

1. VOLUMETRIC ANALYSIS

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Introduction

- Qualitative analysis tells us:
 - how much of a substance is present
 - what substance is present
 - the molecular weight
 - the density
- An example of quantitative analysis is
 - Detection of functional group
 - Estimation of iron
 - Detection of foreign elements
 - Identification of nitrate
- The analysis of a chemical substance by determining the masses is
 - Volumetric analysis
 - qualitative analysis
 - Gravimetric analysis
 - instrumental analysis
- Gravimetric analysis is based on:
 - volume of solution
 - colour of precipitate
 - mass of precipitate
 - boiling point
- Volumetric analysis determines the concentration of a solution by measuring its:
 - mass
 - volume
 - density
 - temperature
- To estimate the chloride ion present in the tap water, volumetric analysis is commonly used in the laboratory. Which of the following solutions can be used for the above-mentioned titration?
 - BaCl₂
 - NaOH
 - K₂Cr₂O₇
 - AgNO₃

Equivalent Weights

- The combining capacity in terms of mass is
 - Valency
 - equivalent mass
 - molecular mass
 - normality
- The equivalent weight of an element is related to its atomic weight by:
 - $E = A + V$
 - $E = A \times V$
 - $E = A / V$
 - $E = V / A$
- The equivalent weight has:
 - unit of grams
 - unit of mol/L
 - no unit
 - unit of kg
- If the weight of metal and chloride in a metal chloride is in the ratio 1:2, then the equivalent weight of the metal is
 - 71
 - 17.75
 - 35.5
 - 8.9
- In 1 gram of a metal oxide, the metal precipitated is 0.68 grams. What is the equivalent weight of the metal
 - 17
 - 34
 - 68
 - 52
- If 8 grams of metallic oxide on decomposition gives 1.6 grams of oxygen, what is the equivalent mass of the metal?
 - 8
 - 16
 - 32
 - 64
- 9 grams of a trivalent element combine with 8 gm of O₂, the relative atomic mass of the element is
 - 3
 - 18
 - 27
 - 9
- A metallic oxide contains 60% of the metal by weight. The equivalent weight of the metal is
 - 12
 - 40
 - 24
 - 48
- How many gram equivalents are present in 4.9 g of H₂SO₄?
 - 0.5
 - 0.1
 - 1.0
 - 0.2

Equivalent weights of acid, base, and salts

- The basicity of H₃PO₄ is:
 - 1
 - 2
 - 3
 - 4
- The equivalent weight of HCl is:
 - 36.5
 - 18
 - 73
 - 1
- The equivalent weight of H₂SO₄ is:
 - 98
 - 49
 - 32
 - 196
- The equivalent weight of NaOH is:
 - 20
 - 80
 - 40
 - 10
- The equivalent weight of Ca(OH)₂ is:
 - 74
 - 37
 - 148
 - 18.5
- The equivalent weight of Na₂CO₃ (Mol. wt. 106) is:

- a) 106 b) 53 c) 26.5 d) 212
22. A chemical reaction occurs as follows
 $\text{NaOH} + \text{H}_3\text{PO}_4 \rightarrow \text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$
 What is the equivalent weight of H_3PO_4 ?
 a. 32.67 b. 49 c. 59 d. 98
23. What is the equivalent weight of H_3PO_3 in the reaction:
 $\text{H}_3\text{PO}_3 + 2 \text{NaOH} \rightarrow \text{Na}_2\text{HPO}_3 + 2 \text{H}_2\text{O}$
 a. 2M b. 1/M c. M/2 d. M/3
24. Which of the following pairs is correctly matched for equivalent weight?
 a) $\text{HCl} : 73$ b) $\text{H}_2\text{SO}_4 : 49$ c) $\text{NaOH} : 80$ d) $\text{Ca(OH)}_2 : 74$

