kcalmol^{-1}$

$\Delta_f H^{\Theta} AgC1 = -30.36kcalmol^{-1}$

$S^{\Theta}Ag^{\oplus}, S^{\Theta}C1^{\Theta}$, and $S^{\Theta}AgC1$are $17.7, 13.2$ and $23.0calmol^{-1}$

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130. Calculate the minimum mass of $NaCI$ necessary to dissolve $0.01molAgC1$ in $100L$ solution.

(Assume no change in volume)

$\left(K_f AgC1_2^{\Theta} = 2.5 \times 10^5\right)\left(K_{sp}AGCl = 2 \times 10^{-10}\right)$

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131. What is the concentration of free Cd^{2+} in $0.005 MCdC1_2 ? K_1$ for chloride complexation of Cd^{2+} is 100, K_2 need not be considered.

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132. In the quantitative estimation of $Ag^{\oplus}$ ions as $AgCl$, solution of $NaCl$ is used as the precipitating reagent. Why a large excess of $NaCl$ should be avoided?

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133. A solution was made up by $0.01 MCo\left(NO_3\right)_2$ and $.02 MN_2H_4$ and was found to have at equilibrium $\left[Co^{2+}\right] = 0.0062 M$. Calculate K_1 for the complex formation of $Co\left(N_2H_4\right)^{2+}$.

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134. $K_1, K_2$and k_3 for the complexation of SCN^{Θ} with Fe^{3+} are $130, 16,$ and 1.0, respectively. (i) Calculate the overall formation costant of $Fe(SCN)_3$ from its constituent ions.

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135. Explain why $0.1MNH_3$ solution:

a. Will precipitate $Fe(OH)_2$ from $0.1M$ soluton Fe^{2+}.

b. Will not precipitate $Mg(OH)_2$ from a solution which is $0.2M$ in $\overset{\oplus}{NH_4}$ and $0.01M$ in Mg^{2+}.

c. Will not precipitate $AgOH$ from a solution which is $0.01M$ in $Ag^{\oplus}$.

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136. K_a for HA is 4.9×10^{-8}. After making the necessary approximation, calculate for its decimolar solution,

a. % dissociation b. $\overset{\Theta}{OH}$ concentration

c. pH

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137. Nicotinic acid $\left(K_a = 1.4 \times 10^{-5}\right)$ is represented by the formula $HNiC$. Calculate its percent dissociation in a solution which contains 0.10 moles of nicotinic acid per $2.0L$ of solution.

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138. An aqueous solution contains 10% amonia by mass and has a density of $0.99gcm^{-3}$. Calculate hydroxy1 and hydrogen ion concentration in this solution K_a for $NH_4^{\oplus} = 5.0 \times 10^{-10}M$.

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139. Determine the dergee of dissociation of $0.05MNH_3$ at $25^{\circ}C$ in a solution of $pH = 11$

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140. Three suggestion are made for ways to removes silver ions from solution:

a. Make the solution $0.01M$in NaI.

b. Buffer the solution at $pH = 13$.

c. Make the solution $0.01MNa_2S$. What will be the equilibrium silver ion concentartion in each case? which course of action is most effective in removing $Ag^{\oplus}$ ions?

$K_{sp}(AgI) = 8.5 \times 10^{-17}, K_{sp}(AgOH) = 2 \times 10^{-8},$

$K_{sp}\left(Ag_2S\right) = 5.5 \times 10^{-51}$

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141. Calculate the the ratio of conjugate base// weak acid required to prepare an aqueous solution of benzoic acid and sodium benzoate with pH of 4.5. The acid dissociation constant of benzoic acid is 6.5×10^{-5}.

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142. A solution is saturated with respect to $SrF_2; K_{sp} = 7.9 \times 10^{-10}$ and $SrCO_3, K_{sp} = 7.0 \times 10^{-10}$. If the fluoride ion concentration is found to be $4.0 \times 10^{-2} M$. What is the concentration of carbonates ions.

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143. The solubility of $Mg(OH)_2$ in pure water is $9.57 \times 10^{-3} gL^{-1}$ .Calculate its solubility I $\left(gL^{-1}\right)$ in 0.02 M Mg $\left(NO_3\right)_2$ solutions.

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144. Compare the solubility of $Fe(OH)_3\left(K_{sp} = 4 \times 10^{-38}\right)$ and $Ni(OH)_2.\left(K_{sp} = 2 \times 10^{-16}\right)$ at $pH = 5.0$

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145. What is the pH at which $0.01MCo^{2+}$ ions in solution precipitate down as $Co(OH)_2?K_{sp}$ of $Co(OH)_2$ is 2.5×10^{-16}.

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146. Freshly prepared aluminium and magnesium hydroxides are stirred vigorously in a buffer solution containing $0.25M$ of ammonium chloride and $0.05M$ of ammonium hydroxide. Calculate the concentration of aluminium and magesium ions in solution $\left(K_bNH_4OH = 1.8 \times 10^{-5}, K_{sp}Mg(OH)_2 = 6 \times 10^{-10}, K_{sp}Al(OH)_3 = 6 \times 10^{-32}\right.$

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147. A solution contains a mixture of $Ag^+(0.10M)$ and $Hg_2^{2+}(0.10M)$ which are to be separated by selective precipitation. Calculate the maximum concentration of iodide ion at which one of them gets precipitated almost completely. $\left(K_{SP} of AgI = 8.5 \times 10^{-17}\right.$ and K_{SP} of $\left.Hg_2I_2 = 2.5 \times 10^{-26}\right)$

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148. Freshly prepared aluminium and magnesium hydroxides are stirred vigorously in a buffer solution containing $0.25M$ of ammonium chloride and $0.05M$ of ammonium hydroxide. Calculate the concentration of aluminium and magesium ions in solution $\left(K_b NH_4OH = 1.8 \times 10^{-5}, K_{sp} Mg(OH)_2 = 6 \times 10^{-10}, K_{sp} Al(OH)_3 = 6 \times 10^{-32}\right.$

.

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149. The solubility product K_{sp} of Ca $(OH)_2$ at $25^\circ C$ is 4.42×10^{-5} A 500 mL of saturated solution of $Ca(OH)_2$ is mixed with equal volume of 0.4 M NaOH . How much $Ca(OH)_2$ in milligrams is precipitated?

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150. Determine the mass of PbI_2 that will dissolve in (a) $500mL$ water (b) $500mL$ of $0.01MKI$ solution (c) $500mL$ of a solution containing $1.33gPb\left(NO_3\right)_2$, $K_{sp}$of $PbI = 1.4 \times 10^{-8}$.

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151. Should a precipitate of barium fluoride be obtained when $100mL$ of $0.25MNaF$ and $100mL$ of $0.015MBa\left(NO_3\right)_2$ are mixed. K_{sp} of $BaF_2 = 1.7 \times 10^{-6}$

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152. A saturated solution of silver benzoate, $AgOCOC_6H_5$ has a pH of 8.63, K_a for benzoic acid is 6.5×10^{-5}. Estimate K_{sp} for silver benzoate.

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153. For the indicator 'HIn' the ratio $\left(Ind^{\ominus}\right)/(HIn)$ is 7.0 at pH of 4.3. What is K_{eq} for the indicator.

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154. Determine $\left[\overset{\ominus}{O}H\right]$ of a $0.050M$ solution of ammonia to which sufficient NH_4Cl has been added to make the total $\left[NH_4^{\oplus}\right]$ equal to $0.1M$. $(K_b = 1.8 \cdot 10^{-5})$

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155. K_{sp} of AgCl is 2.8×10^{-10} at $25\,^{\circ}C$. Calculate solubility of AgCl in.

a. Pure water b. $0.1MAgNO_3$

c. $0.1MKCl$ or $0.1MNaCl$

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156. K_{sp} of $PbC1_2$ is 10^{-13}. What will be $\left[Pb^{2+}\right]$ in a of solution prepared by mixing $100mL$ of $0.1MPb\left(NO_3\right)_2$ of solution $1.0mL1MHCI$?

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157. K_{sp} of $PbBr_2$ is 8×10^{-5}. If the salt is 80% dissociated in solution, calculate the solubility of salt in gL^{-1}.

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158. Equal volumes of $0.02MCaC1_2$ and $0.0004MNa_2SO_4$ are mixed. Will a precipitate form? K_{sp} for $CaSO_4 = 2.4 \times 10^{-5}$?

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159. A solution containing both Zn^{2+} and Mn^{2+} ions at a concentration of $0.01M$ is saturated with H_2S. What is pH at which MnS will form a ppt ?

Under these conditions what will be the concentration of Zn^{2+} ions remaining in the solution ? Given K_{sp} of $ZnSis10^{-22}$ and K_{sp} of MnS is $5.6 \times 10^{-16}, K_1 \times K_2$ of $H_2S = 1.10 \times 10^{-21}$.

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160. For the reaction

$Ag(CN)_2^{\ominus} \Leftrightarrow Ag^{\oplus} + 2CN^{\ominus}$, the K_c at $25^\circ C$ is 4×10^{-19} Calculate $\left[Ag^{\oplus}\right]$ in solution which was originally $0.1M$ in KCN and $0.03M$ in $AgNO_3$.

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161. A sample of hard water contains $0.05mol$ of $CaC1_2$, per litre, What is the minimum concentration of Na_2SO_4, which must be added for removing Ca^{2+} ions from this water sample? K_{sp} for $CaSO_4$ is $2.4 \times 10^{-5}at25^\circ C.$

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162. An aqueous solution of a metal bromide $MBr_2(0.05M)$ is saturated with H_2S. What is the minimum pH at which MS will precipitate ? K_{SP} for $MS = 6.0 \times 10^{-21}$. Concentration of saturqated $H_2S = 0.1M, K_1 = 10^{-7}$ and $K_2 = 1.3 \times 10^{-13}$ for H_2S .

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163. Calculate pH of saturated solution $Mg(OH)_2, K_{sp}$ for $Mg(OH)_2$ is 8.9×10^{-12}.

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164. 0.1 mili moles of $CdSO_4$ are present in $10ml$ acid solution of $0.08NHCI$. Now H_2S is passed to precipitate all the Cd^{2+} ions. Find the pH of solution after filtering off percipitate, boilling of H_2S and making the solution $100ml$ by adding H_2O?

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165. The solubility of $Mg(OH)_2$ is increased by the addition of $\overset{\oplus}{NH_4}$ ion. Calculate

a. Kc for the reaction:

$Mg(OH)_2 + 2\overset{\oplus}{NH_4} \Leftrightarrow 2NH_3 + 2H_2O + Mg^{+2}$

$K_{sp} of Mg(OH)_2 = 6 \times 10^{-12}, K_b of NH_3 = 1.8 \times 10^{-5}$.

b. Find the solubility of $Mg(OH)_2$ in a solution containing $0.5 M NH_4C1$ before addition of $Mg(OH)_2$.b

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166. The solubility of $Ag_2C_2O_4$ at $25\,^{\circ}C$ is 1.20×10^{-11}. A solution of $K_2C_2O_4$ containing $0.15 mol$ in $500 mL$ water is mixed with excess of Ag_2CO_3 till the following equilibrium is established:

$Ag_2CO_3 + K_2C_2O_4 \Leftrightarrow Ag_2C_2O_4 + K_2CO_3$

At equilibrium, the solution constains $0.03 mol$ of K_2CO_3. Assuming that the degree of dissociation of $K_2C_2O_4$ and K_2CO_3 to be equal, calculate the solubility product of Ag_2CO_3. [Take $100\,\%$ ionisation of $K_2C_2O_4$ and K_2CO_3]

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167. $1.0L$ of solution which was in equilibrium with solid mixture of $AgC1$ and $AgC1$ and Ag_2CrO_4 was found to contain $1 \times 10^{-4} molofAg^{\oplus}$ ions, $1.0 \times 10^{-6} mol$ of $C1^{\ominus}$ ions and 8.0×10^{-4} moles of CrO_4^{2-} ions. $Ag^{\oplus}$ ions added slowely to the above mixture (keeping volume constant) till 8.0×10^{-7} mol of $AgC1$ got precipitated. How many moles of Ag_2CrO_4 were also precipitated?

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168. K_{sp} of $SrF_2 = 2.8 \times 10^{-9}$ at $25^{\circ} C$. How much NaF should be added to $100mL$ of solution having $0.016M$ in Sr^{2+} ions to reduce its concentration to $2.5 \times 10^{-3}M$?

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169. Calculate the degree of hydrolysis and pH of $0.2M$ solution of NH_4C1

Given K_b for NH_4OH is 1.8×10^{-5}.

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170. Calculate for $0.01N$ solution of sodium acetate,

a. Hydrolysis constant b. Dergee of hydrolysis

c. pH Given $K_a = 1.9 \times 10^{-5}$

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171. Calcium lactate is salt of weak acid and represented as $Ca(LaC)_2$. A saturated solution of $Ca(LaC)_2$ contains $0.13mol$ of salt in $0.50L$ solution. The pOH of this is 5.60. Assuming complete dissociation of salt, calculate K_a of lacetic acid.

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172. The vapour pressur of $0.01 molal$ solution of weak base BOH in water at $20^{\circ} C$ is $17.536 mm$. Calculate K_b for base. Aqueous tension at $20^{\circ} C$ is $17.540 mm$. Assume molality and molarity same.

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173. Calculate the pH of $0.1 M K_3PO_4$soln. The third dissociation constant of orthophosphoric acid is 1.3×10^{-12}. Assume that the hydrolysis proceeds only in the first step.

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174. The ionization constant of $\overset{\oplus}{NH_4}$ ion in water is 5.6×10^{-10} at $25^{\circ} C$. The rate constant the reaction of $\overset{\oplus}{NH_4}$ and $\overset{\ominus}{OH}$ ion to form NH_3 and H_2O at $25^{\circ} C$ is $3.4 \times 10^{10} L mol^{-1} s^{-1}$. Calculate the rate constant for proton transfer from water to NH_3.

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175. What is $\left[Ag^+\right]$ in a solution made by dissolving both Ag_2CrO_4 and $Ag_2C_2O_4$ until saturation is reached with respect to both salts ?

$[K_{sp}\left(Ag_2C_2O_4\right) = 2 \times 10^{-11}, \quad K_{sp}\left(Ag_2CrO_4\right) = 2 \times 10^{-12}]$

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176. Using CO_2, NH_3, NH_4NO_3, and K_2CrO_4 as the only reagents, devise a qualitative analysis scheme for separating and identifying the following ions, which might all be present in the same mixture: $Ba^{2+}, Ca^{2+}, Mg^{2+}, Na^{\oplus}, Pb^{2+}$. Assume that each cation present is $0.10M$. State the conditions of pH and the reagent concentration which are required in each step.

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177. Assuming that the only source of perodic group IIA metals is an equimolar mixture of $NaC1$, $BaC1_2$ and $MgCl_2$, suggest ways of preparing pure samples of

a. $MgSO_4$ b. Ba metal c. $Ba\left(C_2H_3O_2\right)_2$.

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178. When a solution of Zn^{2+} was added to a solution of $NaOH$, a clear solution was obtained. What NH_4C1 was added to the clear solution, $Zn(OH)_2$, precipitated. Using balanced chemical equation, explain these observations.

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179. Given reagents NH_3, $NaOH$, HCl, and H_2S which one could be used to separated the ions in each of the following mixtures?

a. Cu^{2+} and Zn^{2+} b. Cu^{2+} and Al^{3+} c. Zn^{2+} and Al^{3+}

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180. Estimate the K_{sp} of $AgBr$. Given $\Delta_f H^\ominus$ of $Ag^\oplus$, $Br^\ominus$, and $AgBr$ are 25.31, -28.9, and $-23.8 kcal$, $\Delta S^\ominus$ of $Ag^\oplus$, $Br^\ominus$, and $AgBr$ are $17.7, 19.3$, and $26.6 cal/K$.

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181. When $40 mL$ of a $0.1 M$ weak base, BOH is titrated with $0.01 MHCl$, the pH of the solution at the end point is 5.5. What will be the pH if $10 mL$ of $0.10 MNaOH$ is added to the resulting solution ?

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182. Malonic acid is an organic dibasic acid such as H_2S having first ionistion constant, $K_1 = 1.42 \times 10^{-3}$ and second ionisation constant, $K_2 = 2.0 \times 10^{-6}$. Compute the divalent molanate ion concentration in:

a. $0.001 M$ malonic acid.

b. a solution that is $0.0001 M$ in malonic acid and $0.1 MHC1$.

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183. What mass of pb^{2+} ions is left in solution, when $50.0mL$ of $0.20MPb\left(NO_3\right)_2$ is added to $50.0mL$ of $1.5MNAC1$?

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184. It is given that $0.001mol$ each of Cd^{2+} and Fe^{2+} ions are contained in $1.0L$ of $0.02MHC1$ solution. This solutions is now saturated with H_2S gas at $25^{\circ}C$.

a. Determine whether or not each of these ions will be precipitated as sulphide?

b. How much Cd^{2+} ions remains in the solution at equilibrium?

$K_1\left(H_2S\right) = 1.0 \times 10^{-7}, K_2\left(H_2S\right) = 1.0 \times 10^{-14}$: ltbRgt

$K_{sp}(CdS) = 8 \times 10^{-27} : K_{sp}(FeS) = 3.7 \times 10^{-19}$.

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185. Calculate the $\left[F^{\Theta}\right]$ in a solution saturated with respect ot MgF_2 and SrF_2.

$K_{sp}\left(MgF_2\right) = 6.0 \times 10^{-9}, K_{sp}\left(SrF_2\right) = 3.0 \times 10^{-9}$

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186. HN_3 (hydroazic acid) is a weak acid dissociating as: $HN_3 \Leftrightarrow H^{\oplus} + N_3^{\Theta}$. Find the concentration of Ag^{Θ} ions, if excess of solid AgN_3 is added to a solution maintained at $pH = 4$. The ionisation constant K_a of HN_3 is 2.0×10^{-5}. The solubility of AgN_3 in pure water is found to be 5.4×10^{-3} at $25\,^{\circ}C$.

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187. Calculate the solubility of $AgCN$ in a buffer solution of $pH3.0$. Assume that no cyano complex is formed $K_{sp}AgCN = 2.2 \times 10^{-16}, K_aHCN = 6.2 \times 10^{-10}$.

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188. Find moles of NH_4Cl required to prevent $Mg(OH)_2$ from precipitating in a litre of solution which contains 0.02 mole NH_3 and 0.001 mole Mg^{2+} ions.

Given : $K_b\left(NH_3\right) = 10^{-5}$, $K_{sp}\left[Mg(OH)_2\right] = 10^{-11}$.

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189. A solution containing $10^{-3}MSr\left(C1O_4\right)_2$ and $0.05MKNO_3$ was found to have only 75% of its strontium in the uncomplexed Sr^{2+} form, the rest being $Sr\left(NO_3\right)^{\oplus}$. Calcualate the K_1 for complexation reaction:

$Sr^{2+} + NO_3^{\ominus} \rightarrow Sr\left(NO_3\right)^{\ominus}$

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190. Glycine $\left[NH_2CH_2COOH\right)$ is basic and acidic due to presence of $-NH_2$ and $-COOH$ group. It acquires a $H^{\oplus}$ to form $\overset{\oplus}{N}H_3COOH$, which is a diprotic acid with $K_1 = 4.55 \times 10^{-3}$ and $K_2 = 1.7 \times 10^{-10}$. In a $0.01M$ solution of neutral glycine,

a. What is the pH and

b. What percent of the glycine is in the cationic form at equilibrium?

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191. A $0.01M$ aqueous solution of weak acid HA has an osotic pressure $0.293atm$ at $25^{\circ}C$. Another $0.01M$ aqueous solution of other weak acid HB has an osmotic pressure of $0.345atm$ under the same conditions. Calculate equilibrium constants of two acids for their dissociation.

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192. The salt $Zn(OH)_2$ is involved in the following two equilibria:

$$Zn(OH)_2(s) \Leftrightarrow Zn^{3+}(aq) + 2\overset{\Theta}{O}H(aq)K_{sp} = 1.2 \times 10^{-17}$$

$$Zn(OH)_2(s) + 2\overset{\Theta}{O}H \Leftrightarrow Zn(OH)_4^{2-}(aq)K_f = 0.12$$

Calculate $\left|\overset{\Theta}{OH}\right|$ at which solubility of $Zn(OH)_2$ be a minimum. Also find the solubility of $Zn(OH)_2$ at this pH.

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193. A $500mL$ of an equilibrium mixture of gaseous N_2O_4 and NO_2 at $25^\circ C$ and $753mm$ of Hg was allowed to react with enough water to make $250mL$ of solution at $25^\circ C$. Assume that all the dissolved N_2O_4 is converted to NO_2 which disproportionates in water yielding a solution of nitrous acid and nitric acid. aAsume further that disproportionation reaction goes to completion and that none of the nitrous acid disproportionates. The equilibrium constant $\left(K_p\right)$ for $N_2O_4(g) \Leftrightarrow 2NO_2(g)0.113$ at $25^\circ C. K_a$ for HNO_2 is $4.5 \times 10^{-4} at 25^\circ C$.

a. Write balanced equation for disproportionation.

b. What is the molar concentration of NO_2 and pH of the solution?

c. What is osmotic pressure of solution?

d. How many grams of lime (CaO) would be required to neutralise the solution?

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194. A buffer solution 0.04 M in Na_2HPO_4 and 0.02 in Na_3PO_4 is prepared. The electrolytic oxidation of 1.0 milli-mole of the organic compound RNHOH is carried out in 100 mL of the buffer. The reaction is $RNHOH + H_2O \rightarrow RNO_2 + 4H^+ + 4e^-$ The approximate pH of solution after the oxidation is complete is :

$\left[Given: f \text{ or } H_3PO_4, pK_{a1} = 2.2, pK_{a2} = 7.20, pK_{a3} = 12\right]$

(a)6.90

(b)7.20

(c)7.5

(d)None of these

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195. Calculate the pH of $0.05MKHC_8H_4O_4$

$H_2C_8H_4O_4 + H_2O \Leftrightarrow H_3O^{\oplus} + HC_8H_4O_4^{\oplus}\ pK_{a_1} = 2.94$

$HC_8H_4O_4^{\ominus} + H_2O \Leftrightarrow H_3O^{\oplus} + C_8H_4O_4^{2-}\ pK_{a_2} = 5.44$

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196. It is found that $0.1M$ solution of three sodium salts NaX, NaY, and NaZ have pH 7.0, 9.0 and 11.0, respectively. Arrange the acids (HX, HY, and HZ) in order of increasing acidic character. Calculate dissociation constant of acids.

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197. What is $\left[Cd^{2+}\right]$ in $1.0L$ of solution prepared by dissolving $0.001 mol Cd\left(NO_3\right)_2$ and $1.5 mmol. NH_3 ? K_d$ for the dissociation of $Cd\left(NH_3\right)_4^{2+}$ into Cd^{2+} and $4NH_3$ is 1.8×10^{-7}. Neglect the amount of Cd in complexes containing fewer than 4 ammonia molecules.

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198. $0.001mol$ of solid $NaC1$ was added to $1.0L$ of $0.01MHg\left(NO_3\right)_2$. Calculate $\left[c1^{\ominus}\right]$ equilibrated with newly formed $HgC1^{\oplus}$. K_1 for $HgC1^{\oplus}$ formation is 5.5×10^6, neglect the K_2 equilibrium.

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199. How much NH_3should be added to a solution of $0.01MCu\left(NO_3\right)_2$ to reduce $\left[Cu^{2+}\right.$ to 10^{-13}. Neglect the amount of copper in complexes containing fewer than 4 ammonia molecules per copper atom. Given K_d for $Cu\left(NH_3\right)_4^{2+} = 1.0 \times 10^{-12}$

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200. Calculated the minimum amount of Nh_3 which must be added to $1.0L$ of solution in order to dissolve $0.1molAgC1$ by forming $\left[Ag\left(NH_3\right)_2\right]^{\oplus}$? K_{sp} of $AgC1 = 1 \times 10^{-10}$, $K_f\left(NH_3\right)_2^{\oplus} = 1 \times 10^8$.

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201. A certain insoluble compound of M^{2+}, when shaken with water, provides an M^{2+} concentration of $1.0 \times 10^{-4}M$. A ligand is added to the system in a quantify which forms a soluble complex with M^{2+} and leaves $1.0 \times 10^{-6}M, M^{2+}$ in solution. Will the insoluble compound tend to dissolve? Explain.

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Ex 8.1

1. $100mL$ of HCl gas at $25^{\circ} C$ and $740mm$ pressure is dissolved in $1L$ of H_2O. Calculate the pH of solution. Given vapour presure of H_2O at $25^{\circ} C$ is $23.7mm$.

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2. Calculate $\left[Cl^{\Theta}\right], \left[Na^{\oplus}\right], \left[H^{\oplus}\right], \left[\overset{\Theta}{O}H\right]$, and the pH of resulting solution obtained by mixing $50mL$ of $0.6MHCl$ and $50mL$ of $0.3MNaOH$.

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3. Calculate the pH of solution obtained by mixing $10ml$ of $0.1MHCl$ and $40ml$ of $0.2MH_2SO_4$

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4. Calculate the pH of a solution which contains $100mL$ of $0.1MHC1$ and $9.9mL$ of $1.0MNaOH$.

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5. Calculate the $\left[H^{\oplus}\right]$ and $\left[\overset{\Theta}{OH}\right]$ of $0.0315g$ of HNO_3 in $500mL$ of water.

Calculate pH and pOH also.

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6. A 25.0 mL. sample of 0.10 M HCl is titrated with 0.10 M NaOH. What is the pH of the solution at the points where 24.9 and 25.1 mL of NaOH have been added?

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7. Conjugate acid of NH_2 :

A. N_2H_4

B. NH_3

C. NH_2OH

D. $\overset{\Theta}{NH_4}$

Answer: B

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8. Which of the following solutions will have pH close to 1.0?

