

A. General Characteristics of Solid State

Section-A : Multiple Choice Questions

1. Which of the following statement about the interstitial compound is INCORRECT?
 (a) They retain metallic conductivity
 (b) They are chemically reactive
 (c) They are much harder than the pure metal.
 (d) They have higher melting points than the pure metal.

Manipur Board-2018

Ans. (b)

2. Which type of solid is carborundum?
 (a) Ionic solid (b) Metallic solid
 (c) Molecular solid (d) Network solid

Gujarat Board-2019

Ans. (c)

3. H₂O (ice) is an example of
 (a) Polar molecular solid
 (b) Hydrogen bonded molecular solid
 (c) Ionic solid
 (d) None of these

Jharkhand Board-2019

Ans. (b)

4. Graphite is a good conductor of electricity due to the presence of:
 (a) Lone pair of electron
 (b) Free valence electron
 (c) Cations
 (d) Anions

Haryana Board-2017

Ans. (b)

5. Which of the following exists as covalent crystal in solid state?
 (a) Phosphorus (b) Iodine
 (c) Silicon (d) Sulphur

Haryana Board-2017

Ans. (c)

6. Which of the following is a molecular solid?
 (a) Diamond (b) Graphite
 (c) Ice (d) Quartz

Kerala Board-2016

Ans. (c)

7. Which solid has the least melting point?
 (a) SiO₂ (b) NaCl
 (c) Ag (d) CCl₄

Gujarat Board-2016

Ans.(d)

8. Diamond is a–
 (i) Solid containing hydrogen bond
 (ii) Ionic solid
 (iii) Covalent solid
 (iv) Metallic solid

MP Board-2015

Ans. (c)

Section-B : Very Short Answer

1. State the main characteristics of an ionic and network type of crystal and give a suitable example for each.
 ISC Board-2005
2. Why is glass considered as a super cooled liquid?
 All India-2008C
3. What is the coordination number of each type of ions in a rock salt type crystal structure?
 Delh-2008; All India-2008
4. "Stability of a crystal is related to the magnitude of its melting point". How?
 All India-2009C
5. Some of the glass objects recovered from ancient monuments look milky instead of being transparent. Why?
 All India-2012C
6. What type of interactions hold the molecules together in a polar molecular solid?
 All India-2010
7. Write a distinguishing feature of metallic solids.
 All India-2010
8. Why are crystalline solids anisotropic?
 All India-2014C
9. 'Crystalline solids are anisotropic in nature'. What does this statement mean?
 Delh-2011
 Foreign-2011
10. Which one of the following is an example of molecular solid CO₂ or SiO₂?
 Foreign-2014
11. Write a distinguishing feature between a metallic solid and an ionic solid.
 All India-2014C
12. How would you distinguish between a metallic solid and an ionic solid other than by metallic luster?
 Foreign-2012
13. Write a feature which will distinguish a metallic solid from an ionic solid.
 Delh-2010; Foreign-2010

14. Give an example each of a molecular solid and ionic solid.

All India-2016

15. What is molecular crystal? Give example.

Tamil Nadu Board-2011

16. Solids have volume and shape.

Haryana Board-2021

17. Write any two characteristics of molecular solids.

Goa Board-2018

18. Classify the following solids as metallic, molecular, ionic or covalent solids:

(a) Sodium Chloride

(b) Silica

19. Draw a neat labelled diagram of a tetrahedral void observed in a crystal lattice.

Goa Board-2019

20. Write any one example of network solid.

Rajasthan Board-2019

21. At low temperature hydrogen is which type of molecular solid?

Rajasthan Board-2016

22. Fill in the blanks:

(a) Co-ordination number of Sodium in NaCl is

MP Board-2016

Section-C : Short Answer

1. Write the properties of ionic crystals.

Tamil Nadu Board-2018

2. Ionic solids are hard and brittle. Explain.

Maharashtra Board-2018

3. Why are solids rigid?

Haryana Board -2016

4. Give any one difference between anisotropy and isotropy nature of solid.

Rajasthan Board-2017

5. Which of the following are polar molecular solids?

Solid sulphur dioxide, solid ammonia, iodine crystals, graphite, carbon tetrachloride.

Rajasthan Board-2013

Section-E : Long Answer

1. What type of solids are electrical conductors, malleable and ductile?

"Ionic solids conduct electricity in molten state but not in solid state". Explain.

Assam Board-2020

B. Amorphous and Crystalline Solids

Section-A : Multiple Choice Questions

1. (a) Which of the following is not a molecular solid?

(a) N₂

(b) I₂

(c) SiC

(d) CO₂

CBSE-2021

Ans. (b)

2. In a face centered cubic lattice, atom (A) occupies the corner positions and at (B) occupies the face centre positions. If one atom of (B) is missing from the face centered points, the formula of the compound is :

(a) A₂B₅

(b) A₂B₃

(c) AB₂

(d) A₂B

ISC Board-2017

Ans. (a)

3. Which of the following is not characteristic of crystalline solid?

(a) Melts at a sharp and characteristic temperature

(b) Definite characteristic geometrical shape

(c) Anisotropic in nature

(d) Pseudo solids or super cooled liquids

Gujarat Board-2021

Ans. (d)

4. Maximum amount of a solid solute that can be dissolved in a given amount of a liquid solvent does not depend upon:

(a) Pressure

(b) Temperature

(c) Nature of solute

(d) Nature of solvent

Haryana Board-2017

Ans. (a)

5. Amorphous solid is:

(a) Rubber

(b) Plastic

(c) Glass

(d) All

Haryana Board-2018

Ans. (d)

6. Which type of solid is graphite?

(a) Ionic

(b) Molecular

(c) Metallic

(d) Covalent

Gujarat Board-2017

Ans. (d) :

7. In which of the following solid substance dispersion forces exist?

(a) SiO₂

(b) CO₂

(c) H₂O

(d) SO₂

Gujarat Board-2019

Ans. (b)

8. Dry Ice (Solid CO₂) is a/an:

(a) Ionic crystal

(b) Covalent crystal

(c) Molecular crystal

(d) Metallic crystal

MP Board-2012

Ans. (c)

9. Which one of the following is non-crystalline or amorphous in nature?

(a) Diamond

(b) Graphite

(c) Common salt

(d) Glass

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer	
1.	What type of defection can arise when Sr^{2+} (as SrCl_2) is added as impurity in ionic solid NaCl . Justify your answer. Manipur Board 2020
2.	Name the type of crystalline solid, which is electrical insulator in solid state but conduct electricity in aqueous solution. Karnataka board 2023
3.	Explain Schottky defect and Frenkel defect. Uttarakhand Board 2022
4.	A compound is formed by two elements X and Y. Atoms of the element Y (as anions) make ccp and those of the element X (as cations) occupy all octahedral voids. What is the formula of the compound? CBSE-2019
5.	Why are powdered substances more effective adsorbents than their crystalline forms? CBSE-2019
6.	Correct the following statement. "Molarity of a solution is independent of temperature". ISC Board-2005
7.	Mention three differences between crystalline and amorphous solids. ISC Board-2000
8.	Explain why graphite is soft and can be used as lubricant? ISC Board-2009
9.	Compare the crystals of copper and diamond giving one similarity and one difference. ISC Board-2010
10.	Correct the statement : Diamond is crystalline while graphite is amorphous. ISC Board-2001
11.	Graphite is anisotropic to electrical conduction. Explain. ISC Board-2001
12.	Correct the statement : Graphite has a two-dimensional sheet like structure in which each carbon atom is sp^3 -hybridised. ISC Board-2005
13.	The crystal of diamond is made up of while that of calcium chloride is made of
14.	The crystal of graphite is made up ofwhile that of sodium chloride is made up of..... ISC Board-2014
15.	Write three differences between crystalline and amorphous solids. Odisha Board-2020
16.	Write two differences between crystalline solids and amorphous solids. Manipur Board-2017

17.	Given the differences between crystalline and amorphous solids with respect to shape and melting point. Karnataka Board-2017
18.solids are electrical conductors, malleable and ductile. Haryana Board-2022
19.	Given one example of Ionic solid. Haryana Board-2022
20.	Write any three differences between crystalline and amorphous solids. Kerala Board-2022

Section-C : Short Answer	
1.	What are crystalline solids? Give two examples. Haryana Board-2017
2.	Write down distinction between crystalline and amorphous solids on the basis of the following properties. (a) Melting point (b) Cleavage property and (c) Order in arrangement of constituent particles Gujarat Board 2023 (March)
3.(a)	Write any two differences between crystalline and amorphous solids.
(b)	Draw the diagram showing impurity defect. Rajasthan Board-2020
4.	Define chromophores and auxochromes. Rajasthan Board-2010
5.	Define the terms crystalline & amorphous solids. Haryana Board-2016

Section-D : Case Based Study	
1.	An amorphous solid 'A' which has a crown shaped structure, burns in air to form a gas 'B' which turns lime water milky. 'B' is also produced by roasting of sulphide ores. 'B' undergoes oxidation in the presence of V_2O_5 to give 'C' and to carry out this oxidation low temperature and high pressure is mandatory to get a good yield of 'C'. 'C' is then absorbed in H_2SO_4 to give 'D'. 'D' is then diluted to give a very important compound 'E'. 'E' is largely responsible for the manufacture of variety of compounds in industry. 'E' in concentrated form, when combined with Cu metal, gives compound 'F'. From this description (a) Elucidate the structure of 'A' to 'F'. (b) Give a balanced chemical equation for the conversion of 'E' to 'F'. (c) Give two important functions of 'E' in the chemical industry. CBSE-2020

Section-E : Long Answer	
1.	Define Anisotropy. Distinguish between crystalline solids and amorphous solids. Maharashtra Board-2019

C. Crystal Lattices and Unit Cells

Section-A : Multiple Choice Questions

1. For unit cell BaSO_4 crystal which option for axial angles is correct?
(a) $\alpha = \beta = \gamma \neq 90^\circ$
(b) $\alpha = \beta = 90^\circ \gamma = 120^\circ$
(c) $\alpha = \gamma = 90^\circ \beta \neq 90^\circ$
(d) $\alpha = \beta = \gamma = 90^\circ$

Gujarat Board 2023 (March)

Ans. (a)

2. Four alternatives are given in each part of this question. Select the correct alternative and write it in your answer book.

