



CHEMISTRY

BOOKS - PEARSON IIT JEE FOUNDATION

ACIDS, BASES AND SALTS

Example

1. How is the concentration of hydronium ions (H_3O^+) affected when a solution of an acid is diluted?



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2. Give reasons for the following :

(i) Metal oxides generally react with acids. However, zinc oxide reacts even with sodium hydroxide.

(ii) Heat of neutralisation value for the reaction of HCl and NH_4OH is less than 13.7 kcal/mol

(iii) All indicators are not suitable for all titrations



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3. Explain the action of phenolphthalein indicator in the titration of acetic acid, sodium hydroxide



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4. Is a solution with pH 6 acidic, basic or neutral ?

Justify



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5. Define salt hydrolysis. Explain the nature of aqueous solution of $CuSO_4$, on the basis of the above phenomenon



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6. Explain the amphoteric nature of zinc oxide and aluminium oxide



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7. How do you identify the following cations in their aqueous solutions by using caustic soda solution ?

(i) Fe^{+2} (ii) Zn^{+2} (iii) Al^{+3}



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8. What is the use of an indicator in titration ?

Name the indicator used when sodium hydroxide is titrated against sulphuric acid



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Very Short Answer Type Question

1. What is meant by ionic product of water ?



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2. Give examples of some acidic substance without H^+ ions



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3. Which acids/base are used for the following ?

(i) to neutralise sting of wasps

(ii) in alkaline batteries

(iii) manufacturing of soap



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4. Define oxyacid. Give two examples



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5. According to Bronsted - Lowry theory neutralisation reaction is the formation of ____



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6. Give one example of acid-base reaction without formation of water



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7. $X + H_2O \rightarrow Y$. Y is used to remove grease stains from woollen clothes. Identify X and Y



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8. How do neutral, acidic and basic salt solutions respond to litmus test ?



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9. Give examples of some basic substances without OH^- ions



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10. How does a complex salt dissociate in its aqueous solution ?



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11. What is the principle involved in the preparation of $FeCl_3$



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12. In the equation $X + HCl \rightarrow NaCl + H_2S$,
what is X ?



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13. Mention any two methods of preparation of
acids. Illustrate with equations.



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14. How are basic salts formed ?



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15. How are soluble salts prepared by direct combination ? Give an example



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16. Illustrate any one method of preparation of bases with equations



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17. What is the pH range in which phenolphthalein is colourless ?



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18. Name the insoluble salts that can be prepared by direct combination ?



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19. What are the pH values of the following solutions at $25^{\circ}C$?

(i) 0.001 M of HCl

(ii) 0.05 M of H_2SO_4

(iii) 0.01 M of NaOH



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20. The formula of the basic salt formed by treating calcium hydroxide with HCl is ____



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21. Which method is employed for the preparation of sulphate of Ba, Ca and Pb ?



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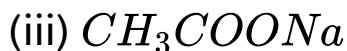
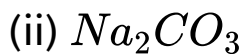
22. Define pH and give its mathematical representation.



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23. What would be the nature of aqueous solution of the following salts ?

(i) KNO_3



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24. Define basicity of an acid. Give an example each for monobasic, dibasic and tribasic acids.



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25. Normality of 0.01 M aluminium hydroxide is ____
(assuming complete ionisation)



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26. Write the equation for the action of a dilute acid on a metal oxide.



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27. The hydroxyl ion concentration of sodium hydroxide having a pH value of 12, at $25^{\circ}C$ is _____



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28. Mention the steps involved in ionisation of phosphoric acid



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29. Non-metallic oxides are either _____ or _____ in nature.



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30. The number of ions produced by one mole of $[Co(NH_3)_6]Cl_3$ in its aqueous solution is _____

A. 2

B. 3

C. 10

D. 4

Answer:



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Short Answer Type Question

1. What is meant by a universal indicator ? State the colour given by a universal indicator to the

solution of following pH values

(i) pH = 1 (ii) pH = 8

(iii) pH = 5 (iv) pH = 12



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2. How is NH_4OH helpful as a reagent for the analysis of cations in the aqueous solutions of their salts? Give equations.