A. $75mL$ of $M/5HC1 + 25mL$ of $M/5NaOh$

B. $10mL$ of $M/10HC1 + 90mL$ of $M/10NaOH$

C. $55mL$ of $M/10HC1 + 54mL$ of $M/10NaOH$

D. $100mL$ of $M/10HC1 + 100mL$ of $M/10NaOH$

Answer: A

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9. An acid solution of $pH = 6$ is diluted 100 times. The pH of solution becomes

A. (a) 6.95

B. (b) 6

C. (c) 4

D. (d) 8

Answer: A

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10. The number of $H^{\oplus}$ ions present in $1mL$ of solution having $pH = 13$ is

A. (a) 6.023×10^{10}

B. (b) 6.023×10^{7}

C. (c) 6.023×10^{13}

D. (d) 10^{13}

Answer: B

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11. Equal volumes of two solutions of HCl are mixed. One solution has a $pH = 1$, while the other has a $pH = 5$. The pH of the resulting solution is

A. < 1

B. Between 1 and 2

C. 3

D. Between 4 and 5

Answer: B

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12. For pure water:

A. Both pH and pOH decrease with increase in temperature.

B. Both pH and pOH increase with increase in temperature.

C. pH decreases and pOH increases with increase in temperature.

D. pH increase and pOHdecreases with increase in temperature.

Answer: A

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13. The pH of a solution increased from 3 to 6. Its $\left[H^{\oplus}\right]$ will be

A. Reduced by 1000 times

B. Increased to 1000 times

C. Doubled

D. Reduced to half

Answer: A

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14. The following equilibria is established when H_2SO_4 is dissolved in acetic acid:

$$H_2SO_4 + CH_3COOH \Leftrightarrow H\overset{\ominus}{S}O_4 + CH_3COO\overset{\oplus}{H}_2$$

The set that characterised the conjugate acid-base pairs is:

A. $\left(H_2SO_4, CH_3COOH\right)$ and $\left(CH_3COO\overset{\oplus}{H}_2, HS\overset{\ominus}{O}_4\right)$

B. $\left(H_2SO_4, CH_3COO\overset{\oplus}{H}_2\right)$ and $\left(CH_3COOH, H_2SO_4\right)$

C. $\left(CH_3COO\overset{\oplus}{H}_2, H_2SO_4\right)$ and $\left(Hs\overset{\ominus}{O}_4, CH_3COOH\right)$

D. $\left(H_2SO_4, HS\overset{\ominus}{O}_4\right)$ and $\left(CH_3COO\overset{\oplus}{H}_2, CH_3COOH\right)$

Answer: C

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15. Which is the set of amphiprotic species?

A. $H_2O, H_2PO_3^{\ominus}, HPO_4^{2-}$

B. $HC_2O_4^{\ominus}, H_2PO_4^{\ominus}, SO_4^{2-}$

C. $H_2O, HPO_4^{2-}, H_2PO_2^{\ominus}$

D. $H_3O^{\oplus}, H_2PO_4^{\ominus}, HCO_3^{\ominus}$

Answer: A

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16. One litre of $0.5MKCl$ is electrolysed by passing 9650 coulombs of electricity. The `pH of resulting solution is

A. 1.0

B. 2.0

C. 7.0

D. 13.0

Answer: D

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17. pH of a solution made by mixing $200mL$ of $0.0657MNaOH$, $140mL$ of $0.107MHCl$ and $160mL$ of H_2O is

A. 3.04

B. 2.43

C. 2.74

D. 2.27

Answer: B

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18. When one drop of a concentrated HCl is added to $1L$ of pure water at $25^\circ C$, the pH drops suddenly from 7 to 4. When the second drop of the same acid is added, the pH of the solution further drops to about

A. 0

B. 1.0

C. 2.0

D. 3.7

Answer: D

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Ex 8.2

1. The dissociation constant of acetic acid is 8×10^{-5} ta $25^{\circ} C$. Find the pH of

i. $M/10$ ii. $M/100$ solution of acetic acid.

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2. Calculate the amount of acetic acid present in $1L$ of solution having $\alpha = 1\%$ and $K_a = 1.8 \times 10^{-5}$.

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3. 0.16g of N_2H_4 are dissolved in water and the total volume made upto 500 mL. Calculate the percentage of N_2H_4 that has reacted with water in this solution. $\left(K_b \text{ for } N_2H_4 = 4.0 \times 10^{-6}\right)$

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4. If the pH of $0.26MHNO_2$ is 2.5, what will be its dissociation constant.

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5. Find the dissociation constant K_a of HA (weak monobasic acid) which is 3.5% dissociated in an $M/20$ solution.

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6. Ionic product of water $\left(K_w \text{ is } 10^{-14}\right)$ at $25^{\circ}C$. What is the dissociation constant of water and auto protonation constant of water?

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7. $2.0g$ of diborane $\left(B_2H_6\right)$ reacts with water to product $100mL$ solution. If K_a for H_3BO_3 is 7.3×10^{-10}, calculated the pH of solution.

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8. At $90^{\circ}C$, pure water has $\left[H_3O^{\oplus}\right] = 10^{-6}M$. What is the value of K_w at $90^{\circ}C$

A. 10^{-6}

B. 10^{-8}

C. 10^{-12}

D. 10^{-14}

Answer: C

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9. $HCOOH$ and CH_3COOH solutions have equal pH. If K_1/K_2 is 4, the ratio of their molar concentration will be

A. 0.25

B. 0.5

C. 2

D. 4

Answer: A

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10. $2H_2O \Leftrightarrow H_3O^{\oplus} + \overset{\Theta}{O}H, K_w = 10^{-14}$ at $25^{\circ}C$, hence K_a is

A. 10^{-7}

B. 5.55×10^{-13}

C. 10^{-14}

D. 18×10^{-17}

Answer: D

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11. Which of the following expression is wrong?

A. $\left[H^{\oplus}\right] = \left[\overset{\Theta}{O}H\right] = 10^{-7}$ for a neutral solution at all temperatures.

B. $\left[H^{\oplus}\right] < \sqrt{K_w}$ and $\left[\overset{\Theta}{O}H\right] > \sqrt{K_w}$ for basic solution

C. $\left[H^{\oplus}\right] = \left[\overset{\Theta}{O}H\right] = \sqrt{K_w}$ for a neutral solution

D. $\left[H^{\oplus}\right] > \sqrt{K_w}$ and $\left[\overset{\Theta}{OH}\right] < \sqrt{K_w}$ for an acidic solution

Answer: A

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12. For a 'C'M concentrated solution of a weak electrolyte 'A_(x)B_(y) 'alpha' degree of dissociation) is

A. $\sqrt{K_{eq}/xyC}$

B. $\left[K_{eq}.\,C/(xy)\right]^{1/2}$

C. $\left(K_{eq}/C^{x+y-1}.\,x^{x}x^{y}\right)^{\frac{1}{x+y}}$

D. $\left[K_{eq}/C(x+y)\right]^{1/2}$

Answer: C

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13. K_b for NH_4OH is 1.8×10^{-5}. The $\left[\overset{\Theta}{O}H\right]$ of $0.1MNH_4OH$ is

A. 5.0×10^{-2}

B. 4.20×10^{-3}

C. 1.34×10^{-3}

D. 1.8×10^{-6}

Answer: C

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14. The dissociation constant of monobasic acids A, B, C and D are $6 \times 10^{-4}, 5 \times 10^{-5}, 3.6 \times 10^{-6}$, and 7×10^{-10}, respectively. The pH values of their $0.1M$ aqueous solutions are in the order.

A. $D > C > B > A$

B. $A > B > C > D$

C. $A = B = C = D$

D. None

Answer: A

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15. The molarity of $NH_3 of pH = 12 at 25^{\circ} C$ is $\left(K_b = 1.8 \times 10^{-5}\right)$

A. $11.7M$

B. $5.5M$

C. $0.55M$

D. $0.01M$

Answer: C

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16. A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mol of the acid is dissolved in 1 L of water, the percentage of the acid dissociated at equilibrium is the close to

A. $0.1\ \%$

B. $1.0\ \%$

C. $99.0\ \%$

D. $99.9\ \%$

Answer: B

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17. For a polyprotic acid, H_3PO_4 its three dissociation constant K_1, K_2 and K_3 are in the order

A. $K_1 = K_2 > K_3$

B. $K_1 = K_2 = K_3$

C. $K_1 > K_2 > K_3$

D. $K_1 < K_2 < K_3$

Answer: C

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18. Given $HF + H_2O \Leftrightarrow H_3O^+ + F^- : K_a$

$F^- + H_2O \Leftrightarrow HF + OH^-, K_b$

Which of the following relations is correct ?

A. $K_b = K_w$

B. $K_a \times K_b = K_w$

C. $K_b = \frac{1}{K_w}$

D. $\frac{K_a}{K_b} = K_w$

Answer: B

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19. A certain weak acid has a dissociation constant 1.0×10^{-4}. The equilibrium constant for its reaction with a strong base is :

A. 10^{-14}

B. 10^{-9}

C. 10^{-10}

D. 10^{10}

Answer: D

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20. The percentage error in $\left[H^{\oplus}\right]$ provided by $10^{-8} MHC1$, if ionisation of water is not neglected, is

A. 2 %

B. 3 %

C. 4%

D. 5%

Answer: D

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21. H_3BO_3 is :

A. Monobasic and weak Lewis acid

B. Monobasic and weak Bronsted acid

C. Tribasic and weak Bronsted acid

D. Monobasic and strong Lewis acid

Answer: A

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22. The enthalpy change for first proton neutralisation of H_2S is $-37.1 kJmol^{-1}$. What is the enthalpy change for first ionisation of `H_(2)S.' in KJ/mol.

A. 94.2

B. -20.0

C. 20.0

D. -94.2

Answer: C

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23. The factor by which the degree of ionisation of $200 mL$ of $0.1 M$ benzoic acid solution $\left(K_a = 4 \times 10^{-5}\right)$ changes on addition of $100 mL$ of $0.2 M HCl$ is:

A. 0.02

B. 0.03

C. 33.33

D. None

Answer: B

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24. The concentration of CO_2 in atmosphere is 88ppm. If all of the CO_2 present in $10^5 mL$ of air is dissolved in $1dm^3$ water, then approximate pOH of solution at $27^\circ C$ will be $\left(K_{a_1} = 10^{-7}, K_{a_2} = 10^{-11} \text{ for } H_2CO_3\right]$

A. 3.2

B. 3.85

C. 10.15

D. None

Answer: C

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25. A solution of a weak monoprotic acid has dissociation constant K_a. The minimum initial concentration C such that the concentration of the undissociated acid can be equated to C within an error of 1% would be

A. $9900K_a$

B. $10000K_a$

C. $99K_a$

D. K_a

Answer: A

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26. Two weak acids HX and HY have K_a values 1.75×10^{-5} and 1.3×10^{-5}, respectively, at a certain temperature. An equimolar solution of mixture of two acids is parially neutralised by $NaOH$. How is the ratio of the contents of X^{Θ} and Y^{Θ} ions related to the K_a values and molarity?

A. $\left[\frac{\alpha}{1-\alpha}\right] = \frac{1.75}{1.3} \times \left[\frac{\alpha'}{1-\alpha'}\right], 0$, where α and α' are ionised fractions of the acids HX and HY respectively.

B. The ratio is unrelated to the K_a values.

C. The ratio is unrelated to the molarity.

D. The ratio is unrelated to the pH of the solution.

Answer: A

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27. H_2S behaves as a weak diprotic acid in aqueous solution. Which of the following is the correct explanantion for pH of a solution of H_2S in terms of its $pK_1, pK_2, \left[H_2S\right]$ and $\left[S^{2-}\right]$

A. $pH = \frac{1}{2}\left(pK_1 + pK_2\right)$

B. $pH = \frac{1}{2}\left(pK_1 + pK_2 - \log\frac{\left[S^{2-}\right]}{\left[H_2S\right]}\right)$

C. $pH = \frac{1}{2}\left(pK_1 + pK_2 + \log\frac{\left[S^{2-}\right]}{\left[H_2S\right]}\right)$

D. $pH = \frac{1}{2}\left(pK_1 - pK_2 + \log\frac{\left[H_{2-}S\right]}{\left[S^{2-}\right]}\right)$

Answer: C

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Ex 8.3

1. Calculate the pH of a solution of given mixture.

$\left(2gCH_3COOH + 3gCH_3COONa\right)$ in $100mL$ of mixture.

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2. How many moles of NH_4Cl should be added to $200 mL$ solution of $0.18 M NH_4OH$ to have a pH of 9.60. K_b of $NH_4OH = 2 \times 10^{-5}$

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3. A buffer solution was made by adding $15.0 g$ of CH_3COOH and $20.5 g CH_3COONa$. The buffer is diluted to $1.0 L$.

Calculate the pH of solution.

Given: $pK_a of CH_3COOH = 4.74, \log\left(\frac{13}{12}\right) = 0.035$

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4. A buffer solution contains $0.25 M NH_4OH$ and $0.3 NH_4C1$.

a. Calculate the pH of the solution.

$K_b = 2 \times 10^{-5}$.

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5. Calculate the hydrolysis constant $\left(K_h\right)$ and degree of hydrloysis (h) of NH_4C1 in $0.1M$ solution.

$K_b = 2.0 \times 10^{-5}$. Calculate the $\left[\overset{\Theta}{OH}\right]$ ions in the solution.

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6. Calcualte the percentage hydrolysis of $10^{-3}M\overset{\oplus}{N_2}H_5C1^{\Theta}$ (hydrazinium chloride), salt contining acid ion conjugate to hydrazine base $\left(NH_2NH_2\right)$. K_b for $N_2H_4 = 1.0 \times 10^{-6}$.

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7. Calculate the amount of NH_4Cl required to dissolve in $500mL$ of water to have a $pH = 4.5, K_b = 2.0 \times 10^{-5}$.

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8. A $0.25M$ solution of pyridinium chloride $\left(C_5H_5\overset{\oplus}{N}HCl^{\ominus}\right)$ has pH of 2.89. Calculate pK_b for pyridine $\left(C_5H_5N\right)$.

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9. Which of the following is a buffer solution?

A. A solution of $KC1$ and KOH

B. A solution of CH_3COONH_4

C. A solution of K_2SO_4 and NH_4OH

D. A solution of $PhCOOK$ nad $PhCOOH$

Answer: D

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10. Which of the following is not a buffer?

A. $NH_4OH + C_6H_5COOH$

B. $HCOOH + HCOONa$

C. $H_2CO_3 + HCOOK$

D. $NH_4OH + (NH_4)_2SO_4$

Answer: A

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11. In an acidic buffer solution, if some H_2So_4 is added, its pH will

A. Remain constant

B. Change but cannot be predicted

C. Decrease

D. Increase

Answer: C

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12. Which of the following solutions containing weak acid and salt of its conjugate base has maximum buffer capaity?

A. $[\text{Salt}] < [\text{Acid}]$

B. $[\text{Salt}] = [\text{Acid}]$

C. $[\text{Salt}] > [\text{Acid}]$

D. $[\text{Salt}] + [\text{Acid}]$ is minimum

Answer: B

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13. A weak acid HA has $K_a = 10^{-6}$. What would be the molar ratio of this acid and its salt with strong base so that pH of the buffer solution is 5?

A. $1/10$

B. 10

C. 1

D. 2

Answer: B

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14. The addition of NaH_2PO_4 to $0.1MH_3PO_4$ will cuase

A. No change in pH value

B. Increases in its pH value

C. Decrease in its pH value

D. Change in pH but cannot be predicted

Answer: B

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15. On diluting a buffer solution, its pH

A. Increases

B. Decreases

C. Remains same

D. Cannot be predicted

Answer: C

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16. The pH of a solution containing $0.1 mol$ of $CH_3COOH, 0.2 mol$ of CH_3COONa,and $0.05 mol$ of $NaOH$ in $1L$. $\left(pK_a of CH_3COOH = 4.74\right)$ is:

A. 5.44

B. 5.20

C. 5.04

D. 4.74

Answer: A

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17. A weak base BOH is titrated with strong acid HA. When $10mL$ of HA is added, the pH is 9.0 and when $25mL$ is added, pH is 8.0. The volume of acid required to reach the equivalence point is

A. $50mL$

B. $40mL$

C. $35mL$

D. $30mL$

Answer: D

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18. To $1.0L$ solution containing $0.1mol$ each of NH_3 and $NH_4C1, 0.05molNaOH$ is added. The change in pH will be $\left(pK_a$ for $CH_3COOH = 4.74\right)$

A. 0.30

B. -0.30

C. 0.48

D. -0.48

Answer: C

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19. The pH of blood is $7, 4$. If the buffer in blood constitute CO_2 and HCO_3^{Θ} ions, calculate the ratio of conjugate base of acid $\left(H_2CO_3\right)$ to maintain the pH of blood. Given K_1 of $H_2CO_3 = 4.5 \times 10^{-7}$.

A. 11.25

B. 10.0

C. 8.5

D. None

Answer: A

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20. The pH of blood is

A. > 10

B. Between 8 and 0

C. Between 7 and 8

D. < 6

Answer: C

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21. Buffer in blood consists of

A. H_2CO_3 and Cl^-

B. HCl and HCO_3^-

C. HCl and Cl^-

D. $H_2CO_3$and HCO_3^-

Answer: D

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22. K_a for HCN is 5×10^{-10} at $25^\circ C$. For maintaining a constant pH of 9.0, the volume of $5MKCN$ solution required to be added to $10mL$ of $2MHCN$ solution is

A. $9.3mL$

B. $7.95mL$

C. $4mL$

D. $2mL$

Answer: D

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23. $18mL$ of mixture of CH_3COOH and CH_3COONa required $6mL$ of $0.1MNaOH$ for neutralisation of the acid $12mL$ of $0.1MHCl$ for reaction with salt, separately. If pK_a of the acid is 4.75, what is the pH of the mixture

A. 4.5

B. 4.6

C. 4.75

D. 5.05

Answer: D

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24. The pH of blood is maintained by the balance between H_2CO_3 and $NaHCO_3$. If the amount of CO_2 in the blood is increased, how will it effect the pH of blood`?

A. pH will remain same.

B. pH wil be 7

C. pH will increases.

D. pH will decrease.

Answer: A

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25. Fixed volume of $0.1M$ benzoic acid $\left(pK_a = 4.2\right)$ solution is added into $0.2M$ sodium benzote solution and formed a $300mL$, resulting acidic buffer solution. If pH of the resulting solution is 3.9, then added volume of banzoic acid is

A. $240mL$

B. $150mL$

C. $100mL$

D. None

Answer: A

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26. $0.1mol$ of $RNH_2\left(K_b = 5 \times 10^{-4}\right)$ is mixed with $0.08mol$ of $HC1$ and diluted to $1L$. Calculate the $\left[H^{\oplus}\right]$ in the solution.

A. $8 \times 10^{-11}M$

B. $1.6 \times 10^{-11}M$

C. $8 \times 10^{-5}M$

D. $8 \times 10^{-2}M$

Answer: A

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27. A weak acid $HX\left(K_a = 10^{-5}\right)$ on reaction with $NaOH$ gives NaX. For $0.1M$ aqueous solution of NaX, the $\%$ hydrolysis is

A. $1\ \%$

B. $0.01\ \%$

C. $0.001\ \%$

D. $0.15\ \%$

Answer: B

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28. The pH of $0.1M$ solution of the following salts decreases in the order

A. $HCl > NaCl > NH_4Cl > NaCN$

B. $HCl > NaCN > NH_4Cl > NaCl$

C. $NaCN > NaCl > NH_4Cl > HCl$

D. $NH_4Cl > NaCN > NaCl > HCl$

Answer: C

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29. The degree of hydrolysis of a salt of W_A and W_B in its $0.1M$ solution is 50%. If the molarity of the solution is $0.2M$, the percentage hydrolysis of the salt woukd be

A. 25%

B. 50%

C. 75%

D. 100%

Answer: B

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30. pH of separate solution of four potassium salts, KW, KX, KY and KZ are $7.0, 9.0, 10.0,$ and $10.5,$ respectively. If each solution is $0.2M$, the strongest acid would be

A. HW

B. HX

C. HY

D. HZ

Answer: A

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31. Which of the following solutions have $pH < 7$.

A. BaI_2

B. $AI(NO_3)_3$

C. CH_3COONH_4

D. CsI

Answer: B

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32. Which of the following solution have $pH > 7$.

I. BaF_2 II. RbI

III. C_6H_5COONa

IV. $\left(CH_3COO\right)_2Ba$

A. I

B. I, II, III

C. I, III

D. I, III, IV

Answer: D

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33. The expression to calculate pH of sodium acetate solution at $25\,^{\circ}C$ is

A. $pH = 7 + \frac{1}{2}pK_b\left(CH_3COOH\right) - \frac{1}{2}\log[\text{salt}]$

B. $pH = 7 + \frac{1}{2}pK_a\left(CH_3COOH\right) - \frac{1}{2}\log[\text{salt}]$

C. $pH = 7 + \frac{1}{2}pK_b\left(CH_3COOH\right) + \frac{1}{2}\log[\text{salt}]$

D. $pH = 7 + \frac{1}{2}pK_a\left(CH_3COOH\right) + \frac{1}{2}\log[\text{salt}]$

Answer: D

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34. The correct order of increasing $\left[H_3O^{\oplus}\right]$ in the following aqueous solution is

A. $0.01MH_2S < 0.01MH_2SO_4 < 0.01MNaC1 < 0.01MNaNO_3$

B. $0.01MNaC1 = 0.01MNaNO_3 < 0.01MH_2S < 0.01MH_2SO_4$

C. $0.01MH_2S < 0.01MNaNO_3 = 0.01MNaC1 < 0.01MH_2SO_4$

D. $0.01MH_2S < 0.01MNaNO_3 < 0.01MNaC1 < 0.01MH_2SO_4$

Answer: B

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35. pH of water is 7. When a substance Y is dissolved in water, the pH becomes 13. The substance Y is a salt of

A. Weak acid and weak base

B. Strong acid and strong base

C. Strong acid and weak base

D. Weak acid and strong base

Answer: D

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36. The hydrolysis constant of $0.1M$ aqueous solution of sodium acetate if K_a of $CH_3COOH = 1.8 \times 10^{-5}$ is

A. 5.5×10^{-10}

B. 4.5×10^{-8}

C. 5.5×10^{-12}

D. None of these

Answer: A

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37. The compound whose $0.1M$ solution is basic is

A. CH_3COONH_4

B. NH_4C1

C. $\left(NH_4\right)_2SO_4$

D. CH_3COONa

Answer: D

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38. K_a for ascorbic acid $(HASc)$ is 5×10^{-5}. Calculate the $\left[H^{\oplus}\right]$ in an aqueous solution in which the concentration of Asc^{Θ} ions is $0.02M$.

A. 2×10^{-6}

B. 2×10^{-7}

C. 5×10^{-9}

D. 5×10^{-10}

Answer: C

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Ex 8.4

1. a. At what pH does indicator change colour if the indicator is a weak acid with $K_{Ind} = 4.0 \times 10^{-4}$.

b. For which of the following neutralisation would the indicator be useful?

i. $HCl + NaOH$

ii. $CH_3COOH + NaOH$

iii. $HCl + NH_3$

c. Name the indicators which can be used for such titration.

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2. The acid from of an acid base indicator is yellow in acid and red in basic from. What is the change in pH in order to change the indicator form 80% yellow to 80% red.

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3. Given that solubility product of $BaSO_4$ is 1×10^{-10} will be precipiate from when

Equal volumes of $2 \times 10^{-3} MBaCl_2$ solution and $2 \times 10^{-4} MNa_2SO_4$ solution, are mixed?

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4. The K_{sp} of $AgC1$ at $25^{\circ} C$ is 1.6×10^{-9}, find the solubility of salt in gL^{-1} in water.

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5. If solutbility of $Ca\left(IO_3\right)_2$ in water at $20^{\circ} C$ is $3.9 gL^{-1}$. Calculate the K_{sp}. Given $MwCa\left(IO_3\right)_2 = 390$.

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6. Find the solubility of $Ca\left(IO_3\right)_2$ is $molL^{-1}$ in a solution containing $0.1MCaC1$ at $25^\circ C. K_{sp}$ of $Ca\left(IO_3\right)_2 = 6.3 \times 10^{-7}$

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7. The solubility product $\left(K_{sp}\right)$ of $BaSO_4$ is 1.5×10^{-9}. Calculate the solubility of barium sulphate in pure water and in 0.1 M $BaCl_2$.

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8. A solution contains $1.4 \times 10^{-3} MAgNO_3$. What concentration of $KC1$ will be required to initiate the precipitation of $AgC1 ? K_{sp} AgC1 = 2.8 \times 10^{-10}$

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9. If the solubility of $CaSO_4$ in H_2O is $10^{-5}M$, Calculate the solubility in $0.005M$ solution of H_2SO_4.

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10. The concentration of $Ag^{\oplus}$ ions in a saturated solution of $Ag_2C_2O_4$ is $2.2 \times 10^{-4}M$. Calculate the solubility product of $Ag_2C_2O_4$

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11. $500mL$ of $2 \times 10^{-3}MA1C1_3$ and $500mol$ of $4 \times 10^{-2}M$ solution of $NaOH$ are mixed and solution is diluted to $10^{-2}L$ with water at room temperature wil a precipitate exist? Given:

$K_{sp}$of $A1(OH)_3 = 5 \times 10^{-33}$.

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12. You are provided with $500mL$ of hard water, containing $0.005mol$ of $CaC1_2$ and two H_2SO_4 samples of $0.001M$ and $0.02M$ concentration. Which one or both or none can be used for precipitating Ca^{2+} ions.

K_{sp} of $CaSO_4 = 2.4 \times 10^{-4}$.

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13. A lead salts is dissolved in $HC1$ which si 94% ionised. It is found to have $0.1MPb^{2+}$ and $0.28MH^{\oplus}$ ions. The solution is satured with $H_2S(g)$. Calculate the amount of Pb^{2+} ions that remains unprecipitated.

K_{sp} of $PbS = 4 \times 10^{-29}$,

K_{sp} of $H_2S = 1.1 \times 10^{-22}$

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14. A solution constains Zn^{2+} ions and Cu^{2+} ions each of $0.02M$. If the solution is made $1M$ in $H^{\oplus}$, and H_2S is passed untill the solution is satured, should a precipitate be formed? Given: $K_{sp}ZnS = 10^{-22}$, $K_{sp}Cus = 8 \times 10^{-37}$.