equivalent weights of oxidising agents

25. The equivalent weight of the oxidising agent in the following reaction is
 $\text{SO}_2 + \text{H}_2\text{S} \rightarrow \text{S} + \text{H}_2\text{O}$
 a. 17 b. 34 c. 16 d. 32
26. Equivalent weight of KMnO_4 in acidic medium ($\text{Mn}: +7 \rightarrow +2$) is:
 a) 158 b) 52.67 c) 31.6 d) 79
27. Equivalent weight of KMnO_4 in basic medium ($\text{Mn}: +7 \rightarrow +6$) is:
 a) 31.6 b) 52.67 c) 79 d) 158
28. Equivalent weight of KMnO_4 in neutral medium ($\text{Mn}: +7 \rightarrow +4$) is:
 a) 31.6 b) 52.67 c) 158 d) 26.33
29. What is the equivalent weight of KMnO_4 in the following reaction:
 $\text{KMnO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{S} \rightarrow \text{K}_2\text{SO}_4 + \text{MnSO}_4 + \text{H}_2\text{O} + \text{S}$ (at wt. of Mn = 55)
 a. M/2 b. 2M c. M/3 d. M/4 e. M/5
30. If the molecular weight of KMnO_4 is M, its equivalent weight in an acidic medium is:
 a. M b. M/5 c. M/2 d. M/8
31. If the molecular weight of KMnO_4 is M, its equivalent weight in a basic medium is
 a. M b. M/2 c. M/3 d. M/4 e. 2M
32. KMnO_4 reacts with oxalic acid in an acidic medium. In this reaction, the oxidation number of Mn changes from
 a. +7 to +5 b. +7 to +2 c. +2 to +7 d. +5 to +7
33. Equivalent weight of anhydrous oxalic acid $\text{H}_2\text{C}_2\text{O}_4$ (Mol. wt. 90) as a reducing agent is:
 a) 90 b) 45 c) 63 d) 30
34. Equivalent weight of oxalic acid crystals $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ (Mol. wt. 126) is:
 a) 63 b) 45 c) 126 d) 31.5
35. Equivalent weight of Mohr's salt $[\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}]$ (Mol. wt. 392) is:
 a) 196 b) 392 c) 98 d) 784

Concentrations

36. Molarity is defined as the number of moles of solute dissolved in:
 a) 1 kg of solvent b) 1 litre of solution c) 100 mL of solution d) 1 mole of solvent
37. The molarity of a solution made by dissolving 40 g of NaOH in water to make a 500 mL solution is:
 a) 1 M b) 2 M c) 4 M d) 0.5 M
38. The weight of sodium carbonate required to prepare 100 mL of its decinormal solution is
 (a) 0.53 g (b) 5.3 g (c) 0.053 g (d) 5.6 g
39. Normality is defined as the number of gram equivalents of solute per:
 a) 100 mL of solution b) 1 kg of solvent c) 1 litre of solution d) 1 mole of solution
40. A solution contains 1 gram equivalent of solute per litre. It is called:
 a) Molar solution b) Normal solution c) Molal solution d) Formal solution

41. How many grams of H_2SO_4 are required to prepare 2000 ml of 0.5 N H_2SO_4 solution?
 a. 98 g b. 49 g c. 100 g d. 196 g
42. A 10 mL solution labelled '10 N HCl' contains:
 a) 10 gram equivalents b) 1 gram equivalent c) 100 gram equivalents d) 0.1 gram equivalents
43. The required amount of crystalline oxalic acid (eq. wt. = 63) to prepare (N/10) 250 ml oxalic acid solution is
 a. 0.158 g b. 1.575 g c. 15.75 g d. 6.3 g
44. The amount of H_2SO_4 present in 500 ml of 2N H_2SO_4 solution is
 a. 89 g b. 49 g c. 33.55 g d. 24.5 g
45. Which of the following expressions gives the concentration in g/L directly?
 a) $N \times \text{Mol. wt.}$ b) $M \times \text{Eq. wt.}$ c) $N \times \text{Eq. wt.}$ d) $M / \text{Eq. wt.}$
46. The relationship between normality and molarity is:
 a) $N = M / n\text{-factor}$ b) $N = M + n\text{-factor}$ c) $N = M \times n\text{-factor}$ d) $N = n\text{-factor} - M$
47. The normality of 2 M H_2SO_4 is:
 a) 1 N b) 2 N c) 4 N d) 0.5 N
48. The normality of 0.1 M Na_2CO_3 solution is:
 a) 0.1 N b) 0.2 N c) 0.05 N d) 0.3 N
49. The normality of 2 M oxalic acid acting as a reducing agent is:
 a) 1 N b) 2 N c) 4 N d) 0.5 N
50. A decinormal (N/10) solution of H_2SO_4 contains how many grams of H_2SO_4 per litre?
 a) 4.9 g b) 9.8 g c) 49 g d) 98 g
51. A solution containing 98 g of H_2SO_4 per litre is
 a. Normal b. Molar c. Decinormal d. Decimolar
52. 2 M Na_2CO_3 is equal to its Normality
 a. 1N b. 2 N c. 3 N d. 4N
53. What is the normality of a 0.4 M Na_2CO_3 solution?
 a. 0.1 N b. 0.2 N c. 0.4 N d. 0.8 N
54. What is the normality of 0.3 M phosphorus acid (H_3PO_3)?
 a. 0.1 N b. 0.3 N c. 0.6 N d. 0.9 N
55. Which of the following has the highest Normality?
 a. 1 M H_3PO_4 b. 1 M HCl c. 1 M H_2SO_4 d. 1M HNO_3
56. The normality of 2 M oxalic acid is
 a. 1 N b. 2 N c. 4N d. N/2
57. The number of moles of solute dissolved by 1000 g of water is
 a. Molality b. molarity c. mole fraction d. %(w/v)
58. Which concentration unit is independent of temperature?
 a) Molarity b) Normality c) Molality d) Formality
59. If the percentage (w/v) of a solution is 5%, then its concentration in g/L is:
 a) 0.5 b) 5 c) 50 d) 500
60. Formality is used to express concentration of:
 a) molecular compounds b) gases
 c) ionic solids that don't exist as molecules d) organic acids
61. If a solution contains one-tenth of a gram equivalent of solute per liter of solution, it is
 a. Normal solution b. decinormal solution c. Seminormal solution d. molar solution
62. The normality of 10%(w/v) acetic acid is
 a. 10 b. 0.83 c. 1.67 d. 3.45
63. What is the Molarity of a 10% NaOH solution?
 a. 1.5 b. 2.5 c. 0.4 d. 4
64. Which of the following do not have the same concentration?
 a. 80 g/L of NaOH and 2N of NaOH c. 106 g/L of Na_2CO_3 and 1N Na_2CO_3
 b. 1M H_2SO_4 and 2N H_2SO_4 d. 9.8% (w/v) H_3PO_4 and 98g/liter of H_3PO_4
65. Which of the following modes of expressing concentration is independent of temperature?
 a. Molarity b. Molality c. Formality d. Normality

