CHEMISTRY 107 STUDY QUESTIONS
By
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1. Which of the following methods will hasten the reaction of $CaCO_3$ with HCl?
A. Cooling the acid
B. Using a lump of marble
C. Using pulverized marble
D. Adding excess water

2. Which of these is a standard solution?
A. Tap water
B. Vinegar
C. A solution of known concentration
D. A supersaturated sugar solution

3. The colour change of phenolphthalein in a basic solution is:
A. Colourless
B. Pink
C. Blue
D. Red

4. In a redox reaction, the species that gains electrons is:
A. Oxidized
B. Reduced
C. Neutralized
D. Precipitated

5. What is the mole of HCl in 250 cm³ of 0.1 M solution?
A. 0.0025 mol
B. 0.025 mol
C. 0.25 mol
D. 2.5 mol

6. Which acid is commonly used in titrations with sodium hydroxide?
A. Nitric acid
B. Acetic acid
C. Hydrochloric acid
D. Sulfuric acid

7. The indicator used for strong acid–strong base titration is:
A. Methyl orange
B. Phenolphthalein
C. Litmus
D. Universal indicator

8. Which is an example of a basic salt?
A. NaCl
B. CH_3COONa
C. NH_4Cl
D. $Zn(OH)Cl$

9. Calculate the volume of 2.0 M HCl needed to supply 0.01 mol of HCl.
A. 5 cm³
B. 10 cm³
C. 15 cm³
D. 20 cm³

10. Which of the following is a redox reaction?
A. $NaOH + HCl \rightarrow NaCl + H_2O$
B. $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
C. $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
D. $Na_2CO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$

11. What is the function of a stock solution in volumetric analysis?
A. Indicator
B. Standard reference
C. Unknown solution
D. Precipitate

12. A solution of 25 cm³ of NaOH neutralizes 20 cm³ of 0.2 M HCl. What is the molarity of NaOH?
A. 0.1 M
B. 0.16 M
C. 0.2 M
D. 0.25 M

13. The part of a titration curve where rapid pH change occurs is:
A. Buffer region
B. Equivalence point
C. Starting point
D. Plateau

14. What is the molar concentration of 10 g NaOH in 500 mL solution? (Na = 23, O = 16, H = 1)
A. 0.25 M
B. 0.4 M
C. 0.5 M
D. 1.0 M

15. Which of the following is an acidic salt?
A. Na_2SO_4
B. NH_4Cl
C. $NaHSO_4$
D. K_2CO_3

16. A standard solution must:
A. Have colour
B. Be acidic
C. Have known concentration
D. Be prepared from an unknown solute

17. The endpoint of a titration is:
A. When the beaker breaks
B. When the solution boils
C. When there is a permanent colour change
D. When the burette is empty

18. Which of the following can act as both acid and base?
A. HCl
B. NH_3
C. H_2O
D. NaOH

19. In redox reactions, oxidizing agents:
A. Lose electrons
B. Gain electrons
C. Donate protons
D. Are reduced

20. What is the normality of 1 M H_2SO_4?
A. 0.5 N
B. 1 N
C. 2 N
D. 3 N

21. What volume of 0.5 M NaOH will neutralize 25 cm³ of 0.1 M HCl?
A. 2.5 cm³
B. 5.0 cm³
C. 10.0 cm³
D. 12.5 cm³

22. What is observed when NaOH is added to phenolphthalein?
A. Colourless
B. Pink
C. Yellow
D. Red

23. In preparing a standard solution of Na_2CO_3, the solid is first:
A. Washed in acid
B. Dried in an oven
C. Dissolved in ethanol
D. Crushed and heated

24. Which of the following is not a salt?

A. NaCl
B. CuSO$_4$
C. HNO$_3$
D. NH$_4$NO$_3$

25. Which process separates salt from a salt solution?
A. Sublimation
B. Filtration
C. Evaporation
D. Chromatography

26. Redox titration involves:
A. Acid-base only
B. Oxidation-reduction
C. Filtration
D. Neutralization

27. What is the colour of methyl orange in acid?
A. Red
B. Yellow
C. Blue
D. Colourless

28. The mole ratio in the reaction: Zn + 2HCl → ZnCl$_2$ + H$_2$ is:
A. 1:1:1:1
B. 1:2:1:1
C. 2:1:2:1
D. 1:2:2:1

29. Which of the following is a conjugate base?
A. H$_2$O
B. OH$^-$
C. NH$_4^+$
D. Cl$^-$

30. A salt formed by the reaction of a strong acid and weak base is:
A. Neutral
B. Basic

C. Acidic
D. Amphoteric

31. The main use of a pipette in titration is to:
A. Measure acids
B. Wash burette
C. Deliver accurate volume
D. Mix reagents