In satured solution, $K_{sp}\left(H_2S\right) = 10^{-22}$

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15. The following pH range where the indicator shows change in colour are given

i. 4 - 9.7 ii. 7.46 - 10.0 iii. 6.5 - 4

Which of the above pH range represent titration of

I. Strong acid/strong base $\left(S_A/S_B\right)$,

II. Weak acid/strong base $\left(W_A/S_B\right)$,

III. Weak base/strong acid $\left(W_B/S_A\right)$

A. $(i) \rightarrow I, (ii) \rightarrow II, (iii) \rightarrow III$

B. $(iii) \rightarrow I, (ii) \rightarrow II, (i) \rightarrow III$

C. $(ii) \rightarrow I, (iii) \rightarrow II, (i) \rightarrow III$

D. $(i) \rightarrow I, (iii) \rightarrow II, (ii) \rightarrow III$

Answer: A

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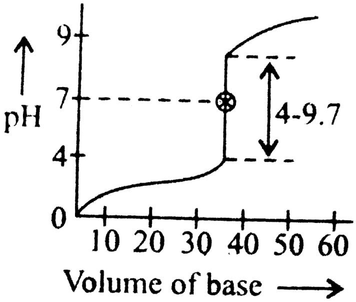
16. The following acid base titration graphs are given:



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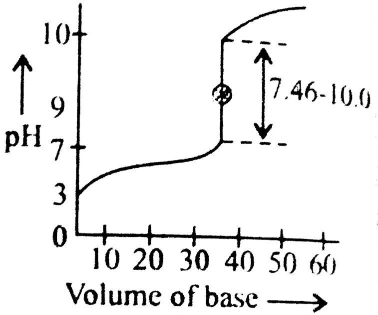
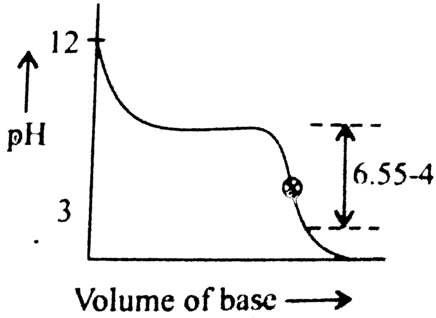


(II)



(III)

(I)

Which of the following graph represents titration of

i. $NH_4OH/HCl\left(W_B/S_A\right)$

ii. $HNO_3/KOH\left(S_A/S_B\right)$

iii. $C_6H_5COOH/KOH\left(W_A/S_B\right)$

A. *Graph* *Titration*
I. II. III *i. ii. iii*

B. *Graph* *Titration*
I. II. III *ii. iii. i*

C. *Graph* *Titration*
I. II. III *iii. ii. i*

D. $\begin{array}{ll} Graph & Titration \\ I. II. III & iii. i. ii \end{array}$

Answer: B

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17. What indicators will be suitable for the following acid-base titrations:

a. $HCOOH$ against $NaOH$

b. HBr against KOH

c. NH_4OH with HNO_3

A. $(i) \rightarrow A, (ii) \rightarrow B, (iii) \rightarrow C$

B. $(i) \rightarrow A, (ii) \rightarrow C, (iii) \rightarrow B$

C. $(i) \rightarrow B, (ii) \rightarrow C, (iii) \rightarrow A$

D. $(i) \rightarrow C, (iii) \rightarrow A, (iii) \rightarrow B$

Answer: D

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18. A solution gives the following colours with different indicators:

a. Methy1 orange $\Rightarrow$ Yellow

b. Methy1 red $\Rightarrow$ Yellow

c. Bromothymol blue $\Rightarrow$ Orange

What is the pH of the solution?

A. > 4.5

B. > 6.0

C. 6.0 to 6.3

D. 4.5 to 6

Answer: C

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19. In the titration of NH_4OH versus HCl, the pH of the solution at equivalence point is about:

A. 5.5

B. 7

C. 8.5

D. 9.5

Answer: A

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20. The pH indicators are

A. Salts of strong acids and strong bases

B. Salts of weak acids and weak bases

C. Either weak acids or weak bases

D. Either strong acids or strong base

Answer: C

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21. In which of the following acid-base titration, the pH is greater than 8 at the equivalence point ?

A. Aceitic acid vs ammonia

B. Acetic acid vs sodium hydroxide

C. Hydrochloric acid vs ammonia

D. Hydrochloric acid vs sodium hydroxide

Answer: B

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22. Strong acids are generally used as standard solution in acid-base titrations because:

A. The pH at the equivalent point will always be 7.

B. They can be used to titrate both strong and weak bases.

C. Strong acids from more stable soluitons than weak acids.

D. The salts of strong acids do not hydrolyse.

Answer: C

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23. The best indicator for detection of end point in titration of a weak acid and a strong base is

A. Methy1 orange (3 to 4)

B. Methy1 red (5 to 6)

C. Bromotymol blue (6 to 7.5)

D. Phenolphthalein (8 to 9.6)

Answer: D

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24. The precipitate of $CaF_2\left(K_{sp} = 1.7 \times 10^{-10}\right)$ is obtained when equal volumes of the following are mixed

A. $10^{-2}MCa^{2+} + 10^{-3}MF^{\Theta}$

B. $10^{-4}MCa^{2+} + 10^{-4}MF^{\Theta}$

C. $10^{-3}MCa^{2+} + 10^{-5}MF^{\Theta}$

D. $10^{-5}MCa^{2+} + 10^{-3}MF^{\Theta}$

Answer: A

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25. The solubility of A_2B_3 is "x mol dm"^(-3). ItsK_(sp)` is

A. $6x^4$

B. $64x^4$

C. $36x^5$

D. $108x^5$

Answer: D

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26. The pH of $Ca(OH)_2$ is 10.6 at $25^\circ C$. K_{sp} of $Ca(OH)_2$ is

A. $3.2 \times 10^{-12} M^3$

B. $3.2 \times 10^{-11} M^3$

C. $1.6 \times 10^{-12} M^3$

D. $1.6 \times 10^{-11} M^3$

Answer: B

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27. Solubility of AgI in $0.05 M BaI_2$ solution is $10^{-15} M$. The solubility of AgI in water is

A. 25×10^{-7}

B. $10^{-7}M$

C. 5×10^{-8}

D. $10^{-8}M.$

Answer: D

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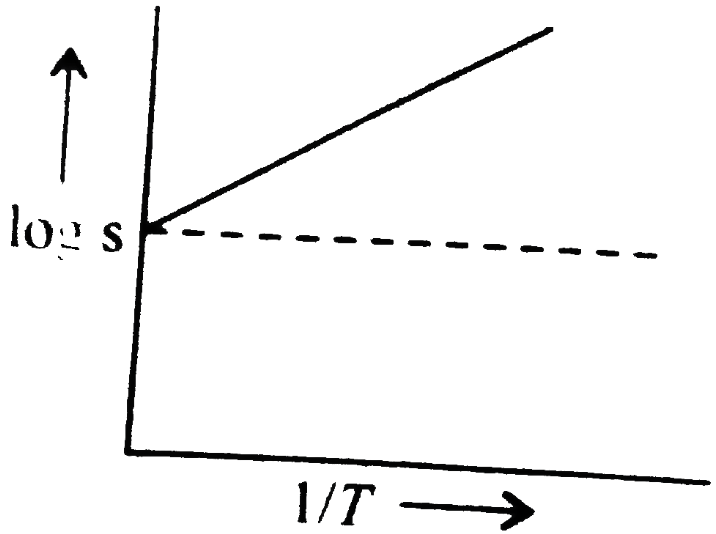
28. Solubility of a solute in water is dependent on temperature as given by

$S = Ae^{-\Delta H/RT}$, where ΔH=heat of solution

$\text{Solute}+H_2O(l) \Leftrightarrow \text{Solution}, \Delta H = \pm x$

For given solution, variation of log S with temperature is shown graphically. Hence, solution is



A. CaO

B. $MgSO_4$

C. $CuSO_4$

D. $CuSO_4.5H_2O$

Answer: D

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29. The solubility of CaF_2 in a solution of $0.1MCa\left(NO_3\right)_2$ is

A. $\left[Ca^{2+}\right]$

B. $2\left[F^{\Theta}\right]$

C. $\frac{\left[F^{\Theta}\right]}{2}$

D. $2\left[NO_3^{\Theta}\right]$

Answer: C

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30. The volume of water needed to dissolve $1mg$ of $PbSO_4\left(K_{sp} = 1.44 \times 10^{-8}, MwofPbSO_4 = 303g\right)$ at $25\ ^{\circ}C$ is

A. $80mL$

B. $43mL$

C. $27.5mL$

D. $10mL$

Answer: C

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31. The volume of water needed to prepare a satured solution of $Ag^{\oplus}$ having maximum $\left[Ag^{\oplus}\right]$ ion by selecting one out of three slats form: $AgC1\left(K_{sp} = 2.0 \times 10^{-10}\right), AgBr\left(K_{sp} = 5 \times 10^{-13}\right)$, and $Ag_2CrO_4\left(K_{sp} = 2.4 \times 10^{-12}\right)$. whcih compound should be used to have maximum $\left[Ag^{\oplus}\right]$?

A. $AgC1$

B. $AgBr$

C. Ag_2CrO_4

D. Any one of them

Answer: C

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32. How many grams of KBr can be added to $1L$ of $0.12M$ solution of $AgNO_3$ just to start the precipitation of $AgBr$. $\left(MwofKBr = 120, K_{sp}ofAgBr = 10^{-13}\right)$

A. $10^{-10}g$

B. $10^{-9}g$

C. $0.5 \times 10^{-10}g$

D. $0.5 \times 10^{-9}g$

Answer: A

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33. The solubility of silver benzoate $\left(C_6H_5COOAg\right)$ in H_2O and in a buffer solution of $pH = 2, 3,$ and 4 are S_1, S_2, S_3 and S_4 respectively. The decreasing order of solubility is

A. $S_1 > S_2 > S_3 > S_4$

B. $S_4 > S_3 > S_2 > S_1$

C. $S_2 > S_3 > S_4 > S_1$

D. $S_3 > S_2 > S_4 > S_1$

Answer: C

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34. The solubility of CH_3COOAg in a buffer solution with $pH = 4$, whose $K_{sp} = 10^{-12}$ and $K_a = \frac{10^{-4}}{3}$ is

A. 10^{-6}

B. 0.5×10^{-6}

C. 5×10^{-6}

D. 2×10^{-6}

Answer: D

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35. the ratio of solubility of CH_3COOAg in a buffer solution with $pH = 4$ and in H_2O is

$\left(SolBuffer = 2 \times 10^{-6}\right)$

A. $1/2$

B. 2

C. $1/3$

D. 3

Answer: B

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36. What is the maximum molarity of Co^{+2} ions in $0.1 MHC1$ saturated with $0.1 MH_2S$. $\left(K_a = 4 \times 10^{-21}\right)$. Given: K_{sp} of $CoS = 2 \times 10^{-21}$.

A. $0.10M$

B. $1.00M$

C. $4.48 \times 10^{-11}M$

D. $0.050M$

Answer: D

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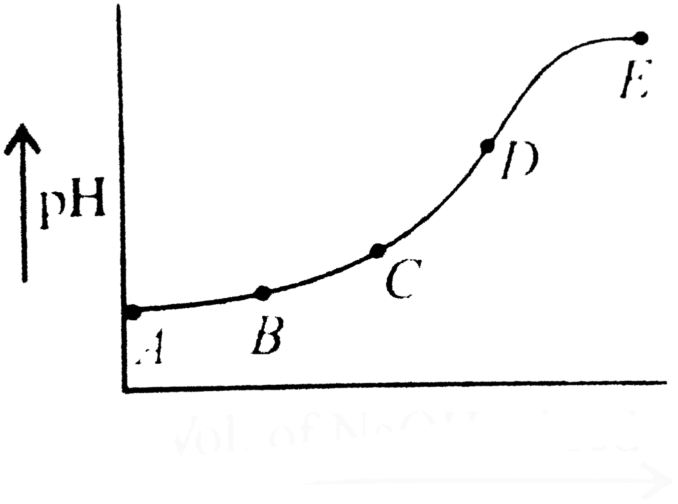
37. The following curve shows the change of pH during the course of titration of weak acid HA with a strong base. At which point in the titration curve is the concentration of acid equal to that of its conjugate base.



A. Point B

B. Point C

C. Point D

D. Point E

Answer: C

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38. If the salts M_2X, QY_2, and PZ_3 have the same solubilities $\left(<\frac{4}{27}\right)$, their K_{sp} values are related

A. $K_{sp}(M_2X)=K_{sp}(QY_2)>K_{sp}(PZ_3)$

B. $K_{sp}(M_2X)>K_{sp}(QY_2)=K_{sp}(PZ_3)$

C. $K_{sp}(M_2X)=K_{sp}(QY_2)=K_{sp}(PZ_3)$

D. $K_{sp}(M_2X)>K_{sp}(QY_2)>K_{sp}(PZ_3)$

Answer: A

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39. Arrange the following solutions in decreasing order of $\left[Ag^{\oplus}\right]$ ion:

I. $1M\left[Ag(CN)_2\right]^{\Theta}$

II. Saturated $AgC1$

III. $1M\left[Ag\left(NH_3\right)_2\right]^{\oplus} \in 0.1MNH_3$

IV. Saturated AgI

$\left(K_{sp} ofAgC1 = 10^{-10}, K_{sp} ofAgI = 8.3 \times 10^{-17} K_f\right.$ (formation constant) $\left[Ag\left(CN_2\right)\right]^{\Theta} = 10^{21}, K_f\left[Ag\left(NH_3\right)_2\right]^{\oplus} = 10^8$

A. $I > II > III > IV$

B. $II > III > I > IV$

C. $IV > II > II > I$

D. $I > IV > III > II$

Answer: B

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Ex 8.5

1. How many moles of NH_3 must be added to $1.0L$ of $0.75MAgNO_3$ in order to reduce the $\left[Ag^{\oplus}\right]$ to $5.0 \times 10^{-8}M. K_f Ag\left(NH_3\right)_2^{\oplus} = 1 \times 10^8$.

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2. Calculate the $\left[Fe^{2}\right]$ in a solution prepared by mixting $75.0mL$ of $0.03MFeSO_4$ with $125.0mL$ of $0.2\text{M KCN}K_fFe(CN)_6^{4-} = 1 \times 10^{24}$.

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3. a. Calculate $\left[Ag^{\oplus}\right]$ in a solution of $\left[Ag\left(NH_3\right)_2^{\oplus}\right]$ prepared by adding $1.0 \times 10^{-3}molAgNO_3$ to $1.0Lof1.0MNH_3$ solution $K_fAg\left(NH_3\right)_2^{\oplus} = 10^8$.

b. Calculate $\left[Ag^{\oplus}\right]$ which is in equilibrium with $0.15M\left[Ag\left(NH_3\right)_2\right]^{\oplus}$ and $1.5NH_3$.

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4. Calculate the $\left[Fe^{2+}\right]$ in a solution containing $0.2M\left[Fe(CN)_6\right]^{4-}$ and $0.1MCN^{\Theta}.K_fFe(CN)_6^{4-} = 1 \times 10^{24}$.

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5. How much $AgBr$ could dissolve in $1.0L$ of $0.4MNH_3$? Assume that $Ag\left(NH_3\right)_2^{\oplus}$ is the only complex formed. Given: the dissociation constant for

$Ag\left(NH_3\right)_2^{\oplus} \Leftrightarrow Ag^{\oplus} + 2NH_3$,

$K_d = 6.0 \times 10^{-8}$ and $K_{sp}(AgBr) = 5.0 \times 10^{-13}$.

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6. Calculate K_f for the reaction:

$M^{3+} + SCN^{\Theta} \Leftrightarrow MSCN^{2+}$,

The $\left[M^{3+}\right]$ in the solution is $2.0 \times 10^{-3}M$, $\left[SCN^{\Theta}\right] = 1.5 \times 10^{-3}M$ and Free $\left[SCN^{\Theta}\right] = 1.0 \times 10^{-5}M$.

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Exercises Subjective (Weak Acid And Weak Bases)

1. a. Distinguish between acid strength and acid concentration.

b. Distinuish between weak base and an isoluble base.

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2. Write an equilibrium equation for a solution containing CH_3COOH and CH_3COONa. What effect does CH_3COONa have on a solution of CH_3COOH?

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3. Which of the reagents listed below could be added to water to make $0.1M$ solutions of each of the following ions?

a. $\overset{\oplus}{N}H_4$

b. $CH_3COO^{\ominus}$

c. $C1^{\ominus}$

i. NH_3 ii. NH_4C1

iii. CH_3COOH

iv. CH_3COONa

v. $HC1$

vi. $NaC1$.

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4. Saccharin $\left(K_a = 2 \times 10^{-12}\right)$ is a weak acid represented by formula HSaC. A 4×10^{-4} mole amount of saccharin is dissolved in 200 cm^3 water of pH 3. Assuming no change in volume. Calculate the soncentration of SaC^- ions in the resulting solution at equilibrium.

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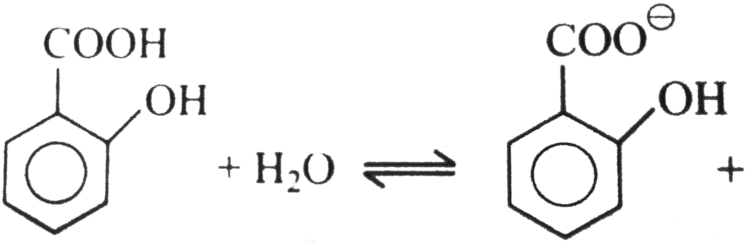
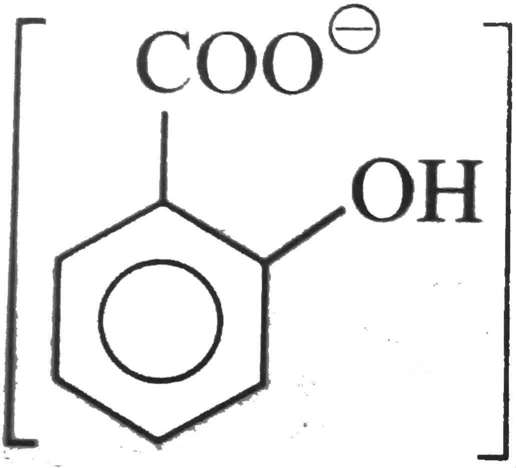
5. Accetyl salicylic acid (aspirin) ionises in water as:



$\left(K_a = 2.75 \times 10^{-9}\right)$

If two tablets of aspirin each of $0.32g$ is dissolved in water to produce $250mL$ solution, calculate



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6. Calculate the $\left[CH_2FCOOH\right]$ (fluoroacetic acid) which is required to get $\left[H^{\oplus}\right] = 1.5 \times 10^{-3}M. K_a$ of acid $= 2.6 \times 10^{-3}$.

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7. Calculate the dissociation constant of NH_4OH at $298k$, if $\Delta H^{\ominus}$ and $\Delta S^{\ominus}$ for the given changes are as follows:-

$NH_3 + H^{\oplus} \Leftrightarrow \overset{\oplus}{NH_4}$,

$\Delta H^{\ominus} = -52.2KJmol^{-1}, \Delta S^{\ominus} = 1.67JK^{-1}mol^{-1}$

$H_2O \Leftrightarrow H^{\oplus} + \overset{\ominus}{OH}, \Delta H^{\ominus} = 56.6kJmol^{-1}$.

$\Delta S^{\ominus} = -76.53JK^{-1}mol^{-1}$

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8. Determine the dergee of dissociation of $0.05MNH_3$ at $25^{\circ}C$ in a solution of $pH = 11$

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9. In the eqantitative analysis Bi^{3+} is detected precipitation of $[BiO(OH)(s)]$ [bismuthy1 hydroxide). Calculate the pH when the following equilibria exists:

$$BiO(OH)(s) \Leftrightarrow BiO^{\oplus}(aq) + \overset{\Theta}{O}H(aq)\left(K = 4 \times 10^{-10}\right)$$

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10. Calculate $\left[\overset{\Theta}{O}H\right]$ of $\left[NH_2C_2H_4NH_3\right]^{\oplus}$ and $\left[H_3N - C_2H_4NH_3\right]^{2+}$ in $0.15M$ ethylene diamine (aq) if

$$NH_2C_2H_4NH_2 + H_2O \Leftrightarrow NH_2C_2H_4\overset{\oplus}{N}H_3 + \overset{\Theta}{O}H\left(K_1 = 8.5 \times 10^{-5}\right)$$

$$NH_2C_2H_4\overset{\oplus}{N}H_3 + H_2O \Leftrightarrow \left[NH_3C_2H_4NH_3\right]^{2+} + \overset{\Theta}{O}H\left(K_2 = 2.7 \times 10^{-8}\right)$$

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11. Calculate pH of

a. $0.002NCH_3COOH$ having 2.3% dissociation.

b. $0.002NNH_4OH$ having 2.3% dissociation.

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12. Calculate $\left[H^{\oplus}\right]$ and $\left[CHCl_2COO^{\Theta}\right]$ in a solution that is $0.01MHCl$ and $0.01MCHCl_2COOH$. K_a for $CHCl_2COOH$ is 5×10^{-3}.

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13. A solution contains $0.09HC1$, $0.09MCHC1_2COOH$, and $0.1MCH_3COOH$. The pH of this solution is one. Calculate $K_a$for $CHC1_2COOH$. (Given $K_aCH_3COOH = 10^{-5}$)

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14. What is the concentration of CH_3COOH which can be added to $0.5MHCOOH$ solution so that dissociation of both is same.

$K_{CH_3COOH} = 1.8 \times 10^{-5}, K_{HCOOH} = 2.4 \times 10^{-4}$

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15. What are $\left[H^{\oplus}\right], \left[A^{\Theta}, \text{ and } \left[B^{\Theta}\right]$ in a solution that is $0.3MHA$ and $0.1MHB?K_a$ for HA and HB are 1.38×10^{-4} and 1.05×10^{-10}, respectively.

Watch Video Solution

Exercises Subjective (Buffer Solutions)

1. What will be the amount of $\left(NH_4\right)_2SO_4$ (in g) which must be added to 500 mL of 0.2 M NH_4OH to yield a solution of pH 9.35? $\left[\text{Given}, pK_a\text{of } NH_4^+ = 9.26, pK_bNH_4OH = 14 - pK_a\left(NH_4^+\right)\right]$

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2. A $0.1M$solution of weak acid HA is 1% dissociated at $298k$. what is its K_a? what will be the new degree of dissociation of HA and pH when $0.2M$ of NaA is added to it.

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Exercises Subjective (Hydrolysis Of Salt)

1. a. Calculate the percentage hydrolysis of $0.003M$ aqueous solution of $NaOH. K_a$ for $HOCN = 3.3 \times 10^{-4}$.

b. What is the pH and $\left[\overset{\Theta}{OH}\right]$ of $0.02M$ aqueous solution of sodium butyrate. $\left(K_a = 2.0 \times 10^{-5}\right)$.

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2. K_a for the reaction, $Fe^{3+}(aq.) + H_2O(l) \Leftrightarrow Fe(OH)^{2+}(aq.) + H_3O^+(aq.)$ is 6.5×10^{-3} What is the max. pH value which could be used so that at least 80% of the total iron (III) in a dilute solution exists as Fe^{3+}?

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Exercises Subjective (Polyprotic Acid)

1. Calculate the equilibrium constants for the reactions with water of $H_2PO_4^{\Theta}$, HPO_4^{2-}, and PO_4^{3-} as ase. Comparing the relative values of two equilibrium constants of $H_2PO_4^{\Theta}$ with water, deduce whether solutions of this ion in water are acidic or base, Deduce whether solutions of HPO_4^{2-} are acidic or bases. Given K_1, K_2,and K_3 for H_3PO_4 are $7.1 \times 10^{-3}, 6.3 \times 10^{-8}$, and 4.5×10^{-13} respectively.

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2. Citric acid $\left(H_3A\right)$ is a polyprotic acid with K_1, K_2, and K_3 equals to $7.4 \times 10^{-4}, 1.7 \times 10^{-5}$, and 4.0×10^{-7}, respectively. Calculate the $\left[H^{\oplus}\right], \left[H_2A^{\Theta}\right], \left[HA^{2-}\right]$, and $\left[A^{3-}\right]$ in $0.01M$ citric acid.

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Exercises Subjective (Solubility And K_{Sp})

1. a. $25mL$ of sample of saturated solution of PbI_2 requires $10mL$ of a certain $AgNO_3(aq)$ for its titration. What is the molarity of this $AgNO_3(aq)$? K_{sp} of $PbI_2 = 4 \times 10^{-9}$.

b. $M(OH)x$ has $K_{sp} = 27 \times 10^{-12}$ and solubility in water is $10^{-3}M$. Calculate the value of x.

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2. Equal volumes of $0.02MCaC1_2$ and $0.0004MNa_2SO_4$ are mixed. Will a precipitate form? K_{sp} for $CaSO_4 = 2.4 \times 10^{-5}$?

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3. What $\left(H_3O^+\right)$ must be maintained in a saturated H_2S solution to precipitate Pb^{2+}, but not Zn^{2+} from a solution in which each ion is present at a concetration of $0.01M$? $\left(K_{SP}\text{for } H_2S = 1.1 \times 10^{-22}, K_{SP}\text{for } ZnS = 1.0 \times 10^{-21}\right)$

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4. Calculate the solubility of CaF_2 in a solution buffered at $pH = 3.0$. K_a for $HF = 6.3 \times 10^{-4}$ and K_{sp} of $CaF_2 = 3.45 \times 10^{-11}$.

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5. Will a precipitate of $Mg(OH)_2$ be formed in a $0.002M$ solution of $Mg\left(NO_3\right)_2$ if the pH of solution is adjusted to 9. K_{sp} of $Mg(OH)_2 = 8.9 \times 10^{-12}$.

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6. 0.01 mole of $AgNO_3$ is added to 1 litre of a solution which is $0.1M$ in Na_2CrO_4 and $0.005M$ in $NaIO_3$. Calculate the mole of precipitate formed at equilibrium and the concentrations of Ag^+, IO_3^- and CrO_4^{2-}. (K_{sP} values of Ag_2CrO_4 and $AgIO_3$ are 10^{-8} and 10^{-13} respectively)

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7. $1.75g$ of solid $NaOH$ is added to $0.25dm^3$ of $0.1MNiCl_2$ solution. Calculate:

a. Mass of $Ni(OH)_2$ forms

b. pH if final solution Given K_{sp} of $Ni(OH)_2 = 1.6 \times 10^{-14}$

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8. Zn salt is mixed with $\left(NH_4\right)_2S$ of $0.021M$. What amount of Zn^{2+} will remain uprecipitated in $12mL$ of the solution? K_{sp} of $ZnS = 4.51 \times 10^{-24}$.

