# Answer Key

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46. \[3\]

\[
\text{BaCl}_2 + \text{H}_2\text{S} \rightarrow \text{BaS} \downarrow + 2\text{HCl}
\]

\[
(2\times32 = 64) \quad (32 = 32) \quad (137 = 169)
\]

\[\therefore \] 169 g of BaS is obtained by 34 g H\(_2\)S.

\[\therefore \] 1.69 g BaS will be obtained by H\(_2\)S = \(\frac{34 \times 1.69}{169}\) = 0.34 g

47. \[3\]

\[
\nu_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.314 \times 298}{4 \times 10^{-3}}} = 1363 \text{ ms}^{-1}
\]

\[
\lambda = \frac{h}{\nu m v} = \frac{6.626 \times 10^{-34} \times 6.023 \times 10^{23}}{4 \times 10^{-3} \times 1363}
\]

\[= 7.32 \times 10^{-11} \text{ m}\]

48. \[1\]

According to Heisenberg’s uncertainty principle,

\[\Delta x \times \Delta P \geq \frac{h}{4\pi}\]

Here, \(\Delta x = \Delta P\) and \(\Delta P = m \cdot \Delta v\)

\[\therefore \] \(\Delta v^2 = \frac{h}{m^2 \pi}\)

or \(\Delta v = \frac{1}{2m} \sqrt{\frac{h}{\pi}}\)

49. \[2\]

C\(^4^-\), N\(^3^-\) and O\(^2^-\) are isoelectronic species. The ionic radius of isoelectronic species decreases with increase in nuclear charge. Hence, the order of ionic radius is

Species : C\(^4^-\) > N\(^3^-\) > O\(^2^-\)

Ionic radii (Å) 2.60 1.71 1.40

50. \[2\]

\[
\text{Li}_2 : \text{KK}, \sigma(2s)^2, \text{B.O} = \frac{1}{2}(2 - 0) = 1
\]

Hence, structure of Li\(_2\) [Li – Li]

51. \[4\]

Hydrogen bond is found in compound in which H-atom is directly attached to highly electronegative elements as F, O, N. Formaldehyde shows very less H-bonding as H atom is not attached to oxygen atom. CH\(_3\)OH has stronger H-bond as compared to C\(_6\)H\(_5\)OH due to steric hinderance of bulky C\(_6\)H\(_5\) group in phenol. thus, methanol has the strongest H-bond.

52. \[4\]

53. \[1\]

Surface tension of H\(_2\)O is maximum due to maximum hydrogen bonding in comparison to C\(_6\)H\(_6\), CH\(_3\)OH, C\(_2\)H\(_5\)OH. the order of H-bonding is H\(_2\)O > CH\(_3\)OH > C\(_2\)H\(_5\)OH

(Benzene does not form H-bond).

54. \[3\]

Lanthanides (total 14) are called rare earth elements. Hence, total number of rare earth elements is 14.

55. \[2\]

\[
\begin{align*}
\text{A} + \text{B} & \rightarrow \text{C} + \text{D} \\
\text{3} & \quad \text{5} \\
\text{10} & \quad \text{15 at equ.}
\end{align*}
\]

\[\therefore \] \(K = \frac{10 \times 15}{3 \times 5} = 10\)
\[ \Delta G^\circ = -2.303 \, RT \, \log K \]
\[ \Delta G^\circ = -2.303 \times 2 \times 300 \times \log 10 \]
\[ = -2.303 \times 2 \times 300 \times 1 \]
\[ = -1381.8 \, \text{cal} \]

56. \[ \text{[3]} \]

\[ \text{Fe(OH)}_3(s) \xrightarrows{\text{Fe}^{3+}}(aq) + 3\text{OH}^{-}(aq) \]

\[ K_{sp} = [\text{Fe}^{3+}] [\text{OH}^{-}]^3 \]

Hence, if OH\(^{-}\) ion concentration is decreased to \( \frac{1}{4} \) times, then equilibrium concentration of Fe\(^{3+}\) ions will increase to 64 times.

57. \[ \text{[2]} \]

For the reaction,
\[ \text{C(s)} + \text{CO}_2(g) \xrightarrows{2\text{CO}(g)} \]

\[ K_p = \frac{\text{partial pressure of gaseous products}}{\text{partial pressure of gaseous reactants}} \]

\[ = \frac{p_{\text{CO}}^2}{p_{\text{C}} \times p_{\text{CO}_2}} = \frac{(4)^2}{1 \times 2} \]

\[ = 8 \, \text{atm.} \]

58. \[ \text{[3]} \]

\[
\begin{array}{c}
\text{NH}_2 \\
\text{CH}_2\text{OH}
\end{array}
\]

It is achiral as it has two \((–\text{CH}_2\text{OH})\) groups.