32. The equivalence point in titration is when:
A. The acid is in excess
B. The base is in excess
C. Both are equal
D. Colour disappears

33. A standard solution is always:
A. Dilute
B. Strong
C. Of known concentration
D. Slightly basic

34. Oxidation involves:
A. Gain of electrons
B. Loss of electrons
C. Absorption of water
D. Precipitation

35. In redox titration, KMnO$_4$ acts as:
A. Reducing agent
B. Base
C. Oxidizing agent
D. Solvent

36. The molar mass of Na$_2$CO$_3$ is:
A. 84 g/mol
B. 86 g/mol
C. 106 g/mol
D. 100 g/mol

37. What is the volume of gas at STP that contains 1 mole of gas?

A. 11.2 L
B. 22.4 L
C. 44.8 L
D. 33.6 L

38. A buffer solution resists change in:
A. Colour
B. Pressure
C. Temperature
D. pH

39. Which of the following can be used to standardize NaOH?
A. H_2SO_4
B. HCl
C. Oxalic acid
D. NaCl

40. When zinc reacts with HCl, the gas evolved is:
A. Oxygen
B. Hydrogen
C. Carbon dioxide
D. Chlorine

41. What is a primary standard?
A. An acid used once
B. A solution of weak acid
C. A stable solid of known purity
D. A solution of unknown concentration

42. Calculate the number of moles in 40 g of NaOH (Na=23, O=16, H=1):
A. 0.5 mol
B. 1.0 mol
C. 2.0 mol
D. 1.5 mol

43. Which of the following is a base?
A. H_2O
B. NaCl
C. NH_3
D. CO_2

44. What is the equivalent weight of H_2SO_4?
A. 49
B. 50
C. 98
D. 196

45. A colour change from pink to colourless in phenolphthalein indicates:
A. Basic to neutral
B. Neutral to acidic
C. Basic to acidic
D. Acidic to basic

46. Which acid is diprotic?
A. HCl
B. H_2SO_4
C. CH_3COOH
D. HNO_3

47. One mole of Na_2CO_3 reacts with how many moles of HCl?
A. 1
B. 2
C. 3
D. 4

48. Which of these is NOT required during a titration?
A. Pipette
B. Burette
C. Crucible
D. Conical flask

49. An indicator is used in titration to:
A. Neutralize the acid
B. Speed up reaction
C. Show end point
D. Act as a base

50. A solution that resists pH change when small amount of acid or base is added is called:
A. Neutral solution
B. Standard solution
C. Buffer solution
D. Titrant

51. What is the pH of a neutral solution at 25°C?
A. 0
B. 7.5
C. 7
D. 14

52. Which of the following compounds is amphoteric?
A. NaOH
B. HCl
C. Al(OH)₃
D. KCl

53. The molarity of a solution is defined as:
A. Moles per gram
B. Moles per litre
C. Volume per mole
D. Mass per volume

54. Which of these gases is acidic in nature?
A. NH_3
B. CO
C. CO_2
D. O_2

55. In a titration curve, the steep vertical portion corresponds to:
A. Starting point
B. Initial pH
C. Equivalence point
D. End point

56. Which salt is formed from a strong acid and a strong base?
A. NH_4Cl
B. CH_3COONa
C. NaCl
D. $AlCl_3$

57. Which of the following is a strong acid?
A. H_2CO_3
B. CH_3COOH
C. HCl
D. HCN

58. A solution that contains equal moles of weak acid and its conjugate base is:
A. Strong acid
B. Buffer solution
C. Neutral solution
D. Weak base

59. What is the main characteristic of a primary standard?
A. Easily contaminated
B. Reacts slowly
C. High purity
D. Low solubility

60. Which indicator changes from colourless in acid to pink in base?
A. Methyl orange
B. Bromothymol blue
C. Phenolphthalein
D. Litmus