(a) The length of core of an fcc unit cell is a and its atomic radius is r . The relationship between them is

$$(a) \quad r = \left(\frac{\sqrt{3}}{4}\right)a \quad (b) \quad r = \left(\frac{\sqrt{2}}{4}\right)a$$
$$(c) \quad r = \frac{a}{2} \quad (d) \quad r = \left(\frac{\sqrt{4}}{6}\right)a$$

UP Board 2019

Ans. (a)

3. Example of Hexagonal crystal is—
(a) Diamond (b) Graphite
(c) Salt (d) Water

MP Board 2020

Ans. (b)

4. The crystal system having dimensions $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$ is —
(a) Hexagonal
(b) Monoclinic
(c) Triclinic
(d) Orthorhombic

UP Board 2023

Ans. (d)

5. In an orthorhombic system axis angles, $\alpha = \beta = \gamma$ are —
(a) equal 90° (b) Less than 90°
(c) greater than 90° (d) None of these

Jharkhand Board-2020

Ans. (a)

6. Number of octahedral sites per sphere in FCC structure:
(a) 1 (b) 3
(c) 6 (d) 4

Haryana Board-2016

Ans. (a)

7. What is the number of atoms in end centered unit cell?
(a) 4 (b) 1
(c) 2 (d) 6

Gujarat Board-2018

Ans. (c) :

8. What is the number of atoms in face centred unit cell?
(a) 2 (b) 4
(c) 6 (d) 3

Gujarat Board-2017

Ans. (b)

9. In which crystal system, edge length is not $a \neq b \neq c$?
(a) Monoclinic (b) Hexagonal
(c) Orthorhombic (d) Triclinic

Gujarat Board-2020

Ans. (d)

10. Crystal structure of NaCl is—
(i) Face centred cubic (ii) Body centred cubic
(iii) Hexagonal (iv) Tetrahedral

MP Board-2015

Ans. (a)

Section-B : Very Short Answer

1. What do you understand by Lattice point?
Uttarakhand Board 2022
2. Define crystal lattice.
J&K Board-2020
3. A cube solid is made up of two elements A and B. Element A forms hcp while atoms of element B occupy two-third of the octahedral voids. What is the formula of the solid?
CBSE-2019
4. (a) Atoms of element Q form ccp lattice and those of the element P occupy $\frac{2}{3}$ rd of tetrahedral voids. What is the formula of the compound formed by the elements P and Q?
(b) What type of stoichiometric defect is shown by KCl and why?
CBSE-2019
5. For sodium chloride crystal, state
(i) the type of unit cell.
(ii) the nature of forces holding the particles together.
(iii) the geometry of the sodium ions which are arranged around a chloride ion.
ISC Board-2001, 2003
6. Crystals of and have face centered cubic lattices.
ISC Board-2004
7. (i) Name the crystal structure of copper metal.
(ii) What is the coordination number of copper in its crystalline state?
ISC Board-2013, 2015
8. Express the relationship between atomic radius (r) and the edge length (a) in the fcc unit cell.
Foreign-2014

9. Express the relationship between atomic radius (r) and the edge length (a) in the bcc unit cell.
Foreign-2014
10. Aluminium crystallizes in fcc structure. Atomic radius of the metal is 125 pm. What is length of the side of the unit cell of the metal?
All India-2013
11. Define the following terms in relation to crystalline solids.
(a) Unit cell
(b) Coordination number
Give one example in each case.
All India-2011
12. An ionic compound AB₂ possesses CaF₂ type crystal structure. Write the coordination number of A²⁺ and B⁻ ions in crystals AB₂.
All India-2009C
13. Define primitive unit cells.
All India-2015; Delh-2009
14. The smallest repeating unit in crystal lattice which when repeated over and over again produces the complete crystal is _____.
Odisha Board-2020
15. Aluminium crystallizes in an FCC structure. Atomic radius of the metal is 125 pm. Calculate the edge length of unit cell of the metal.
Karnataka Board-2014
16. (a) Based on the nature of intermolecular forces, classify the following solids.
(i) SiO₂
(ii) Ice
(b) ZnO turns yellow on heating. Why?
Kerala Board-2018
17. Write the value of axial distances and axial angles of triclinic crystal.
Rajasthan Board-2017
18. Fill the blanks:
(a) There are _____ type of crystal system.
MP Board-2017
19. What is the coordination number of Cs⁺ and Cl⁻ in CsCl structure?
MP Board-2015
20. Define Crystal Lattice.
J & K board-2023

Section-C : Short Answer

1. Calculate number of particles per unit cell in a FCC crystal.
Haryana Board-2017
- 2.(i) Write two difference between crystalline and amorphous solids.
(ii) Draw a diagram for anisotropic behaviour of crystalline solids.
Rajasthan Board-2011
3. What are lattice compounds? Write one example of such compounds.
Rajasthan Board-2010

4. Sketch the:
(a) Simple cube
(b) Face-centred cube and
(c) Body centred cube
Tamil Nadu Board-March, 2016
5. (a) Give the significance of a 'lattice point'. Which point defect increases the density of a crystal?
Assam Board-2020
6. Element B crystallizes in body centered cubic (bcc) unit cell. Calculate approximate number of unit cells in 9.2 gm of element B. (Atomic number of B = 23)
Assam Board-2023
7. (a) Aluminium crystallizes in a cubic close-packed structure. Its metallic radius is 125 pm. What is the length of the side of the unit cell?
(b) Why is potassium chloride sometimes violet instead of pure white?
Meghalaya Board-2018

D. No. of Atoms in a Unit Cell

Section-A : Multiple Choice Questions

8. Sodium metal crystallises in bcc structure. How many unit cell are present in 9.2 g crystal of sodium metal? [Atomic Mass: Na = 23 g mol⁻¹]
(a) 3.2×10^{24} (b) 1.20×10^{23}
(c) 2.4×10^{23} (d) 6.022×10^{24}
Gujarat Board 2023 (March)

Ans. ()

9. The number of atoms per unit cell in a body-centred cubic unit cell is
(a) 4 (b) 2
(c) 1 (d) 3
CBSE-2021

Ans. (b)

10. Total number of atoms present in Face Centred Cubic unit cell are.....
(a) 3 (b) 4
(c) 2 (d) 1
Gujarat Board-2021

Ans. (b)

11. (a) The number of octahedral voids in the unit cell of ccp lattice is:
(a) 2 (b) 3
(c) 4 (d) 6
Odisha Board-2023

Ans. (c)

12. The total number of atoms per unit cell in bcc is:
(a) 3 (b) 1
(c) 4 (d) 2
Tamil Nadu Board-2018

Ans. (d)

13. In a face centred unit cell (FCC) the number of Octahedral Voids:

- (a) 4 (b) 2
(c) 6 (d) 12

Haryana Board-2022

Ans. (a)

14. Percentage of empty space in a BCC arrangement is :

- (a) 74% (b) 68%
(c) 32% (d) 26%

Haryana Board-2021

Ans. (c)

15. The total number of particles in a body centred cubic [bcc] unit cell is

- (a) one (b) two
(c) three (d) four

Jharkhand Board-2018

Ans. (b)

16. The co-ordination number of atoms in body centered cubic structure (bcc) is ____.

- (a) 4 (b) 6
(c) 8 (d) 12

Maharashtra Board-2022

Ans. (c)

17. The relation between radius of sphere and edge length in body centered cubic lattice is given by formula :

- (a) $\sqrt{3}r = 4a$ (b) $r = \frac{\sqrt{3}}{4} \times a$
(c) $r = \frac{\sqrt{3}}{4} a$ (d) $r = \frac{\sqrt{2}}{4} \times a$

Maharashtra Board-2023

Ans. (c)

18. Number of tetrahedral voids in the FCC unit cell is:

- (a) 8 (b) 4
(c) 6 (d) 12

Haryana Board-2017

Ans. (a)

19. In a triclinic unit cell :

- (a) $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$
(b) $a = b = c, \alpha = \beta = \gamma = 120^\circ$
(c) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90^\circ$
(d) $a = b \neq c, \alpha = \beta \neq \gamma = 90^\circ$

Haryana Board -2016

Ans. (c) :

20. The total number of atoms in a face centered cubic unit cell are:

- (a) 1 (b) 4
(c) 6 (d) 2

Haryana Board-2018

Ans. (b)

21. An atom present at the corner of a cube, contributes its

- (a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{1}{8}$ (d) 1

Rajasthan Board-2011

Ans. (c)

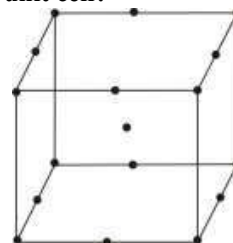
22. A compound is formed of two elements 'A' and 'B'. The atoms of element 'A' forms face centered cubic close packing and atoms of 'B' occupies all the tetrahedral voids What will be the formula of the compound?

