(3) Gases cannot mix evenly and completely in all proportions without any mechanical aid.
(4) All are incorrect.

54. Azeotropic mixture are:
(1) Constant temperature boiling mixture
(2) Those which boils at different temperatures
(3) Mixture of two solids
(4) None of the above

(2) Intermolecular repulsions
(3) Intermolecular attraction
(4) Volume occupied by the molecules

58. The vapour pressure (VP) of a dilute solution of non-volatile solute is P and the VP of pure solvent is P_0, the lowering of the VP is:
(1) +ve (2) –ve
(3) P/P_0 (4) P_0/P

59. Real gases show same behaviour as that of an ideal gas at:
(1) High temperature and high pressure
(2) Low temperature and high pressure
(3) High temperature and low pressure
(4) Low temperature and low pressure

60. The concentration in gms per litre of a solution of cane sugar (M = 342) which is isotonic with a solution containing 6 gms of urea (M = 60) per litre is:
(1) 3.42 (2) 34.2
(3) 5.7 (4) 19

61. The postulates of kinetic molecular theory of gases include all those that follow, except:
(1) No forces exist between the gas molecules.
(2) Gas molecules are in random motion.
(3) Gas molecules are repelled by the walls of container.
(4) Gas molecules are point masses.

62. A solution of sulphuric acid in water exhibits:
(1) Negative deviations from Raoult's law
(2) Positive deviations from Raoult's law
(3) Ideal properties
(4) The applicability of Henry's law

63. If the pressure of a gas increase up to nine times keeping temperature constant, then its RMS velocity will become:
(1) 3 times (2) 9 times
(3) $\frac{1}{3}$ times (4) Remains the same

64. Boiling point of water is defined as the temperature at which:
(1) Vapour pressure of water becomes equal to that of atmospheric pressure
(2) Bubbles are formed
(3) Steam comes out
(4) None of the above

65. The critical temperature of a gas is related to van der Waal's constant as:
(1) $T_c = \frac{8a}{27bR}$ (2) $T_c = \frac{27bR}{8a}$
(3) $T_c = \frac{a}{27b^2}$ (4) $T_c = 3b$

66. Which of the following is an example of a solid solution?
(1) O_2 in N_2 (2) Cu in Au
(3) $C_6H_{12}O_6$ in H_2O (4) NaCl in H_2O

67. If P, V, T represent pressure, volume and temperature of the gas, the correct representation of Boyle's law is:
(1) $V \propto \frac{1}{T}$ (at constant P)
(2) PV = RT
(3) $V \propto 1/P$ (at constant T)
(4) PV = nRT

68. The van't Hoff factor (i) for a dilute aqueous solution of glucose is:
(1) zero (2) 1.0
(3) 1.5 (4) 2.0

69. At room temperature Dalton's law of partial pressure is not applicable to-
(1) H_2 and N_2 mixture
(2) H_2 and Cl_2 mixture
(3) H_2 and CO_2 mixture
(4) None of these

70. The relative lowering of the vapour pressure is equal to the ratio between the number of:
(1) Solute molecules to the solvent molecules.
(2) Solute molecules to the total molecules in the solutions.
(3) Solvent molecules to the total molecules in the solution.
(4) Solvent molecules to the total number of ions of the solute.

71. A gas 'A' having molecular weight 4, diffuses thrice as fast as the gas B. The molecular weight of gas B is-
(1) 36 (2) 12
(3) 18 (4) 24

72. The partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. This is known as:
(1) Henry's law (2) Raoult's law
(3) Distribution law (4) Ostwald's dilution law

73. The density of a gas is equal to? (P = pressure; V = volume; T = temperature, R = gas constant, n = number of moles and M = molecular wt.)-
(1) nP (2) PM/RT
(3) P/RT (4) M/V

74. The molarity of a glucose solution containing 36 g of glucose per 400 mL of the solution is:
(Gram molecular mass of glucose = 180 g)
(1) 1.0 (2) 0.5
(3) 2.0 (4) 0.05

75. When the pressure of 5 L of N_2 is doubled and its temperature is raised from 300 K to 600 K, the final volume of the gas would be-
(1) 10 L (2) 5 L
(3) 15 L (4) 20 L

76. Sprinkling of salt helps in clearing the snow covered roads in hills. The phenomenon involved in the process is:
(1) Lowering in vapour pressure of snow
(2) Depression in Freezing point of snow
(3) Melting of ice due to increase in temperature by porting salt
(4) Increase in Freezing point of snow

77. The correction factor 'a' to the ideal gas equation corresponds to _____.
(1) Density of the gas molecules.
(2) Volume of the gas molecules.
(3) Electric field present between the gas molecules.
(4) Forces of attraction between the gas molecules.