61. What is the mass of 1 mole of $CaCO_3$ (Ca=40, C=12, O=16)?
A. 56 g
B. 84 g
C. 100 g
D. 120 g

62. In titration, the solution of known concentration is called:
A. Titrand
B. Indicator
C. Titrant
D. Buffer

63. When a strong acid is diluted, the pH:
A. Decreases
B. Stays same
C. Increases
D. Becomes zero

64. The reaction between an acid and a base produces:
A. Salt only
B. Water only
C. Salt and water
D. Acid and base

65. Which of these is a weak base?
A. NaOH
B. NH$_3$
C. KOH
D. Ca(OH)$_2$

66. The term "mole" in chemistry refers to:
A. 6.022×10^{23} particles
B. Mass of a substance
C. Quantity of substance
D. Volume of gas

67. The burette is used to:
A. Transfer fixed volume
B. Measure mass
C. Deliver variable volume
D. Hold solution

68. Which is the correct expression for normality?
A. Molarity × number of equivalents
B. Molarity ÷ number of equivalents
C. Molarity × number of protons
D. Molarity × volume

69. Which of the following substances can act as a base?
A. HCl
B. NH$_4^+$
C. OH$^-$
D. CO$_2$

70. The point in titration where indicator changes colour is called:
A. Starting point
B. End point
C. Equivalence point
D. Neutralization point

71. How many moles of H$_2$SO$_4$ are there in 98 g of the acid?
A. 1 mole
B. 2 moles
C. 1 mole
D. 0.5 mole

72. Which of these is an example of a strong base?
A. NH$_3$
B. Na$_2$CO$_3$
C. NaOH
D. CH$_3$NH$_2$

73. What is the function of a conical flask in titration?
A. Measure volume
B. Store reagent
C. Mix reactants
D. Deliver acid

74. Which of these salts will hydrolyze to produce acidic solution?
A. NaCl
B. NH$_4$Cl
C. KNO$_3$
D. NaNO$_3$

75. The volume of 0.1 M HCl required to neutralize 25 cm³ of 0.2 M NaOH is:
A. 12.5 cm³
B. 25 cm³
C. 50 cm³
D. 75 cm³

76. The molar concentration of a solution is 2 M. The normality of H_2SO_4 solution is:
A. 2 N
B. 1 N
C. 4 N
D. 0.5 N

77. Which acid-base indicator changes from red in acid to yellow in base?
A. Phenolphthalein
B. Methyl orange
C. Litmus
D. Bromothymol blue

78. The oxidation number of sulfur in H_2SO_4 is:
A. +4
B. +2
C. +6
D. -2

79. Which solution is basic?
A. pH = 5
B. pH = 7
C. pH = 9
D. pH = 3

80. Which salt produces a basic solution when dissolved in water?
A. NH_4Cl
B. NaCl
C. Na_2CO_3
D. KCl

81. Which of these acids is diprotic?
A. HCl
B. H_2SO_4
C. HNO_3
D. CH_3COOH

82. Which of the following is NOT an acid-base indicator?
A. Methyl orange
B. Phenolphthalein
C. Sodium chloride
D. Litmus

83. The molar mass of a substance is:
A. Mass of one molecule
B. Mass of one mole
C. Mass of one atom
D. Mass of 6.022×10^{23} molecules

84. Which of the following is a neutral salt?
A. NH_4Cl
B. NaCl
C. KNO_3
D. Na_2CO_3

85. A solution with pH 3 is:
A. Neutral
B. Acidic
C. Basic
D. Alkaline

86. Which of the following bases is weak?
A. KOH
B. NaOH
C. NH_3
D. $Ba(OH)_2$

87. What volume of 0.5 M NaOH will neutralize 50 cm³ of 1 M HCl?
A. 25 cm³
B. 100 cm³

C. 50 cm³
D. 75 cm³

88. What is the molarity of 4 moles of solute dissolved in 2 liters of solution?
A. 2 M
B. 4 M
C. 2 M
D. 0.5 M

89. The formula for normality (N) is:
A. Molarity × valency factor
B. Molarity ÷ valency factor
C. Molarity × number of equivalents
D. Molarity × volume