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9. A solution has $0.05MMg^{2+}$ and $0.05MNH_3$. Calculate the concentration of NH_4CI required to prevent the formation of $Mg(Oh)_2$ in solution. K_{SP} for $Mg(OH)_2 = 9.0 \times 10^{-12}$ and ionisation constant of NH_3 is 1.8×10^{-5}.

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10. A hard water sample has 131 ppm $CaSO_4$. What fraction of the water must be evaporated in a container before solid $CaSO_4$ begins to deposit. $K_{sp} of CaSO_4 = 9.0 \times 10^{-6}$.

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11. To a solution of $0.01 M Mg^{2+}$ and $0.8 M NH_4Cl$, and equal volume of NH_3 is added which just gives precipitates. Calculate $\left[NH_3\right]$ in solution. $K_{sp} of Mg(OH)_2 = 1.4 \times 10^{-11}$ and $K_b of NH_4OH = 1.8 \times 10^{-5}$.

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12. $10 mL$ of $0.3 M Na_2SO_4$ are mixed with $20 mL$ solution having initially $0.1 M Ca^{2+}$ and $0.1 M Sr^{2+}$ in it. Calculate the final $\left[Ca^{2+}\right], \left[Sr^{2+}\right]$ and $\left[SO_4^{2-}\right]$ in solution? Given $K_{sp} SrSO_4 = 7.6 \times 10^{-7}$ and $K_{sp} CaSO_4 = 2.4 \times 10^{-5}$.

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13. The solubility of $CaCO_3$ is $7mg/L$. Calculate the K_{sp} of $BaCO_3$ when Na_2CO_3 is added slowly a solution containing equimolar concentration of Ca^{2+} and Ba^{2+} and no precipitate is formed until 90% of Ba^{2+} has been precipitated as $BaCO_3$.

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14. Calculate the solubility of $AgCN$ in a buffer solution of $pH3.0$. Assume that no cyano complex is formed $K_{sp}AgCN = 2.2 \times 10^{-16}$, $K_aHCN = 6.2 \times 10^{-10}$.

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15. Equal volumes of $0.02MAgNO_3$ and $0.01MHCN$ are mixed. Calculate $\left[Ag^{\oplus}\right]$ in solution after attaining equilibrium. $K_aHCN = 6.2 \times 10^{-10}$ and K_{sp} of $AgCN = 2.2 \times 10^{-16}$.

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16. Determine the number of mole of AgI which may be dissolved in 1.0 litre of $1MCN^{-}$ solution. K_{SP} for AgI and K_C for $Ag(CN)_2^{-}$ are $1.2 \times 10^{-17}M^2$ and $7.1 \times 10^{19}M^{-2}$ respectively.

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17. $100.0mL$ of a saturated solution of Ag_2SO_4 is added to $250.0mL$ of saturated solution of $PbCrO_4$. Will may precipitate form and if so what? Given K_{sp} for $Ag_2SO_4, Ag_2CrO_4, PbCrO_4$,and $PbSO_4$ are 1.4×10^{-5}, 2.4×10^{-12}, 2.8×10^{-13}, and 1.6×10^{-8}, respectively.

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18. $2M$ solution of Na_2CO_3 is boiled in a closed container with excess of CaF_2. Very small amount of $CaCO_3$ and NaF are formed. If K_{sp} of $CaCO_3$ is x and molar solubility of CaF_2 is y, find the molar after cocentration of F^{Θ} in the resulting solution after equilibrium is attained.

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19. K_{sp} of $SrF_2 = 2.8 \times 10^{-9}$ at $25\,^{\circ}C$. How much NaF should be added to $100mL$ of solution having $0.016M$ in Sr^{2+} ions to reduce its concentration to $2.5 \times 10^{-3}M$?

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Exercises Subjective(Coordination Equilibria)

1. H_2S is bubbled into a $0.2MNaCN$ solution which is $0.02M$ each in $Ag(CN)_2^{\Theta}$ and $Cd(CN)_4^{2-}$. If K_{sp} of Ag_2S and CdS are 10^{-50} and 7.1×10^{-28} and K instability for $\left[Ag(CN)_2^{\Theta}\right]$ and $\left[Cd(CN)^{2-'}4\right]$ are 1.0×10^{-20} and 7.8×10^{-18}, which sulphide will precipitate first?

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2. Calculate the equilibrium constants of each of the indicated species necessary to reduce an initial $0.2MZn^{2+}$ solution to $1.0 \times 10^{-4}Zn^{2+}$.

$\overset{\Theta}{OH}$ in equilibrium with $Zn(OH)_2(s)$.

Given.

$K_{sp}ZN(OH)_2 = 1.8 \times 10^{-14}$.

$K_fZn(OH)_4^{2-} = 5 \times 10^{14}$.

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Exercises Linked Comprehension

1. $Pb\left(IO_3\right)_2$ is a sparingly soluble salt $\left(K_{sp} = 2.6 \times 10^{-13}\right)$. To $35mL$ of $0.15MPb\left(NO_3\right)_2$ solution, $15mL$ of $0.8MKIO_3$ solution is added, and a precipiatte of $Pb\left(IO_3\right)_2$ is formed.

Which is the limiting reactant of teh reaction that takes place in the solution?

A. $Pb\left(IO_3\right)_2$

B. $Pb(NO_3)_2$

C. KIO_3

D. Both (b) and (c).

Answer: B

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2. $Pb(IO_3)_2$ is a sparingly soluble salt $(K_{sp} = 2.6 \times 10^{-13})$. To $35mL$ of $0.15MPb(NO_3)_2$ solution, $15mL$ of $0.8MKIO_3$ solution is added, and a precipiatte of $Pb(IO_3)_2$ is formed.

What will be molarity of Pb^{2+} ions in the solution after completion of the reactions? $[IO3^-] = 0.03M$

A. 0.152

B. 0.081

C. 0.41

D. 0.03

Answer: D

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3. $Pb\left(IO_3\right)_2$ is a sparingly soluble salt $\left(K_{sp} = 2.6 \times 10^{-13}\right)$. To $35mL$ of $0.15MPb\left(NO_3\right)_2$ solution, $15mL$ of $0.8MKIO_3$ solution is added, and a precipiatte of $Pb\left(IO_3\right)_2$ is formed.

What will be molarity of Pb^{2+} ions in the solution after completion of the reactions? $\left[IO3^{-}\right] = 0.03M$

A. 8.4×10^{-10}

B. 1.6×10^{-10}

C. 2.8×10^{-10}

D. 6.1×10^{-10}

Answer: C

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4. Acid-base indicator such as methy1 orange, phenolphthalein, and bromothymol blue ate substances which change colour accroding to the hydrogen ion concentration of the solution to which they are added. Most indicators are weak acids (or more rarely weak base) in which the undissociated and dissociated forms have different and distinct colours. If methy1 orange is used as the examples and the un-dissociated forms is written as HMO, then dissociation occurs as shown below:

Reaction: $\underset{Red}{HMO} \Leftrightarrow \underset{\text{Colourless}}{H^{\oplus}} + \underset{\text{Yellow}}{MO^{\ominus}}$

The indicator should have a sharp colour change with the equivalence point of the titration. Usually the colour change of the indicator occurs over a range of about two pH units. It should be noted that the eye cannot detect the exact end point of the tiytration. The pK_a of the indicator should be near the pH of the solution at the equivalance point. Which of the following sitution exists at the equivalence point of titration?

A. $\left[H^{\oplus}\right] = 10^{-7}M$

B. $\left[H^{\oplus}\right] = \left[\overset{\ominus}{OH}\right]$

C. $\left[\overset{\Theta}{OH}\right] = 10^{-7}M$

D. $\dfrac{\left[H^{\oplus}\right]}{\left[\overset{\Theta}{OH}\right]} = 10^{-14}$

Answer: B

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5. If methyl orange is used as a solution at pH = 2 containing the indicator would be

A. Orange

B. Yellow

C. Colorless

D. Red

Answer: D

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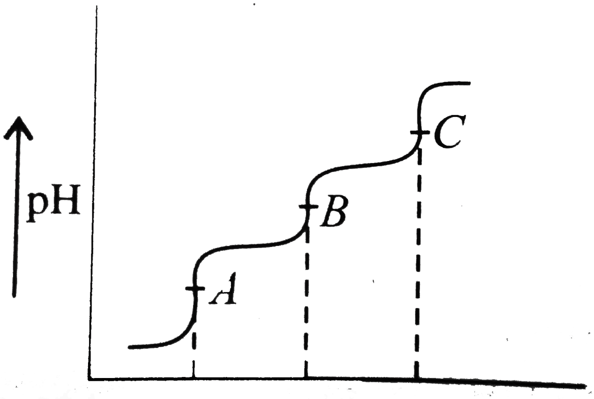
6. Acidic solution is defined as a solution whose $\left[H^{\oplus}\right] > \left[\overset{\Theta}{OH}\right]$. Base solution has $\left[\overset{\Theta}{OH}\right] > \left[H^{\oplus}\right]$. During acid-base titrations, pH of the mixture will change depending on the amount base added. This variation is shown in the form of graph by making plot as titration curves $100mL$ of $1.0MH_3A\left(K_{a_1} = 10^{-3}, K_{a_2} = 10^{-5}, K_{a_3} = 10^{-7}\right)$ is titrated against $0.1MNaOh$. The titration curve is as follows.



What is the pH at point `A?

A. 3

B. 4

C. 5

D. 6

Answer: B

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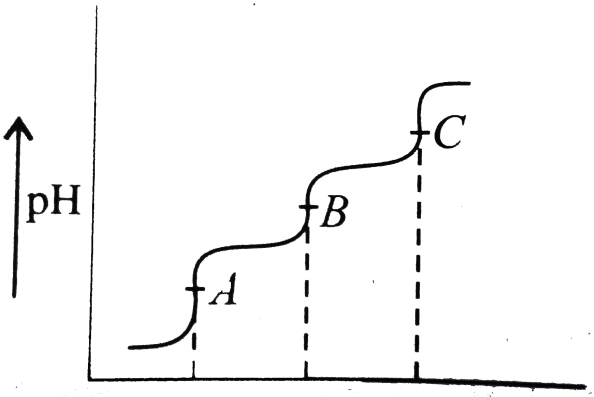
7. Acidic solution is defined as a solution whose $\left[H^{\oplus}\right] > \left[\overset{\Theta}{OH}\right]$. Base solution has $\left[\overset{\Theta}{OH}\right] > \left[H^{\oplus}\right]$. During acid-base titrations, pH of the mixture will change depending on the amount base added. This variation is shown in the form of graph by making plot as titration curves $100mL$ of $1.0MH_3A\left(K_{a_1} = 10^{-3}, K_{a_2} = 10^{-5}, K_{a_3} = 10^{-7}\right)$ is titrated against $0.1MNaOh$. The titration curve is as follows.



What is the pH at point `A?

A. 11.0

B. 10.2

C. 9.7

D. 7.7

Answer: C

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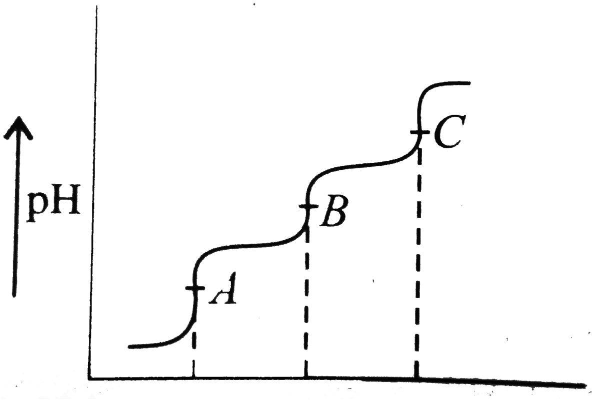
8. Acidic solution is defined as a solution whose $\left[H^{\oplus}\right] > \left[\overset{\ominus}{OH}\right]$. Base solution has $\left[\overset{\ominus}{OH}\right] > \left[H^{\oplus}\right]$. During acid-base titrations, pH of the mixture will change depending on the amount base added. This variation is shown in the form of graph by making plot as titration curves $100mL$ of $1.0MH_3A\left(K_{a_1} = 10^{-3}, K_{a_2} = 10^{-5}, K_{a_3} = 10^{-7}\right)$ is titrated against $0.1MNaOh$. The titration curve is as follows.



What will be the change in pH from point B to point C?

A. 2.8

B. 3.2

C. 4.6

D. 0.94

Answer: D

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9. In equalitative analysis, cations of graph II as well as group IV both are precipitated in the form of sulphides. Due to low value of K_{sp} of group II sulphides, group reagent is H_2S in the presence of dil. $HC1$, and due to high value of K_{sp} of group IV sulphides, group reagent is H_2S in the presence of NH_4OH and NH_4C1. In a solution containing $0.1M$ each of Sn^{2+}, Cd^{2+}, and Ni^{2+} ions, H_2Sgas is passed.

$K_{sp} ofSnS = 8 \times 10^{-29}, K_{sp} ofCdS = 1510^{-28}, K_{sp} ofNiS - 3 \times 10^{-21}, K_1 ofH_2S = 1 \times$

If H_2S is passed into the above mixture in the presence of $HC1$, which ion will be precipitated first?

A. SnS

B. CdS

C. NiS

D. SnS and CdS (both together)

Answer: C

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10. In equalitative analysis, cations of graph II as well as group IV both are precipitated in the form of sulphides. Due to low value of K_{sp} of group II sulphides, group reagent is H_2S in the presence of dil. $HC1$, and due to high value of K_{sp} of group IV sulphides, group reagent is H_2S in the presence of NH_4OH and NH_4C1. In a solution containing $0.1M$ each of Sn^{2+}, Cd^{2+}, and Ni^{2+} ions, H_2Sgas is passed.

$K_{sp}ofSnS = 8 \times 10^{-29}, K_{sp}ofCdS = 1510^{-28}, K_{sp}ofNiS - 3 \times 10^{-21}, K_1ofH_2S = 1 \times$

At what value of pH, NiS will start to precipitate?

A. 12.76

B. 7

C. 1.24

D. 4`

Answer: C

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11. In equalitative analysis, cations of graph II as well as group IV both are precipitated in the form of sulphides. Due to low value of K_{sp} of group II sulphides, group reagent is H_2S in the presence of dil. $HC1$, and due to high value of K_{sp} of group IV sulphides, group reagent is H_2S in the presence of NH_4OH and NH_4C1. In a solution containing $0.1M$ each of Sn^{2+}, Cd^{2+}, and Ni^{2+} ions, H_2Sgas is passed.

$K_{sp}ofSnS = 8 \times 10^{-29}, K_{sp}ofCdS = 1510^{-28}, K_{sp}ofNiS - 3 \times 10^{-21}, K_1ofH_2S = 1 \times$

Which of the following sulphides is more soluble in pure water?

A. CdS

B. NiS

C. SnS

D. Equal solubility for all

Answer: A

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12. In equalitative analysis, cations of graph II as well as group IV both are precipitated in the form of sulphides. Due to low value of K_{sp} of group II sulphides, group reagent is H_2S in the presence of dil. $HC1$, and due to high value of K_{sp} of group IV sulphides, group reagent is H_2S in the presence of NH_4OH and NH_4C1. In a solution containing $0.1M$ each of Sn^{2+}, Cd^{2+}, and Ni^{2+} ions, H_2Sgas is passed.

$K_{sp}ofSnS = 8 \times 10^{-29}, K_{sp}ofCdS = 10^{-28}, K_{sp}ofNiS - 3 \times 10^{-21}$

$K_1ofH_2S = 1 \times 10^{-7}, K_2ofH_2S = 1 \times 10^{-14}$

If $0.1MHC1$ is mixed in the solution containing only $0.1MCd^{2+}$ ions and saturated with H_2S, then $\left[Cd^{2+}\right]$ remaining in the solution after CdS stopes to precipitate is:

A. 10^{-8}

B. 8.2×10^{-9}

C. 5.6×10^{-6}

D. 5.6×10^{-10}

Answer: A

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13. The degree of dissociation of weak electrolyde is inversely proportional to the square root fo concentration. It is called Ostwald's dilution law.

$\alpha = \sqrt{\frac{K_a}{c}}$ As the tempertaure increases, degree of dissociation will increase.

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{K_{a_1}}{K_{a_2}}}$ if concentration is same.

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{c_2}{c_1}}$ if acid is same.

$0.01 MCH_3COOH$ has 4.24% degree of dissociation, the degree of dissociation of $0.1 MCH_3COOH$ will be

A. $1.33\ \%$

B. $4.24\ \%$

C. $5.24\ \%$

D. $0.33\ \%$

Answer: A

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14. The degree of dissociation of weak electrolyde is inversely proportional to the square root fo concentration. It is called Ostwald's dilution law.

$\alpha = \sqrt{\frac{K_a}{c}}$ As the tempertaure increases, degree of dissociation will increase.

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{K_{a_1}}{K_{a_2}}}$ if concentration is same.

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{c_2}{c_1}}$ if acid is same.

pH of $0.005 M HCOOH \left[K_a = 2 \times 10^{-4}\right]$ is equal to

A. 3

B. 2

C. 4

D. 5

Answer: A

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15. The degree of dissociation of weak electrolyde is inversely proportional to the square root fo concentration. It is called Ostwald's dilution law.

$\alpha = \sqrt{\frac{K_a}{c}}$ As the tempertaure increases, degree of dissociation will increase.

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{K_{a_1}}{K_{a_2}}}$ if concentration is same.

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{c_2}{c_1}}$ if acid is same.

a_1 and a_2 are in ratio of $1:2, K_{a_1} = 2 \times 10^{-4}$. What will be K_{a_2}?

A. 8×10^{-4}

B. 2×10^{-4}

C. 4×10^{-4}

D. 1×10^{-4}

Answer: A

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16. The following solutions are mixed: $500 mL of 0.01 M AgNO_3$ and $500 mL$ solution that was both $0.01 M$ in $NaCI$ and $0.01 M$ in $NaBr$. Given $K_{sp} AGCI = 10^{-10}, K_{sp} AgBr = 5 \times 10^{-13}$.

Calculate the $\left[CI^{\Theta}\right]$ in the equilibrium solution.

A. $5 \times 10^{-5} M$

B. 2.5×10^{-5}

C. $5 \times 10^{-3} M$

D. $2.5 \times 10^{-3} M$

Answer: C

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17. The following solutions are mixed: $500 mL of 0.01 M AgNO_3$ and $500 mL$ solution that was both $0.01 M$ in $NaCI$ and $0.01 M$ in $NaBr$. Given $K_{sp} AGCI = 10^{-10}, K_{sp} AgBr = 5 \times 10^{-13}$.

Calculate the $\left[Ag^{\oplus}\right]$ in the equilibrium solution.

A. $2.0 \times 10^{-8} M$

B. $2.0 \times 10^{-10} M$

C. $2.5 \times 10^{-5} M$

D. $2.5 \times 10^{-8} M$

Answer: A

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18. The following solutions are mixed: $500 mL of 0.01 M AgNO_3$ and $500 mL$ solution that was both $0.01M$ in $NaCI$ and $0.01M$ in $NaBr$. Given $K_{sp} AGCI = 10^{-10}, K_{sp} AgBr = 5 \times 10^{-13}, \left[Ag^+\right] = 2 \times 10^{-8}$.

Calculate the $\left[Br^{\Theta}\right]$ in the equilibrium solution.

A. $2.0 \times 10^{-8} M$

B. $2.0 \times 10^{-10} M$

C. $2.5 \times 10^{-5} M$

D. $2.5 \times 10^{-8} M$

Answer: C

Watch Video Solution

19. When $1.5 mol$ of $CuCI_2.2H_2O$ is dissolved in enough water to make $1.0L$ of solution.

Given: $K_f CuCI^{\Theta} 1.0 \left(K_f\right.$ is the formation constant of $\left.CuCi^{\oplus}\right)$

$\left[Cu^{2+}\right]$ in solution is

A. $1.0M$

B. $0.5M$

C. $2.0M$

D. None

Answer: A

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20. When $1.5 mol$ of $CuCI_2.2H_2O$ is dissolved in enough water to make $1.0L$ of solution.

Given: $K_f CuCI^{\Theta} 1.0 \left(K_f\right.$ is the formation constant of $\left.CuCi^{\oplus}\right)$

$\left[CI^{\Theta}\right]$ in solution is

A. $2.0M$

B. $1.0M$

C. $3.0M$

D. None

Answer: A

Watch Video Solution

21. When $1.5mol$ of $CuCI_2.2H_2O$ is dissolved in enough water to make $1.0L$ of solution.

Given: $K_fCuCI^{\ominus}1.0\left(K_f\right.$ is the formation constant of $\left.CuCi^{\oplus}\right)$

$\left[CiCI^{\oplus}\right]$ in solution is

A. $1.0M$

B. $2.0M$

C. $3.0M$

D. $0.5M$

Answer: B

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22. Acid rain takes place dur to combination of acidic oxides with water and it is an environmental concern all over the world. Assuming rain water is uncontaminated with HNO_3 or H_2SO_4 and is in equilibrium with $1.25 \times 10^{-4} atmCO_2$. The Henry's law constant $\left(K_H\right)$ is $1.25 \times 10^6 \text{torr}. K_{a_1}$ of $H_2CO_3 = 4.3 \times 10^{-7}$

What is the pH of neutral rain water ?

A. 5.64

B. 7.00

C. 5.85

D. 7.40

Answer: C

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23. Acid rain takes place dur to combination of acidic oxides with water and it is an envirronmental concern all over the world. Assuming rain water is uncontaminated with HNO_3 or H_2SO_4 and is in equilibrium with 1.25×10^{-4} atm CO_2. The Henry's law constant $\left(K_H\right)$ is $1.25 \times 10^6 \text{torr}$. K_{a_1} of $H_2CO_3 = 4.3 \times 10^{-7}$

Given : $K_f CuCI^{\ominus} = 1.0\left(K_f\right.$ is formation constant of $\left.CuCI^{\oplus}\right)$

If SO_2 content is the atomsphere is 0.64ppm by volume, pH of rain water is (assume 100% ionisation of acid rain as monobasic acid).

A. 4.0

B. 5.0

C. 6.0

D. 7.0

Answer: B

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24. In atmosphere, SO_2 and NO are oxidised to SO_3 and NO_2, respectively,w hcih react with water to given H_2SO_4 and HNO_3. The resultant solution is called acid rain. SO_2dissolves in water to form diprotic acid.

$SO_2(g) + H_2O(l) \Leftrightarrow HSO_3^{\Theta} + H^{\oplus}, K_{a_1} = 10^{-2}$.

$HSO_3^{\Theta} \Leftrightarrow SO_3^{2-} + H^{\oplus}, K_{a_2} = 10^{-7}$

and for equilibrium,

$SO_2(aq) + H_2O(l) \Leftrightarrow SO_3^{2-}(aq) + 2H^{\oplus}(aq)$

$K_a = K_{a_1} \times K_{a_2} = 10^{-9} at 300K.$

Which of the following reagnets will given white precipitate with the aqueous solution of sulphurous acid?

A. $BaCI_2$

B. HCI

C. $NaCI$

D. KCI

Answer: A

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25. In atmosphere, SO_2 and NO are oxidised to SO_3 and NO_2, respectively,w hcih react with water to given H_2SO_4 and HNO_3. The resultant solution is called acid rain. SO_2dissolves in water to form diprotic acid.

$SO_2(g) + H_2O(l) \Leftrightarrow HSO_3^{\ominus} + H^{\oplus}, K_{a_1} = 10^{-2}.$

$HSO_3^{\ominus} \Leftrightarrow SO_3^{2-} + H^{\oplus}, K_{a_2} = 10^{-7}$

and for equilibrium,

$SO_2(aq) + H_2O(l) \Leftrightarrow SO_3^{2-}(aq) + 2H^{\oplus}(aq)$

$K_a = K_{a_1} \times K_{a_2} = 10^{-9} at 300K.$

The pH of $0.01M$ aqueous solutioon of sodium sulphite (Na_2SO_3)

A. 4.5

B. 8.5

C. 9.0

D. 9.5

Answer: D

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26. In atmosphere, SO_2 and NO are oxidised to SO_3 and NO_2, respectively,w hcih react with water to given H_2SO_4 and HNO_3. The resultant solution is called acid rain. SO_2dissolves in water to form diprotic acid.

$SO_2(g) + H_2O(l) \Leftrightarrow HSO_3^{\ominus} + H^{\oplus}, K_{a_1} = 10^{-2}.$

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and for equilibrium,

$SO_2(aq) + H_2O(l) \Leftrightarrow SO_3^{2-}(aq) + 2H^{\oplus}(aq)$

$K_a = K_{a_1} \times K_{a_2} = 10^{-9} at 300 K.$

The dominant equilibrium in an aqueous solution of sodium hydrogen sulphite $\left(NaHSO_3\right)$ is

$2HSO_3^{\ominus}(aq) \Leftrightarrow SO_2(aq) + SO_3^{2-}(aq) + H_2O(l)$

The equilibrium constant for the above reaction is

A. 10^{-3}

B. 10^{-5}

C. 10^{-6}

D. 10^{-9}

Answer: B

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27. In atmosphere, SO_2 and NO are oxidised to SO_3 and NO_2, respectively,w hcih react with water to given H_2SO_4 and HNO_3. The resultant solution is called acid rain. SO_2dissolves in water to form diprotic acid.

$SO_2(g) + H_2O(l) \Leftrightarrow HSO_3^{\Theta} + H^{\oplus}, K_{a_1} = 10^{-2}$.

$HSO_3^{\Theta} \Leftrightarrow SO_3^{2-} + H^{\oplus}, K_{a_2} = 10^{-7}$

and for equilibrium,

$SO_2(aq) + H_2O(l) \Leftrightarrow SO_3^{2-}(aq) + 2H^{\oplus}(aq)$

$K_a = K_{a_1} \times K_{a_2} = 10^{-9} at 300K.$

Which of the following statement is correct?