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3. What is meant by acidity of a base ? Give the acidities of the following bases.

(i) caustic potash (ii) slaked lime

(iii) aluminium hydroxide



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4. Define indicator. Why are different indicators used in different pH ranges ?



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5. Define salt hydrolysis. Explain the hydrolysis of potassium carbonate by giving ionic equations



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6. Explain protonic concept of acids and base with one example each



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7. How do bases react with the following ? Write the equations.

(i) non-metallic oxide (ii) ammonium salt (iii)
soluble metallic salt



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8. What is meant by neutralisation? Give some examples identifying spectator ions in the reactions.



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9. What is the value of ionic product of water at $25^{\circ}C$? How does it change with temperature ?

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10. Give pH range for various solution at $25^{\circ}C$.

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11. Distinguish between acidic and basic salts giving examples

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12. Mention any four applications of pH



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13. Define basicity of an acid. Give an example for monobasic, dibasic and tribasic acids.



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14. What is the difference between mixed and complex salts with respect to chemical reactions?
Explain with an example



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Essay Type Question

1. State the postulates of Arrhenius theory. Explain with examples. What are the limitation of Arrhenius theory ?



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2. On the basis of ionisation explain classification of acids and base with suitable examples. Classify acids/bases on the basis of amount of water present in the solution



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3. Explain the formation of hydronium ion and ammonium ion



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4. Define salt hydrolysis. Explain the nature of aqueous solution of the following salts on the basis of salt hydrolysis.

(i) $(NH_4)_2CO_3$ (ii) $CuSO_4$

(iii) $NaNO_3$ (iv) $CaCl_2$



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5. Explain with examples the use of NaOH and NH_4OH as reagents for the identification of cations in salts



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Level 1

1. Formation of Co-ordinate covalent bond between NH_3 and BF_3 is an example of neutralisation reaction according to Bronsted theory



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2. A diacidic base has one replaceable hydroxide ion



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3. For a dibasic acid, normality is twice the molarity
for a given solution



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4. S^{-2} is the conjugate base of HS^{-}



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5. Methyl orange exhibits yellow colour in basic medium.



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6. Curd is sour in taste due to the presence of an acidic substance.



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7. $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ gives reactions of both K^+ and Al^{+3} ions respectively



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8. Phenolphthalein is a/an ____ indicator



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9. The salt obtained by partial neutralisation of sodium hydroxide and sulphuric acid is _____ in nature



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10. Metallic oxides are either _____ or _____ in nature.



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11. $[H^+]$ of nitric acid having a pH value of 6 is _____



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12. The pH of aqueous solution of salt obtained by the reaction between NaOH and CH_3COOH is _____ at $25^\circ C$



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13. A salt, X is prepared by the complete neutralisation of $Cu(OH)_2$ with H_2SO_4 . The nature of X is _____



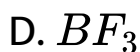
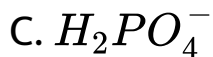
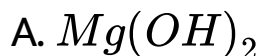
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14. The units of K_w are _____



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15. Which of the following is not a base according to any of the theories ?



Answer: D



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16. According to Lewis acid-base concept, which is a correct statement ?

- A. Species in which central atom has completed octet cannot act as acid
- B. All negatively charged ions are acids
- C. Molecule in which the central atom has vacant 'd' orbitals acts as acid

D. All positively charged ions are base

Answer: C



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17. At a certain temperature, K_w was found to be $1 \times 10^{-10} \text{ mol}^2 / \text{L}^2$. At this temperature, a solution is taken and red litmus is added to this solution. The solution turned to blue. pH range of the solution could be

A. between 5 and 7

B. between 7 and 10

C. less than 5

D. both 1 and 2

Answer: D



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18. Which of the following indicators is the best indicator for the detection of end point in the titration of CH_3COOH and KOH ?