78. Isotonic solution have same-
(1) Vapour pressure
(2) Freezing temperature
(3) Osmotic pressure
(4) Boiling temperature

79. Containers A, B and C of equal volume contain oxygen, neon and methane respectively at the same temperature and pressure. The correct increasing order of their masses is _____.
(1) A < B < C (2) B < C < A
(3) C < A < B (4) C < B < A

80. Henry's law constant (K_H) values for gases P, Q, R and S are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Which gas has maximum solubility?
(1) P (2) Q
(3) R (4) S

81. In terms of critical constant, the compressibility factor is _____.
(1) $\frac{3}{8}$ (2) $\frac{8}{3}$
(3) $\frac{3}{4}$ (4) $\frac{2}{3}$

82. 5.85 g NaCl is dissolved in 200 ml of water at 27°C. The osmotic pressure of solution will be: (Assume that NaCl is completely ionised. Gram molecular mass of NaCl = 58.5 g)
(1) 6 atm (2) 12.315 atm
(3) 24.63 atm (4) 30 atm

83. In order to increases the volume of a gas by 10% the pressure of the gas should be _____.
(1) Decreased by 10%
(2) Decreased by 1%
(3) increased by 10%
(4) increased by 1%

84. If molality of the dilute solution is doubled, the value of the molal depression constant (K_f) will be:
(1) Halved (2) Tripled
(3) Unchanged (4) Doubled

85. If the density of a gas A is 1.5 times that of B, then the molecular mass of A is M. The molecular mass of B will be-
(1) 1.5 M (2) M/1.5
(3) 3 M (4) M/3

SECTION - B

86. K_f for water is 1.86 K kg mol^{-1}. If your automobile radiator holds 1.0 kg water, how many grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to –2.8°C? (Gram molecular mass of $C_2H_6O_2$ = 62 g)
(1) 93.33 g (2) 39.33 g
(3) 27.21 g (4) 72 g

87. The vander Waal's parameters for gases W, X, Y and Z are

Gas	a (atm L^2 mol^{-2})	b (L mol^{-1})
W	4.0	0.027
X	8.0	0.030
Y	6.0	0.032
Z	12.0	0.027

Which of these gases has the highest critical temperature?
(1) W (2) X
(3) Y (4) Z

88. Which of the following is true about gaseous state?
(1) Thermal Energy = Molecular attraction
(2) Thermal Energy >> Molecular attraction
(3) Thermal Energy << Molecular attraction
(4) Molecular forces >> Those in liquids.

89. 5.85 g of NaCl are dissolved in 90 g of water. The mole fraction of NaCl is: (Gram molecular mass of NaCl = 58.5 g and H_2O = 18 g)
(1) 0.1 (2) 0.01
(3) 0.2 (4) 0.0196

90. The boiling point of 0.1 m KCl solution in water having ebullioscopic constant (K_b) of 0.51 K kg mol^{-1} is:

(1) 100.102°C (2) 99.49°C
(3) 100.051°C (4) 99.949°C

91. Absolute zero is:

(1) –273.15 °C
(2) Zero K
(3) Temperature at which no substance exists in gaseous sate.
(4) All of these

92. A gas occupies 20 litre of volume under STP. What will be its volume if the pressure is increased four times keeping the temperature constant?