59. \[ \text{[2]} \]

60. \[ \text{[3]} \]

For weak acid and strong base,

\[ \text{pH} = 7 + \frac{1}{2} \text{pK}_a + \frac{1}{2} \log C \]

\[ = 7 + \frac{4.74}{2} + \frac{1}{2} \log 10^{-1} \]

\[ = 8.87 \]

61. \[ \text{[3]} \]

Hydrolysis constant of sodium acetate

\[ K_h = \frac{K_w}{K_a} \]

\[ \therefore \quad K_a = 2 \times 10^{-5} \quad \text{(given)} \]

\[ K_h = \frac{10^{-14}}{2 \times 10^{-5}} = 5 \times 10^{-10} \]

62. \[ \text{[3]} \]

The balanced chemical reaction is
\[ 14\text{H}^+ + \text{Cr}_2\text{O}_7^{2-} + 6\text{I}^- \rightarrow 2\text{Cr}^{3+} + 3\text{I}_2 + 7\text{H}_2\text{O} \]

Thus, 3 mole of I\(_2\) is evolved, when KI reacts with 1 mole of potassium dichromate.

63. \[ \text{[1]} \]

64. \[ \text{[1]} \]

\[ \text{Al}_4\text{C}_3 + 12\text{H}_2\text{O} \rightarrow 4\text{Al(OH)}_3 + 3\text{CH}_4 \]

65. \[ \text{[3]} \]

66. \[ \text{[2]} \]
The addition of HBr to unsymmetrical alkene proceeds via the formation of carbocation which may undergo rearrangement to give more stable carbocation. The major product is formed when Br attacks the more stable carbocation.

\[
\begin{align*}
C_6H_2 - CH_2CH = CH_2 & \xrightarrow{H^+} C_6H_3 - CH = CH - \stackrel{H}{\cdot}CH - CH_3 \\
\rightarrow C_6H_3 - CH - CH_2CH_3 & \xrightarrow{Br^-} C_6H_3 - CH - CH_2 - CHBr
\end{align*}
\]

67. [4]
Reaction of HBr with propene in the presence of peroxide gives n-propyl bromide. This addition reaction is an example of anti-Markownikoff addition reaction.

68. [1]
Chlorofluoro carbons (CFCs or freons like CF₂Cl₂) are responsible for depletion of the ozone layer in the upper strata of atmosphere. They are stable and inert compounds. They absorb UV rays and break down liberating free atomic chlorine which causes depletion of ozone through free radical reaction.

\[
\begin{align*}
\text{Cl} + O_3 & \rightarrow \text{ClO} + O_2 \\
\text{ClO} + O_3 & \rightarrow \text{Cl} + 2O_2
\end{align*}
\]

69. [4]
For a body centred cubic lattice, the radius of atom is

\[
r = \frac{\sqrt{3}}{4} \cdot a
\]

\[
a = 4.29 \text{ Å}
\]

\[
\therefore r = \frac{\sqrt{3}}{4} \cdot 4.29 = 1.86 \text{ Å}
\]

70. [2]
In AgI crystal, number of Ag⁺ ions is equal to I⁻ ions. However, the numbers of tetrahedral voids are twice the number of atoms forming the cubic lattice.

\[
\therefore \text{Number of tetrahedral voids occupied by Ag⁺ ion} = 50\%
\]

71. [1]
Molality of solution = 0.25 m
Mass of solvent = 1000 gm
Moles of solute = 0.25
Mass of solute = 0.25 × 60 = 15 gm
Mass of solution = 1015 gm

Mass of solute in 2.5 kg solution = \(\frac{15 \times 2500}{1015} = 36.94\text{ gm}\)

72. [4]
Aqueous solution of any substance (non-volatile) freezes below 0°C because the vapour pressure of the solution becomes lower than that of pure solvent.

73. [1]
Number of moles of H₂ = \(\frac{1.12}{22400}\)

\[
\therefore \text{Number of equivalents of hydrogen} = \frac{1.12 \times 2}{22400} = 10^{-4}
\]

Number of Faraday required = \(10^{-4}\)

\[
\therefore \text{Current to be passed in 1 s} = 96500 \times 10^{-4} = 9.65 \text{ A}
\]

74. [3]
\[
E_{\text{cell}}^o = E_{\text{cathode (RP)}}^o - E_{\text{anode (RP)}}^o
\]
= 0.15 – (–0.74)  
= + 0.89 V

**75.** [2]

When the reactants and the catalyst are in same phase, the catalysis is homogeneous.