- (a) AB_2 (b) AB_8
(c) A_4B (d) A_2B

Gujarat Board-2018

Ans.(a) :

23. How many number of atoms per unit cell in the following unit cell?



- (a) 5 (b) 3
(c) 2 (d) 4

Gujarat Board-2018

Ans. (d)

24. In a crystal of compound having molecular formula X_2Y_3 , Y atoms are arranged as CCP, then what fraction of tetrahedral voids will be covered by X atoms?

- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
(c) $\frac{1}{4}$ (d) $\frac{3}{4}$

Gujarat Board-2019

Ans. (a)

25. An element has a body-centred cubic structure with a cell edge of 4×10^{-4} cm. Calculate diameter of an particle.

- (a) 1.73×10^{-8} cm (b) 6.92×10^{-8} cm
(c) 3.46×10^{-8} cm (d) 0.865×10^{-8} cm

Gujarat Board-2020

Ans. (c)

26. In a Face Centered Unit Cell (FCC) the number of atoms present:

- (a) 4 (b) 2
(c) 3 (d) 1

Haryana Board-2016

Ans. (a)

27. Number of Na atoms present in the unit cell of NaCl crystal is:
 (a) 1 (b) 2
 (c) 3 (d) 4

MP Board-2012

Ans. (d)

28. The number of atoms in a body centred cubic unit cell of an element is
 (a) 4 (b) 3
 (c) 2 (d) 1

Nagaland Board-2018

Ans. (c)

Section-B : Very Short Answer

1. A first order reaction takes 40 min. for 30% decomposition. Calculate half-life period.
 Haryana Board 2023
- (c). Silver forms ccp lattice. Edge length of its unit cell is 408.6 pm. Calculate the density of silver. (Atomic weight of Ag = 108)
 UP Board 2023
2. Atoms of element B (as anions) make CCP and those of element A (as cations) occupy all the octahedral voids. Predict the formula of the compound.
 Manipur Board 2020
3. Write short notes on the following
 (a) Forth floatation method (b) Flux
 Uttarakhand Board 2023
4. Explain simple cubic, body centred cubic and face centred cubic unit cells and find the total number of atoms per unit cell of each.
 OR
 An element has body-centred cubic (bcc) structure with a cell edge of 288 pm. The density of the element is 7.2 g/cm^3 . How many atoms are present in 208 g of this element?
 Uttarakhand Board 2023
5. An element X with an atomic mass of 81 u has density 10.2 g cm^{-3} . If the volume of unit cell is $2.7 \times 10^{-23} \text{ cm}^3$, identify the type of cubic unit cell.
 (Given : $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
 CBSE-2019
6. For a crystal of diamond, state
 (i) the hybridisation of the carbon atom.
 (ii) the coordination number of each carbon atom.
 (iii) the type of lattice in which it crystallises.
 (iv) the number of carbon atoms present per unit cell.
 (v) type of arrangement.
 ISC Board-2008, 2012,2014
7. For a crystal of sodium chloride, state :
 (i) The type of lattice in which it crystallises .
 (ii) The coordination number of each sodium ion and chloride ion in the crystal lattice.

- (iii) The number of sodium ions and chloride ions present in a unit cell of sodium chloride.
 (iv) The structural arrangement of the sodium chloride crystals.

ISC Board-2015

8. (i) How many sodium ions and chloride ions are present in a unit cell of sodium chloride?
 (ii) What is the coordination number of sodium and chloride ions in sodium chloride crystals?
 ISC Board-2007
9. In a body-centred and face-centred arrangement of atoms of an element, what will be the number of atoms present in respective unit cell? Justify your answer with calculation.
 ISC Board-2016
10. In a body centered and face centered arrangement of atoms of an element, what will be the number of atoms present in a respective unit cells?
 ISC Board-2009
11. Calculate the number of unit cells in 8.1 g of aluminum, if it crystallizes in a face centred cubic (fcc) structure.
 (Atomic mass of Al = 27 g mol^{-1})
 All India-2017
12. How will you distinguish between the following pairs of terms?
 (i) Tetrahedral and octahedral voids
 (ii) Crystal lattice and unit cell
 Delh-2014
13. A compound forms hcp structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?
 All India-2013C
14. What is the number of atoms in unit cell of a simple cubic crystal?
 Foreign-2010
15. How many atoms constitute one unit cell of a face centred cubic crystal?
 Delh-2013, 2008
 All India-2009, 2008
 Foreign-2008
16. Calculate the number of atoms in a face centred cubic unit cell.
 Delh-2013C
17. What is the number of atoms per unit cell (Z) in a body centred cubic structure?
 Delhi-2014, 2015 C
18. Calculate the number of atoms present in FCC crystal.
 Karnataka Board-2014
19. Calculate the number of particles present per unit cell in a B.C.C unit cell.
 Karnataka Board-2020
20. Calculate the number of particles (atom) per unit cell in a FCC crystal lattice.
 Karnataka Board-2018, 2016
21. What is the co-ordination number of particles present in FCC crystal structure?
 Kerala Board-2018

22. Unit cells can be classified into primitive and centered unit cells. Differentiate between primitive and centered unit cells.

Kerala Board-2016

23. Mention the number of atoms in a b.c.c. unit cell.

Assam Board-2017

Section-C : Short Answer

1. Distinguish between Crystal Lattice and Unit Cell.

Uttarakhand Board-2020

2. Sodium metal crystallises in the cubic lattice and edge of the unit cell is 430 pm. Calculate the number of atoms in the unit cell.

(Density of sodium = 0.9623 g.cm^{-3} At. wt. = 23, Avogadro No. $N_A = 6.023 \times 10^{23}$)

UP Board 2019

3. The density of iron crystal is $8.54 \text{ gram cm}^{-3}$. If the edge length of unit cell is 2.8 \AA and atomic mass is 56 gram mol^{-1} , find the number of atoms in the unit cell.

(Given : Avogadro's number = 6.022×10^{23} , $1 \text{ \AA} = 1 \times 10^{-8} \text{ cm}$).

Maharashtra Board-2018

4. Define unit cell. Calculate the number of particles per unit cell in Body centered cube and Face centered cube.

Kerala Board-2021

5. What is face-centered cubic (f.c.c.) cell? Explain with diagram. Calculate the number of atoms in unit cell.

Chhattisgarh Board-2021

6. How many sodium ions and chloride ions are present in a unit cell of sodium chloride crystal?

ISC Board-2017

7. Calculate the number of atoms in FCC unit cell.

Haryana Board-2016

8. A cubic unit cell made up of X and Y elements. If X present on the corners of the cube and Y are present on centers of faces, of cube then find formula of the compound.

Haryana Board-2018

9. Define the following terms:
(b) Unit Cell

Haryana Board-2018

10. Assuming that atoms are touching each other, calculate the efficiency of packing in case of a crystal for simple cubic metal.

Rajasthan Board-2014

11. A compound forms hexagonal close packed (hcp) structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?

Assam Board-2019

E. Close Packed Structures

Section-A : Multiple Choice Questions

1. Structure of the crystal of sodium chloride is
(a) body centred cubic (bcc)
(b) face centred cubic (fcc)
(c) orthorhombic
(d) tetragonal

UP Board 2023

Ans. (b)

2. Efficiency of packing in Simple Cubic Lattice is—
(a) 52.4% (b) 62.4%
(c) 68% (d) 74%

Rajasthan Board 2022

Ans. (a)

3. A compound formed by elements P and Q Crystallizes in a cubic structure where P atoms are at the corners of a cube and Q atoms are at the face centres. The formula of the compound is:
(a) $P_2 Q_2$ (b) PQ_3
(c) PQ (d) $P_3 Q$

CBSE-2021

Ans. (b)

4. A compound is formed by two elements P and Q. Atoms of the element Q (as anions) make CCP and those of the element P (as cations) occupy all the octahedral voids. What is the formula of the compound?
(a) PQ_2 (b) $P_2 Q$
(c) PQ (d) $P_4 Q_3$

Gujarat Board-2021

Ans. (b)

5. If axial distances $a = b = c$ and axial angles 90° then crystal system is.....
(a) Cubic (b) Rhombohedral or Trigonal
(c) Hexagonal (d) Triclinic

Gujarat Board-2021

Ans. (b)

6. In a face centred unit cell (FCC) the number of Tetrahedral Voids.
(a) 8 (b) 4
(c) 6 (d) 2

Haryana Board-2022

Ans. (a)

7. An ionic crystal lattice has $\frac{r^+}{r^-}$ radius ratio of 0.32, its co-ordination number is _____.
(a) 3 (b) 4
(c) 6 (d) 8