66. The normality factor (f) is defined as:
 a) wt. to be taken / wt. taken b) wt. taken / wt. to be taken c) actual N / given N d) given N / actual N
67. If 5.36 g of Na_2CO_3 is taken instead of 5.30 g for a N/10 solution, the actual normality is:
 a) 0.1 N b) 0.1011 N c) 0.099 N d) 0.113 N
68. If the normality factor $f > 1$, it means:
 a) less solute was taken than required b) more solute was taken than required
 c) the solution is dilute d) the solution expired
69. The concentration of solute present in trace quantities is expressed in
 a. Normality b. molarity c. molality d. ppm
70. ppm stands for:
 a) parts per mole b) parts per million c) percentage per mole d) partial pressure mean
71. 1 ppm means one part per million. What is the meaning of 1 ppb?
 a) One part per ten billion b) One part per billion c) One part per thousand d) One part per trillion
72. The iodide salt consists of 50 ppm iodine in a 1 kg packet. Calculate the amount of iodine in the packet:
 a) 50 mg b) 0.5 mg c) 50 g d) 100 mg
73. Which concentration unit would you use to express the amount of fluoride in drinking water (0.001 g per kg of water)?
 a) Molarity b) Normality c) Formality d) ppm

Dilution

74. You are asked to prepare 2000 mL of 0.1 M H_2SO_4 from the 2M H_2SO_4 solution provided. What volume would you need?
 a. 200 ml b. 50 ml c. 100 ml d. 500 ml
75. A 5 molar solution of H_2SO_4 is diluted from 1 litre to a volume of 10 litres. The normality of the solution will be:
 a. 1 N b. 0.1 N c. 5 N d. 0.5 N
76. 0.5M H_2SO_4 is diluted from 1 litre to 10 litres. What is the normality of the resulting solution?
 A) 1 N B) 0.1 N C) 0.01 N D) 0.05 N
77. Find out the volume of water to be added to 20 ml of 2N HCl to make it exactly decinormal.
 a. 375 ml b. 380 ml c. 385 ml d. 390 ml
78. How much water should be evaporated from 400 mL N/10 HCl to make it exactly 2N?
 a. 360 ml b. 370 ml c. 380 ml d. 390 ml
79. Equal volumes of decinormal AgNO_3 solution and decimolar NaCl solution are mixed, then the normal concentration of the resulting solution with respect to NO_3^- ion is
 a. 0.1 N b. 0.01 N c. 0.5 N d. 0.05 N
80. What is the concentration of nitrate ions if an equal volume of 1 M NaNO_3 and 1 M KCl is mixed?
 a. 0.25 M b. 0.5M c. 1M d. 2 M
81. If 10 mL of 0.1 M H_2SO_4 is diluted to 100 mL, the new molarity is:
 a) 0.01 M b) 0.02 M c) 0.1 M d) 1 M
82. How much water should be evaporated from 400 ml of N/10 HCl to make it exactly 2N?
 a. 360ml b. 370ml c. 380 ml d. 390ml
83. How much volume of water must be added to 200 mL of 2 M HCl to make it 0.5 M?
 a) 400 mL b) 600 mL c) 200 mL d) 800 mL