(1) 20 L (2) 80 L
(3) 5 L (4) 4 L

93. Which of the following 0.1 M aqueous solution will have the lowest freezing point?

(1) Potassium sulphate
(2) Sodium chloride
(3) Urea
(4) Glucose

94. The partial pressure of a dry gas is:

(1) Less than that of wet gas
(2) Greater than that of wet gas
(3) Equal to that of wet gas
(4) None of these

95. Which of the following pair will diffuse at the same rate?

(1) CO_2 and N_2O (2) CO_2 and NO
(3) CO_2 and CO (4) N_2O and NO

96. At relatively high pressure, van der Waals equation for one mole of gas reduces to:

(1) $PV = RT$ (2) $PV = RT + \frac{a}{V}$
(3) $PV = RT + Pb$ (4) $PV = RT - \frac{a}{V^2}$

97. Gas is more difficult to compress when Z is:

(1) 0 (2) 1/2
(3) 1 (4) 2

98. One mole of a solute A is dissolved in a given volume of a solvent. The association of the solute take place as follows:

$nA \rightleftharpoons A_n$

If α is the degree of association of A, the van't Hoff factor 'i' is expressed as:

(1) $i = 1 - \alpha$ (2) $i = 1 + \frac{\alpha}{n}$
(3) $i = \frac{1 - \alpha + \frac{\alpha}{n}}{1}$ (4) $i = 1$

99. The values of van der Waal's constant 'a' for the gases O_2, N_2, NH_3 and CH_4 are 1.36, 1.39, 4.17 and 2.53 L^2 atm mol^{-2} respectively. The gas which can most easily be liquified is:

(1) N_2 (2) O_2
(3) CH_4 (4) NH_3

100. The temperature of a gas is raised from 27°C to 927°C. The root mean square speed of the gas:

(1) Remains same (2) Gets $\sqrt{\frac{927}{27}}$ times
(3) Gets halved (4) Gets doubled

Solution

51. (2)
Ideal gas equation for n moles is PV = nRT
When n = 1 then,
Ideal gas equation is PV = RT
(Old NCERT – Page 145)

52. (2)
Semipermeable membrane is that which permits the passage of solvent molecules only.
(NCERT – Page 20 – 23)

53. (4)
Properties of gases are:
(a) Gases are highly compressible.
(b) Gases exert pressure in all directions equally.
(c) Gases always mix evenly and completely in all proportions without any mechanical aid.
(Old NCERT – Page 139 – 140)

54. (1)
Azeotropic mixture has constant boiling mixture, it is not possible to separate the components of azeotropic mixture by boiling.
(NCERT – Page 14 – 15)

55. (3)
Hot air balloon technology is based on Charles's law.
On increase in temperature air expands so density of air decrease. The hot air inside the balloon is less dense and lighter than atmospheric air. Therefore, the balloons filled with hot air rise up.
(Old NCERT – Page 142 – 143)

56. (4)
Addition of ethylene glycol lowers the freezing point of water and thus, ethylene glycol water mixture is used as anti freeze in radiators of cars.
(NCERT – Page 18 – 19)

57. (4)
In van der Waal's equation, the constant 'b' is the measure of volume occupied by the molecules.
(Old NCERT – Page 150 – 152)

58. (1)
Lowering of VP is always positive.
(NCERT – Page 12)

59. (3)
Real gases show same behaviour as that of an ideal gas at high temperature and low pressure.
(Old NCERT – Page 150 – 152)

60. (2)

$$\text{Isotonic solution} = \frac{w_1}{M_1V_1} = \frac{w_2}{M_2V_2}$$

$$= \frac{w_1}{342\times1} = \frac{6}{60\times1} = \frac{342\times6}{60} = 34.2.$$

(NCERT – Page 20 – 23)

61. (3)
The following statement is not the postulate of KTG:
Gas molecules are repelled by the walls of container.
(Old NCERT – Page 149)

62. (1)
Mixture of H_2SO_4 and H_2O exhibits negative deviation from Raoult's law due to stronger intermolecular forces of attraction between H_2SO_4 and H_2O molecules
(NCERT – Page 13 – 14)

63. (4)

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

Hence,
V_{rms} is independent of pressure.
(Old NCERT – Page 147 – 149)

64. (1)
Boiling Point: The temperature at which vapour pressure of a liquid becomes equal to the atmospheric pressure is called boiling point of that liquid.