A. methyl orange

B. phenolphthalein

C. methyl red

D. none of these

Answer: B



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19. According to Lewis theory, neutralisation is the

A. transfer of proton from acid to base

B. transfer of proton from base to acid

C. transfer of electron pair from acid to base

D. transfer of electron pair from base to acid

Answer: D



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20. The indicator that shows colour changes in the entire pH range is

- A. phenolphthalein
- B. methyl orange
- C. universal indicator
- D. thymol blue

Answer: C



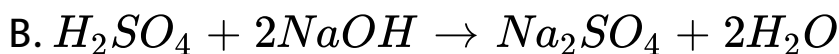
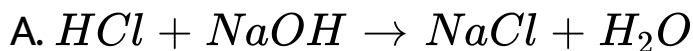
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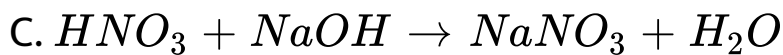
21. Which of the following has the highest value of pH ?



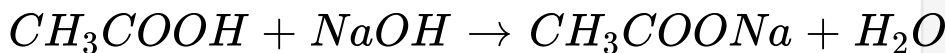
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22. Heat of neutralisation is less than 13.7 kcal/mol for the reaction





D.

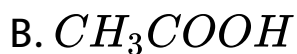
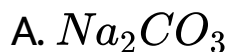


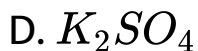
Answer: A



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23. Which among the following does not undergo hydrolysis ?





Answer: D



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24. Which of the following acts as both Bronsted acid and Lewis acid ?





Answer: D



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25. Which among the following factors changes the value of ionic product of water ?

A. change in temperature

B. addition of acid

C. addition of base

D. addition of either acid and base

Answer: A



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26. Which of the following solutions has the same concentration of H^+ ions as 0.1 N HCl ?

A. 0.1 N H_2SO_4

B. 0.3 N H_3PO_4

C. 0.2 N HNO_3

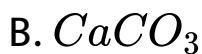
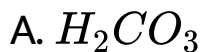
D. All of these

Answer: A



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27. Which of the following cannot show acidic nature ?

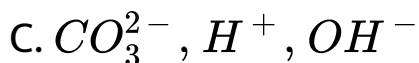
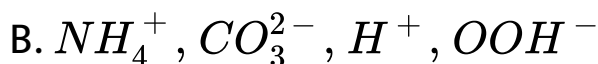
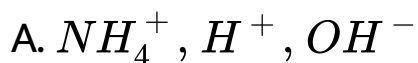


Answer: B



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28. The spectator ions in the hydrolysis of $(NH_4)_2CO_3$ are



D. no spectator ions

Answer: D



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29. Disodium potassium phosphate is a/an ____ salt

A. acid

B. mixed

C. complex

D. double

Answer: B



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30. V_1 mL of x molar hydrochloric acid is mixed with V_2 mL of y molar sodium hydroxide. Arrange the following steps in correct sequence for calculation of pH of the mixture. ($y > x$ and $V_1 > V_2$)

(1) Calculation of the number of equivalents of acid and base

(2) Calculation of the total volume of mixture

(3) Calculation of the normality of acid and base

(4) Calculation of the net OH^- ion concentration.

(5) Taking the negative logarithm of H^+ ion concentration.

(6) Dividing K_w by OH^- ion concentration

A. 1 3 2 6 4 5

B. 3 1 2 4 5 6

C. 3 1 2 6 4 5

D. 1 2 3 4 5 6

Answer:



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31. A strongly acidic solution is taken and a base is slowly added to it drop by drop. Arrange the colours observed during the process of addition in

proper sequence.

- (1) green (2) indigo
(3) orange (4) red
(5) blue (6) violet
(7) yellow

A. 3 4 1 7 2 5 6

B. 4 3 7 1 5 2 6

C. 4 3 1 7 5 2 6

D. 3 4 7 1 6 2 5

Answer: b



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32. A red litmus paper when dipped in an aqueous solution of potassium acetate turned blue. Arrange the following steps in proper sequence to explain the above observation.