Titration Basics (theory)

84. A standard solution is one whose concentration is:
 a) approximately known b) exactly known c) zero d) very high
85. Two or more consecutive titration readings that agree within 0.1 mL are called:
 a) Normality readings b) Endpoint readings c) Concordant readings d) Standard readings
86. Which apparatus is used to add the titrant in a titration?
 a) Pipette b) Measuring cylinder c) Burette d) Conical flask
87. In titration, the solution taken in the burette is called the:
 a) Titrand b) Indicator c) Titrant d) Standard
88. The practical completion of a titration is indicated by the:
 a) Equivalence point b) Endpoint c) Neutral point d) Buffer point

89. The difference between the endpoint and the equivalence point is called:
 a) Indicator error b) Parallax error c) Titration error d) Normality factor
90. Which of the following statements is wrong?
 a. The primary standard substances must be hygroscopic, non-toxic, and found in the pure state.
 b. Normality is the number of gram equivalents dissolved in 1000 cc of the solution.
 c. The basicity of an acid is the number of moles of H^+ ions furnished by 1 mole of the acid.
 d. Generally, the equivalence point comes before the endpoint.
91. Which of the following statements is correct?
 a. Titration is the process of finding the weight of an unknown substance with the help of a known substance.
 b. Oxalic acid is not an example of a primary standard substance.
 c. The normality factor is generally taken as the ratio of the weight to be taken to the weight actually taken.
 d. Normality and Molarity are the same for a monobasic acid.
92. Which of the following is a primary standard substance?
 a) NaOH b) HCl c) H_2SO_4 d) Mohr's salt
93. A primary standard substance should have a high equivalent weight because:
 a) it reacts faster b) a small weighing error causes a minimum concentration error
 c) it is cheaper d) it dissolves faster
94. Why is oxalic acid used as a primary standard for $KMnO_4$ standardization?
 a) It is a strong acid b) It is stable, pure, and has high eq. wt., and reacts stoichiometrically
 c) It is a strong reducing agent d) It is soluble in acetone
95. Which pair has both primary standard substances?
 a) NaOH and HCl b) Na_2CO_3 and Mohr's salt c) $KMnO_4$ and H_2SO_4 d) HCl and Mohr's salt
96. The concentration of a secondary standard solution is determined by:
 a) direct weighing b) standardizing against a primary standard
 c) using a pH meter d) calculation from density
97. NaOH cannot be used as a primary standard because it:
 a) has low molecular weight b) absorbs CO_2 and moisture from air
 c) is insoluble in water d) is a weak base
98. $KMnO_4$ is a secondary standard because:
 a) it is colourless b) it decomposes and is difficult to obtain in pure form
 c) it has low equivalent weight d) it is a weak oxidizer
99. Acidimetry involves determining the strength of an acid using a:
 a) standard acid b) standard alkali c) indicator only d) salt solution
100. In acid-base titration, the equivalence point for a strong acid vs. a strong base reaction is:
 a) acidic ($pH < 7$) b) basic ($pH > 7$) c) neutral ($pH = 7$) d) variable
101. Redox titration involves the transfer of:
 a) protons b) electrons c) neutrons d) molecules
102. In a $KMnO_4$ titration with oxalic acid in an acidic medium, $KMnO_4$ acts as:
 a) an indicator only b) a self-indicator c) an external indicator d) a primary standard
103. In the titration of oxalic acid using $KMnO_4$ solution in an acidic medium, the best indicator is
 a. Phenolphthalein c. $KMnO_4$ itself
 b. Starch d. Methyl orange
104. In $KMnO_4$ titration with oxalic acid, the endpoint is indicated by:
 a) colourless solution turning pink/purple (lasting 30 s) b) pink solution turning colourless
 c) yellow to red d) red to colourless
105. In a redox titration involving potassium permanganate ($KMnO_4$) and oxalic acid ($C_2H_2O_4$), which of the following statements is true regarding $KMnO_4$?
 a) An oxidizing agent because it gains electrons b) A reducing agent because it gains electrons
 c) An oxidizing agent because it loses electrons d) A reducing agent because it loses electrons
106. In redox titration, permanganometric titration uses which self-indicator?
 a) Potassium dichromate b) Iodine c) Sodium thiosulphate d) Potassium permanganate