90. Which salt solution will have a pH less than 7?
A. NaCl
B. KNO_3
C. NH_4Cl
D. Na_2SO_4

91. The pH of a 0.01 M HCl solution is:
A. 2
B. 2
C. 1
D. 4

92. Which of these substances is a strong electrolyte?
A. CH_3COOH
B. NH_3
C. NaCl
D. C_2H_5OH

93. In a titration, the volume at equivalence point is:
A. Equal to starting volume
B. Less than initial volume
C. Volume where moles acid = moles base
D. Zero volume

94. What is the normality of 1 M H_2SO_4 solution?
A. 1 N
B. 2 N
C. 2 N
D. 0.5 N

95. Which of the following salts will produce a basic solution in water?
A. NH_4Cl
B. Na_2CO_3
C. KCl
D. $AlCl_3$

96. What is the molar mass of NaOH? (Na=23, O=16, H=1)
A. 40 g/mol
B. 39 g/mol
C. 40 g/mol
D. 42 g/mol

97. Which of these is a strong acid?
A. HCN
B. H_2CO_3
C. HCl
D. CH_3COOH

98. What is the role of an indicator in titration?
A. React with acid
B. React with base
C. Show end point by colour change
D. Increase concentration

99. Which of the following acids is monoprotic?
A. H_2SO_4
B. H_3PO_4
C. HCl
D. H_2CO_3

100. The ion responsible for acidic properties in water is:

A. OH⁻
B. H₃O⁺ (or H⁺)
C. Na⁺
D. Cl⁻

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101. Which of these substances can act as both acid and base?
A. NaOH
B. HCl
C. H₂O
D. NH₃

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102. What is the normality of 0.5 M H₃PO₄?
A. 0.5 N
B. 1 N
C. 1.5 N
D. 2 N

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103. What volume of 0.1 M H₂SO₄ is needed to neutralize 25 cm³ of 0.2 M NaOH?
A. 25 cm³
B. 50 cm³
C. 12.5 cm³
D. 100 cm³

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104. Which acid is triprotic?
A. HCl
B. H₂SO₄
C. H₃PO₄
D. HNO₃

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105. The pH of a basic solution is:
A. < 7
B. 7
C. > 7
D. 0

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106. Which of the following salts is formed from a weak acid and a strong base?
A. NaCl
B. CH₃COONa

C. NH₄Cl
D. KNO₃

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107. Which of these bases is considered strong?
A. NH₃
B. CH₃NH₂
C. NaOH
D. C₅H₅N

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108. What is the oxidation state of carbon in CO₂?
A. +2
B. 0
C. +4
D. -4

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109. Which of the following is an example of a weak acid?
A. HCl
B. CH₃COOH
C. H₂SO₄
D. HNO₃

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110. What is the purpose of washing the precipitate in gravimetric analysis?
A. To dissolve the precipitate
B. To react with precipitate
C. To remove impurities
D. To dry the precipitate

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111. Which of the following compounds is a salt?
A. NaOH
B. HCl
C. Na₂SO₄
D. H₂SO₄

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112. The volume of 0.1 M NaOH needed to neutralize 50 cm³ of 0.1 M HCl is:
A. 25 cm³
B. 50 cm³

C. 75 cm³
D. 100 cm³

113. Which acid-base reaction is called neutralization?
A. Acid + Acid
B. Base + Base
C. Acid + Base → Salt + Water
D. Salt + Water

114. The pH of a solution changes from 3 to 5. The concentration of H^+ ions:
A. Increases 100 times
B. Decreases 2 times
C. Decreases 100 times
D. Stays same

115. Which indicator turns yellow in acidic medium and red in alkaline medium?
A. Phenolphthalein
B. Litmus
C. Methyl orange
D. Bromothymol blue

116. Which of these is a polyprotic acid?
A. HCl
B. HNO_3
C. H_2SO_4
D. CH_3COOH

117. What is the concentration of H^+ ions in pure water at 25°C?
A. 1×10^{-7} M
B. 1 M
C. 1×10^{-7} M
D. 7 M

118. The reaction between an acid and carbonate produces:
A. Salt and water only
B. Salt, water, and CO_2

C. Salt only
D. Water and CO_2 only

119. Which of the following compounds acts as a buffer?
A. NaCl
B. HCl
C. CH_3COOH and CH_3COONa mixture
D. NaOH

120. What is the effect of dilution on the pH of a weak acid?
A. pH decreases
B. pH remains constant
C. pH increases
D. pH becomes zero