Maharashtra Board-2018

Ans. (b)

8. The number of tetrahedral voids present per atom in a cubic close packed structure is
- (a) 1 (b) 2
(c) 3 (d) 4

Goa Board-2019

Ans. (b)

9. Which of the following lattices has the highest packing efficiency (assuming that atoms are touching each other)?
- (a) Simple cubic
(b) Body centred cubic
(c) Face centred cubic

Kerala Board-2020

Ans. (c)

10. In a Tetragonal unit cell:

- (a) $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$
(b) $a = b \neq c, \alpha = \beta = \gamma = 90^\circ$
(c) $a = b = c, \alpha = \beta = \gamma = 90^\circ$
(d) $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$

Haryana Board-2016

Ans. (b)

11. Which crystal system does CaSO_4 possess?

- (a) Triclinic (b) Hexagonal
(c) Monoclinic (d) Tetragonal

Gujarat Board-2016

Ans.(c)

12. An element possess cubic close packing structure Calculate the radius (r) of the atom in the unit cell. (The edge length of unit cell is $a = 252 \text{ nm}$)

- (a) 152 nm (b) 89.36 nm
(c) 126 nm (d) 109.1 nm

Gujarat Board-2018

Ans.(b) :

13. A compound is formed by two elements M and N. The element N forms CCP and atoms of M occupy $1/3^{\text{rd}}$ of tetrahedral voids. What is the formula of the compound?

- (a) M_2N_3 (b) M_3N_2
(c) MN (d) M_4N_3

Gujarat Board-2020

Ans. (a)

14. The crystal lattice of NaCl is:

- (a) Face-centered cubic lattice
(b) Body-centered cubic lattice
(c) Simple cubic lattice
(d) Hexagonal close packing

MP Board-2013

Ans. (b)

15. Which type of crystal system has axial angles $\alpha = \beta = \gamma = 90^\circ$?

- (a) cubic (b) tetrahedral
(c) hexagonal (d) trigonal

Nagaland Board-2020

Ans. (a)

16. In which pair is the most efficient packing present?

- (i) hcp and bcc
(ii) bcc and ccp
(iii) hcp and ccp
(iv) bcc and simple cubic

Meghalaya Board-2019

Ans. (c) :

17. An ionic compound has bcc structure with atoms A occupying the corners of the unit cell and B at the body centre. The formula of the ionic compound is

- (a) AB (b) AB_3
(c) AB_2 (d) AB_4

Jharkhand Board-2023

Ans. (b)

18. In a face-centred cubic unit cell, the edge length is

- (i) $\frac{4}{\sqrt{3}}r$ (ii) $\frac{4}{\sqrt{2}}r$
(iii) $2r$ (iv) $\frac{\sqrt{3}}{2}r$

Meghalaya Board-2018

Ans. (b)

Section-B : Very Short Answer

1. Describe the unit cell of sodium chloride with a neat diagram stating
(i) type of bonding.
(ii) type of unit cell.
(iii) number of nearest neighbours around sodium and chloride.

ISC Board-2001, 2003

2. (i) Why does the presence of excess of lithium makes LiCl crystal pink?
(ii) A solid with cubic crystal is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body centre. What is the formula of the compound?

All India-2013

3. How many effective atoms are located at the edge centre of a unit cell in a sodium chloride crystal?

Delh-2008

4. What is meant by the term coordination number I solids?
What is the coordination number in a face centered cubic close packing structure.

Karnataka Board-2015

5. What would be the coordination numbers of an ion occupying (a) an octahedral void and (b) a tetrahedral void?

NIOS Board-2011

6. The radius of Na^+ ion is 95 pm and that of Cl^- ion is 181 pm. Predict whether the Coordination number of Na^+ ion is 6 or 4.

Punjab Board-2017

7. Platinum crystallizes in a face-centered cubic lattice with all atoms at the lattice points. Calculate the mass of a unit-cell of the metallic crystal (Atomic mass of platinum = 195 amu).
Manipur Board-2022
8. Classify solids into different types on the basis of the arrangement of constituent particles.
Manipur Board-2022
9. Unit cells can be divided into two categories, Primitive and centered unit cells.
(a) Differentiate between Unit Cell and Crystal Lattice.
(b) Calculate the number of atoms per unit cell in the following:
(i) Body centered cubic unit cell (bcc).
(ii) Face centered cubic unit cell (fcc).
Kerala Board-2015
10. How many atoms can be assigned to its unit cell if an element forms.
(i) a body centered cubic (bcc) cell.
(ii) a face centered cubic (fcc) cell? Show by calculation.
Assam Board-2012

Section-C : Short Answer

1. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length 300 pm. If its density is 6.6 g cm^{-3} , identify the nature of cubic unit cell.
CBSE-2021
2. A metal crystallises in a body-centred cubic structure. If 'a' is the edge length of its unit cell, 'r' is the radius of the sphere, what is the relationship between 'r' and 'a'?
Assam Board-2022
3. Classify the following solids as metallic, molecular, ionic or covalent solids:
(a) Sodium Chloride
(b) Silica
Draw a neat labelled diagram of a tetrahedral void observed in a crystal lattice.
Goa Board-2023
4. How is body centered cubic cell (b.c.c) formed? Calculate the number of atoms in its unit cell.
Chhattisgarh Board-2023
5. An atom is present in a special type of void surrounded by six neighbours in a solid having cubic close-packed (ccp) structure. What types of voids are they and why are they so named?
NIOS Board-2014
6. Determine the type of cubic lattice to which the crystal of the element indicated here belongs. It has an edge length of 290 pm and a density 7.80 g cm^{-3} . Atomic mass of element = 56 amu.
Punjab Board-2017
7. A compound is formed by two elements M and N. The element N forms CCP and atoms of M occupy $\frac{1}{3}$ of tetrahedral voids. What is the formula of compound?
Haryana Board-2021
8. What is meant by Hexagonal close packing in three dimensions?
J&K Board-2019
9. Explain the following:
(a) Face-centered cubic
(b) Body-centered cubic
Chhattisgarh Board-2022
10. An element has cubic close packed structure.
(i) What is the co-ordination number of each atom?
(ii) Give the total number of voids in N mol of it.
Kerala Board-2021
11. Write the values of axial angles for hexagonal crystal system.
Rajasthan Board-2015
12. A compound forms h.c.p. structure. Calculate the total number of voids in 0.5 mol of it.
Assam Board-2017
13. (a) For one mole close packed spheres, how many octahedral and tetrahedral voids are present?
Assam Board-2015
14. (b) Atoms of element X form hcp lattice and those of element Y form occupy $\frac{2}{3}$ rd of the tetrahedral voids. Determine the formula of the compound formed by the elements X and Y?
Assam Board-2015
15. If the radius of octahedral void is 'r' and the radius of the atoms in the close packing is 'R'. What is the relation between 'r' and 'R'?
J & K Board-2021

Section-E : Long Answer

1. (a) Calculate the packing efficiency in simple cubic crystal lattice.
(b) Calculate the number of particles [atoms] per unit cell in Body Centred Cubic [BCC] crystal lattice.
Karnataka board 2023
2. An alloy of three metals A, B and C has the A atoms forming ccp lattice while B atoms occupy the edge centres and C atoms occupy the body centres. Establish the formula of the alloy.
Manipur Board 2023
3. Find the total number of voids in 0.50 mol of a compound having hexagonal close packed structure.
Haryana Board-2016

F. Packing Efficiency

Section-A : Multiple Choice Questions

1. What is percentage of empty space in hexagonal close packing (hcp) solid?
(a) 52% (b) 74%
(c) 26% (d) 68%

Gujarat Board-2019

Ans. (c)

2. Percentage of empty space in a BCC arrangement is:
(a) 74% (b) 68%
(c) 32% (d) 26%

Haryana Board-2017

Ans. (c)

3. What is percentage of unoccupied space in hcp unit cell?
(a) 74 (b) 48
(c) 64 (d) 26

Gujarat Board-2017

Ans. (d)

4. The fraction of the total volume occupied by the atoms present in a simple cubic is

- (i) $\frac{\pi}{4}$ (ii) $\frac{\pi}{6}$
(iii) $\frac{\pi}{3\sqrt{2}}$ (iv) $\frac{\pi}{4\sqrt{2}}$

Meghalaya Board-2019

Ans. (b) :

Section-B : Very Short Answer

1. Calculate the efficiency of packing in Body centred cubic structures.
Gujarat Board-2022 (July)
2. What are tetrahedral voids ?
UP Board 2023
3. Both ccp and hcp are packings and occupy about % of the available space.
ISC Board-2015
4. Packing efficiency in BCC crystal is percent.
Haryana Board-2022
5. An element crystallizes in F.C.C manner. What is the length of a side of the unit cell, if the atomic radius of the element is 0.144 nm?
Kerala Board-2019
6. Distinguish between the following pairs
(i) Crystal lattice and Unit cell
(ii) Tetrahedral void and Octahedral void
Chhattisgarh Board-2021
7. Write the value of packing efficiency in body-centred cubic structure.
Rajasthan Board-2020
8. How much percentage of space is empty in a hexagonal closed packed solid?
Assam Board-2023