- (1) identification of spectator ions
- (2) identification of free ions that caused the colour change of the litmus paper
- (3) identification of positive and negative radicals
- (4) writing the net reaction taking place
- (5) writing ionic equation for the reaction of positive and negative radicals with water

A. 3 5 1 4 2

B. 3 1 5 4 2

C. 5 1 4 3 2

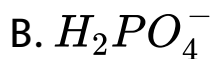
D. 5 3 1 4 2

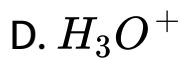
Answer:



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33. Identify the species that can give both conjugate acid and conjugate base



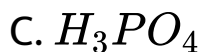
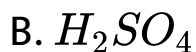


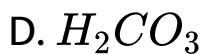
Answer:



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34. The basicity of acetic acid is the same as the basicity of _____



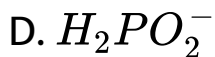


Answer:



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35. Which of the following species cannot have conjugate base ?



Answer:



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36. Which among the following pairs of acid and base are weak respectively ?

A. HCOOH and NH_4OH

B. HCl and NaOH

C. CH_3COOH and KOH

D. HClO_4 and CsOH

Answer:



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37. The pH of 0.001 N sodium hydroxide solution at $25^{\circ}C$ is

A. 3

B. 4

C. 11

D. 12

Answer:



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38. A solution turns methyl orange red. It can turn the universal indicator to _____

A. violet

B. blue

C. orange

D. green

Answer: C



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39. Which of the following pH values at 25°C corresponds to the strongest acid ?

A. 2

B. 4

C. 6

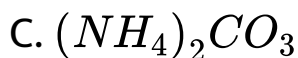
D. 8

Answer:



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40. Which of the following during hydrolysis gives an acidic solution in water ?



Answer:



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41. X is formed by the partial replacement of hydroxyl groups of a diacidic base by an acidic radical. The number of ionizable hydroxyl groups in X is _____

A. 0

B. 1

C. 2

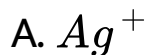
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Answer:



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42. In the reaction between silver nitrate and sodium chloride, the spectator ion is ____



D. All of these

Answer:



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43. Which among the following statements is false ?

- A. Every protonic acid has its conjugate acid
- B. Pair of Bronsted acid and base that differ by a proton is conjugate acid-base pair
- C. A substance that accepts an electron pair to form co-ordinate covalent bond is an acid
- D. Arrhenius theory is confined to aqueous solution

Answer:



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44. Which of the following salts can produce only two types of radicals ?



Answer:



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1. Calculate the resultant pH of a solution when 20 mL 0.1 N NaOH is mixed with 20 mL of 0.05 M $Ca(OH)_2$ at $25^\circ C$



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2. The ionic product of water is found to be $1 \times 10^{-12} \text{ mol}^2 / L^2$ at $60^\circ C$. What would be the nature of solution with $pH = 7$? Explain giving reasons



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3. Explain why phosphorous acid is not a tribasic acid like phosphoric acid through both acids contain three hydrogen in their molecules



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4. What volume of 0.45 M H_3PO_4 is needed to neutralise 60 mL of 0.60 N NaOH solution ?
(Assume that there is a complete ionisation of acid and base)



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5. Explain the nature of resultant solution when 20 mL of 0.05 M NaOH is mixed with 10 mL of 0.1 N HCl solution at 25°C . When 10 mL of this solution is diluted 100 times what is the change in pH ?



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6. Account for the variation of acidic character with increases in the oxidation state of central atom



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7. Two salts are dissolved in water separately. When phenolphthalein is added to the two solutions, one solution turned pink and the other solution was colourless. How do you justify this ?



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8. How many moles of NaOH must be added to 200 mL of 0.1 M solution of HNO_3 to get a solution having pH value 2.00 ?



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9. Explain the nature of the following salts:

(a) NaH_2PO_2 (b) Na_2HPO_3

(c) Na_2HPO_4



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10. An aqueous solution of Mohr's salt can give a precipitate with NaOH or NH_4OH . But the aqueous solution of potassium ferrocyanide cannot give a precipitate with both reagents. How do you account for this ?



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11. Two coloured salt solution of two metals A and B gave precipitates with NaOH and NH_4OH . On further additions of NH_4OH , the precipitate disappears, in the case of B. There is no such change in the case of A either with NaOH or NH_4OH . Identify A and B. Give equations



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12. Compare and contrast the nature of aqueous solutions of ammonium acetate and sodium sulphate.