Reactant: $H_2O_2$; Phase: (aq)

Catalyst: $Br^-$; Phase (aq)

**76.** [1]

**77.** [1]

**78.** [1]

chlorine reacts slowly with $H_2O$ to form $HCl$ and $HOCl$. The $HOCl$ then decomposes into $HCl$ and $[O]$ radicals

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$

$HOCl \rightarrow HCl + [O]$  

This nascent oxygen is very strong oxidizing as well as effective bleaching agent in aqueous solution of $Cl_2$ or hypochlorite salt.

**79.** [3]

$XeF_6$ on complete hydrolysis gives xenon trioxide which is highly explosive.

$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

**80.** [3]

On treating zinc with excess of NaOH, sodium zincate is obtained as major product

$Zn + NaOH \rightarrow Na_2ZnO_2 + H_2$

**81.** [3]

$2K[Ag(CN)_2] + ZN \rightarrow 2Ag + K_2[Zn(CN)_4]$  

$Ag^+ \rightarrow Ag$, gain of $e^-$, reduction  

$Zn \rightarrow Zn^{2+}$, loss of $e^-$, oxidation.

**82.** [1]

Let the oxidation state of Mn is $x$

[1] $KMnO_4 + 1 + x + (-2) \times 4 = 0$  

$x - 7 = 0$

[2] $K_2MnO_4 (+1) \times 2 + x + (-2) \times 4 = 0$  

$x - 6 = 0$

$x = +6$

[3] $Mn_2O_3 \times 2 + (-2) \times 3 = 0$  

$2x = +6$

$x = +3$

[4] $MnO_2 \ x + (-2) \times 2 = 0$  

$x = +4$.

Thus, oxidation state of Mn is highest in $KMnO_4$.

**83.** [2]

In acetyl acetone, the enol form is stabilized by H-bonding, hence it has more enol content then others.

**84.** [4]

Tautomerism is observed in urea
85. [4]
The possible isomers of $\text{C}_2\text{BrClFI}$ are as

(I) \[ \begin{array}{c} \text{Br} \\ \text{C} \equiv \text{C} \\ \text{F} \end{array} \]

(II) \[ \begin{array}{c} \text{Br} \\ \text{C} \equiv \text{C} \\ \text{I} \end{array} \]

(III) \[ \begin{array}{c} \text{Br} \\ \text{C} \equiv \text{C} \\ \text{Cl} \end{array} \]

(IV) \[ \begin{array}{c} \text{Br} \\ \text{C} \equiv \text{C} \\ \text{F} \end{array} \]

(V) \[ \begin{array}{c} \text{Br} \\ \text{C} \equiv \text{C} \\ \text{I} \end{array} \]

(VI) \[ \begin{array}{c} \text{Br} \\ \text{C} \equiv \text{C} \\ \text{Cl} \end{array} \]

86. [2]
87. [2]

\[ \text{HIO}_4 \rightarrow \text{COOH} \]

88. [2]
$(\text{C}_2\text{H}_5)_2\text{NH}$, i.e., N-ethylethanamine is the most basic amine among the given compounds.

89. [1]
Intermolecular association is more in primary amines than in secondary amines as there are two H-atoms available for hydrogen bond formation in it. Tertiary amines do not have intermolecular association due to the absence of H-atom available for hydrogen bond formation. Hence, the order of boiling point of isomeric alkyl amines is as $1^\circ > 2^\circ > 3^\circ$.

90. [4]
Aliphatic and aromatic primary amines when warmed with chloroform and an alcoholic solution of KOH, form isocyanide or carbylamine.

\[ \text{C}_2\text{H}_5\text{NH}_2 + \text{CHCl}_3 + 3\text{KOH(alc.)} \xrightarrow{\text{Warm}} \text{C}_2\text{H}_5\text{NC} + 3\text{KCl} + 3\text{H}_2\text{O} \]

Carbylamine reaction is a characteristic reaction of primary amines and can be used to distinguish primary amines from secondary and tertiary amines.

**BOTANY**

91. (d)
92. (d)

Sol: Dikaryon and dikaryophase is seen in both ascomycetes and basidiomycetes

93. (b)

Sol: Flagellated protozoans have flagella and parasitic forms cause diseases such as sleeping sickness.