A. H_2SO_3 is less acidic than H_2SO_4.

B. HNO_3 is less acidic than HNO_2.

C. $SO_2(g)$ is reduced in the atmosphere during thunderstron.

D. CO_2 gas develop more acidity in rain water than SO_2.

Answer: A

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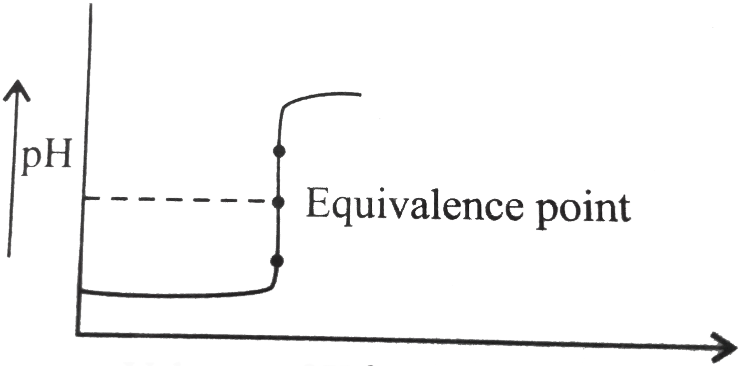
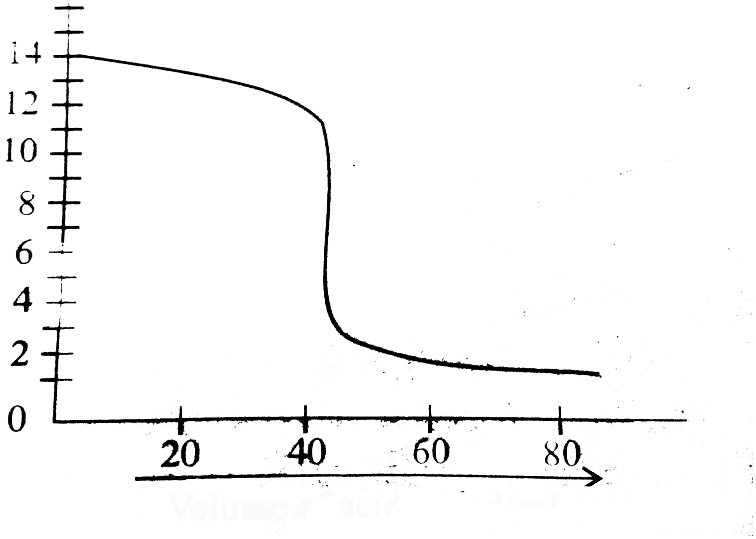
28. In acid-base titration react rapidly to neutralise each other. Equivalence point is a point at which the acid and the base (or oxidising agent and reducing agent) have beem added in equivalent quantities. The end point in the point at which the titration stops. since the purpose of the indicator is to stop the titration close to the point at which the acid and base were added in equivalent quantities, it is important that the equivalent point and the end point be as close as must change colour at a pH close to that of a solution of the salt of the acid base. Singificantly, the pH changes most rapidly near the equivalent point. The exact shape of a titration curve depends on K_a and K_b of acid and base.



The following curve represents titration curve of HCI against KOH. The pH at equivalent point is

Examine the titration curve below and answer the question.



A. 3

B. 6

C. 7

D. 8

Answer: C

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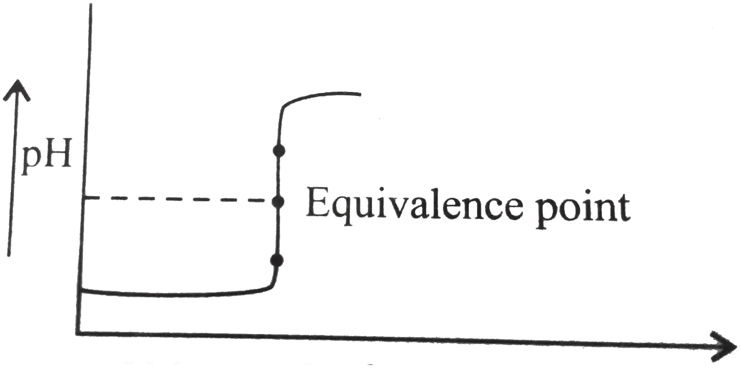
29. In acid-base titration react rapidly to neutralise each other. Equivalence point is a point at which the acid and the base (or oxidising agent and reducing agent) have beem added in equivalent quantities. The end point in the point at which the titration stops. since the purpose of the indicator is to stop the titration close to the point at which the acid and base were added in equivalent quantities, it is important that the equivalent point and the end point be as close as must change colour at a pH close to that of a solution of the salt of the acid base. Singificantly, the pH changes most rapidly near the equivalent point. The exact shape of a titration curve depends on K_a and K_b of acid and base.



The curve represents the titration of

A. $CsOHbyHBr$

B. $HCIbyNaOH$

C. HCI by ammonium hydroxide

D. NH_3byHNO_3

Answer: A

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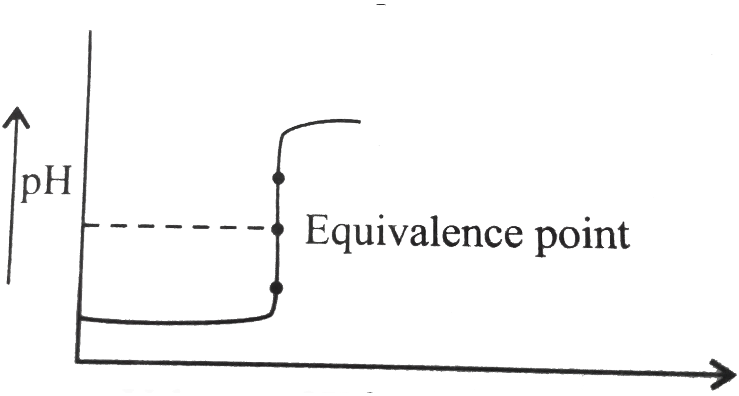
30.



The suitable indicator for the titration is

A. Methy1 orange

B. Bromothymol

C. Methy1 red

D. All of these

Answer: D

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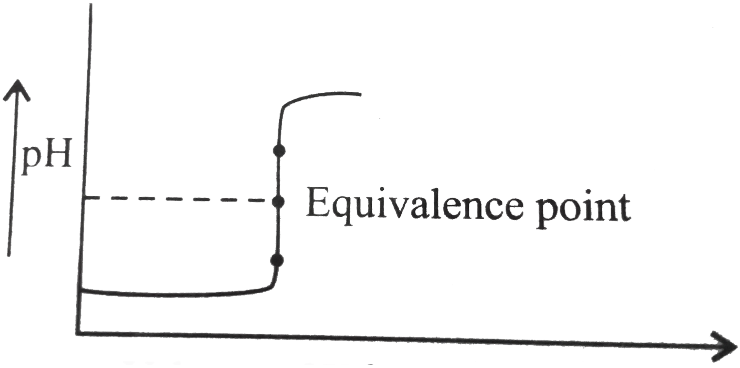
31. In acid-base titration react rapidly to neutralise each other. Equivalence point is a point at which the acid and the base (or oxidising agent and reducing agent) have beem added in equivalent quantities. The end point in the point at which the titration stops. since the purpose of the indicator is to stop the titration close to the point at which the acid and base were added in equivalent quantities, it is important that the equivalent point and the end point be as close as must change colour at a pH close to that of a solution of the salt of the acid base. Singificantly, the pH changes most rapidly near the equivalent point. The exact shape of a titration curve depends on K_a and K_b of acid and base.



The pH at equivalence point is

A. 2

B. 3

C. 7

D. 11

Answer: C

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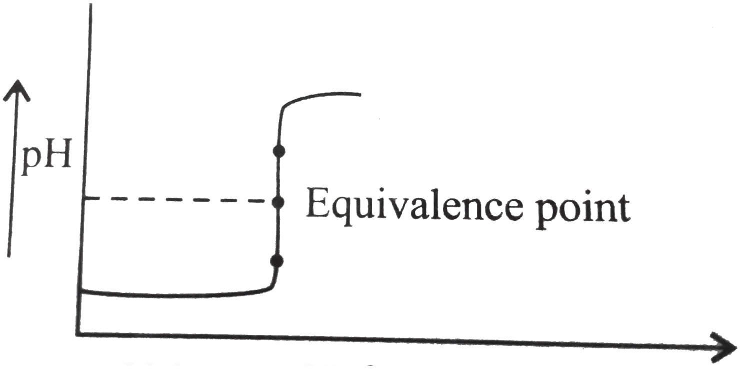
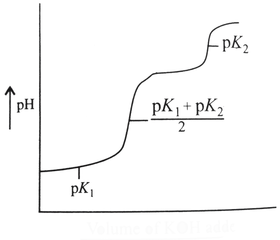
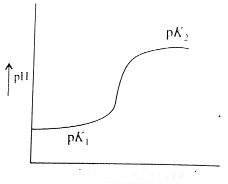
32. In acid-base titration react rapidly to neutralise each other. Equivalence point is a point at which the acid and the base (or oxidising agent and reducing agent) have beem added in equivalent quantities. The end point in the point at which the titration stops. since the purpose of the indicator is to stop the titration close to the point at which the acid and base were added in equivalent quantities, it is important that the equivalent point and the end point be as close as must change colour at a pH close to that of a solution of the salt of the acid base. Singificantly, the pH changes most rapidly near the equivalent point. The exact shape of a titration curve depends on K_a and K_b of acid and base.



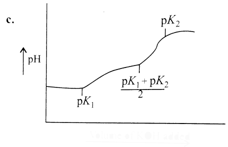
Which of the following curves indicates the titration of a weak diprotic acid by KOH of equivalent strength?



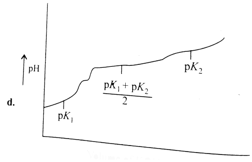
A.



B.



C.



D.

Answer: A

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33. Physical and chemical equilibrium can respond to a change in their pressure, temperature, and concentration of reactants and products. To describe the change in the equilibrium we have a principle named Le Chatelier principle. According to this principle, even if we make some changes in equilibrium, then also the system even re-establishes the equilibrium by undoing the effect.

In the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$. If we increase the pressure of the system, the equilibrium is

A. Shifts in the product side

B. Remains unchanged

C. Shifts in the reactant side

D. Cannot be predicted

Answer: A

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34. Physical and chemical equilibrium can respond to a change in their pressure, temperature, and concentration of reactants and products. To describe the change in the equilibrium we have a principle named Le Chatelier principle. According to this principle, even if we make some changes in equilibrium, then also the system even re-establishes the equilibrium by undoing the effect.

If we add SO_4^{2-} ion to a saturated solution of Ag_2SO_4, it will result in a//an

A. Result in an increase in $Ag^{\oplus}$ concentration

B. Result in a decrease in $Ag^{\oplus}$ concentration

C. Shift $Ag^{\oplus}$ ions from solid Ag_2CrO_4 into solution.

D. Result in a decrease the CrO_4^{2-} ion concentration in the solution.

Answer: B

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35. Physical and chemical equilibria can respond to a change in their pressure, temperature, and concentration of reactants and products. To describe the change in the equilibrium, we have a principle named Le Chatelier's principle. This we can define in terms of energy, as the free energy change in equilibrium is zero means the system is stable. So if we are doing some changes in equilibrium, then the system having a tendency to reestablish the equilibrium by undoing the effect we brought. Consider the following equilibrium.

Three sparingly soluble salts A_2B, AB, and AB_3 are given. If all the three having the same value of solubility products $\left(K_{sp}\right)$, in the saturated solution, the correct order of their solubilites is

A. $AB_3 > AB > A_2B$

B. $AB_3 > A_2B > AB$

C. $AB > AB_3 > A_2B$

D. $AB > A_2B > AB_3$

Answer: D

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36. H_3PO_4 is a tribasic acid with pK_{a_1}, pK_{a_2} and $pK_{a_3}1.12, 7.21$, and 12.32, respectively. It is used in fertiliser productions and its various salts are used in food, detrgent, toothpaste, and in metal treatment.

Small quantities of H_3PO_4 are used in inparting the sour or tart taste of soft drinkes, such as Coca Cola, and beers, in which H_3PO_4 is prese4nt 0.05% by weight (density $= 1.0gmL^{-1}\big)$.

$10^{-3}MH_3PO_4(pH = 7)$ is used in fertilisers as an aqueous soil digesting. Plants can absorb zinc in whater soluble from only. Zinc phosphate is the source of zinc and $PO_4^{3-})$ ions in the soil. K_{sp} of zinc phosphate $= 9.1 \times 10^{-33}$.

Calculate the pH of a Coca Cola, assuming that the acidity of the cola arises only from H_3PO_4 and K_{a_2} and K_{a_3} are no importance.

A. $.18$

B. 2.2

C. 3.3

D. 4.4

Answer: B

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37. H_3PO_4 is a tribasic acid with pK_{a_1}, pK_{a_2} and $pK_{a_3} 1.12, 7.21$, and 12.32, respectively.$10^{-3} MH_3PO_4(pH = 7)$ is used in fertilizers as an aqueous soil digesting. Plants can absorb zinc in water soluble from only. Zinc phosphate is the source of zinc and PO_4^{3-}) ions in the soil. K_{sp} of zinc phosphate $= 9.1 \times 10^{-33}$.

$\left[PO_4^{3-}\right]$ ion in the soil with $pH = 7$, is

A. $10^{-3} M$

B. $1.2 \times 10^{-4} M$

C. $2.2 \times 10^{-4}M$

D. $1.1 \times 10^{-10}M$

Answer: C

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38. H_3PO_4 is a tribasic acid with pK_{a_1}, pK_{a_2} and $pK_{a_3}1.12, 7.21,$ and $12.32,$ respectively. 10^(-3)M 'H_(3)PO_(4)'(pH = 7) $. KspofZ \in cphosp\hat{e} = 9.1 \times 10^{-33}.$

$\left[Zn^{2+}\right]$ ion in the soil is

A. $2.9 \times 10^{-11}M$

B. $4.0 \times 10^{-10}M$

C. $3.0 \times 10^{-6}M$

D. $9.1 \times 10^{-5}M$

Answer: A

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39. The number of moles of $KMnO_4$ required to oxidise $1mol$ of $Fe\left(C_2O_4\right)$ in acidic medium is

A. $6 \times 10^{-6}, 6 \times 10^{-6}$

B. $6 \times 10^{-6}, 1.5 \times 10^{-5}$

C. $1.5 \times 10^{-5}, 6 \times 10^{-6}$

D. $6 \times 10^{-6}, 3 \times 10^{-6}$

Answer: B

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40. Aqueous solutions of $Na_2C_2O_4$ and $CaCI_2$ are mixed and precipitate of CaC_2O_4 formed is filered and dried. $250mL$ of the saturated solution of CaC_2O_4 required $6.0mL$ of $0.001MKMnO_4$ solution in acidic medium for complete titration.

Equivalent of $KMNO_4$ required in the titration and equivalent of $C_2O_4^{2-}$ ion present in CaC_2O_4, respectively, are

A. $3 \times 10^{-5}, 3 \times 10^{-5}$

B. $1.8 \times 10^{-5}, 3 \times 10^{-6}$

C. $3 \times 10^{-6}, 6 \times 10^{-6}$

D. $6 \times 10^{-6}, 3 \times 10^{-6}$

Answer: A

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41. Aqueous solutions of $Na_2C_2O_4$ and $CaCI_2$ are mixed and precipitate of CaC_2O_4 formed is filered and dried. $250mL$ of the saturated solution of CaC_2O_4 required $6.0mL$ of $0.001MKMnO_4$ solution in acidic medium for complete titration.

K_{sp} of CaC_2O_4 is

A. 2.25×10^{-12}

B. 2.25×10^{-10}

C. 3.6×10^{-9}

D. 4.0×10^{-9}

Answer: C

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42. Aqueous solutions of $Na_2C_2O_4$ and $CaCI_2$ are mixed and precipitate of CaC_2O_4 formed is filered and dried. $250mL$ of the saturated solution of CaC_2O_4 required $6.0mL$ of $0.001MKMnO_4$ solution in acidic medium for complete titration.

Which is the indicator in the above titration?

A. Phenolphthalein

B. Methy1 ornage

C. $KMnO_4$ it self

D. None

Answer: C

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43. Hin is an acidic indicator $\left(K_{Ind} = 10^{-7}\right)$ which dissociates into aqueous acidic solution of $30mL$ of $0.05MH_3PO_4\left(K_1 = 10^{-3}, K_2 = 10^{-7}, K_3 = 10^{-13}\right)$

Calculate the $\left[\frac{Ind^{\Theta}}{H \in}\right]$

A. 1.413×10^{-5}

B. 1.413×10^{-4}

C. 3.128×10^{-5}

D. 3.128×10^{-14}

Answer: A

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44. Hin is an acidic indicator $\left(K_{Ind} = 10^{-7}\right)$ which dissociates into aqueous acidic solution of $30mL$ of $0.05MH_3PO_4\left(K_1 = 10^{-3}, K_2 = 10^{-7}, K_3 = 10^{-13}\right)$

If Hin and Ind^{Θ} posses colour P and Q, respectively, and concentration of HIn is 120 times than that of Ind^{Θ}. colour Q predominates over P when concnetration of Ind^{Θ} is 127 times of HIn.

What is the pH range of the indicator.

A. $4.896 \rightarrow 9.0792$

B. $4.896 \rightarrow 8.0792$

C. $4.896 \rightarrow 7.0792$

D. $4.896 \rightarrow 6.0792$

Answer: A

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45. $H \in$ is an acidic indicator $\left(K_{Ind} = 10^{-7}\right)$ which dissociates into aqueous acidic solution of $30mL$ of $0.05MH_3PO_4\left(K_1 = 10^{-3}, K_2 = 10^{-7}, K_3 = 10^{-13}\right)$

If this solution is treated with $30mL$of $NaOH$ solution, then what molarity of $NaOH$ is needed to reach the equivalence point with indicator?

A. $0.1M$

B. $0.2M$

C. $0.3M$

D. $0.4M$

Answer: A

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Exercises Multiple Correct

1. $0.1 mol$ of $RNH_2\left(K_b = 5 \times 10^{-4}\right)$ is mixed with $0.08 mol$ of $HC1$ and diluted to $1L$. Calculate the $\left[H^{\oplus}\right]$ in the solution.

A. The concentration of $H^{\oplus}$ ion is $8 \times 10^{-11} M.$

B. The concentration of $H^{\oplus}$ ion is $8 \times 10^{-5} M.$

C. The pH of solution is 9.8

D. The pOH of solution is $10.2.$

Answer: A::C

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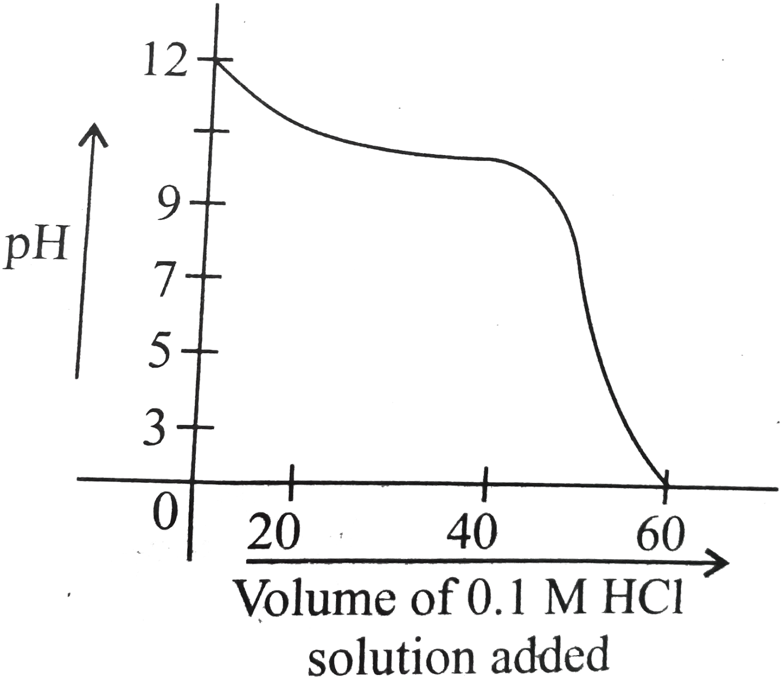
2. When weak base solution $\left(50 mL of 0.1 N NH_4OH\right)$ is titrated with strong acid $(0.1 N HCI)$, the pH of the solution initially decrease fast and then decreases slowely till near the equivalence point (as shown in figure).

Which of the following is//are correct.



A. The slow decrease of pH is due to the formation of an acidic buffer solution after the addition of some HCI.

B. The slope of shown graph will be minimum when $25mL$ of $0.1NHCI$ is added.

C. The slow decrease of pH is due to the formation of basic buffer solution.

D. The initial fast decrease in pH is due to fast consumption of $\overset{\Theta}{OH}$ ions by HCI.

Answer: B::C::D

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3. Which of the following statements about a weak acid strong base titration is//are correct?

A. The pH after the equivalence point of the weal acid string base titration is determined by using the K_b expression for the conjugate base.

B. A buffer solution of weal acid and its conjugate base is formed before the equivalence is reached.

C. The pH at the equivalence point of a weak monoprotic acid strong base titration is equal to the pH at the equivalence point of a strong acid-strong base titration.

D. The increase in pH in the region near the equivalence point of a weak acid strong base titration is grater than the pH change in the same region of a strong acid strong base titration

Answer: A::B

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4. An acid-base indicator has $K_a = 10^{-5}$. The acid form of the indicator is red and basic form is blue. Which of the following is//are correct?

A. At $pH = 4.52$, solution is red

B. At $pH - 5.47$, solution is blue.

C. At $pH = 6$, solution is 75% red

D. At $pH = 8$, solution is 75% blue.

Answer: A::B

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5. When HCl gas is passed through a saturated solution of common salt, pure NaCl is Precipitated because:

A. HCl is higly soluble in water.

B. The ionic product $\left[Na^{\oplus}\right]\left[Cl^{\Theta}\right]$ exceeds its solubility product $\left(K_{sp}\right)$.

C. The K_{sp} of $NaCl$ is lowered the presence of HCl^{Θ} ions.

D. HCl causes precipitation.

Answer: A::B::D

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6. Excess of $Ag_2SO_4(s)$, $BaSO_4(s)$, and $Ba_3\left(PO_4\right)_2(s)$ are simultaneously in euqilibrium with distilled water. Which of the following is (are) true? Assume no hydrolysis of dissolved ions.

A. $\left[Ag^{\oplus}\right] + 2\left[Ba^{2+}\right] = 2\left[SO_4^{2-}\right] + 3\left[PO_4^{3-}\right]$

B. $2\left[Ag^{\oplus}\right] + 4\left[Ba^{2+}\right] = 2\left[SO_4^{2-}\right] + 2\left[PO_4^{3-}\right]$

C. $2\left[Ag^{\oplus}\right] + 3\left[Ba^{2+}\right] = 2\left[SO_4^{2-}\right] + 2\left[PO_4^{3-}\right]$

D. $\left[Ag^{\oplus}\right] + \left[Ba^{2+}\right] = \left[SO_4^{2-}\right] + \left[PO_4^{3-}\right]$

Answer: A

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7. A solution is found to contain $\left[CI^{\ominus}\right] = 1.5 \times 10^{-1}M, \left[Br^{\ominus}\right] = 5.0 \times 10^{-4}M, \left[CrO_4^{2-}\right] = 1.9 \times 10^{-2}M.$

A solution of $AgNO_3$ (100 % dissociated) is added to the above solution drop by drop. Which silver salt will precipitate first ? Given:

$K_{sp}(AgCI) = 1.5 \times 10^{-10}, K_{sp}(AgBr) = 5.0 \times 10^{-13}, K_{sp}\left(Ag_2CrO_4\right) = 1.9 \times 10^{-1}$

.

A. $AgCI$

B. $AgBr$

C. Ag_2CrO_4

D. $AgCI$ and $AgBr$ togther

Answer: D

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8. $HgCrO_4$ just begins to peripitate when equal volumes of $4 \times 10^{-4} M Hg_2\left(NO_3\right)_2$ and $2 \times 10^{-5} M K_2CrO_4$ are combind. What is the approximate K_{sp} value of Hg_2CrO_4?

A. $1 \times 10^{-18} molL^{-1}$

B. $8 \times 10^{-9} molL^{-1}$

C. $2 \times 10^{-9} molL^{-1}$

D. $4 \times 10^{-9} molL^{-1}$

Answer: B

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9. What is general criteria of choosing a suitable indicator for a given titration?

A. The indicator should have a broad pH range.

B. pH at the end point of titration should be close of neutral point of indicator

C. The indicator should have neutral point at $pH = 7$.

D. The indicator must show a sharp colour changes near the equivalence point of titration point.

Answer: B::D

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10. Which of the following are true for an acid- base titration?

A. Indicators catalyse the acid-base reactions by releasing or accepting $H^{\oplus}$ ions.

B. Indicators do not significantly affect the pH of the solution to which they are added

C. Acid-base reactions do not occur in the absence of indicators

D. Indicators have different colours in dissociated and undissociated forms.

Answer: B::D

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11. An acid-base indicator has $K_a = 3.0 \times 10^{-5}$. The acid form of the indicator is red and the basic form is blue. Then:

A. pH is 4.04 when indicator is 75% red.

B. pH is 5.00 when indicator is 75% blue.

C. pH is 5.00 when indicator is 75% red.

D. pH is 5.05 when indicator is 75% blue.

Answer: A::B

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12. At the end point, there is a sharp change of colour in the indicator. This happened because the

A. pH a end point changes sharply.

B. Structure of the indicator changes.

C. Colour of indicator is adsorbed by water.

D. Dissociation constant of acid and base differ by 10.

Answer: A::B

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13. For a series of indicators, the colour and pH range over which colour change takes place are as follows:

Indicator	Colour change over pH range
U	Yellow to blue pH 0.0 to 1.6
V	Red to yellow pH 2.8 to 4.1
W	Red to yellow pH 4.2 to 5.8
X	Yellow to blue pH 6.0 to 7.7
Y	Colourless to red pH 8.2 to 10.0

Which of the following statements is correct ?

A. Indicator V could be used to find the equivalence point for $0.01M$ acetic and $0.1M$ ammonium hydroxide (ammonia solution) titration.