Section-C : Short Answer

1. a) Calculate the packing efficiency in a simple cubic lattice.
b) What is Frenkel defect? Give example?
Karnataka Board-2014
2. a) Calculate packing efficiency in simple cubic lattice.
b) An element having atomic mass 107.9 u has FCC lattice. The edge length of its unit cell is 408.6 pm Calculate density of the unit cell. [Given, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]
Karnataka Board-2018
3. a) Calculate the packing efficiency in a unit cell of Cubic Close Packing (CCP) structure.
b) Name the crystal defect which lowers the density in an ionic crystal.
Karnataka Board-2015
4. (i) What do you mean by packing fraction of cubic unit cell ?
(ii) Calculate packing fraction of a face-centred cubic unit cell.
West Bengal Board-2019
5. a) Calculate the packing efficiency in Body Centered Cubic structure (BCC).
b) Calculate the number of particles per unit cell of FCC.
Karnataka Board-2016
6. a) Calculate packing efficiency of Face Centered Cubic (FCC) lattice.
b) Give any two differences between schottky and Frankel defect.
Karnataka Board-2019
7. Calculate the packing efficiency in simple cubic lattice.
Rajasthan Board-2019
8. Calculate the packing efficiency of a simple cubic lattice.
Assam Board-2019

Section-E : Long Answer

1. What is packing efficiency? Calculate packing efficiency in simple cubic lattice. (Figure is required)
Gujarat Board-2021
2. a) Calculate the packing efficiency in F.C.C. cube lattice.
b) Calculate metal crystallizes in a face centered cubic lattice with edge length of 0.556 nm. Calculate the density of the metal. [Atomic mass of calcium 40g/mol]
 $N_A = 6.022 \times 10^{23} \text{ atoms/mol}$.
Karnataka Board-2020
3. a) Calculate the packing efficiency of in face centred Cubic lattice.
b) what is Frenkel defect? What is its effect on density of Solid?
Karnataka Board-2019

4. a) Calculate packing efficiency of a Simple cubic lattice.
b) An element having atomic mass 63.1 g/mol has face centred cubic unit cell with edge length 3.608×10^{-8} cm. Calculate the density of unit cell.
[Given: $N_A = 6.022 \times 10^{23}$ atoms/mol]

Karnataka Board-2017

5. a) Calculate the packing efficiency in a Body Centered Cubic (BCC) lattice.
b) Silver forms a ccp lattice. The edge length of its unit cell is 408.6 pm. Calculate the density of silver.
($N_A = 6.022 \times 10^{23}$, Atomic mass of Ag = 108 g mol^{-1})

Karnataka Board-2016

6. a) Calculate the packing efficiency in simple cubic lattice.
b) What is Frankel defect? Give an example.

Karnataka Board-2014

7. a) Calculate the packing efficiency in Simple Cubic lattice.
b) Silver crystallizes in Face-Centered Cubic (FCC) lattice. If the edge length of the cell is 4.1×10^{-8} cm and density is 10.4 g cm^{-3} , calculate the atomic mass (M) of Silver ($N_A = 6.022 \times 10^{23}$ atoms mol^{-1})

Karnataka Board-2020

8. a) Calculate the packing efficiency in Body Centered cubic (BCC) lattice.
b) An element having atomic mass 107.9 g mol^{-1} has FCC lattice. The edge length of unit cell is 408.6 pm. Calculate the density of the unit cell.
[Given $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]

Karnataka Board-2015

9. a) Calculate packing efficiency in Body centered cubic lattice.
b) What is Schottky defect?

Karnataka Board-2018

10. Derive packing efficiency in face centred cubic close packed structures.

Gujarat Board-2020

11. Atoms of element B from h.c.p. lattice and those of the element A occupy $\frac{2}{3}$ rd of tetrahedral voids. Determine the formula of the compound formed by the elements A and B.

Assam Board-2017

G. Calculation Involving Unit Cell

Section-A : Multiple Choice Questions

12. A compound is formed by two elements M and N. The element N forms CCP and atoms of M occupy $\frac{1}{3}$ rd of tetrahedral voids. What is the formula of the compound?
(a) M_3N_2 (b) MN
(c) M_3N (d) M_2N_3

Gujarat Borad-2022 (July)

Ans. (d)

13. Edge length is 200 pm in body centred unit cell what will be radius of atom in pm.
(a) 139 (b) 150
(c) 86.6 (d) 93.4

Gujarat Board-2018

Ans. (c)

14. In which of the following crystal system, all the edge length are not same?
(a) CaCO_3 (b) CaSO_4
(c) ZnS (d) HgS

Gujarat Board-2018

Ans. (b)

15. Formula of unit cells Density is:

- (a) $\frac{ZM}{a^3N_0}$ (b) $\frac{ZN_0}{a^3M}$
(c) $\frac{N_0a^3}{MZ}$ (d) $\frac{Z}{MN_0}$

MP Board-2016

Ans. (a)

Section-B : Very Short Answer

1. An element with molar mass 72 g mol^{-1} forms a cubic unit cell with edge length 400 pm. If its density is 7.5 g cm^{-3} , identify the nature of the cubic unit cell.
CBSE-2021
2. An element X with an atomic mass of 81 u has density 10.2 g cm^{-3} . If the volume of unit cell is $2.7 \times 10^{-23} \text{ cm}^3$, identify the type of cubic unit cell.
(Given : $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
CBSE-2019
3. An element crystallizes in fcc lattice with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3} . Calculate the number of atoms in 108 g of the element.
CBSE-2019
4. (a) Atoms of element B form hcp lattice and those of the element A occupy $\frac{2}{3}$ rd of octahedral voids. What is the formula of the compound formed by the elements A and B?
(b) What type of stoichiometric defect is shown by ZnS and why?
CBSE-2019
5. An element crystallizes in a fcc lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contains 2×10^{24} atoms.
CBSE-2019
6. Aluminium crystallises in a fcc structure. Atomic radius of the metal is 125 pm. What is the length of the side of unit cell of the metal?
CBSE-2019
7. The compound CuCl has fcc structure like ZnS. Its density is 3.04 g cm^{-3} . What is the volume of unit cell?
Given : Atomic mass of Cu = 63.5 u; Cl = 35.5 u
 $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
CBSE-2019

8. An element crystallizes in a bcc lattice with cell edge of 400 pm. Calculate the density of 250 g of this element contains 2.5×10^{24} atoms
CBSE-2019
9. An element crystallizes in a FCC lattice with cell edge of 400 pm. The density of the element is 7 g cm^{-3} . How many atoms are present in 280 of the element?
CBSE-2019
10. What is the formula of a compound in which the element 'Y' forms hcp lattice and atoms of 'X' occupy 1/3rd of octahedral voids ?
CBSE-2019
11. Write the formula of the compound in which element 'Y' forms hcp lattice and atoms of 'X' occupy 2/3rd of tetrahedral voids.
CBSE-2019
12. What is the coordination number of atoms in a (i) bcc structure, and (ii) fcc structure ?
CBSE-2019
13. Chromium crystallises in bcc structure. If its edge length is 300 pm, find its density. Atomic mass of chromium is 52 u. [$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]
CBSE-2019
14. A compound AB has a cubic structure and molecular mass 99. Its density is 3.4 g/cm^3 . What is the length of the edge of the unit cell?
ISC Board-2011
15. The edge length of unit cell of a body centred cubic (bcc) crystal is 352 pm. Calculate the radius of the atom.
ISC Board-2016
16. Lead (II) sulphide has fcc crystal structure. The edge length of the unit cell of PbS crystal is 500 pm. What is its density? (Pb = 207.2, S = 32).
ISC Board-2010
17. A bcc element (atomic mass 65) has a cell edge of 420 pm. Calculate its density in g/cm^3 .
ISC Board-2013
18. A compound AB has a simple cubic structure and has molecular mass 99. Its density is 3.4 g cm^{-3} . What will be the edge length of the unit cell?
ISC Board-2016
19. Chromium metal crystallises with a body centred cubic lattice. The edge length of the unit cell is found to be 287 pm. Calculate the atomic radius. What would be the density of chromium in g/cm^3 ? (Atomic mass of $C_r = 52.99$)
ISC Board-2015
20. Lead sulphide has face centered cubic crystal structure. If the edge length of the unit cell of lead sulphide is 495 pm, calculate the density of the crystal. (at. wt. Pb = 207, S = 32)
ISC Board-2017
21. An ionic compound is made up of A cations and B anions. If A cations are present at the alternate corners and B anion is present on the body of the diagonal, what is the formula of the ionic compound?
ISC Board-2014
22. Which point defect in crystals of a solid decreases the density of the solid?
Delh-2010; All India-2009
Foreign-2009
23. What is the percentage efficiency of packing in case of a simple cubic lattice?
All India-2009C
24. An element with density 2.8 g cm^{-3} forms a fcc unit cell with edge length $4 \times 10^{-8} \text{ cm}$. Calculate the molar mass of the element. (Given, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
Delh-2014
25. The density of copper is 8.95 g cm^{-3} . It has a face centered cubic structure. What is the radius of copper atom? (Atomic mass of Cu = 63.5 g mol^{-1} , $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
Delh-2014C
26. An element with density 11.2 g cm^{-3} forms a fcc lattice with edge length of $4 \times 10^{-8} \text{ cm}$. Calculate the atomic mass of the element. (Given, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
All India-2014
27. Iron has a body centered cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3} , use this information to calculate Avogadro's number. (Gram atomic mass of Fe = 55.84 g mol^{-1}).
Foreign-2014
28. Iron has a body centred cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.874 g cm^{-3} . Use this information to calculate Avogadro's number. (Atomic mass of iron = 56 g mol^{-1}).
All India-2012,2009;
Delh-2012, 2009; Foreign-2010 2010,2009
29. Explain how can you determine the atomic mass of an unknown metal if you know its mass, density and the dimensions and type of unit cell of its crystal?
All India-2011
30. Calculate the packing efficiency of a metal crystal for a simple cubic lattice.
All India-2011; Delh-2011C
31. Silver crystallizes in face centred cubic unit cell. Each side of the unit cell has a length of 409 pm. What is the radius of silver atom?
Foreign-2011, 2009; All India-2010,2009
32. Copper crystallises into fcc Lattice with edge length $3.61 \times 10^{-8} \text{ cm}$. Calculate the density of copper. (Atomic mass of Cu = 63.5 g mol^{-1} , $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
Delh-2010, 2009C