94. (d)

Sol: Antherwall is made up of Epidermis, Endothecium, Middle layer, D-Microspore mother cell, and Tapetum

95. (a)
96. (c)
97. (c)
98. (b)

sol: Although seeds in general are the product of fertilisation but a few flower plants species like Asteraceae and grasses have evolved special mechanism to produce seeds without fertilisation.

99. (d) 

sol.

\[ \text{Number of gametes} = 2^n \] (n has to be, 2 to the power of n)

\( n \) = number of heterozygous pair = ABC and Abc

101. (d) 

sol: Walter Sutton and Theodore Boveri noted that the behaviour of chromosomes was parallel to the behaviour of genes.

102. (d) 

Sol. Phase Of Elongation: The cells proximal (just next, away from the tip) to the meristematic zone represents the phase of elongation. Increased vacuolation, cell enlargement and new cell wall deposition are the characteristics of the cells in this phase.

103. (c) 

104. (d) 

sol. Certain marine brown and red algae produce large amounts of hydrocolloids (water holding substances), e.g., algin (brown algae) and carrageen (red algae) are used commercially

105. (c) 

106. (b) 

Sol: Semi dwarf varieties were introduced were introduced in India in 1966.

107. (a) 

108. (a) 

Sol: All statements are correct except Vth as in the digesters heterotrophic microbes anaerobically digest bacteria and fungi in sludge mixture of gases such as methane, hydrogen sulphide and carbon dioxide which forms the biogas.

109. (b) 

110. (c)
Sol: DNA being hydrophilic molecule cannot pass through cell membranes therefor the bacteria should be made competent to accept the DNA molecule. So the cell is treated with specific conc. of a divalent cation as Calcium to increase the pore size in cell wall.

111. (d)
112. (c)

Sol: Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and the targeted pest, as most Bt toxins are insect-group specific. The toxin is coded by a gene named cry. There are a number of them, for example, the proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms, that *oclcryIAb* controls corn borer.

113. (a)
114. (b)

Sol: Several nematodes parasitise a wide variety of plants and animals including human beings. A nematode *Meloidogyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi). RNAi takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).

115. (b)

116. (d)

117. (b)

118. (a)

\[
\frac{dN}{dt} = rN \left( \frac{K - N}{K} \right)
\]

Sol: Verhulst-Pearl Logistic Growth is described by the following equation: where \( N \) = Population density at time \( t \), \( r \) = Intrinsic rate of natural increase, \( K \) = Carrying capacity

119. (b)

Sol: Population growth curve A - when resources are not limiting, Plot is exponential. Geometrical curve B - when resources are limiting the growth plot is logistic.

120. (a)

Sol. *Sacharomyces, Penicillium, Claviceps, Neurospora, Aspergillus, Morels, Truffles* belongs to ascomycetes

121. (a)

122. (a)

123. (c)
124. (c)

125. (d)

Sol: Genetic diversity: A single species might show high diversity at the genetic level over its distributional range. The genetic variations shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.

126. (d)

sol: Ex situ conservation methods include protective maintenance of threatened species in zoological parks and botanical gardens, in vitro fertilisation, tissue culture propagation and cryopreservation of gametes.

127. (b)

Sol.

Development of root nodules in soyabean: (a) Rhizobium bacteria contact a susceptible root hair, divide near it, (b) Successful infection of the root hair causes it to curl, (c) Infected thread carries the bacteria to the inner cortex. The bacteria get modified into rod-shaped bacteroids and cause inner cortical and pericycle cells to divide. Division and growth of cortical and pericycle cells lead to nodule formation, (d) A mature nodule is complete with vascular tissues continuous with those of the root.

128. (c)

Sol: Asexual reproduction in most brown algae is by biflagellate zoospores that are pear-shaped and have two unequal laterally attached flagella

129. (a)

Sol: Trees areaxed for timber, firewood, cattle ranching and for several other purposes. Slash and burn agriculture, commonly called as Jhum cultivation in the north-eastern states of India.
Sol. The sizeranges from the microscopic unicellular forms like *Chlamydomonas*, tocolonial forms like *Volvox* and to the filamentous forms like *Ulothrix* and *Spirogyra*. A few of the marineforms such as kelps, form massive plantbodies.

131. (b)

132. (b)

133. (c)

134. (c)

135. (b)

Sol: As the anther develops, the cells of the sporogenous tissue undergo meiotic divisions to form microspore tetrads. As each cell of the sporogenous tissue is capable of giving rise to a microspore tetrad. Each one is a potential pollen or microspore mothercell (PMC). The process of formation of microspores from a pollen mothercell through meiosis is called microsporogenesis.