B. Indicator Y could be used to distinguish between $0.1MHCI$ and $0.01MNaOH$ solutions in water.

C. Indicator X could be used to distinguish between solution of ammonium chloride and sodium acetate.

D. Indicator W could be suitable for use in determining the concentration of acetic acid in vinegar by base titration.

Answer: C

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14. $H_3PO_4 \Leftrightarrow H^{\oplus} + H_2PO_4^{\ominus}, K_{a_1}:$

$H_2PO_4^{\ominus} \Leftrightarrow H^{\oplus} + HPO_4^{2-}, ' K_{a_2}:$

$HPO_4^{2-} \Leftrightarrow H^{\oplus} + PO_4^{3-}, K_{a_3}:$

Mark out the incorrect statements:

A. $K_{a_1} > K_{a_2} > K_{a_3}$

B. $pH\left(H_2PO_4^{\ominus}\right) = \dfrac{pK_{a_1} + pK_{a_2}}{2}$

C. Both H_3PO_4 and $H_2PO_4^{\ominus}$ are more acidic than HPO_4^{2-}

D. Only HPO_4^{2-} is amphiprotic anion in the solution.

Answer: B::D

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15. Aqueous solution of $HNO_3, CH_3, CH_3COOH,$ and CH_3COOK of identical concentrations are given. The pair (s) of the solution which may form a buffer upon mixing is (are):

A. $NaOH$ and CH_3COOH

B. HNO_3 and CH_3COOK

C. CH_3COOH and CH_3COOK

D. $HNO_3 + CH_3COOH$

Answer: A::B::C

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16. To which of the solution, addition of water would not effect the pH ? .

A. $100mLof0.2MCH_3COOH + 100mLof0.1MNaOH$

B. $100mLof0.2MCH_3COOH + 100mLof0.2MNaOH$

C. $200mLof0.2MCH_3COOH + 100mLof0.1MNaOH$

D. $100mLof0.2MCH_3COOH + 200mLof0.1MNaOH$

Answer: A::C

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17. Which of the following salt solutions has $pH < 7$? .

A. NH_4F

B. $Cr(NO_3)_3$

C. $\left[(CN_3)_3\overset{\oplus}{N}H\right]CI^{\Theta}$

D. CaI_2

Answer: A::B::C

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18. Which of the following represents hydrolysis ? .

A. $\overset{\oplus}{N}H_4 + 2H_2O \Leftrightarrow NH_4OH + H_3O^{\oplus}$

B. $\overset{\oplus}{N}H_4 + H_2O \Leftrightarrow NH_3 + H_3O^{\oplus}$

C. $HCO_3^{\ominus} + H_2O \Leftrightarrow H_2CO_3 + \overset{\ominus}{O}H$

D. $HCO_3^{\ominus} + H_2O \Leftrightarrow CO_3^{2-} + H_3O^{\oplus}$

Answer: A::C

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19. The pH values of aqueous solutions of which of the following compounds does not change on dilution?

A. $PhCOONH_4$

B. NH_4CN

C. $HCOONa$

D. NH_4CI

Answer: A::B

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20. In H_3PO_4 which of the following is true?

A. $K_a = K_{a_1} \times K_{a_2} \times K_{a_3}$

B. $K_{a_1} < K_{a_2} < K_{a_3}$

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = K_{a_2} = K_{a_3}$

Answer: A::C

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21. Degree of hydrolysis (α) for a salt of strong acid and weak base is :

A. Is independent of dilution

B. Increases with dilution

C. Increases with decrease in K_b of the base

D. Decreases with decrease in temperature

Answer: B::C::D

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22. A solution containing a mixture of $0.05 MNaCI$ and $0.05 M$ NaI is taken. $\left(K_{sp} of AgCI = 10^{-10}\text{and } K_{sp}\text{of } AgI = 4 \times 10^{-16}\right)$. When $AgNO_3$ is added to such a solution:

A. The concentartion fo $Ag^{\oplus}$ required to precipitate CI^{Θ} is $2 \times 10^{-9} molL^{-1}$.

B. The concentartion of $Ag^{\oplus}$ required to precipitate I^{Θ} is $8 \times 10^{-15} molL^{-1}$.

C. $AgCI$ and AgI will be precipitate togther.

D. First AgI will be precipitated.

Answer: A::B::D

Watch Video Solution

23. Which of the following is(are) correct when $0.1L$ of $0.0015MMgCl_2$ and $0.1L$ of $0.025MNaF$ are mixed togther? $\left(K_{sp}ofMgF_2 = 3.7 \times 10^{-8}\right)$.

A. MgF_2 remains in solution

B. MgF_2 precipitates out

C. $MgCl_2$ precipitates out

D. Cl^{Θ} ions remains in solution

Answer: B::D

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24. Choose the correct statement:

A. pH of acidic buffer solution decrease if more salt is added

B. pH of acidic solution increases if more salt is added.

C. pH of basic buffer increase if more salt is added.

D. pH of basic buffer increase if more salt is added.

Answer: B::C

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25. Which of the following is (are) correct for buffer solution?

A. Acidic buffer will be effective within in the pH range $\left(pK_a \pm 1\right)$.

B. Basic buffer will be effective within the pH range $\left(pK_w - pK_b \pm 1\right)$.

C. $H_3PO_4 + NaH_2PO_4$ is not a buffer solution.

D. Buffers behave most effectively when the $[\text{Salt}]/[\text{Acid}]$

Answer: A::B::D

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26. A solution is prepared by dissolving $1.5g$ of a monoacidic base into $1.5kg$ of water at $300K$, which showed a depression in freezing point by $0.165\,^\circ C$. When $0.496g$ of the same base titrated, after dissolution, required $40mL$ of semimolar H_2SO_4 solution. If $K_f$of water is $1.86Kkgmol^{-1}$, then select the correct statements (s) out of the following(assuming molarity $=$ molarity):

A. The pH of the solution of weak base is 12.9.

B. The ionisation constant of the base is 8×10^{-3}.

C. The osmotic pressure of the aqueous solution of base is $21.67atm$

D. The base is $10\,\%$ ionized in aqueous solution.

Answer: A::B::C::D

Watch Video Solution

27. A solution of $0.01 M Fe^{2+}$ in a saturated H_2S solution and (i) $0.2 M of H^{\oplus} (ii) 0.001 M of H^{\oplus}$. $\left(K_1 \times K_2 of H_2S = 10^{-21}, K_{sp} FeS = 3.7 \times 10^{-19}\right)$. Which of the following statements is//are correct

A. FeS will precipitate in solution (i).

B. FeS will not precipitate in solution (i).

C. FeS will precipitate in solution (ii).

D. FeS will precipitate in solution (ii).

Answer: B::C

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28. Which statements is//are correct?

A. $0.1 M NH_3$ solution will precipitate $Fe(OH)_2$ from a $0.1 M$ solution Fe^{2+}.

B. $0.1MNH_3$ solution will not precipitate $Mg(OH)_2$ from a solution which is $0.2M$ in $\overset{\oplus}{NH_4}$ and $0.1M$ in Mg^{2+}

C. $0.1MNH_3$ solution will not precipitate $AgOH$ from a solution which is $0.01M$in $Ag^{\oplus}$.

D. Will precipitate is part (c).

Answer: A::B::C

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29. Which statements is//are correct?

A. Compared to a strong acid, a weak acid titration with base starts at a higher pH.

B. Compared to a strong base, a weak base titration ends at a lower pH.

C. In both (a) and (b) titration curve is shortened at each end.

D. For titration of a weak base, the neraly vertical portion of the curve would be insufficient for an effective titration.

Answer: A::B::C::D

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30. Which of the following solution will have $pH = 13$?

A. $2gNaOH\text{in}500mL$ solution.

B. $100mL$ solution fo $0.05MCa(OH)_2$.

C. $100mL$ solution of $1.0NCa(OH)_2$.

D. $4gNaOH$ in $500mL$ solution.

Answer: A::B::C

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31. Which of the following statements (s) is (are) correct?

A. The pH of $1.0 \times 10^{-8}M$ solution of HCI is 8.

B. The conjugate base of $H_2PO_4^{\ominus}$ is HPO_4^{-2}.

C. Autoprotoysis constant of water increases with temperature.

D. When a solution of weak monoprotic acid is titrated against a strong base, at half-neutralisation, point $pH = (1/2)pK_a$.

Answer: B::C

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32. The pH of $0.1M$ solution of the following salts decreases in the order

A. $NaCI < NH_4CI < NaCN < HCI$

B. $HCI < NH_4CI < NaCI < NaCN$

C. $NaCN < NH_4CI < NaCI < HCI$

D. $HCI < NaCI < NaCN < NH_4CI$

Answer: B

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33. A buffer solution can be prepared from a mixture of

A. Sodium acetate and acetic acid in water.

B. Sodium acetat and hydrochloric acid in water.

C. Ammonia and ammonia chloride in water.

D. Ammonia and sodium hydroxide in water.

Answer: A::C

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Exercises Single Correct

1. $100mL$ of a buffer solution contains $0.1M$ each of weak acid HA and salt NaA. How many gram of $NaOH$ should be added to the buffer so that it pH will be 6? $\left(K_a \text{ of } HA = 10^{-5}\right)$.

A. 0.328

B. 0458

C. 4.19

D. None

Answer: A

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2. K_a for the reaction, $Fe^{3+}(aq.) + H_2O(l) \Leftrightarrow Fe(OH)^{2+}(aq.) + H_3O^+(aq.)$ is 6.5×10^{-3} What is the max. pH value which could be used so that at least 80% of the total iron (III) in a dilute solution exists as Fe^{3+}?

A. 2.0

B. ~2.4

C. ~2.8

D. ~1.6

Answer: D

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3. The pK_b of CN^{Θ} is 4.7. The pH is solution prepared by mixing $2.5mol$ of $2.5mol$ of KCN of $2.5mol$ of HCN in water and making the total volume upto $500mL$ is

A. 10.3

B. 9.3

C. 8.3

D. 4.7

Answer: B

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4. A $0.1 molar$ solution of weak base BOH is 1% dissociated. If $0.2 mol$ of BCl is added in $1L$ solution of BOH. The degree of dissociation of BOH will become

A. 0.02

B. 0.005

C. 5×10^{-5}

D. 2×10^{-3}

Answer: C

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5. If the equilibrium constant of $BOH \leftrightarrow B^{\oplus} + \overset{\Theta}{O}H$ at $25^{\circ} C$ is 2.5×10^{-6}, then equilibrium constant for $BOH + H^{\oplus} \Leftrightarrow B^{\oplus} + H_2O$ at the same temperature is

A. 4.0×10^{-9}

B. 4.0×10^{-5}

C. 2.5×10^{8}

D. 2.5×10^{-6}

Answer: C

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6. An aqueous solution of metal chloride $MCI_2(0.05M)$ is saturated with $H_2S(0.1M)$. The minimum pH at which metal sulphide will be precipiated is

$\left[K_{sp}MS = 5 \times 10^{-21}, K_1\left(H_2S\right) = 10^{-7}, K_2\left(H_2S\right) = 10^{-14}.\right.$

A. 3.25

B. 2.50

C. 1.50

D. 1.25

Answer: C

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7. The pH of a solution of weak base at neutralisation with strong acid is $8. K_b$ for the base is

A. 1.0×10^{-4}

B. 1.0×10^{-6}

C. 1.0×10^{-8}

D. None of these

Answer: B

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8. The ionisation constant of an acid base indicator (a weak acid) is 1.0×10^{-6}. The ionised form of the indicator is red and unionised form is blue. The pH change required to alter the colour of indicator from 80% red to 20% red is

A. 0.80

B. 1.20

C. 1.40

D. 2.00

Answer: B

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9. K_{sp} of $Mg(OH)_2$ is 4.0×10^{-6}. At what minimum pH, Mg^{2+} ions starts precipitating $0.01MgCl_2$

A. $2 + \log 2$

B. $2 - \log 2$

C. $12 + \log 2$

D. $12 - \log 2$

Answer: C

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10. A solution of $0.1 M NaZ$ has $pH = 8.90$. The K_a of HZ is

A. 6.3×10^{-11}

B. 6.3×10^{-10}

C. 1.6×10^{-5}

D. 1.6×10^{-6}

Answer: C

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11. Phenolphalein does not act as an indicator for the titration between

A. HCI and NH_4OH

B. $Ca(OH)_2$ and HCI

C. $NaOH$ and H_2SO_4

D. KOH and CH_3COOH

Answer: A

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12. The pink colour of phenolphthalein in alkaline medium is due to

A. $\overset{\Theta}{OH}$ ions

B. Positive ion

C. Negative ion

D. Neutral form

Answer: C

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13. Methyl` orange gives red colour in

A. KOH solution

B. HCl solution

C. Na_2CO_3 solution

D. $NaCl$ solution

Answer: B

Watch Video Solution

14. A solution containing NH_4CI and NH_4OH has $\left[\overset{\Theta}{OH}\right] = 10^{-6} molL^{-1}$, which of the following hydroxides would be precipitated when this solution in added in equal volume to a solution containing $0.1M$ of metal ions?

A. $Mg(OH)_2, \left(K_{sp} = 3 \times 10^{-11}\right)$

B. $Fe(OH)_2\left(K_{sp} = 8 \times 10^{-16}\right)$

C. $Cd(OH)_2\left(K_{sp} = 8 \times 10^{-6}\right)$

D. $AgOH\left(K_{sp} = 5 \times 10^{-3}\right)$

Answer: B

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15. If equal volumes of $BaCl_2$ and NaF solutions are mixed, which of these combination will not give a precipitate? $\left(K_{sp} of BaF_2 = 1.7 \times 10^{-7}\right)$.

A. $10^{-3} BaCl_2$ and $2 \times 10^{-2} MNaF$

B. $10^{-3} MBaCl_2$ and $1.5 \times 10^{-2} MNaF$

C. $1.5 \times 10^{-2} MBaCl_2$ and $10^{-2} MNaF$

D. $2 \times 10^{-2} MBaCl_2$ and $2 \times 10^{-2} MNaF$

Answer: C

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16. The solubility of solid silver chromate, Ag_2CrO_4, is determined in three solvents K_{sp} of $Ag_2CrO_4 = 9 \times 10^{-12}$

I. pure water II. $0.1AgNO_3$

III. $0.1MNa_2CrO_4$

Predict the relative solubility of Ag_2CrO_4 in the three solvents.

A. $I = II = III$

B. $I < II < III$

C. $II = III < I$

D. $II < III < I$

Answer: D

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17. The solubility products of $Al(OH)_3$ and $Zn(OH)_2$ are 8.5×10^{-23} and 1.8×10^{-14} respectively. If NH_4OH is added to a solution containing Al^{3+} and Zn^{2+} ions, then substance precipitated first is:

A. $Al(OH)_3$

B. $Zn(OH)_2$

C. Both (a) and (b)

D. None of these

Answer: A

Watch Video Solution

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18. If $K_{sp}\left(PbSO_4\right) = 1.8 \times 10^{-8}$ and $K_a\left(HSO_4^{\ominus}\right) = 1.0 \times 10^{-2}$ the equilibrium constant for the reaction.

$PbSO_4(s) + H^{\oplus}(aq) \Leftrightarrow HSO_4^{\ominus}(aq) + Pb^{2+}(aq)$ is

A. 1.8×10^{-6}

B. 1.8×10^{-10}

C. 2.8×10^{-10}

D. 1.0×10^{-2}

Answer: A

Watch Video Solution

19. Which one of the following is true for any diprotic acid, H_2X ?

A. $K_{a_2} > K_{a_1}$

B. $K_{a_1} > K_{a_2}$

C. $K_{a_2} = \frac{1}{K_{a_1}}$

D. $K_{a_2} = K_{a_1}$

Answer: B

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20. The K_{sp} of $Mg(OH)_2$ is 1×10^{-12}. $0.01 M Mg^{2+}$ will precipitate at the limiting pH of

A. (a) 8

B. (b) 9

C. (c) 10

D. (d) 12

Answer: B

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21. The solubility products of MA, MB, MC and MD are $1.8 \times 10^{-10}, 4 \times 10^{-3}, 4 \times 10^{-8}$ and 6×10^{-5} respectively. If a $0.01M$ solution of MX is added dropwise to a mixture containing A^-, B^-, C^- and D^- ions, then the one to be precipitated first will be:

A. MA

B. MB

C. MC

D. MD

Answer: A

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22. A solution is saturated with respect to $SrCO_3$ and SrF_2. The $\left[CO_3^{2-}\right]$ was found to be $1.2 \times 10^{-3}M$. The concnetration of F^{Θ} in the solution would be

Given K_{sp} of $SrCO_3 = 7.0 \times 10^{-10}M^2$,

$K_{sp} \text{of} SrF_2 = 7.9 \times 10^{-10}M^3$,

A. $1.3 \times 10^{-3}M$

B. $2.6 \times 10^{-2}M$

C. $3.7 \times 10^{-2}M$

D. $5.8 \times 10^{-7}M$

Answer: C

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23. The number of S^{2-} ions present in $1L$ of $0.1MH_2S\left[K_{a}\left(H_2S\right) = 10^{-21}\right]$ solution having $\left[H^{\oplus}\right] = 0.1M$ is:

A. (a) 6.023×10^3

B. (b) 6.023×10^4

C. (c) 6.023×10^5

D. (d) 6.023×10^6

Answer: A

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24. The solubility of AgI in NaI solutions is less than that in pure water because:

A. (a) AgI forms complex with NaI

B. (b) Of common ion effect

C. (c) Solubility product of AgI is less than that of NaI.

D. (d) The temperature of the solution decreases.

Answer: B

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25. Three sparigly soluble salts $M_2X, MX,$and MX_3 have the same solubility product. Their solubilities will be in the order

A. $MX_3 > MX > M_2X$

B. $MX_3 > M_2X > MX$

C. $MX > MX_3 > M_2X$

D. $MX > M_2X > MX_3$

Answer: B

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26. When $0.2M$ solution of acetic acid is neutralised with $0.2MNaOH$ in $500mL$ of water, the pH of the resulting solution will be: $\left[pK_a\right.$ of acetic acid $= 4.74]$

A. 12.67

B. 7.87

C. 8.87

D. 7

Answer: C

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27. A weak acid HX has the dissociation constant $1 \times 10^{-5}M$. It forms a salt NaX on reaction with alkali. The percentage hydrolysis of $0.1M$ solution of NaX is

A. $0.001\ \%$

B. $0.01\ \%$

C. $0.1\ \%$

D. $0.15\ \%$

Answer: B

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28. A certain buffer solution contains equal concentartion of X^{Θ} and HX. The K_b for X^{Θ} is 10^{-10}. The pH of the buffer is

A. 4

B. 7

C. 10

D. 14

Answer: A

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29. K_a of HA is 10^{-4}. The equilibrium constant for its reaction with a strong base is

A. 1.0×10^{-4}

B. 1.0×10^{-10}

C. 1.0×10^{10}

D. 1.0×10^{14}

Answer: C

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30. Auto-ionisation of liquid NH_3 is

$2NH_3 \Leftrightarrow NH_4^{\oplus} + NH_2^{\Theta}$

with $K_{NH_3} = \left[NH_4^{\oplus}\right]\left[NH_2^{\Theta}\right] = 10^{-30} at - 50\,^{\circ}C$ Number of amide ions $\left(NH_2^{\Theta}\right)$, present per mm^3 of pure liquid NH_3 is

A. (a) 602

B. (b) 301

C. (c) 200

D. (d) 100

Answer: A

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31. A mixture of weak acid is $0.1M$ in $HCOOH\left(K_a = 1.8 \times 10^{-4}\right)$ and $0.1M$ in $HOCN\left(K_a = 3.1 \times 10^{-4}\right)$. Hence, $\left[H_3O^{\oplus}\right]$ is

A. (a) $7.0 \times 10^{-3}M$

B. (b) $4.1 \times 10^{-4}M$

C. (c) $0.20M$

D. (d) $4.1 \times 10^{-3}M$

Answer: A

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32. pH of solution made by mixing $50mL$ of $0.2MNH_4CI$ and $75mL$ of $0.1MNaOH$ is $\left[pK_bofNH_3(aq) = 4.74. \log 3 = 0.47\right]$

A. 7.02

B. 13.0

C. 7.02

D. 9.73

Answer: D

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33. Some chemists at wished to perpare a saturated solution of a silver compound and they wanted it to have the highest concentration of silver ion possible. Which of the following compound would they use ?

$K_{sp}(AgCI) = 1.8 \times 10^{-10}, K_{sp}(AgBr) = 5.0 \times 10^{-13},$

$K_{sp}\left(Ag_2CrO_4\right) = 2.4 \times 10^{-12}\left[\text{Use}3\sqrt{0.6} = 0.84\right]$

A. $AgCI$

B. $AgBr$

C. Ag_2CrO_4

D. all of these

Answer: C

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34. An acid-base indicator has a $K_a = 3.0 \times 10^{-5}$. The acid form of the indicator is red and the basic form is blue. Then

A. pH is 4.05 when indicator is 75% red.

B. pH is 5.00 when indicator is 75% blue.

C. Both (a) and (b) are correct.

D. None of these

Answer: C

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35. The pH value of $0.001M$ aqueous solution of $NaCl$ is

A. (a) 7

B. (b) 4

C. (c) 11

D. (d) Unpredictable

Answer: A

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36. Which of the following will supress the ionisation of acetic acid in aquoeus solution ?

A. $NaCI$

B. HCI

C. KCI

D. Unpredictable

Answer: B

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37. An aqueous solution of HCl is $10^{-9}MHCl$. The pH of the solution should be

A. 9

B. Between 6 and 7

C. 7

D. Unpredictable

Answer: B

Watch Video Solution

38. Which of the following represents the conjugate pair of NH_3?

A. $NH_2^{\ominus}$

B. $NH_4^{\oplus}$

C. Both (a) and (b)

D. N^{3-}

Answer: C

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39. One of the following is a Bronsted acid but not a Bronsted base:

A. H_2S

B. H_2S

C. HCO_3^{Θ}

D. NH_3

Answer: A

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40. In the third group of qualitive analysis, the precipitating reagent is NH_4CI/NH_4OH. The function of NH_4CI is to

A. increases the ionisation of NH_4OH.

B. Supress the ionisation of NH_4OH.

C. Convert the ions of group theird into their respective chlorides.

D. Stabilise the hydroxides of group III cations.

Answer: B

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41. At a certain temperature the value of pK_w is 13.4 and the measured pH of soln is 7. The solution is

A. Acidic

B. Basic

C. Neutral

D. Unpredictable

Answer: B

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42. When $2mol$ of HCI is added to $1L$ of an acidic buffer, its pH changes from 3.4 to 2.9. The buffer capacity of the buffer solution is

A. 2

B. 0

C. 4

D. 8

Answer: C

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43. Let the solubilities of $AgCI$ in H_2O, and in $0.01 MCaCI_2, 0.01 MNaCI$, and $0.05 MAgNO_3$ be S_1, S_2, S_3, S_4, respectively. What is the correct relationship between these quantites.

A. $S_1 > S_2 > S_3 > S_4$

B. $S_1 > S_2 = S_3 > S_4$

C. $S_1 > S_3 > S_2 > S_4$

D. $S_4 > S_2 > S_3 > S_1$

Answer: C

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44. Which of the following salts will not undergo hydrolysis in water?

A. Sodium sulphate

B. Ammonium sulphate

C. Aluminimum sulphate

D. All the salts will hydrolyse

Answer: A

Watch Video Solution

45. Which of the following salts will not change the pH of pure water on dissociation?

A. (a) KCl

B. (b) $AICl_3$

C. (c) Na_2CO_3

D. (d) $AI_2(SO_4)_3$

Answer: A

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46. A salt X is dissolved in water having $pH = 7$. The resulting solution has a pH more than 7. The salt is made by neutralisation of

A. A strong acid and strong base

B. A strong acid and strong weak base

C. A weak acid and weak base

D. A weak acid and strong base

Answer: D

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47. The pH of a solution 7.00. To this solution, sufficient base is added to increase the pH to 12.0. The increase in $\overset{\Theta}{OH}$ ion concentration is

A. $5 \times$

B. $100 \times$

C. $10^5 \times$

D. $4 \times$

Answer: C

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48. Assuming H_2SO_4 to be completely ionised the pH of a $0.05M$ aqueous of sulphuric acid is approximately

A. 0.01

B. 0.005

C. 2

D. 1

Answer: D

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49. A solution has pOH equal to 13 at $298K$. The solution will be

A. Highly acidic

B. Highly basic

C. Moderatly basic

D. Unpredictable

Answer: A

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50. If ammonia is added to pure water, the concentration of a chemical species already present will decrease. The species is

A. $O_2^{\ominus}$

B. $\overset{\ominus}{OH}$

C. $H_3O^{\oplus}$

D. H_2O

Answer: C

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51. The pH of a dilute solution of acetic acid was found to be 4.3. The addition of a small crystal of sodium acetate will cause pH to

A. (a) Become less than 4.3

B. (b) Become more than 4.3

C. (c) Remain equal to 4.3

D. (d) Unpredictable

Answer: B

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52. Which of the following can act both as a Bronsted acid and a Bronsted base?

A. (a) O_2^{Θ}

B. (b) HCl

C. (c) HSO_4^{Θ}

D. (d) Na_2CO_3

Answer: C

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53. Which of the following is a Lewis base?

A. H_2O

B. CI^{Θ}

C. BF_3

D. NH_3

Answer: C

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54. Which of the following is not a Lewis base?

A. CN^{Θ}

B. ROH

C. NH_3

D. $AICI_3$

Answer: D

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55. Conjugate base of $\overset{\Theta}{OH}$ is

A. H_2O

B. $H_3O^{\oplus}$

C. $H^{\oplus}$

D. O^{2-}

Answer: D

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56. Which of the following will have the largest pH?

A. (a) $M/10HCI$

B. (b) $M/100HCI$

C. (c) $M/10NaOH$

D. (d) $M/100NaOH$

Answer: C

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57. Which one of following will have the largest pH?

A. Solution containing $1 \times 10^{-2} molofK_2SO_4L^{-1}$.

B. Pure water.

C. Solution containing $1.0 \times 10^{-2} molofHCIL^{-1}$.

D. Solution containing $1 \times 10^2 molofNH_4OHL^{-1}$.

Answer: D

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58. When $20mL$ of $M/20NaOH$ is added to $10mL$ of $M/10HCI$, the resulting solution will

A. Turn blue litmus red.

B. Turn phenolpthalein solution pink.

C. Turns methy orange red.

D. Will have no effect on either red or blue litmus

Answer: D

Watch Video Solution

59. pOH water is $7.0at298K$. If water is heated to $350K$, which of the following should be ture?