33. Chromium metal crystallizes in a body centred cubic lattice. The length of the unit cell edge is found to be 287 pm. Calculate the atomic radius of chromium.
Delh-2010C
34. The edge of the face centred cubic unit cell of aluminium is 404 pm. Calculate the radius of aluminium atom.
Delh-2010C
35. An element crystallizes in a bcc lattice with cell edge of 500 pm. The density of the element is 7.5 g cm^{-3} . How many atoms are present in 300 g of the element?
All India-2016
36. An alloy of gold and cadmium crystallizes with a cubic structure in which gold atoms occupy the corners and cadmium atoms fit into the face centres. Assign formula for this alloy.
All India-2011C
37. (i) In reference to crystal structure, explain the meaning of the coordination number.
(ii) What is the number of atoms in a unit cell of
(a) a face centred cubic structure?
(b) a body centred cubic structure?
Delh-2009C
38. What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy $\frac{2}{3}$ rd of octahedral voids?
All India-2015; Foreign-2015
39. What is the formula of a compound in which the element y forms ccp lattice and atoms of X occupy $\frac{1}{3}$ rd of tetrahedral voids?
Delhi- 2015
40. An element 'X' (At. mass = 40 g mol^{-1}) having f.c.c. structure, has unit cell edge length of 400 pm. Calculate the density of 'X' and the number of unit cells in 4 g of 'X'. ($N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
UP Board-2018
41. Analysis shows that FeO has a non-stoichiometric composition with formula $\text{Fe}_{0.95}\text{O}$. Give reason.
UP Board-2018
42. If the radius of octahedral void is r and radius of the atom in close packing is R. Write the relation between r and R.
Manipur Board-2018
43. Lithium metal has a body centred cubic lattice structure with edge length of edge unit cell 352 pm. Calculate the density of lithium metal. [Given: Atomic mass of Li = 7 g mol^{-1} , $N_A = 6.022 \times 10^{23} \text{ Atoms mol}^{-1}$]
Karnataka Board-2019
44. (a) An element having bcc geometry has atomic mass 60 g mol^{-1} . Calculate the density of Unit cell, if its edge length is 300 pm.
(b) Give two differences between Crystalline solids and Amorphous solids.
Punjab Board-2019
45. (a) An element with density 11.2 g cm^{-3} forms fcc lattice with edge length of $4 \times 10^{-8} \text{ cm}$. Calculate the atomic mass of the substance
(b) Define Unit cell and Paramagnetic substance.
Punjab Board-2019
46. A compound of X and Y crystallizes in the cubic structure in which Y atoms are at the corners and X atoms are at the alternate faces of the cube. Find the formula of the compound.
Punjab Board-2019
47. Elements A and B form a crystalline compound. In the crystal, atoms of element A form cubic closed packed structure and atoms of element B occupy $\frac{1}{3}$ rd of tetrahedral voids. Calculate the formula of the compound.
Manipur Board-2019
48. How much part of an atom of the primitive cubic unit cell actually belongs to a particular unit cell?
Rajasthan Board-2016
49. A compound forms hexagonal close packed (hcp) structure. What is the total number of voids in 0.5 mol if it? How many of these are tetrahedral void?
Assam Board-2012
50. An element having a face-centred cubic unit cell has a molar mass 60 g mol^{-1} and a cell edge of 400 pm. What is its density? [$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$].
Nagaland Board-2017

Section-C : Short Answer

1. An element crystallises in Face Centred Crystal [FCC] lattice. The edge length of the unit cell is 556 pm and it has density 1.55 g cm^{-3} . Calculate the atomic mass of the element. [Given : $N_A = 6.022 \times 10^{23}$]
Karnataka board 2023
2. Calculate number of particles in face centered cubic unit cell.
Rajasthan Board 2023
3. An element crystallizes in fcc lattice with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3} . Calculate the number of atoms in 108 g of the element.
CBSE-2019
4. (a) An element crystallises in bcc lattice with a cell edge of $3 \times 10^{-8} \text{ cm}$. The density of the element is 6.89 g cm^{-3} . Calculate the molar mass of the element. ($N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
(b) What type of semiconductor is obtained when
(i) Ge is doped with In ?
(ii) Si is doped with P ?
CBSE-2019

5. An element crystallizes in a fcc lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain 2×10^{24} atoms.
Delh-2016
6. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length $4.05 \times 10^{-8} \text{ cm}$. If its density is 2.7 g cm^{-3} , what is the nature of the cubic unit cell?
Delh-2015
7. An element X (molar mass = 60 g mol^{-1}) has a density of 6.23 g cm^{-3} . Identify the type of cubic unit cell, if the edge length of the unit cell is $4 \times 10^{-8} \text{ cm}$.
Foreign-2015
8. Silver crystallizes in fcc lattice. If edge length of the unit cell is $4.077 \times 10^{-8} \text{ cm}$, then calculate the radius of silver atom.
All India-2015C
9. Niobium crystallizes in body centered cubic structure. If its density is 8.55 g cm^{-3} , calculate the atomic radius of niobium, given its atomic mass is 934.
Delh-2013C
10. An element occurs in bcc structure. It has a cell edge length of 250 pm. Calculate the molar mass if its density is 8.0 g cm^{-3} . Also, calculate the radius of an atom of this element.
Delh-2013C
11. Silver crystallizes in face centred cubic (fcc) unit cell. If the radius of silver atom is 145 pm, what is the length of each side of the unit cell?
Foreign-2012
12. Tungsten crystallizes in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of tungsten atom?
Delh-2012
13. Copper crystallizes with face centred cubic unit cell. If the radius of copper atom is 127.8 pm, calculate the density of copper metal. (Atomic mass of Cu = 63.55 u, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
All India-2012
14. An element X crystallizes in fcc structure. 208 g of it has 4.2832×10^{24} atoms. calculate the edge of unit cell if density of X is 7.2 g cm^{-3} .
Delh-2012C
15. The density of lead is 11.35 g cm^{-3} and the metal crystallises with fcc unit cell. Estimate the radius of lead atom (Atomic mass of lead = 207 g mol^{-1} and $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
Delh-2011
16. Aluminium crystallizes in a cubic close packed structure. Radius of the atom in the metal is 125 pm.
(i) What is the length of the side of the unit cell?
(ii) How many unit cells are there in 1 cm^3 of aluminium?
Foreign-2011
17. Silver crystallizes in face centred cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom (Assume, the atoms just touch each other on the diagonal across the face of the unit cell. That is each face atom is touching the four corner atoms).
Delh-2011
18. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral, there are 4Ca^{2+} ions and 8F^- ions and that Ca^{2+} ions are arranged in a fcc lattice. The F^- ions fill all tetrahedral holes in the face centred cubic lattice of Ca^{2+} ions. The edge of the unit cell is $5.46 \times 10^{-8} \text{ cm}$ in length. The density of the solid is 3.18 g cm^{-3} . Use this information to calculate Avogadro's number (Molar mass of $\text{CaF}_2 = 78.08 \text{ g mol}^{-1}$).
Delh-2010
Foreign-2010
19. The density of copper metal is 8.95 g cm^{-3} . If the radius of copper atom is 127.8 pm, is the copper unit cell a simple cubic, a body centred cubic or face centred cubic structure? (Atomic mass of Cu = 63.54 g mol^{-1} and $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
Delh-2010; All India-2010
20. Copper crystallizes in face centred cubic lattice and has density of 8.930 g cm^{-3} at 293 K. Calculate the radius of copper atom. (Atomic mass of Cu = 63.55 u, $N_A = 6.02 \times 10^{23}$).
All India-2010C
21. Silver crystallizes in fcc lattice. If the edge length of the unit cell is $4.07 \times 10^{-8} \text{ cm}$ and the density of the crystal is 10.5 g cm^{-3} , calculate the atomic mass of silver. ($N_A = 6.02 \times 10^{23} \text{ atom mol}^{-1}$).
All India-2008, 2010
Foreign-2008
22. Silver crystallises in fcc lattice. If the edge length of the cell is $4.077 \times 10^{-8} \text{ cm}$. and density is 10.5 gm cm^{-3} then calculate the atomic mass of silver.
Uttarakhand Board-2020
- 23.(i) NaCl has fcc structure Calculate the number of NaCl units in a unit cell of NaCl.
(ii) Calculate the density of NaCl, if edge length of NaCl unit cell is 564 pm. [Molar mass of NaCl = 58.5 g/mol].
Kerala Board-2013
24. What is the ratio of octahedral holes to the number of anions in hexagonal closed packed structure ?
Maharashtra Board-2019
25. An element crystallises as FCC with density 2.8 g cm^{-3} . Its unit cell having edge length $4 \times 10^{-8} \text{ cm}$. Calculate the molar mass of the element . (Given $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
Kerala Board-2018