65. **(1)**

The relation between T_c, a and b is:

$$T_c = \frac{8a}{27bR}$$

(Old NCERT – Page 152 – 154)

66. **(2)**

(1) O_2 in N_2 : Gaseous solution

(2) Cu in Au : Solid solution

(3) $C_6H_{12}O_6$ in H_2O : Liquid solution

(4) NaCl in H_2O : Liquid solution

(NCERT – Page 1 – 2)

67. **(3)**

Boyle's law is $V \propto \frac{1}{P}$ at constant T

(Old NCERT – Page 140 – 142)

68. **(2)**

Glucose ($C_6H_{12}O_6$) is a non-electrolyte. For non-electrolytes, van't Hoff factor (i) = 1

(NCERT – Page 24 – 25)

69. **(2)**

H_2 and Cl_2 are reacting at room temperature.

(Old NCERT – Page 146 – 147)

70. **(2)**

The relative lowering of the vapour pressure of dilute solution is equal to the mole fraction of the solute molecule present in the solution.

(NCERT – Page 15 – 16)

71. **(1)**

$$\frac{r_B}{r_A} = \sqrt{\frac{M_A}{M_B}}$$

Where, r_B = rate of diffusion of gas B, r_A = rate of diffusion of gas A, M_A = Molar mass of gas 'A' and M_B = molar mass of gas 'B'.

72. **(2)**

The partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. This is known as Raoult's law.

(NCERT – Page 12 – 13)

73. **(2)**

$$d = \frac{PM}{RT}$$

(Old NCERT – Page 146)

74. **(2)**

$$\text{Molarity} = \frac{n_{solute}}{V_L \text{solution}}$$

$$= \frac{36/180}{400/1000} M$$

$$= \frac{36}{180} \times \frac{1000}{400} M$$

$$= 0.5 \text{ M}$$

(NCERT – Page 2 – 5)

75. **(2)**

$T_1 = 300$ K

$T_2 = 600$ K

$P_1 = P$

$P_2 = 2P$

$V_1 = 5L$

$V_2 = ?$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

(Old NCERT – Page 145)

76. **(2)**

When salt is spread over snow covered roads, snow starts melting from the surface because depression of freezing point of water takes place due to addition of salt. It helps in clearing of roads. Hence, the phenomena is depression in freezing point, which helps in clearing the snow covered roads in hilly areas.

(NCERT – Page 18 – 19)

77. **(4)**

The correction factor 'a' (van der Waals constant) corresponds to the forces of attraction between the gas molecules.

(Old NCERT – Page 150 – 152)

78. **(3)**

An isotonic solution is a solution that has the same osmotic pressure as another solution.

(NCERT – Page 20 – 23)

79. **(4)**

Under similar conditions of temperature and pressure, equal volumes of different gases contain equal number of moles.

$\therefore$ Masses of O_2, Ne and CH_4 will be in the ratio 32 : 20 : 16

(Old NCERT – Page 144 – 145)

80. **(3)**

$P = K_H X$

At constant P, $X \propto \frac{1}{K_H}$

K_H for 'R' $\rightarrow$ minimum

$\therefore$ Solubility of R $\rightarrow$ maximum

(NCERT – Page 6 – 9)

81. **(1)**

$P_cV_c = \frac{3}{8}RT_c \therefore Z = \frac{P_cV_c}{RT_c} = \frac{3}{8}$

(Old NCERT – Page 152 – 154)

82. **(3)**

$\pi = iCRT$

$\pi = 2 \times \left\{\frac{\frac{5.85}{58.5}\text{mol}}{\frac{200}{1000}\text{L}}\right\} \times 0.0821\text{atmLK}^{-1}\text{mol}^{-1} \times 300\text{K}$

$\pi = 24.63$ atm

(NCERT – Page 20 – 23)

83. **(1)**

$P_1V_1 = P_2V_2$. If $V_1 = V_2$

$V_2 = V + \frac{10}{100}V = V + \frac{V}{10} = \frac{11V}{10}$

$P_1V = P_2\frac{11V}{10}$ or $P_2 = \frac{10}{11}P_1 = 0.9\ P_1$

$\therefore$ Decrease in pressure = 10%

(Old NCERT – Page 140 – 142)

84. **(3)**

$\Delta T_f = K_f \times m$

If molality is doubled, K_f will remain unchanged since it is a constant and it only depends on solvent.