A. pOH will decrease

B. pOH will increase

C. pOH will remain seven

D. Concentration of $H^{\oplus}$ ions will increae but that of $\overset{\Theta}{O}H$ will decrease.

Answer: A

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60. Solubility of salt A_2B_3 is 1×10^{-4}, its solubility product is

A. 1.08×10^{20}

B. 1.08×10^{18}

C. 2.6×10^{-18}

D. 1.08×10^{-18}

Answer: D

Watch Video Solution

61. The value of K_{sp} is $HgCl_2$ at room temperature is 4.0×10^{-15}. The concentration of Cl^- ion in its aqueous solution at saturation point is

A. 1×10^{-5}

B. 2×10^{-5}

C. 2×10^{-15}

D. 8×10^{-15}

Answer: B

Watch Video Solution

62. At $90\,^\circ C$, pure water has $\left[H_3O^{\oplus}\right] = 10^{-7} molL^{-1}$. What is the value of $K_w$at $90\,^\circ C$?

A. 10^{-6}

B. 10^{-12}

C. 10^{-13}

D. 10^{-14}

Answer: C

Watch Video Solution

63. What is the solubility of $PbSO_4$ in $0.01MNa_2SO_4$ solution if K_{sp} for $PbSO_4 = 1.25 \times 10^{-9}$?

A. $1.25 \times 10^{-7} molL^{-1}$

B. $1.25 \times 10^{-9} molL^{-1}$

C. $1.25 \times 10^{-10} molL^{-1}$

D. $0.10 molL^{-1}$

Answer: A

Watch Video Solution

64. The pH of an aqueous solution of $Ba(OH)_2$ is 10. If the K_{sp} of $Ba(OH)_2$ is 1×10^{-9}, then the concentration of Ba^{2+} ions in the solution in $molL^{-1}$ is

A. 1×10^{-2}

B. 1×10^{-4}

C. 1×10^{-1}

D. 1×10^{-5}

Answer: C

Watch Video Solution

65. How many grams of NaOH must be dissolved in 1 L of the solution to give it a pH value of 12?

A. $0.20gL^{-1}$

B. $0.40gL^{-1}$

C. $0.10gL^{-1}$

D. $1.2gL^{-1}$

Answer: B

Watch Video Solution

66. Which of the following solutions will have $pH = 10$ at $298K$?

A. $1 \times 10^{-10} MHCI$ solution

B. $1 \times 10^{-4} MNaOH$ solution

C. $1 \times 10^{-10} MNaOH$ solution

D. Both (a) and (b)

Answer: B

Watch Video Solution

67. An acid HA is 40% dissociated in an aqueous solution. The hydronium ion concentration of its $0.2M$ solution would be

A. $0.08M$

B. $0.4M$

C. $0.2M$

D. None

Answer: A

Watch Video Solution

68. $20cm^3$ of xM solution of HCl is exactly neutralised by $40cm^3$ of $0.05MNaOH$ solutions, the pH of HCl solution is

A. 1.0

B. 2

C. 1.5

D. 2.5

Answer: A

Watch Video Solution

69. A monoprotic acid (HA) is 1% ionised in its aqueous solution of $0.1M$ strength. Its pOH will be

A. 11

B. 3

C. 10

D. 2

Answer: A

Watch Video Solution

70. The pH of a solution is 5. to this solution acid was added so that its pH value bcomes 2.0. The increase in H^{+} concentration is :

A. 1000 times

B. 2.5 times

C. 100 times

D. 5 times

Answer: A

Watch Video Solution

71. What would be the solubility of silver chloride in $0.10MNaCI$ solution?

$K_{sp}f$ or $AgCI = 1.20 \times 10^{-10}$

A. $0.1M$

B. $1.2 \times 10^{-6}M$

C. $1.2 \times 10^{-9}M$

D. $1.2 \times 10^{-10}M$

Answer: C

Watch Video Solution

72. Which of the following metal sulphides has maximum solubility in water?

A. (a) $CdS\left(K_{sp} = 36 \times 10^{-30}\right)$

B. (b) $FeS\left(K_{sp} = 11 \times 10^{-20}\right)$

C. (c) $HgS\left(K_{sp} = 32 \times 10^{-54}\right)$

D. (d) $ZnS\left(K_{sp} = 11 \times 10^{-22}\right)$

Answer: B

Watch Video Solution

73. $M_2SO_4(M^{\oplus}$ is a monovalent metal ion) has a K_{sp} of 3.2×10^{-6}at $298K$. The maximum concentration of SO_4^{2-} ion that could be attained in a saturated solution of this solid at $298K$ is

A. $3 \times 10^{-3}M$

B. $7 \times 10^{-2}M$

C. $2.89 \times 10^{-4}M$

D. $2 \times 10^{-2}M$

Answer: D

Watch Video Solution

74. K_{sp} for lead iodate $\left[Pb(IO_3)_2is3.2 \times 10^{-14}\right.$ at a given temperature. The solubility in $molL^{-1}$ will be

A. 2.0×10^{-5}

B. $\left(3.2 \times 10^{-7}\right)^{1/2}$

C. $\left(3.8 \times 10^{-7}\right)$

D. 4.0×10^{-6}

Answer: A

Watch Video Solution

75. The pH of a $0.1M$ solution of NH_4OH (having dissociation constant $K_b = 1.0 \times 10^{-5}$) is equal to

A. 10

B. 6

C. 11

D. 12

Answer: C

Watch Video Solution

76. The best indicator for the detection of end point in titration of a weak acid and a strong base is :

A. Methy1 orange $(pH$ range $3 \rightarrow 4)$

B. Methy1 red $(pH$ range $4 \rightarrow 6)$

C. Thymol blue $(pH$ range $8 \rightarrow 3)$

D. Phemolphethalein $(pH$ range $8 \rightarrow 10)$

Answer: D

Watch Video Solution

77. When a solid KCI is added to a saturated solution of $AgCI\text{in}H_2O$,

A. Nothing happens.

B. Solubility of $AgCI$ decreases.

C. Solubility of $AgCI$ increases.

D. Solubility product of $AgCI$ increases.

Answer: B

Watch Video Solution

78. Two buffer solutions A and B each made with benzoic acid and sodium benzoate differ in their pH by two units. A has salt : acid$a : b$. B has salt : acid $= b : a$. If $a > b$, then the value of $a : b$ is

a. 3.17 b.10.0 c.3.0 d. 6.0

A. $10, 000$

B. 3.17

C. 6.61

D. 2.10

Answer: B

Watch Video Solution

79. $CaCO_3$ and $BaCO_3$ have solubility product values 1×10^{-8} and 5×10^{-9}, respectively. If water is shaken up with both solids till equilibrium is reached, the concentration of CO_3^{2-} ion is

A. 1.5×10^{-8}

B. 1.225×10^{-4}

C. 2.25×10^{-9}

D. None of these

Answer: B

Watch Video Solution

80. The pH of an acidic buffer can be raised by 2units by

A. Increasing the concentration of both weak acid and salt by two moles

B. Increasing the concentration of both the acid and salt by 10 times.

C. Diluting the solution by 10 times.

D. Increasing the concentration of the salt by 10 times by decreasing concentration of the acid by 10 times.

Answer: D

Watch Video Solution

81. A buffer solution can be prepared from a mixture of

A. HCI and $NaCI$

B. NaH_2PO_4 and Na_2HPO_4

C. $CH_3COOH + NaCI$

D. $NH_4OH + NH_3$

Answer: B

Watch Video Solution

82. $20 mol$ of $M/10 CH_3COOH$ solution is titrated with $M/10 NaOH$ solution. After addition of $16 mL$ solution of $NaOH$. What is the pH of the solution $\left(pK_a = 4.74\right)$

A. 5.05

B. 4.15

C. 4.75

D. 5.35

Answer: D

Watch Video Solution

83. The K_{sp} value of $CaCO_3$ and CaC_2O_4 in water are 4.7×10^{-9} and 1.3×10^{-9}, respectively, at $25^\circ C$. If a mixture of two is washed with H_2O, what is Ca^{2+} ion concentration in water?

A. 7.7×10^{-5}

B. 5.831×10^{-5}

C. 6.856×10^{-5}

D. 3.606×10^{-5}

Answer: A

Watch Video Solution

84. What are the units in which the solubility product of $Ca_3(PO_4)_2$ is expressed?

A. $moldm^{-3}$

B. mol^2dm^{-6}

C. mol^3dm^{-9}

D. mol^5dm^{-15}

Answer: D

Watch Video Solution

85. The Ph of $10^{-5} MHCl$ solution if 1 " mL of " it is diluted to 1000 mL is

A. 5

B. 8

C. 7.02

D. 6.98

Answer: D

Watch Video Solution

86. Which of the following when mixed, will given a solution with $pH > 7$.

A. $0.1 MHCl + 0.1 MNaOH$

B. $100 mLof 0.1 MH_2SO_4 + 100 mLof 0.3 MNaOH$

C. $100 mLof 0.1 MHC_2H_3O_2 + 100 mLof 0.1 MKOH$

D. $25 mLof 0.1 HNO_3 + 25 mLof 0.1 MNH_3$

Answer: C

Watch Video Solution

87. A solution of CaF_2 is found to contain $4 \times 10^{-4} M$ of F^{Θ}, K_{sp} of CaF_2 is

A. 3.2×10^{-11}

B. 0.8×10^{-11}

C. 6.4×10^{-11}

D. 32×10^{-11}

Answer: A

Watch Video Solution

88. At what pH will a $1.0 \times 10^{-3} M$ solution of an indicator with $K_b = 1.0 \times 10^{-10}$ changes colour?

A. 10

B. 4.0

C. 3

D. 7

Answer: B

Watch Video Solution

89. K_b for NH_4OH is 1.8×10^{-5}. The $\left[\overset{\Theta}{OH}\right]$ of $0.1 M NH_4OH$ is

A. 1.8×10^{-6}

B. 1.34×10^{-3}

C. 4.20×10^{-2}

D. 5.0×10^{-2}

Answer: B

Watch Video Solution

90. pH signifies:

A. Puissance de hydrogen

B. $\log\left[H^{+}\right]$

C. - 14 - pOH

D. All the above

Answer: A

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91. A solution with $pH = 2$ is more acidic than one with a $pH = 6$ by a factor of

A. 4

B. 12

C. 400

D. 10^4

Answer: D

Watch Video Solution

92. A definite volume of an aqueous $N/20$ acetic acid $\left(pK_a = 4.74\right)$ is titrated with a strongs base. It is found that 75 equal-sized drops of $NaOH$ added from a burette effect the complete neutralisation. Find the pH when an acid solution is neutralised to the extent of 20%, 40%, and 90%, respectively.

A. 4.14

B. 9.86

C. 5.34

D. 8.68

Answer: A

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93. The pK_a of acteylsalicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about $2 - 3$ and the pH in the small intestine is about 8. Aspirin will be:

A. Unionised in the small intestine and in the stomach.

B. Completely ionised in the small intestine and in the stomach.

C. Ionised in the stomach and alomost unionised in the small intestine.

D. Ionised in small intestine and almost unionised in the stomach.

Answer: D

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94. Which of the following salt is basic?

A. $HOCI$

B. $NaOCI$

C. $NaHSO_4$

D. NH_4NO_3

Answer: B

Watch Video Solution

95. For the indicator 'HIn' the ratio $\left(Ind^{\Theta}\right)/(HIn)$ is 7.0 at pH of 4.3. What is K_{eq} for the indicator.

A. 3.5×10^{-4}

B. 3.5×10^{-5}

C. 3.5×10^{-2}

D. 3.5×10^{-3}

Answer: A

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96. When $0.002 mol$ of acid is added to $250 mL$ of a buffer solution, pH decreases by 0.02units. The buffer capacity of the system is

A. (a) 0.1

B. (b) 0.2

C. (c) 0.3

D. (d) 0.4

Answer: D

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97. pH of an aqueous solution of $0.6MNH_3$ and $0.4MNH_4Cl$ is $9.4\left(pK_b = 4.74\right)$. The new pH when $0.1MCa(OH)_2$ solution is added to it.

A. 9.86

B. 10.14

C. 10.2

D. 10.86

Answer: A

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98. Which of the following salts undergoes anionic hydrolysis?

A. (a) $CuSO_4$

B. (b) NH_4Cl

C. (c) $FeCl_3$

D. (d) Na_2CO_3

Answer: D

Watch Video Solution

99. A saturated solution of $Ag_2SO_4 is 2.5 \times 10^{-2} M$. The value of its solubility product is

A. 62.5×10^{-6}

B. 6.25×10^{-4}

C. 15.625×10^{-10}

D. 3.125×10^{-6}

Answer: A

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100. Which one of the followinf is acid salt?

A. Na_2S

B. Na_2SO_3

C. $NaHSO_3$

D. Na_2SO_4

Answer: C

Watch Video Solution

101. Which one is not an acid salt?

A. NaH_2PO_4

B. NaH_2PO_2

C. NaH_2PO_3

D. All of the above are acid salts

Answer: D

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102. Which one of the following salts when dissolves in water hydrolyse?

A. $NaCI$

B. NH_4CI

C. KCI

D. Na_2SO_4

Answer: B

Watch Video Solution

103. Which of the following salt undergoes hydrolysis?

A. CH_3COOK

B. $NaNO_3$

C. KCI

D. K_2SO_4

Answer: A

Watch Video Solution

104. Out of following the compound whose water solution has the highest pH is

A. $NaCI$

B. Na_2CO_3

C. NH_4CI

D. $NaHCO_3$

Answer: B

Watch Video Solution

105. When equal volumes of the following solutions are mixed, the precipitation of AgCl $\left(K_{sp} = 1.8 \times 10^{-10}\right)$ will occur with :

A. $10^{-4}M\left(Ag^{\oplus}\right)$ and $10^{-4}M\left(CI^{\ominus}\right)$

B. $10^{-5}M\left(Ag^{\oplus}\right)$ and $10^{-5}M\left(CI^{\ominus}\right)$

C. $10^{-5}M\left(Ag^{\oplus}\right)$ and $10^{-6}M\left(CI^{\ominus}\right)$

D. $10^{-4}M\left(Ag^{\oplus}\right)$ and $10^{-10}M\left(CI^{\ominus}\right)$

Answer: A

Watch Video Solution

106. The gastric juice in our stomach contains enough HCl to make the hydrogen ion concentration about $0.01 mol\ L^{-1}$. The pH of gastric juice is

A. (a) 0.01

B. (b) 1

C. (c) 2

D. (d) 14

Answer: C

Watch Video Solution

107. Of the given anions, the strongest Bronsted base is

A. (a) ClO^{Θ}

B. (b) ClO_2^{Θ}

C. (c) ClO_3^{Θ}

D. (d) ClO_4^{Θ}

Answer: A

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108. In decinormal solution, CH_3COOH acid is ionised to the extent of 1.3%. If $\log 1.3 = 0.11$, what is the pH of the solution?

A. 3.89

B. 2.89

C. 4.89

D. Unpredictable

Answer: B

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109. An aqueous solution of aluminium sulphate would show

A. Acidic

B. Neutral

C. Basic

D. Both acidic and basic reaction.

Answer: A

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110. $AICI_3$ achieves stability by forming a dimer. In trivalent state the compound is hydrolysed in water. $AICI_3$ in acidified aqueous solution forms

A. Cation hydrolysis

B. Anion hydrolysis

C. Hydrolysis of both anion and cation

D. Dissociation

Answer: A

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111. A solution contains $10mL$ of $0.1NNaOH$ and $10mL$ of $0.05Na_2SO_4$, pH of this solution is

A. 7

B. Less than 7

C. Greater than 7

D. Zero

Answer: C

Watch Video Solution

112. $20mL$ of $0.1NHCI$ is mixed with $20ml$ of $0.1NKOH$. The pH of the solution would be

A. 0

B. 7

C. 2

D. 9

Answer: B

Watch Video Solution

113. 0.1 M solution of which one of these substances will be basic ?

A. Sodium borate

B. Ammonium ditoride

C. Calcium nitrate

D. Sodium sulphate

Answer: A

Watch Video Solution

114. In which of the following solvents will $AgBr$ has highest solubility?

A. (a) $10^{-3} MNaBr$

B. (b) $10^{-3} MNH_4OH$

C. (c) Pure water

D. (d) $10^{-3} MHBr$

Answer: B

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115. Which of the following solutions will have pH close to 1.0?

A. $100mLM/10HCI + 100mLM/10NaOH$

B. $55mLM/10HCI + 45mLM/10NaOH$

C. $10mLM/10HCI + 90mLM/10NaOH$

D. $75mLM/5HCI + 25mLM/5NaOH$

Answer: D

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116. Fear or excitement, generally cause one to breathe rapidly and it results in the decrease of concentration of CO_2 in blood. In what way it will change pH of blood ?

A. pH will increase

B. pH will decrease

C. No change

D. pH will adjust to 7

Answer: C

Watch Video Solution

117. Which buffer solution out of the following will have $pH > 7$?

A. $CH_3COOH + CH_3COONa$

B. $HCOOH + HCOOK$

C. CH_3COONH_4

D. $NH_4OH + NH_4CI$

Answer: D

Watch Video Solution

118. Which of the following is most soluble ?

A. $Bi_2S_3\left(K_{sp} = 1 \times 10^{-70}\right)$

B. $MnS\left(K_{sp} = 7 \times 10^{-16}\right)$

C. $CuS\left(K_{sp} = 8 \times 10^{-37}\right)$

D. $Ag_2S\left(K_{sp} = 6 \times 10^{-51}\right)$

Answer: B

Watch Video Solution

119. If H_3O^+ ion concentration of a solution is increased by 10 times , its pH will

A. Increase by 1

B. Remains unchanged

C. Decreases by 1

D. Increase by 10

Answer: C

Watch Video Solution

120. If pK_b for fluoride ion at $25^\circ C$ is 10.83 the ionisation constant of hydrofluoric acid in water at this temperature is

A. 1.74×10^{-5}

B. 3.52×10^{-3}

C. 6.75×10^{-4}

D. 5.38×10^{-2}

Answer: C

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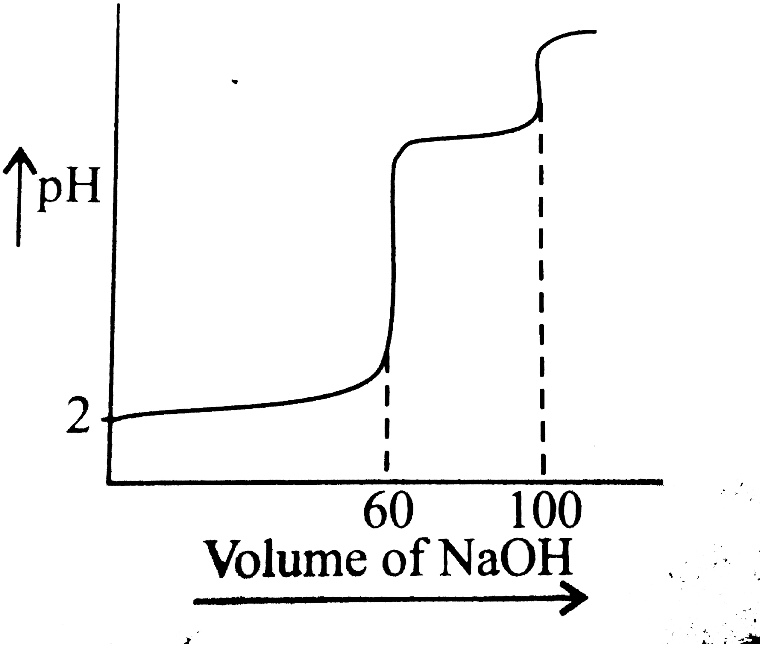
121. The following graph represents the titration of pH vs volume



A. A diprotic acid.

B. Two monoprotic acids with the same K_a but different concentrations.

C. Two monoprotic acids with different K_a but the same concentration.

D. Two monoprotic acids with differnet K_a and different concentartions.

Answer: D

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Exercises Assertion-Reasoning

1. Assertion (A): A solution contains $0.1M$ each of $pB^{2+}, Zn^{2+}, Ni^{2+}$, ions. If H_2S is passed into this solution at $25^\circ C$.

$Pb^{2+}, Ni^{2+}, Zn^{2+}$ will get precpitated simultanously.

Reason (R): Pb^{2+} and Zn^{2+} will get precipitated if the solution contains

$0.1MHCI$.

$\left[K_1H_2S = 10^{-7}, K_2H_2S = 10^{-14}, K_{sp}PbS = 3 \times 10^{-29}K_{sp}NiS = 3 \times 10^{-19}. K_{sp}Zn\right.$

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

2. Assertion (A): Solubility of $AgCN$ in acidic solutions is greater than in pure water.

Reason (R) : Solubility equilibrium of $AgCN$ is shifted in forward direction due to the formation of HCN.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

3. Methy1 red has a $K_a = 10^{-5}$. The acid form Hin is red and its conjugate base, Ind^{Θ} is yellow. Complete the following table:

pH	3	5	7
$\left[\mathrm{Ind}^{\Theta}\right]/[\mathrm{HIn}]$	-	-	-
Colour	-	-	-

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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4. Assertion (A) : On cooling in a freezing mixture, colout of the mixture turns to pink from deep blue for a reaction.

$$Co\left(H_2O\right)_6^{2+}(\text{Pink})(aq) + 4CI^{\Theta} \Leftrightarrow CoCI_4^{2-}(aq)(Blue) + 6H_2O(l)$$

Reason (R) : The reaction is endothermic in forward reaction,so on cooling the reaction, deep blue colour appears.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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5. Assertion (A): Due to common ion effect, the solubility of HgI_2 is expected to be less in an aqueous solution of KI than in water. But HgI_2 dissolves in an aqueous solution of KI to form a clear solution.

Reason (R) : I^{Θ} ions is highly polarisable.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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6. Assertion (A): pK_a of a weak acid become equal of the pH of the solution at the mid-point of titration.

Reason (R) : The molar concentration of the proton donor an proton acceptor beomes equal at the mid-point.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

Watch Video Solution

7. Assertion (A): pH of HCI solution is less than that of acetic acid of the some concentartion.

Reason (R) : In equimolar solution, the number of titrable protons present in HCI is less than that present in acetic acid.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

Watch Video Solution

8. Assertion (A): pH value of HCN solution decreases when $NaCN$ is added to it.

Reason (R) : $NaCN$ provides a common ion CN^{Θ}.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

Watch Video Solution

9. Assertion (A): pH of water increases with an increase in temperature.

Reason (R) : K_w or water increases with increase in temperature.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

Watch Video Solution

10. Assertion (A): $Na_2S_2O_3$ is a salt of unstable acid.

Reason (R) : $H_2S_2O_3$ is a polyprotic acid.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

Watch Video Solution

11. Assertion (A): When a solution of CH_3COOH in water is shaken with charcoal, pH of the solution will get decreased.

Reason (R) : The degree of ionisation of CH_3COOH increase.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

Watch Video Solution

12. Assertion (A): There is very little difference in acid strength of H_3PO_4, H_3PO_3,and H_3PO_2.

Reason (R) : The hydrogens in these acids are not all bonded to oxygens. The electrone-grativities of P and H are almost the same.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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13. Assertion (A): Both reactions are Lewis acid-base recations?

i. $NH_3 + BF_3 \rightarrow H_3N : BF_3$

ii. $Mg + S \rightarrow Mg^{2+} + S^{2-}$

Reason (R) : Lewis acid-base reaction involve the donation of lone pair electrons from base to acid. this donation results in a corrdinate bond.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

Watch Video Solution

14. Assertion (A): Solution of $AICI_3$ in water is neutral.

Reason (R) : $\left[AI\left(H_2O\right)_6\right]^{3+}$ is formed.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

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15. Assertion (A): In dilute benzene solutions, equimolar addition of R_3N and HCI produce a substance with a dipole moment. In the same solvent, equimolar addition of R_3N and SO_3 produce a substance having an almost identical dipole moment.

Reason (R) : Both HCI and SO_3 are Lewis acids and can react with the amine base to form polar substances which undergo ionic dissociation in a solvent sufficiently more polar than benzene.

Moreover, $(N$ - $S)$ bond is a more polar bond.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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16. Assertion (A): A certain recation is catalysed by acids and the catalytic activity of $0.1M$ solutions of the acids in water decrease in the order, $HCI, HCOOH$, and CH_3COOH. The same reaction takes place in anhydrous NH_3, but the three acids have same catalytic effect in $0.1M$ solution.

Reason (R) : The order of catalytic activity in water is the same as the order of acidity. in anhyrous NH_3, all the three acids are strong.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

17. Assertion (A): S reacts with SO_3^{2-} and forms $S_2O_3^{2-}$

Reason (R) : S is electorn deficient and acts and acid and SO_3^{2-} is a base in terms of Lewis acid theroy.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

18. Assertion (A): The amino acid glycine predominatly exists in the form of $^{\wedge}(\oplus)NH_3CH_2COO^{\Theta}$.

Reason (R) : The conjugate acid of glycine is $NH_2CH_2COO^{\Theta}$.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

Watch Video Solution

19. Assertion (A): Sb^{3+} is not precipitated as sulphide when $H_2S(g)$ is passed in alkaline solution.

Reason (R) : $\left[S^{2-}\right]$ ion in basic medium is inadequate for precipitation.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

Watch Video Solution

20. Assertion (A): Addition of $Ag^{\oplus}$ ions to a mixture of aqueous $NaCI$ and $NaBr$ solution will first precipitate $AgBr$ rather than $AgCI$.

Reason (R) : $K_{sp}AgCI < K_{sp}ofAgBr$.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

Watch Video Solution

21. Assertion : The pH of an aqueous solution of acetic acid remains unchanged on addition of sodium acetate.

Reason : The ionization of acetic acid is increased by addition of sodium acetate.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: D

Watch Video Solution

22. Assertion (A): On mixing equal volumes of $1MHCi$ and $2MCH_3COONa$, an acidic buffer solution is formed.

Reason (R) : The resultant mixture contains CH_3COOH and CH_3COONa which are parts of acidic buffer.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

23. Assertion (A): On addition of NH_4CI to NH_4OH, pH decreases but remains greater than 7.

Reason (R) : Addition of $\overset{\oplus}{NH_4}$ ion decreases ionisation of NH_4OH, thus $\left[\overset{\Theta}{OH}\right]$ decreases and also pH decreases.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

Watch Video Solution

24. Assertion (A): A is very dilute acidic solution of Cd^{2+} and Ni^{2+} gives yellow precipitate of CdS on passing hydrogen sulphide.

Reason (R) : Solubility product of CdS is more than that of NiS.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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25. STATEMENT-1: In the titratio of Na_2CO_3 with HCl using methyl orange indicator, the volume of the acid required at the equvalence point is twice that of the acid required using phenolphthalenin as inkdicator.