26. Lead sulphide has face centered cubic crystal structure. If the edge length of the unit cell of lead sulphide is 495 pm, calculate the density of the crystal, (at, wt, Pb = 207, S = 32)
ISC Board-2017
27. Silver metal crystallises with a face centred cubic lattice. The length of the core of unit cell is found to be 4.077×10^{-8} cm. Calculate the atomic radius and density of silver.
Jharkhand Board-2020
28. What is the formula of a compound in which the element Y forms cubic closed packed (ccp) lattice and atoms of X occupy 1/3rd of tetrahedral voids?
Assam Board-2019
29. If the radius of the octahedral void is 'r' and radius of the atoms in closed packing is 'R', derive relation between 'r' and 'R'.
Nagaland Board-2020
30. An element has bcc structure with cell edge of 288 pm. The density of the element is 7.2 g cm^{-3} . How many atoms are present in 208 g of the element?
Meghalaya Board-2019
31. Silver forms c.c.p. lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver. (Atomic mass = 107.9 u)
Meghalaya Board-2021
32. The edge length of a face centered cubic cell of an ionic substance is 508 pm. If the radius of the cation is 110 pm, then calculate the radius of the anion.
Assam Board-2023
33. Silver forms ccp lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver. (Atomic mass = 107.9u).
Nagaland Board-2021
34. Calculate the value of Avogadro's number from the data : density of NaCl = 2.165 g cm^{-3} , distance between Na^+ and Cl^- in NaCl crystal is 281 pm (molar mass of NaCl is 58.5 g mol^{-1}).
Nagaland Board-2018

Section-D : Case Based Study

1. (a) An element having atomic mass 80 g adopts face centre cubic structure. Calculate the number of unit cells present in 8 g of the element.
(b) NaCl crystal becomes yellowish when heated with sodium vapour. Explain what effect would be observed on the density of the crystal?
Manipur Board 2023

Section-E : Long Answer

1. (i) An element has atomic mass 93 g mol^{-1} and density 11.5 g cm^{-3} . If the edge length of its unit cell is 300 pm, identify the type of unit cell.

(ii) Write any two differences between amorphous solids and crystalline solids.

Delh-2017

2. Silver crystallizes in fcc structure. If edge length of unit cell is 400 pm, calculate density of silver (Atomic mass of Ag = 108).
Write a note on Haloform reaction.
Maharashtra Board-2023
3. X-ray diffraction studies show that copper crystallizes in a fee lattice with edge length of 3.608×10^{-8} cm. If density of copper is 8.92 g cm^{-3} , calculate the atomic mass of copper.
Assam Board-2014
4. Calculate the value of Avogadro number (N_0) from following data:
(a) Density of NaCl = 2.165 g cm^{-3}
(b) Distance between Na^+ & Cl^- in NaCl = 281 pm.
Haryana Board-2017
5. Calculate atomic radius of elementary silver which crystallises in face-centered cubic lattice with unit cell edge length 4.086×10^{-10} m.
Assam Board-2016
6. Aluminium crystallises as face-centered cubic lattice and it has a density of $2.7 \times 10^3 \text{ kg m}^{-3}$. Calculate edge length of the unit cell. Given atomic mass of aluminium equal to 27.0 amu.
Assam Board-2016
7. Copper crystallises into a fcc lattice. Its edge length is 3.61×10^{-8} cm. Calculate the density of copper (at mass of copper = 63.5u ; $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
Assam Board-2012

H. Imperfections in Solids

Section-A : Multiple Choice Questions

1. The incorrect statement about interstitial compounds is
(a) They are chemically reactive.
(b) They are very hard.
(c) They retain metallic conductivity.
(d) They have high melting point.
CBSE-2020

Ans. (a)

2. What type of defect is shown by NaCl?
(a) Frenkel defect
(b) Schottky defect
(c) Both Frenkel and Schottky defect
(d) Impurity defect
CBSE-2021

Ans. (b)

3. Which of the following will create F-centre in a crystal?
(a) ZnS (b) NaCl
(c) AgCl (d) AgBr
CBSE-2021

Ans. (b)

4. The stoichiometric defect that decreases the density of an ionic solid is
- (a) Frenkel defect (b) Interstitial defect
(c) Metal excess defect (d) Schottky defect
- Goa Board-2023, 2019**

Ans. (d)

5. Which of the following has Frenkel defects?
- (a) AgBr (b) NaCl
(c) Graphite (d) Diamond
- Haryana Board -2016**

Ans. (a)

6. Due to which defect the density of crystal decreases?
- (a) F-centre (b) Schottky
(c) Interstitial (d) Frenkel
- Gujarat Board-2016**

Ans. (b)

7. In which of the following defect some of the cations are arranged in the interstitial site?
- (a) Schottky defect (b) Metal excess defect
(c) Frenkel defect (d) Interstitial defect
- Gujarat Board-2019**

Ans. (c)

8. When cation of higher oxidation. State is added in ionic solid substance, then which type of defect is formed in it?
- (a) Schottky defect (b) Impurity defect
(c) Frenkel defect (d) Metal Excess defect
- Gujarat Board-2020**

Ans: (b)

9. Which defects does not affect density of the crystal?
- (a) Schottky defects (b) Interstitial defects
(c) Frenkel defects (d) None of the above
- Haryana Board-2016**

Ans. (c)

10. The defect in which the crystal lattice have the vacancy of one cation and one anion is:
- (a) Ionic defect
(b) Atomic defect
(c) Frankel defect
(d) Schottky defect
- MP Board-2018**

Ans. (d)

11. For increasing of electro-conductivity in a solid crystal, mixing of impurities is known as:
- (a) Schottky defect (b) Frenkel defect
(c) Doping (d) Electronic-Defect
- MP Board-2016**

Ans. (a)

12. Which kind of point defect is found in KCl crystal?
- (a) Frenkel (b) Schottky
(c) Linear (d) Impurity
- MP Board-2013**

Ans. (b)

13. The correct example of "Frenkel Defect" is:
- (a) NaCl (b) CsCl
(c) KCl (d) AgCl
- MP Board-2012**

Ans. (d)

14. The appearance of colour in solid alkali metal halides is generally due to
- (a) Schottky defect (b) Frenkel defect
(c) Interstitial defect (d) F-centres
- Meghalaya Board-2021
Nagaland Board-2021**

Ans. (d)

15. The presence of F-centres in a crystal makes it
- (a) conducting (b) non-conducting
(c) coloured (d) colourless
- Nagaland Board-2017**

Ans. (c)

Section-B : Very Short Answer

- (a) What type of stoichiometric defect is shown by NaCl and why?
(b) Calculate the efficiency of packing in case of a metal crystal for face centred cubic unit cell.

CBSE-2019
- Write two differences between Frankel and Schottky defect.

Gujarat Borad-2022 (July)
- KBr crystal does not show Frenkel defect. Give reason

Manipur Board 2020
- The chemical formula of ionic solid showing Frenkel and Schottky both types of point defect is _____.

Rajasthan Board 2022
- What is Schottky defect? What is the effect of the presence of Schottky defect on the density of lattice?

UP Board 2023
- Diferentiate between Schottky defect and Frenkel defect.

Uttarakhand Board 2023
- Out of KCl and AgCl, which one shows Schottky defect and why?

CBSE-2019
- What type of stoichiometric defect is shown by ZnS and why?

CBSE-2019
- Out of NaCl and AgCl, which one shows Frenkel defect and why?