121. The main component of baking soda is:
A. NaCl
B. NaOH
C. $NaHCO_3$
D. Na_2CO_3

122. Which acid is responsible for sour taste in lemons?
A. Acetic acid
B. Citric acid
C. Sulfuric acid
D. Hydrochloric acid

123. The formula for calculating molarity is:
A. Moles ÷ Volume (L)
B. Mass ÷ Volume
C. Moles ÷ Volume (L)
D. Volume ÷ Moles

124. Which of the following substances is a strong electrolyte?
A. CH_3COOH
B. C_2H_5OH

C. NaCl
D. Glucose

125. Which of these is a weak acid?
A. HCl
B. HF
C. H_2SO_4
D. HNO_3

126. Which salt produces acidic solution on hydrolysis?
A. NaCl
B. NH₄Cl
C. Na_2SO_4
D. KNO_3

127. Which of the following is a strong base?
A. NH_3
B. CH_3NH_2
C. KOH
D. C_5H_5N

128. Which of these ions is responsible for basic nature of solution?
A. H^+
B. Cl^-
C. OH^-
D. Na^+

129. What is the pH of a 0.001 M NaOH solution?
A. 3
B. 7
C. 11
D. 1

130. Which of the following is a conjugate acid-base pair?
A. HCl and NaCl
B. H_2SO_4 and HSO_4^-
C. NaOH and NaCl
D. H_2O and O_2

131. Which gas is released when an acid reacts with a carbonate?
A. O_2
B. H_2
C. CO_2
D. N_2

132. The ion responsible for basicity in aqueous solutions is:
A. H_3O^+
B. Na^+
C. OH^-
D. Cl^-

133. What is the pH of a 0.1 M HCl solution?
A. 10
B. 7
C. 1
D. 14

134. Which of these acids is the weakest?
A. HCl
B. H_2SO_4
C. CH_3COOH
D. HNO_3

135. In a neutralization reaction, the products are:
A. Salt and acid
B. Salt and water
C. Water only
D. Acid only

136. Which of these salts is basic in nature?
A. NH_4Cl
B. Na_2CO_3
C. KCl
D. $AlCl_3$

137. The process of determining the concentration of an unknown solution by reacting it with a solution of known concentration is called:
A. Filtration
B. Distillation
C. Titration
D. Crystallization

138. Which indicator is colorless in acidic solution and pink in basic solution?
A. Methyl orange
B. Phenolphthalein
C. Litmus
D. Bromothymol blue

139. The pH scale ranges from:
A. 0 to 10
B. 0 to 14
C. 0 to 14
D. 1 to 7

140. Which of the following is amphoteric?
A. HCl
B. H_2O
C. NaOH
D. NH_3

141. The strength of an acid depends on:
A. Concentration only
B. Degree of ionization
C. Volume
D. Mass

142. A solution that resists changes in pH when small amounts of acid or base are added is called:
A. Acidic solution
B. Basic solution
C. Buffer solution
D. Neutral solution

143. What is the molarity of 2 moles of solute in 4 liters of solution?
A. 2 M
B. 1 M
C. 0.5 M
D. 4 M

144. Which of the following bases is weak?
A. NaOH
B. KOH
C. NH_3
D. $Ba(OH)_2$

145. The pH of a neutral solution at 25°C is:
A. 0
B. 7
C. 7
D. 14

146. What volume of 0.2 M NaOH is required to neutralize 25 cm³ of 0.1 M HCl?
A. 12.5 cm³
B. 25 cm³
C. 50 cm³
D. 100 cm³

147. Which of the following substances will produce an acidic solution when dissolved in water?
A. NaCl
B. KNO_3
C. NH_4Cl
D. Na_2SO_4

148. The number of equivalents of acid in 1 mole of H_2SO_4 is:
A. 1
B. 2
C. 2
D. 3

149. Which of these is a salt?
A. HCl
B. NaOH
C. NaCl
D. H_2O

150. The normality of 1 M H_3PO_4 solution is:
A. 1 N
B. 2 N
C. 3 N
D. 0.5 N

151. Which of the following is a strong acid?
A. HF
B. CH_3COOH
C. HNO_3
D. H_2CO_3

152. The equivalence point in a titration is:
A. When indicator changes color
B. When volumes are equal
C. When moles acid = moles base
D. When solution is neutral