STATEMENT-2: Two moles of HCl are required for the complete neutralisation of one mole of Na_2CO_3

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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26. Statement: In acidic medium, Zn^{2+} is not precipitated by H_2S.

Explanation: Common ion effect reduces the concentration of S^{2-} to a minimum level.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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27. Statement: In an acid-basic titration involving a strong base and a weak acid, methyl orange can be used as an indicator.

Explanation: Methyl orange changes its colour in the pH range 3 to 5.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

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28. Assertion (A): An aqueous solution of ammonium acetate acts as a buffer solution.

Reason (R) : A buffer solution reacts with small quantities of hydrogen or hydroxy ions and keps the pH almost same.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: B

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29. Assertion (A): When small amount of acid or base is added to pure water, its pH undergoes a change.

Reason (R) : Addition of an acid or a basic increases the degree of ionisation of water.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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30. Assertion (A): pH of acidic solution is always below 7 at $25\,^{\circ}C$.

Reason (R) : At $25\,^{\circ}C$, the pH of $10^{-8}MHCI$ is 8.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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31. Assertion (A): H_2SO_4 acts as a base in the presence of $HCIO_4$.

Reason (R) : Perchloride acid is stronger acid than H_2SO_4.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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32. Assertion (A): pH of neutral solution is always 7.

Reason (R) : pH of solution does not depend upon temperature.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

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33. Assertion (A): pH of $10^8 MHCl$ is not equal to 8.

Reason (R) : HCl does not dissociate properly in very dilute solution.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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34. Assertion (A): If a solution with $pH = 2$ is diluted to double the volume, the pH of the solution will fall to 1.

Reason (R) : pH is inversely proportional to the volume of the solution.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

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35. Assertions : When HCl gas is passed through a saturated solution of common salt, pure NaCl is precipitated.

Reason: The solubility product of NaCl gets lowered.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

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36. Assertion (A): pH of buffer chnages with temperature.

Reason (R) : Ionic of a water $\left(K_w\right)$ changes with temperature.

A. If both (A) and (R) are correc, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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Exercises Integer

1. What is the sum of magic numbers of all solutions gives below : (Interger value is between 50 and 60)

(Magic numver of a solution $= pH$ of solution × Weight factor)

	Solution	Weight factor
I	0.1M HCN $\left(K_a = 10^{-10}\right)$	2
II	$0.1MCH_3COOH + 0.1MCH_3COONa\left(K_a = 10^{-5}\right)$	1
III	$0.1MHCl$	3
IV	$0.1MNH_4OH\left(K_b = 10^{-5}\right)$	2
V	$0.01MNaOH$	0.5
VI	10mL of$0.01MCH_3COOH$ + 10ml of 0.1 MNH_4OH	1

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2. How much of the following cations belong to group IIA, III, IV, and V only in qualitative salt analysis?

$Sr^{2+}, Hg_2^{2+}, Pb^{2+}, Zn^{2+}, Cu^{2+}, Cr^{3+}, Ag^+, Mg^{2+}, Sb^{3+}$

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3. How much of the following are strong electrolytes?

a. NH_3 b. NH_4Cl c. CH_3COOH

d. CH_3COONa e. HCl f. $NaCl$

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4. How much of the following $0.1M$ solutions are acidic?

a. NH_4CI b. $NaOH$ c. $HC_2H_3O_2$ d. $NaCI$

e. $NH_3 + NH_4CI$ f. NH_3 g. HCI

h. $HCIO_4$ i. $\left(NH_4\right)_2SO_4$ j. K_2SO_4

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5. How many are basic ?

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6. How many compounds are neutral ? H_2O , NaOH , HCL ,Nacl

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7. How many of the following salts:

i. $NH_4C_2H_3O_2$ ii. $PhCOONH_4$ iii. $NaC_2H_3O_2$

iv. NH_4CI v. MgS vi. Na_2SO_4

vii. KCI

a. Hydrolyse more in water at $25\,^{\circ}C$.

b. Do not hydrolyse.

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8. How many of the following combinations of reactants will react less than $2\,\%$ of theroetically possible extent?

a. $CH_3COOH + H_2O$ b. $CH_3COO^{\Theta} + H_2O$

c. $CH_3COO^{\Theta} + H_3O^{\oplus}$ d. $CH_3COOH + KOH$

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9. How many of the conbinations of reactants in above will react untill more than 98% of the limiting quantity is used up?

a. $CH_3COOH + H_2O$ b. $CH_3COO^{\Theta} + H_2O$

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10. Calculate the pH at equilibrium point when a solution of $10^{-6}MCH_3COOH$ is titrated with a solution of $10^{-6}MNaOH. K_a$ for acid $2 \times 10^{-5}\left(pK_a = 4.7\right)$ (Answer given in whole number).

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Exercises True/ False

1. Silver chloride is more soluble in very concentrated sodium chloride solution than in pure water. (T/F)

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2. Any buffer solution can be used as a buffer upto two pH units only.

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3. Mg^{2+} ions is essential for selective precipitation of $Fe(OH)_3$ by aqueous NH_3.

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4. A mixture of aqueous solution of sodium acetate and sodium propanoate forms a buffer solution. (T/F)

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5. pH of some solution is given by $pH = \frac{pK_{a_1} + pK_{a_2}}{2}$. This formula is valid for the compound NaH_2BO_3.

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6. 0.6 mmol of NaCl and 1 mol of HCI in 1 L solution is a buffer.

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7. The K_a for CH_3COOH at 300 and $310K$ are 1.8×10^{-5} and 1.805×10^{-5}, respectively. The enthalpy of deprotonation for acetic acid is $51.6cal$.

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8. Out of the following salts:

i. NaH_2BO_3 ii. NH_2CH_2COOH

iii. CH_3COONH_4 iv. $NaHS$

Salts (i) has concentration-depends pH.

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9. Out of the following acid base-reactions, reaction (b) and (c) are possible.

a. $PH_3 + \overset{\oplus}{N}H_4 \rightarrow \overset{\oplus}{P}H_4 + NH_3$

b. $NH_3 + \overset{\oplus}{PH}_4 \rightarrow \overset{\oplus}{NH}_4 + PH_3$

c. $\left(CH_3\right)_3P + \overset{\oplus}{N}H_4 \rightarrow \left(CH_3\right)_3\overset{\oplus}{P}H + NH_3$

d. $\left(CH_3\right)_3N + PH_4^{\oplus} \rightarrow \left(CH_3\right)_2\overset{\oplus}{N}H + PH_3$

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10. The oxo-acids of P_2O_5 is H_3PO_4

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Archives Multiple Correct

1. Which of the following statements is//are correct?

A. The pH of $1.0 \times 10^{-8} M$ solution of HCI is 8.

B. The conjugate base of $H_2PO_4^{\Theta}$ is HPO_4^{-2}.

C. The autoprotolysis constant of water increases with temperature.

D. When a solution of a weak monoprotic acid is trated against a strong base, at half-neutralisation point, $pH = (1/2)pK_a$.

Answer: B::C

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2. A buffer solution can be prepared from a mixture of

A. Sodium acetate and acetic acid in water.

B. Sodium acetat and HCI in water

C. Ammonia and ammonia chloride in water.

D. Ammonia and sodium hydroxide in water.

Answer: A::C

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3. Aqueous solution of $HNO_3, CH_3, CH_3COOH,$ and CH_3COOK of identical concentrations are given. The pair (s) of the solution which may form a buffer upon mixing is (are):

A. HNO_3 and CH_3COOH

B. KOH and CH_3COONa

C. HNO_3 and CH_3COONa

D. CH_3COOH and CH_3COONa

Answer: C::D

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Archives Single Correct

1. At $90^{\circ}C$, pure water has $\left[H_3O^{\oplus}\right] = 10^{-7} mol L^{-1}$. What is the value of K_w at $90^{\circ}C$?

A. 10^{-6}

B. 10^{-12}

C. 10^{-14}

D. 10^{-8}

Answer: B

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2. Calculate pH of 1.0×10^{-8} M solution of HCl.

A. 8

B. -8

C. Between 7 and 8

D. Between 6 and 7

Answer: D

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3. An acidic buffer solution can be prepared by mixing the solution of

A. Sodium acetate and acetic acid

B. Ammonium chloride and ammonium hydroxide

C. Sulpuric acid and sodium sulphate

D. Sodium chloride and sodium hydroxide

Answer: A

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4. The strongest Bronsted base in the following anion is

A. CIO^{Θ}

B. CIO_2^{Θ}

C. CIO_3^{Θ}

D. CIO_4^{Θ}

Answer: A

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5. The precipitate of CaF_2 is obtained when equal volumes of the following are mixed.

$\left[K_{sp}\left(CaF_2\right) = 1.7 \times 10^{-10}\right]$

A. $10^{-4}MCa^{2+} + 10^{-4}MF^{\Theta}$

B. $10^{-2}MCa^{2+} + 10^{-3}MF^{\Theta}$

C. $10^{-5}MCa^{2+} + 10^{-3}MF^{\Theta}$

D. $10^{-3}MCa^{2+} + 10^{-5}MF^{\Theta}$

Answer: B

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6. A certain buffer solution contains equal concentartion of X^{Θ} and HX. The K_b for X^{Θ} is 10^{-10}. The pH of the buffer is

A. 4

B. 7

C. 10

D. 14

Answer: A

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7. K_a of HA is 10^{-4}. The equilibrium constant for its reaction with a strong base is

A. 10×10^{-4}

B. 10×10^{-10}

C. 10×10^{10}

D. 1.0×10^{14}

Answer: C

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8. Conjugate acid of NH_2 :

A. NH_3

B. NH_2OH

C. $NH_4^{\oplus}$

D. N_2H_4

Answer: A

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9. The best indicator for the detection of end point in titration of a weak acid and a strong base is :

A. Methy1 orange $(3 \rightarrow 4)$

B. Methy1 red $(5 \rightarrow 6)$

C. Bromothymol blue $(6 \rightarrow 7.5)$

D. Phenolphtalein $(8 \rightarrow 9.6)$

Answer: D

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10. The compound that is not a Lewis acids is

A. BF_3

B. $AICI_3$

C. $BeCI_2$

D. $SnCI_4$

Answer: D

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11. The pK_a of acety1 salicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about 2.3 and the pH in the same intestine is bout 8. A spirin will be

A. Unionised in the small intestine and in the stomach.

B. Completely ionised in the small intestine and in the stomach.

C. Ionised in the stomach and alomost unionised in the small intestine.

D. Ionised in the small intestine and almost unionised in the stomach.

Answer: D

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12. When equal volumes of the following solutions are mixed, the precipitation of AgCl $\left(K_{sp} = 1.8 \times 10^{-10}\right)$ will occur with :

A. $10^{-4}M\left(Ag^{\oplus}\right)$ and $10^{-4}M\left(CI^{\ominus}\right)$

B. $10^{-5}M\left(Ag^{\oplus}\right)$ and $10^{-5}M\left(CI^{\ominus}\right)$

C. $10^{-6}M\left(Ag^{\oplus}\right)$and $10^{-6}M\left(CI^{\ominus}\right)$

D. $10^{-10}M\left(Ag^{\oplus}\right)$ and $10^{-10}M\left(CI^{\ominus}\right)$

Answer: A

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13. Which of the following is the strongest acid?

A. $ClO_3(OH)$

B. $ClO_2(OH)$

C. $SO(OH)_2$

D. $SO_2(OH)_2$

Answer: A

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14. Amongst the following hydroxides, the one which has the lowest value of K_{sp} is:

A. $Mg(OH)_2$

B. $Ca(OH)_2$

C. $Ba(OH)_2$

D. $Be(OH)_2$

Answer: D

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15. Which of the following solutions will have pH close to 1.0?

A. 100 mL of $(M/10)HCI + 100mL$ of $(M/10)NaOH$

B. 55 mL of $(M/10)HCI + 45mL$ of $(M/10)NaOH$

C. 75 mL of $(M/10)HCI$ + 90 mL of $(M/10)NaOH$

D. 75 mL of $(M/5)HCI + 25mLof$(M//5) NaOH`

Answer: D

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16. The pH of 0.1 M solution of the following salts increases in the order.

A. $NaCI < NH_4CI < NaCN < HCI$

B. $HCI < NH_4CI < NaCI < NaCN$

C. $NaCN < NH_4CI < NaCI < HCI$

D. $HCI < NaCI < NaCN < NH_4CI$

Answer: B

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17. For a sparingly soluble salt A_pB_q, the relationship of its solubility product $\left(K_s\right)$ with its solubility (S) is

A. $L_S = S_{p+q}p_pq_q$

B. $L_S = S_{p+q}p_qq_p$

C. $L_S = S_{pq}p_qq_p$

D. $L_S = S_{pq}(pq)^{(p+q)}$

Answer: A

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18. Which of the following acids has the smallest dissociation constant?

A. $CH_3CHFCOOH$

B. FCH_2CH_2COOH

C. $B_1CH_2CH_2COOH$

D. $CH_3CHBrCOOH$

Answer: C

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19. A solution containing $Mn^{2+}, Fe^{2+}, Zn^{2+}$ and Hg^{2+} with a molar concentration of 10^{-3} M each is treated with $10^{-16}M$ sulphide ion solution. Which ion will precipitate first if K_{sp} of MnS, FeS, ZnS and HgS are $10^{-15}, 1-^{-23}, 10^{-20}$ and 10^{-54} respectively ?

A. FeS

B. MgS

C. HgS

D. ZnS

Answer: C

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20. A weak acid $HX\left(K_a = 10^{-5}\right)$ on reaction with $NaOH$ gives NaX. For $0.1M$ aqueous solution of NaX, the $\%$ hydrolysis is

A. $0.01\ \%$

B. $0.001\ \%$

C. $0.1\ \%$

D. $0.5\ \%$

Answer: A

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21. $0.1mol$ of $RNH_2\left(K_b = 5 \times 10^{-4}\right)$ is mixed with $0.08mol$ of $HC1$ and diluted to $1L$. Calculate the $\left[H^{\oplus}\right]$ in the solution.

A. $8 \times 10^{-2}M$

B. $8 \times 10^{-11}M$

C. $1.6 \times 10^{-11}M$

D. $8 \times 10^{-5}M$

Answer: B

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22. $Ag^+ + NH_3 \Leftrightarrow \left[Ag\left(NH_3\right)\right]^+ K_1 = 3.5 \times 10^{-3}$

$\left[Ag\left(NH_3\right)\right]^+ + NH_3 \Leftrightarrow \left[Ag\left(NH_3\right)_2\right]^+ K_2 = 1.8 \times 10^{-3}$:}

then, the overall formation constant of $\left[Ag\left(NH_3\right)_2\right]^+$ is :

A. 6.08×10^{-6}

B. 6.08×10^{6}

C. 6.08×10^{-9}

D. None of these

Answer: A

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23. The solubility product constant (K_{sp}) of salts of types MX, MX_2, and M_3X at temperature T are $4.0 \times 10^{-8}, 3.2 \times 10^{-14}$, and 2.7×10^{-15}, respectively. The solubilities of the salts at temperature T are in the order

A. $MX > MX_2 > M_3X$

B. $M_3X > MX_2 > MX$

C. $MX_2 > M_3X > MX$

D. $MX > M_3X > MX_2$

Answer: D

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24. $2.5mL$of $2/5M$ weak mono-acidic base $\left(K_b = 1 \times 10^{-12} \text{ at } 25^{\circ}C\right)$ is titrated with $2/15MHCI$ in water at $25^{\circ}C$. Find the concentration of $H^{\oplus}$ ions at equivalence point. $\left(K_w = 1 \times 10^{-14} at 25^{\circ}C\right)$

a. $3.7 \times 10^{-13}M$ b. $3.2 \times 10^{-7}M$

c. $3.2 \times 10^{-2}M$ d. $2.7 \times 10^{-2}M$

A. $3.7 \times 10^{-13}M$

B. $3.2 \times 10^{-7}M$

C. $3.2 \times 10^{-2}M$

D. $2.7 \times 10^{-2}M$

Answer: D

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25. In an acidified aqueous solution of $Mn^{2+}, Ni^{2+}, Cu^{2+}$ and hg^{2+} ions, H_2S gas was passed. Precipitates are

A. CuS and HgS

B. MnS and CuS

C. MnS and NiS

D. NiS and HgS

Answer: A

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Archives Integer

1. The dissociation constant of a substitued benzoic acid at $25^{\circ}C$ is 1.0×10^{-4}. Find the pH of a $0.01M$ solution of its sodium salt.

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2. Amongst the following, the total number of compounds whose aqueous solution turns red litmus paper blue is:

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3. Find the total number of diprotic acids among the following:

$H_3PO_4, H_2SO_4, H_3PO_3$

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4. In 1L saturated solution of $AgCl\left[K_{SP}(AgCl) = 1.6 \times 10^{-10}\right]$, 0.1 mole of CuCl $\left[K_{SP}(CuCl) = 1.0 \times 10^{-6}\right]$ is added. The resulrant concentration of Ag^+ in the solution is 1.6×10^{-x}. The value of x is:

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Archives Fill In The Blanks

1. The conjugate base of HSO_4^- in aqueous solution is ....

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2. An element which can exist as a positive ion in acidic solution and also as a negative ion in basic solution is said to be.....

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3. Silver chloride is sparingly soluble in water because its lattice energy is greater than______

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4. $\left(CH_3(OH)_2^+\right)$ is..acidic than $\left(CH_3NH_3^+\right)$.

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5. In the reaction $I^- + I_2 \rightarrow I_3^-$, the Lewis acid is ....

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Archives True/False

1. Aluminium chloride $\left(AlCl_3\right)$ is a Lewis acid because it can donate electrons.

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2. The solubility of sodium hydroxide increases with increase of temperature.

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3. Give the decreasing order of the acidic properties of oxides.

a. ZnO , b. KO_2 , c. P_2O_5 , d. MgO

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Archives Subjective

1. How much moles of sodium propionate should be added to $1L$ of an aqueous solution containing $0.020 mol$ of propionic acid to obtain a buffer solution of $pH 4.75$? What will be the pH if $0.010 mol$ of HCI is dissolved in the above buffer solution. Compare the last pH value with the $pH of 0.010 M HCI$ solution. Dissociation constant of propionic acid, K_a, at $25^{\circ} C$ is 1.34×10^{-5}.

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2. Given reason for the statement that the pH of an aqueous solution of sodium acetate is more than 7.

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3. $20 mL$ of $0.2 M$ sodium hydroxide is added to $50 mL$ of $0.2 M$acetic acid to give $70 mL$ of the solution. What is the pH of this solution. Calculate the additional volume of $0.2 MNaOh$ required to make the pH of the solution 4.74. (Ionisation constant of CH_3COOh is 1.8×10^{-5})

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4. K_a for HA is 4.9×10^{-8}. After making the necessary approximation, calculate for its decimolar solution,

a. % dissociation b. $\overset{\Theta}{OH}$ concentration

c. pH

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5. A solution contains a mixture of $Ag^{+}(0.10M)$ and $Hg_2^{2+}(0.10M)$ which are to be separated by selective precipitation. Calculate the maximum concentration of iodide ion at which one of them gets precipitated almost completely. $\left(K_{SP} of AgI = 8.5 \times 10^{-17}\right.$ and K_{SP} of $\left.Hg_2I_2 = 2.5 \times 10^{-26}\right)$

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6. The concentration of hydrogen ions in a $0.2M$ solution of formic acid is $6.4 \times 10^{-3} molL^{-1}$. To this solution, sodium formate is added so as to adjust the concentration of sodium formate to $1 molL^{-1}$. What will be the pH of this solution? The dissociation constant of formic acid is 2.4×10^{-4} and the degree of dissociation fo sodium formate is 0.75.

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7. The solubility of $Mg(OH)_2$ in pure water is $9.57 \times 10^{-3} gL^{-1}$ .Calculate its solubility I $\left(gL^{-1}\right)$ in 0.02 M Mg $\left(NO_3\right)_2$ solutions.

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8. What is the pH of the solution when $0.20 mol$ of HCI is added to $1L$ of a solution containing

a. $1M$ each of acetic acid and acetate ion.

b. $0.1M$each of aceta acid and acetate ion.

Assume the total volume is $1L$. K_a for acetic acid is 1.8×10^{-5}.

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9. How many moles of HCl will be required to preapare one litre of a buffer solution (containing NaCN and HCN) of pH 8.5 using 0.01 gram formula mass of NaCN .K_a for HCN $= 4.1 \times 10^{-10}$?

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10. Freshly prepared aluminium and magnesium hydroxides are stirred vigorously in a buffer solution containing $0.25M$ of ammonium chloride and $0.05M$ of ammonium hydroxide. Calculate the concentration of aluminium and magesium ions in solution $\left(K_b NH_4OH = 1.8 \times 10^{-5}, K_{sp} Mg(OH)_2 = 6 \times 10^{-10}, K_{sp} Al(OH)_3 = 6 \times 10^{-32}\right.$

.

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11. What is the pH of $1M$ solution of acetic acid. To what volume one litre of this solution be diluted so that pH of the resulting solution will be twice of the original value. $K_a = 1.8 \times 10^{-5}$

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12. A 50 mL solution of weak base BOH is titrated with $0.1NHCI$ solution. The pH of solution is found to be 10.04 and 9.14 after the addition of $5.0mL$ and 20.0 mL of acid respectively. Find out K_b for weak base.

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13. The K_{SP} of $Ag_2C_2O_4$ at $25\,^{\circ}C$ is $1.29 \times 10^{-11} mol^3 L^{-3}$. A solution of $K_2C_2O_4$ containing 0.152 mole in 500 mL water is shaken at $25\,^{\circ}C$ with excess of Ag_2CO_3 till the equilbirium is reached.

$Ag_2CO_3 + K_2C_2O_4 \Leftrightarrow Ag_2C_2O_4 + K_2CO_3$

Ar equilibrium the solution contains 0.0358 mole of K_2CO_3. Assuming degree of dissociation of $K_2C_2O_4$ and K_2CO_3 to be same, calculate K_{SP} of Ag_2CO_3.

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14. The solubility product K_{sp} of Ca $(OH)_2$ at $25^\circ C$ is 4.42×10^{-5} A 500 mL of saturated solution of $Ca(OH)_2$ is mixed with equal volume of 0.4 M NaOH . How much $Ca(OH)_2$ in milligrams is precipitated?

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15. The ph of blood stream is maintained by a proper balance of H_2CO_3 and $NaHCO_3$ concentrations. What volume of $5MNaHCO_3$ solution, should be mixed with $10mL$ sample of blood which is $2M$ in H_2CO_3 in order to maintain a pH of 7.4. K_a for H_2CO_3 in blood is 7.8×10^{-7}?

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16. An aqueous solution of a metal bromode $MBr_2(0.05M)$ is saturated with H_2S. What is the minimum pH at which MS will precipitate? K_{sp} for $MS = 6.0 \times 10^{-21}$. Concentration of satured $H_2S = 0.1M, K_1 = 10^{-7}$ and $K_2 = 1.3 \times 10^{-13}$ for H_2S.

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17. For the reaction

$Ag(CN)_2^{\ominus} \Leftrightarrow Ag^{\oplus} + 2CN^{\ominus}$, the K_c at $25\,^{\circ}C$ is 4×10^{-19} Calculate $\left[Ag^{\oplus}\right]$ in solution which was originally $0.1M$ in KCN and $0.03M$ in $AgNO_3$.

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18. Calculate the pH of an aqueous solution of $1.0M$ ammonium formate assuming complete dissociation. $\left(pK_a \text{ of formic acid } = 3.8 \text{ and } pK_b \text{ of ammonia } = 4.8\right)$

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19. What is the pH of a $0.50M$ aqueous NaCN solution ? $\left(pK_bofCN^- = 4.70\right)$

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20. The ionization constant of $\overset{\oplus}{NH_4}$ ion in water is 5.6×10^{-10} at $25^\circ C$. The rate constant the reaction of $\overset{\oplus}{NH_4}$ and $\overset{\ominus}{OH}$ ion to form NH_3 and H_2O at $25^\circ C$ is $3.4 \times 10^{10} Lmol^{-1}s^{-1}$. Calculate the rate constant for proton transfer from water to NH_3.

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21. A sample of AgCI was treated with $5.00mL$ of $1.5M$ Na_2CO_3 solubility to give Ag_2CO_3 . The remaining solution contained $0.0026gofCI^-$ per litre. Calculate the solubility product of AgCI. $\left(K_{SP}f \text{ or } Ag_2CO_3 = 8.2 \times 10^{-12}\right)$

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22. An acid type indicator, H In differs in colour from its conjugate base $\left(In^-\right)$. The human eye is sensitive to colour differences only when the ratio $\left[In^-\right]/[HIn]$ is greater than 10 or smaller than 0.1. What should to observe a complete colour change ? $\left(K_a = 1.0 \times 10^{-5}\right)$

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23. What will be the resultant pH, when 200 mL of an aqueous solution of $HCI(pH = 2.0)$ is mixed with 300 mL of an aqueous solution of $NaOH(pH = 12.0)$?

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24. Given: $Ag\left(NH_3\right)_2^+ \Leftrightarrow Ag^+ 2NH_3, K_C = 6.2 \times 10^{-8}$ and K_{SP} of $AgCI = 1.8 \times 10^{-10}$ at 298 K. Calculate the concentration of the complex in $1.0M$ aqueous ammonia.

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25. The solubility of $Pb(OH)_2$ in water is 6.7×10^{-6}M. Calculate the solubility of $Pb(OH)_2$ in a buffer solution of $pH = 8$.

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26. The average concentration of SO_2 in the atmosphere over a city on a cetrain day is 10 ppm, when the average temperature is 298 K. Given that the solubility of SO_2 in water at 298 K is 1.3653 mol $litre^{-1}$ and the pK_a of H_2SO_3 is 1.92, estimate the pH of rain on that day.

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27. $500mL$ of $0.2M$ aqueous solution of acetic acid is mixed with $500mL$ of $0.2HCI$ at $25^{\circ} C$.

a. Calculate the degree of dissociation of acetic acid in the resulting solution and pH of the folution.

b. If $6g$ of $NaOH$ is added to the above solution determine the final pH. $\left[K_a \text{ of } CH_3COOH = 2 \times 10^{-5}\right.$.

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28. $0.1 MNaOH$ is titrated with $0.1 MHA$ till the end point. K_a of HA is 5.6×10^{-6} and degree of hydrolysis is less compared to 1. Calculate pH of the resulting solution at the end point ?

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