107. Identify the indicator used to titrate acidified KMnO_4 solution with oxalic acid:
 a) Phenolphthalein b) Dil. H_2SO_4 c) Methyl orange d) Self indicator
108. During titration with KMnO_4 , the solution is made acidic with
 a. Dil. H_2SO_4 b. dil. HCl c. conc. H_2SO_4 d. conc. HCl
109. The normality equation used in titration is:
 a) $N_1 + V_1 = N_2 + V_2$ b) $N_1 / V_1 = N_2 / V_2$ c) $N_1 V_1 = N_2 V_2$ d) $N_1^2 V_1 = N_2^2 V_2$
110. The law of equivalence states that at the equivalence point, gram equivalents of acid equals gram equivalents of base. This is expressed as:
 a) $M_1 V_1 = M_2 V_2$ b) $N_1 V_1 = N_2 V_2$ c) $P_1 V_1 = P_2 V_2$ d) $C_1 V_1 = C_2 V_2$
111. 1 gram equivalent of any acid always reacts with:
 a) 1 mole of any base b) 1 gram equivalent of any base c) 1 gram of any base d) 1 litre of any base

Titration Numericals

112. 100 mL of 1 N HCl is equivalent to:
 a) 10 mL of 10 N HCl b) 1000 mL of 10 N HCl c) 10 mL of 0.1 N HCl d) 100 mL of 10 N HCl
113. 15 ml of N/10 NaOH solution completely neutralises 12 ml of H_2SO_4 solution. The Normality of the H_2SO_4 solution will be
 a. N/5 b. N/10 c. N/8 d. N
114. 8 ml of (N/10) HCl is required to neutralise 20 ml of a solution of Na_2CO_3 in water. The Normality of the Na_2CO_3 solution is
 a. 0.40 N b. 0.040 N c. 4.0 N d. 1.4 N
115. What weight of sodium hydroxide is required to neutralize 100 mL of 0.1 N- HCl
 a. 4.0 gm b. 0.04 gm c. 0.4 gm d. 2.0 gm
116. If 25 mL of a decimolar H_2SO_4 solution completely neutralizes 50 mL of a NaOH solution, what is the Molarity of the NaOH solution?
 a) 0.05 M b) 0.1 M c) 0.2 M d) 0.25 M
117. What volumes of 6 M HCl and 2 M HCl should be mixed to get one litre of 3 M HCl ?
 a. 0.75 L of 6 M HCl + 0.25 L of 2 M HCl b. 0.5 L of 6 M HCl + 0.5 L of 2 M HCl
 c. 0.60 L of 6 M HCl + 0.40 L of 2 M HCl c. 0.25 L of 6 M HCl + 0.75 L of 2 M HCl
118. If 20 ml of 0.25 N strong acid and 30 ml of 0.2 N strong base are mixed, then the resulting solution is
 a. 0.025 N basic c. 0.02 N acidic b. 0.025 N acidic d. 0.02 N basic
119. 0.4 g of NaOH is added to 10 ml of 1N HCl ; the resulting solution is
 a. acidic b. basic c. neutral d. none
120. The volume of 0.1 M $\text{Ca}(\text{OH})_2$ required to neutralize 10 ml of 0.1N HCl is
 a. 5 ml d. 10 ml c. 15 ml d. 20 ml
121. 25 mL of NaOH solution exactly neutralizes 20 mL of 0.5 N HCl . The normality of NaOH is:
 a) 0.2 N b) 0.4 N c) 0.5 N d) 0.8 N
122. 10 mL of 2 N H_2SO_4 reacts completely with how many mL of 1 N NaOH ?
 a) 5 mL b) 10 mL c) 20 mL d) 40 mL
123. How many mL of 0.2 N KMnO_4 would be needed to react with 30 mL of 0.1 N oxalic acid?
 a) 60 mL b) 15 mL c) 30 mL d) 10 mL
124. The volume of 2 N HCl that contains the same number of gram equivalents as 500 mL of 1 N HCl is:
 a) 250 mL b) 1000 mL c) 500 mL d) 125 mL
125. When 100 mL of 1 N NaOH solution and 10 mL of 10 N H_2SO_4 solution are mixed, the resulting solution will be:
 a) Alkaline b) Weakly acidic c) Strongly acidic d) Neutral

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