153. The pH of a 0.01 M NaOH solution is:
A. 2
B. 7
C. 12
D. 14

154. Which salt will give a neutral solution in water?
A. NH_4Cl
B. Na_2CO_3
C. KCl
D. $AlCl_3$

155. The strength of a base depends on:
A. Concentration only
B. Degree of ionization
C. Volume
D. Mass

156. Which of the following is an example of a weak base?
A. NaOH
B. KOH
C. NH_3
D. $Ba(OH)_2$

157. The process of removing impurities from a precipitate is called:
A. Filtration
B. Washing
C. Drying
D. Crystallization

158. Which indicator turns red in acidic solution and blue in alkaline solution?
A. Phenolphthalein
B. Methyl orange
C. Litmus
D. Bromothymol blue

159. What volume of 0.5 M H_2SO_4 is required to neutralize 100 cm³ of 0.5 M NaOH?
A. 25 cm³
B. 50 cm³
C. 100 cm³
D. 200 cm³

160. The molar mass of $CaCO_3$ is (Ca=40, C=12, O=16):
A. 100 g/mol
B. 102 g/mol
C. 100 g/mol
D. 104 g/mol

161. The ionization of a strong acid in water is:
A. Partial
B. No ionization
C. Complete
D. Depends on concentration

162. Which of the following is amphiprotic?
A. NaOH
B. HCl
C. H₂O
D. NH₃

163. The normality of a 1 M solution of HCl is:
A. 0.5 N
B. 1 N
C. 2 N
D. 3 N

164. The pH of a 0.0001 M HCl solution is:
A. 4
B. 1
C. 4
D. 7

165. Which of the following salts is acidic in nature?
A. NaCl
B. NH₄Cl
C. KNO₃
D. Na₂SO₄

166. Which of the following is a polyprotic acid?
A. HCl
B. HNO₃
C. H₂SO₄
D. CH₃COOH

167. Which of the following is a strong electrolyte?

A. CH₃COOH
B. C₂H₅OH
C. NaCl
D. Glucose

168. The reaction between an acid and a metal produces:
A. Salt only
B. Hydrogen only
C. Salt and hydrogen gas
D. Water and salt

169. Which of the following is the strongest base?
A. NH₃
B. CH₃NH₂
C. NaOH
D. C₅H₅N

170. The pH of a 0.1 M NaOH solution is:
A. 3
B. 7
C. 13
D. 1

171. What is the pH of pure water at 25°C?
A. 7
B. 0
C. 7
D. 14

172. Which of the following compounds acts as a buffer?
A. NaCl
B. CH₃COOH and CH₃COONa mixture
C. HCl
D. NaOH

173. The equivalent weight of an acid is:
A. Molar mass × number of replaceable

H atoms

B. Molar mass ÷ number of replaceable H atoms

C. Molar mass ÷ number of replaceable H atoms

D. Molar mass × number of electrons

174. Which salt solution has a pH greater than 7?
A. NH_4Cl
B. NaCl
C. Na_2CO_3
D. $AlCl_3$

175. Which of the following is a weak acid?
A. HCl
B. HNO_3
C. CH_3COOH
D. H_2SO_4

176. The ion responsible for acidity in solution is:
A. OH^-
B. Na^+
C. H^+
D. Cl^-

177. The product of neutralization between acid and base is:
A. Acid
B. Base
C. Salt and water
D. Salt only

178. The pH of a solution changes from 4 to 7, the H^+ concentration:
A. Increases 1000 times
B. Decreases 3 times
C. Decreases 1000 times
D. Remains the same

179. Which of these substances is amphoteric?

A. NaOH
B. HCl
C. H_2O
D. NH_3

180. Which salt solution will have a neutral pH?
A. NH_4Cl
B. Na_2CO_3
C. KCl
D. $AlCl_3$

Calculation Questions (181–230)
Show full workings and include units.
181. Calculate the percentage purity of a sample if 0.245 g of impure Na_2CO_3 required 23.50 mL of 0.1000 M HCl to neutralize.

182. How many grams of $CaCl_2 \cdot 2H_2O$ are needed to prepare 500.0 mL of 0.200 M solution?

183. A titration uses 25.00 mL of 0.150 M $KMnO_4$ to oxidize Fe^{2+}. Calculate moles of Fe^{2+} if the reaction ratio is 1:5.