(NCERT – Page 18 – 19)

85. **(2)**

$d_A = 1.5d_B$

$M_A = M$

$d = \frac{PM}{RT} \Rightarrow \frac{d_A}{d_B} = \frac{M_A}{M_B}$

$\frac{1.5d_B}{d_B} = \frac{M}{M_B} \Rightarrow M_B = \frac{M}{1.5}$

(Old NCERT – Page 146)

86. **(1)**

$\Delta T_f = \frac{1000 \times K_f \times w}{M \times W}$

$\therefore w = \frac{\Delta T_f \times M \times W}{1000 \times K_f}$

$= \frac{2.8 \times 62 \times 1000}{1000 \times 1.86} = 93.33\text{g}$

(NCERT – Page 18 – 19)

87. **(4)**

Greater the value of 'a'

Smaller the value of 'b'

Higher the critical temperature

$T_c = \frac{8a}{27Rb}$

(Old NCERT – Page 150 – 154)

88. **(2)**

In gaseous state, intermolecular forces are weakest, particles are in motion.

Thermal energy >> molecular attractions.

(Old NCERT – Page 139)

89. **(4)**

Mole fraction of NaCl $= \frac{n_{NaCl}}{n_{NaCl} + n_{water}}$

$= \frac{5.85/58.5}{5.85/58.5 + 90/18}$

$= \frac{0.1}{0.1 + 5}$

$= \frac{0.1}{5.1}$

$= 0.0196$

(NCERT – Page 2 – 5)

90. **(1)**

$\Delta T_b = iK_b m$

$= 2 \times 0.51 \times 0.1$

$= 0.102°C$

Hence, Boiling Point = 100°C + ΔT_b

= 100°C + 0.102°C

= 100.102°C

(NCERT – Page 16 – 17)

91. **(4)**

Absolute zero $\rightarrow$ '0' K or –273.15°C

$V_t = V_{0°C} + \frac{1}{237.15} \times V_{0°C} \times t°C$

At, t = –273.15°C, $V_t = 0$

(Old NCERT – Page 142 – 143)

92. **(3)**

$V_1 = 20$ L $\qquad V_2 = ?$

$P_1 \qquad P_2 = 4P_1$

At constant temperature

$P_1V_1 = P_2V_2$

$\Rightarrow \quad V_2 = \frac{20 \times P_1}{4P_1} = 5\text{L}$

(Old NCERT – Page 140 – 142)

93. **(1)**

Freezing point $\propto \frac{1}{C \times i}$

Solution	$C \times i$
0.1 M K_2SO_4	0.3
0.1 M NaCl	0.2
0.1 M urea	0.1
0.1 M glucose	0.1

(NCERT – Page 23 – 25)

94. **(1)**

$\Rightarrow P_{Moist\ gas} = P_{dry\ gas} + Aqueous\ tension$

$\Rightarrow P_{dry\ gas} < P_{Moist\ gas.}$

95. **(1)**

Rate of diffusion $\alpha \frac{1}{\sqrt{M}}$

CO_2	N_2O
44 g/mol	44 g/mol

$\overbrace{\text{Same rate of diffusion}}$

96. **(3)**

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

At very high pressure repulsive forces b/w the molecules dominate ($a \to 0$).

(P) (V – nb) = nRT

n = 1

PV – Pb = RT

PV = Pb + RT

(Old NCERT – Page 150 – 154)

97. **(4)**

If Z > 1, then compression of gas is difficult.

(Old NCERT – Page 150 – 152)

98. **(3)**

In case of association;

$nA \rightleftharpoons A_n$

Initial $\Rightarrow$ 1 0

Final $\Rightarrow$ $1 - \alpha$ $\frac{\alpha}{n}$

Hence, $i = \frac{1 - \alpha + \frac{\alpha}{n}}{1}$

(NCERT – Page 23 – 25)

99. **(4)**

Liquification $\propto$ value of 'a'

(Old NCERT – Page 152 – 154)

100. **(4)**

$$C_{rms} = \sqrt{\frac{3RT}{M}}$$

$T_1 = 27°C = 300\ K$

$T_2 = 927°C = 1200\ K$

$$\frac{C_2}{C_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{1200}{300}} = 2$$

$C_2 = 2C_1$

(Old NCERT – Page 147 – 149)