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13. Find the pH of resultant solution when 100 mL of 0.005 M H_2SO_4 at $25^\circ C$ is diluted to 100 mL. What is the amount of NaOH required to be dissolved in 500 mL to exactly neutralise the above solution ?

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14. A strong alkali forms an acidic salt with a dibasic acid. From the aqueous solution of the salt formed on the addition of dilute acid evolves a gas that

turns lime water milky. Identify the salt and predict the reactions involved in it



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15. Explain the variation in basic strengths of hydrides of VA group elements



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16. 14.3 g of $Na_2CO_3 \cdot xH_2O$ is dissolved in water and the volume is made up to 200 mL. 20 mL of this

solution required 40 mL of $\frac{N}{4} HNO_3$ for complete neutralisation. Calculate x



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17. 10 mL of 1 N HCl, 25 mL of 2 N H_2SO_4 and 40 mL of X N HNO_3 are mixed and made up to 2000 mL. 100 mL of this solution required 30 mL of NaOH taken from a solution containing 4 g of NaOH in 250 mL of solution. What is the value of X ?



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18. 8 g of mixture of $NaNO_3$ and Na_2CO_3 are dissolved and made into 500 mL of solution. 50 mL of this solution neutralises completely 25 mL of N/5 HNO_3 . Calculate the percentage composition of the mixture.



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19. Do equimolar solutions of $NaOH$ and $Ca(OH)_2$ possess same pH value at the same temperature ?
Justify



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20. Explain why no indicator can be used for the titration between formic acid and ammonium hydroxide



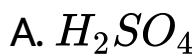
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21. Sodium bicarbonate can be manufactured by Solvay process where addition of brine solution to ammonium bicarbonate solution gives precipitation of sodium bicarbonate. But, its analogue, potassium bicarbonate cannot be prepared by the above process. Explain with respect to the concept of solubility product



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22. Explain the acidic and basic nature of the following substances on the basis of protonic concept



Answer:



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23. All Lewis bases are Bronsted bases. But all Lewis acids are not Bronsted acids'. Comment on the statement



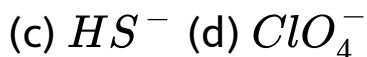
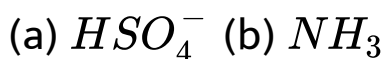
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24. Find the pH of resultant solution when 100 mL of 0.005 M H_2SO_4 at $25^\circ C$ is diluted to 1000 mL. What is the amount of NaOH required to be dissolved in 500 mL to exactly neutralise the above solution ?



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25. Explain the strengths of conjugate acid base pairs of the following species.



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Level 3

1. Acetic acid contains four hydrogen atoms in each molecule. Explain why it is not a tetrabasic acid ?



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2. How do you account for the acidic nature of 10^{-8} M nitric acid ? Justify by mathematical calculation ($\log 1.1 = 0.041$)



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3. Though zinc and manganese get precipitated as their sulphides, they do not get precipitated along with lead or copper when H_2S is passed through acidified solution of their salts. Justify and also

explain how the precipitation of Zn^{+2} and Mz^{+2} ions takes place



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4. How does the acidic character vary among the trihalides of boron ? Give a reason in support of your answer



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5. Among H_3PO_2 , H_3PO_3 and H_3PO_4 which has the maximum acidic strength ? Explain

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6. Calculate the pH value of the $10^{-6}M$ HCl solution when diluted by 100 times. Justify ($\log 1.1 = 0.041$)

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7. Why do both acidic indicator and basic indicator show different colours in acidic and basic solution?

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8. A complex, salt with formula $[Co(NH_3)_6]Cl_3$ can form a white curdy precipitate with silver nitrate solution. Another complex with same ligands cannot form precipitate with $AgNO_3$ solution. What would be the probable formula of the complex ? Given reasons in support of your answer.



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9. Explain why the strengths of strong acids and strong bases cannot be determined in water. How is

it possible to compare the acidic strengths in acetic acid ?



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