184. Determine the concentration of H_2SO_4 if 42.7 mL of NaOH 0.125 M is required to reach the endpoint when titrating 25.00 mL of acid.

185. Calculate activation energy given rate constants $k_1 = 2.5 \times 10^{-3}$ s^{-1} at 300 K and $k_2 = 1.1 \times 10^{-2}$ s^{-1} at 310 K.

186. If 0.500 g of Cu reacts to produce $CuSO_4$, calculate the theoretical yield in grams (M(Cu)=63.55, M($CuSO_4$)=159.61).

187. A reaction follows first-order kinetics with a half-life of 45.0 s. What is the rate constant k?

188. Determine pKa of acetic acid if at half-equivalence pH is 4.76.

189. How long will it take for the concentration of a reactant to drop to 10% of its initial value in a second-

order reaction with $k = 0.250$ $M^{-1}s^{-1}$ and $[A]_0 = 0.800$ M?

190. Calculate the mass of anhydrous Na_2SO_4 produced if 50.0 mL of 0.250 M NaOH reacts completely with excess H_2SO_4.

191. A gas collection experiment yields 0.0234 mol of CO_2 at 25°C and 1.00 atm. Calculate the volume collected (R = 0.08206 L·atm·K^{-1}·mol^{-1}).

192. In a rate experiment, doubling [A] triples the rate. Determine the order with respect to A.

193. Calculate the bond order of O_2^- given its molecular orbital electron configuration.

194. Find the ionic strength of 0.100 M Na_2SO_4 solution.

195. A calorimetry experiment registers a temperature rise of 5.20°C when 0.500 mol of reaction occurs in a 1.00 kg calorimeter (c = 4.18 J·g^{-1}·$°C^{-1}$). Calculate ΔH for the reaction.

196. Calculate the work done (in J) when a gas expands reversibly from 2.00 to 10.0 L at constant pressure of 1.50 atm.

197. Determine the molarity of HCl if 1.00 g of $CaCO_3$ produces 224 mL of CO_2 at STP.

198. A student dissolves 0.250 g of benzoic acid (M = 122.12 g/mol) in 50.0 mL ethanol. Calculate its molarity.

199. Calculate the rate constant k for an enzyme-catalyzed reaction if V_0 = (Vmax[S])/(Km + [S]) with Vmax = 2.00 μM/s, Km = 0.500 mM, and [S] = 0.200 mM.

200. Compute the molar solubility of AgCl in water given Ksp = 1.8×10^{-10}.

201. A 0.100 M solution of a weak acid HA has pH 2.40. Calculate Ka.

202. Calculate the osmotic pressure exerted by 0.250 M glucose solution at 37°C.

203. Determine the pH of a 0.0500 M NH_3 solution (Kb = 1.8×10^{-5}).

204. How many mL of 0.500 M NaOH are required to neutralize 35.0 mL of 0.600 M H_2SO_4?

205. Calculate the standard cell potential for Zn/Cu cell given E°(Cu^{2+}/Cu)=+0.34 V and E°(Zn^{2+}/Zn)=–0.76 V.

206. Determine $\Delta G°$ at 298 K for the cell reaction in question 205.

207. A 0.01000 M solution of HCl is diluted to 0.002000 M. Calculate the change in pH.

208. Calculate the mass of Fe_2O_3 formed when 5.00 g of Fe reacts completely with oxygen.

209. Determine the rate of reaction when [A]=0.300 M and rate law is Rate = k[A]² with k=0.500 $M^{-1}s^{-1}$.

210. Calculate the equilibrium constant K for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 500 K given $\Delta G°$=–16.5 kJ.

211. Compute the freezing point depression for a 0.0200 m NaCl solution (Kf=1.86°C·kg/mol).

212. Determine the concentration of I_3^- in a solution where [I_2]=0.020 M and [I^-]=0.500 M (Ki=700).

213. Calculate the radius of a silver atom assuming close-packed cubic structure and density 10.49 g/cm³.

214. A 0.100 M Br_2 solution is reduced by 10.0 mL of 0.200 M $Na_2S_2O_3$. Calculate remaining [Br_2].

215. Determine the percent ionization of acetic acid in 0.100 M solution (Ka=1.8×10^{-5}).

216. Calculate the mass of CO_2 produced from 10.0 g of $C_6H_{12}O_6$ in complete combustion.

217. Compute the enthalpy change for formation of water given bond energies.

218. Determine the wavelength of light that has photon energy of 3.50×10^{-19} J.

219. Calculate the partition coefficient if concentration in octanol is 0.020 M and in water is 0.100 M.

220. Compute the pressure of a 5.00 g sample of gas in a 10.0 L container at 300 K (M=44.01 g/mol).

221. Find the Debye–Hückel limiting law activity coefficient for Cl^- in 0.010 M solution.

222. Calculate the concentration of a solution prepared by dissolving 2.50 g of KCl in 250 mL water.

223. Determine the half-life of a zero-order reaction with k=0.020 M·s^{-1} and $[A]_0$=0.500 M.

224. Calculate the final temperature when 50.0 mL of 0.100 M HCl is mixed with 50.0 mL of 0.100 M NaOH (ignore heat capacity of calorimeter).

225. Compute the standard enthalpy of reaction using ΔH_f values: $C + O_2 \rightarrow CO_2$.

226. Determine the heat required to raise the temperature of 100.0 g of water by 25.0°C.

227. Calculate the density of a solution containing 5.00 g solute in 100.0 g water assuming additive volumes.

228. Compute the lambertian absorbance for a solution with path length 1.00 cm and concentration 0.00500 M with ε=150 L·mol^{-1}·cm^{-1}.

229. Determine the Gibbs free energy change at nonstandard conditions for reaction with Q=0.010 and $\Delta G°$=–20.0 kJ.

230. Calculate the solubility product of $Ca(OH)_2$ from a saturated solution with pH=12.00.

LABORATORY TERMS TO KNOW

1. **Stoichiometry**: The calculation of reactants and products in chemical reactions.
2. **Rate of Reaction.** How fast a chemical reaction occurs; influenced by temperature, concentration, etc.
3. **Activation Energy**: Minimum energy required for a reaction to take place.
4. **Catalyst**: Substance that increases reaction rate without being consumed.
5. **Limiting Reactant**: The reactant that runs out first, limiting the amount of product formed.
6. **Exothermic Reaction**: Reaction that releases heat.
7. **Endothermic Reaction**: Reaction that absorbs heat.
8. **Effervescence**: Bubbles/fizzing from a reaction releasing gas.
9. **Titration**: Technique to determine concentration using a standard solution and an indicator.
10. **Filtration**: Separation of solid from liquid using a filter.
11. **Evaporation**: Technique to separate solute from solvent by heating.
12. **Centrifugation**: Separation of mixtures by spinning.
13. **Perforation**: Piercing or making holes, often for drainage or passage.
14. **Grinding (Comminution):** Reducing particle size (e.g., marble granules into powder) using mortar & pestle.

15. **Decantation**: Pouring off a liquid to leave behind solid or heavier liquid.
16. **Precipitation**: Formation of a solid in a solution during a chemical reaction.

COMMON LABORATORY EQUIPMENT & USES
 Equipment| Function
1. . **Beaker**: Holding and mixing liquids (not for accurate measuring).
2. **Conical Flask (Erlenmeyer):** Reduces spillage; used for heating/mixing liquids.
3. **Test Tube**: Holding small reaction samples.
4. **Test Tube Rack:** Holding tubes upright.
5. **Measuring Cylinder:** Measuring liquid volumes accurately.
6. **Volumetric Flask:** Preparing solutions of precise volume.
7. **Burette**: Dispensing known volumes in titration.
8. **Pipette**: Accurate transfer of small liquid amounts.
9. **Dropper**: Adding liquids dropwise.
10. **Funnel**: Guiding liquids into containers; also for filtration.
11. **Filter Paper:** Trapping solids during filtration.
12. **Watch Glass:** Holding small amounts of solids/liquids or as a lid.
13. **Evaporating Dish**: Heating solutions to evaporate solvents.
14. **Crucible**: Heating substances to very high temperatures.
15. **Tripod Stand**: Supporting containers over heat source.
16. **Wire Gauze**: Supporting containers and distributing heat evenly.
17. **Bunsen Burner**: Heating and combustion.
18. **Tongs**: Holding hot items.
19. **Spatula**: Scooping solid substances.
20. **Thermometer**: Measuring temperature.
21. **Balance**: Measuring mass.
22. **Mortar and Pestle**: Grinding solid substances into powders.

Stay focused, Stay consistent. See you at the top.