CBSE-2019
- Name the defect in the following crystal :

$$\begin{matrix} X^+ & Y^- & X^+ & Y^- \\ Y^- & \square & Y^- & X^+ \\ X^+ & \square & X^+ & Y^- \\ Y^- & X^+ & Y^- & X^+ \end{matrix}$$

CBSE-2019

11. What type of defect is shown by NaCl in
(a) stoichiometric defects, and
(b) non-stoichiometric defects ?
CBSE-2019
12. Define Frenkel defect in solid crystal.
ISC Board-2014
13. What is Schottky defect in a solid?
ISC Board-2013
14. Define piezoelectricity and give one use of piezoelectric crystals.
ISC Board-2011
15. Frenkel defect does not change the density of the ionic crystal whereas, Schottky defect lowers the density of ionic crystal. Give a reason.
ISC Board-2017
16. (i) What are F-centres in an ionic crystal?
(ii) Why are crystals having F-centres paramagnetic?
ISC Board-2012
17. Account for the following.
(i) Schottky defects lower the density of related solids.
(ii) Conductivity of silicon increases on doping it with phosphorus.
All India-2013
18. What are F-centres?
All India-2008C
19. (i) Write the type of magnetism observed when the magnetic moments are oppositely aligned and cancel out each other.
(ii) Which stoichiometric defect does not change the density of the crystal?
Delh-2014 or All India-2014 (ii)
20. Examine the given defective crystal.
- | | | | | |
|----------------|----------------|----------------|----------------|----------------|
| A ⁺ | B ⁻ | A ⁺ | B ⁻ | A ⁺ |
| B ⁻ | | B ⁻ | A ⁺ | B ⁻ |
| A ⁺ | B ⁻ | A ⁺ | | A ⁺ |
| B ⁻ | A ⁺ | B ⁻ | A ⁺ | B ⁻ |
- Answer the following questions.
(i) What type of stoichiometric defect is shown by the crystal?
(ii) How is the density of the crystal affected by this defect?
(iii) What type of ionic substances show such defect?
All India-2014; Delh-2014
21. (i) What type of non-stoichiometric point defect is responsible for the pink colour of LiCl?
(ii) What type of stoichiometric defect is shown by NaCl?
Delh-2014
22. (i) What type of stoichiometric defect is shown by KCl and why?
(ii) What type of semiconductor is formed when silicon is doped with As?
- (iii) Which one of the following is an example of molecular solid?
CO₂ or SiO₂
- (iv) What type of substance would make better magnets, ferromagnetic or ferrimagnetic?
Foreign-2014
23. Give an example of an ionic compound which shows Frenkel defect.
All India-2010C
24. Why is Frenkel defect not found in pure alkali metal halides?
All India-2010C
25. Which point defect in its crystal units alters the density of a solid?
Delh-2009
26. Which point defect in crystals of a solid does not change the density of the solid?
Delh-2010, 2009
27. What type of stoichiometric defect is shown by AgBr and AgI?
All India-2012
28. What type of defect can arise when a solid is heated?
All India-2012C
29. What type of stoichiometric defect is shown by NaCl?
Delh-2014C
30. What type of stoichiometric defect is shown by AgCl?
All India-2015C; Delh-2013
31. Explain metal excess defect.
Gujarat Board-2016
32. Why is Frenkel defect not shown by alkali metal halides? Name the ionic compound which can show this type of defect.
Manipur Board-2018
33. What is Schottky defect?
Manipur Board-2017
34. What is Frenkel defect? How does it affect density of the solid?
Karnataka Board-2018
35. What types of stoichiometric defects are shown by CsCl and AgBr ?
NIOS Board-2015
36. Explain Schottky defect with a suitable example.
NIOS Board-2012
37. An oxide of chromium is found to have the following composition Cr = 68.4% and O = 31.6%. Determine the empirical formula of the compound.
[Atomic mass : Cr = 52 g mol⁻¹; O = 16.0 g mol⁻¹]
38. Write short note on Frenkel defect.
Gujarat Board-2019
39. What type of stoichiometric defect is shown by ZnS ?
Haryana Board-2019

40. What is Schottky defect ?
Haryana Board-2021
41. Draw neat labelled diagram of the stoichiometric defect observed in ionic solids having ions of similar size. What is the effect of this defect on the density of the crystal?
Goa Board-2018
42. Which type of Stoichiometric defect is shown by the following solids?
Karnataka Board-2016
43. Write the consequences of Schottky defect with reasons.
Maharashtra Board-2022
44. Explain the following terms :
(i) Substitutional impurity defect
(ii) Interstitial impurity defect
Maharashtra Board-2023
45. Write an ionic compound which can exhibit both Schottky and Frenkel defect.
Kerala Board-2022
46. What is meant by imperfections in solids ? What is the effect of interstitial defect on the density of a solid ?
Manipur Board-2019
47. A compound formed by elements A and B has the A atoms forming a ccp lattice and the B atoms occupy half of the tetrahedral voids. What is the co-ordination number of B atoms in the crystal ?
Manipur Board-2022
48. Derive Bragg's equation.
Andhra Pradesh Board-2016
49. Presence of excess Sodium makes NaCl crystal coloured. Explain on the basis of crystal defects.
Kerala Board-2016
50. What is Schottky defect?
Andhra Pradesh Board-2021
51. Derive Bragg's equation .
Andhra Pradesh Board-2021
52. Dislocation of which ion in "Ag Br" develops Frenkel defect?
Rajasthan Board-2016
53. When does Frenkel defect arise? Give reason.
Rajasthan Board-2011
54. What is metal deficiency defect? Given an example.
Tamilnadu Board, Sep.-2016
55. Which point defect lowers the density of a crystal?
Assam Board-2015, 2013
56. F-centers give colour to crystal due to whose presence?
MP Board-2018
57. Due to Schottky defect, density of a crystal
58. Explain Schottky defect.
J & K board-2023
59. Why is Frenkel defect not found in pure alkali metal halides ?
Meghalaya Board-2018

Section-C : Short Answer

1. A metal crystallizes in face centered cubic unit cell with $a = 0.560$ nm. Calculate the density of the metal if it contains 0.1% Schottky defects. Given: atomic mass of metal = 40 g mol^{-1}
All India-2008C
2. Match the pairs :
- | "A" | | "B" | |
|-----|-----------------|-------|-------------------|
| (A) | Schottky defect | (i) | ZnS |
| (B) | Frankel defect | (ii) | NaCl |
| (C) | Paramagnetism | (iii) | O ₂ |
| (D) | Zinc blende | (iv) | Cu ₂ O |
| (E) | Cuprite | (v) | AgCl |
- MP Board 2020
3. Germanium is an intrinsic semiconductor. How can you increase its conductivity?
Manipur Board 2023
4. Explain P-type semiconductor by one example.
Rajasthan Board 2023
5. Explain the following giving a suitable example in each case.
(i) Frenkel defect
(ii) F-centres
(iii) Paramagnetism
Foreign-2008
6. Explain the following terms with suitable examples.
(i) Schottky defect
(ii) Ferromagnetism
Delh-2008C
7. Account for the following:
(i) Fe₃O₄ is ferromagnetic at room temperature but becomes paramagnetic at 850 K.
(ii) Zinc oxide on heating becomes yellow.
(iii) Frenkel defect does not change the density of AgCl crystals.
All India-2008C
8. How would you account for the following?
(i) Frenkel defects are not found in alkali metal halides.
(ii) Schottky defects lower the density of related solids.
(iii) Impurity doped silicon is semiconductor.
Delh-2008
9. Examine the given defective crystal:
- | | | | | |
|----------------|----------------|----------------|----------------|----------------|
| X ⁺ | Y ⁻ | X ⁺ | Y ⁻ | X ⁺ |
| Y ⁻ | O | Y ⁻ | X ⁺ | Y ⁻ |
| X ⁺ | Y ⁻ | X ⁺ | O | X ⁺ |
| Y ⁻ | X ⁺ | Y ⁻ | X ⁺ | Y ⁻ |
- Answer the following questions:
(i) Is the above defect stoichiometric or non-stoichiometric?
(ii) Write the term used for this type of defect. Give an example of the compound which shows this type of defect.
(iii) How does this defect affect the density of the crystal?
All India-2015

10. Define the following:
(i) Schottky defect
(ii) Frenkel defect
(iii) F-centres
Delh-2015
11. How are the following properties of crystals affected by Schottky and Frenkel defects?
(i) Density
(ii) Electrical conductivity
Delh-2010, 2009C
12. Explain Schottky and Frenkel defects.
Telangana Board-2023
Tamil Nadu Board-2015
13. What are stoichiometric and non-stoichiometric defects? Name the stoichiometric defect found in ionic compounds which does not change the density. How does it arise? What type of ionic compounds shows this defect?
NIOS Board-2015
14. (i) Which type of stoichiometric defects is shown by AgBr crystal ?
(ii) Chromium (atomic mass = 52) metal has body centred cubic structure. The radius of chromium atom is 124.3 pm. Calculate the density of chromium metal.
West Bengal Board-2019
15. Define the following with suitable examples :
(a) F-centres
(b) Antiferromagnetism
Haryana Board-2019
16. Explain the following :
(a) Schottky defect
(b) Frenkel defect
Chhattisgarh Board-2022
17. What are point defects? Explain the non-stoichiometric point defects in ionic crystals.
Kerala Board-2019
18. Draw a neat labelled diagram to show Frenkel defect and write any one condition for an ionic solid to show this defect.
Goa Board-2019
19. Frenkel defect does not change the density of the ionic crystal whereas, Schottky defect lowers the density of ionic crystal. Give a reason.
ISC Board-2017
20. Schottky defect and Frenkel defect are two types of stoichiometric point defects shown by ionic solids. Give two points of difference between Schottky defect and Frenkel defect.
Kerala Board-2020
21. Explain the following.
(a) Frenkel defect.
(b) Ferromagnetism.
Assam Board-2014
22. Explain the following terms with examples :
(i) Metal excess defects
(ii) Metal deficiency defects
Haryana Board -2016
23. Define the following terms:
(a) F-Centre
Haryana Board-2018
24. Write any two differences between Schottky and Frenkel defects.
Rajasthan Board-2019
25. On the basis of nature of ionic solids compare Frenkel defect with Schottky defect.
Rajasthan Board-2014
26. Give the names of defects found in AgBr crystal. Explain these defects with reason.
Rajasthan Board-2010
27. Explain Frenkel defect.
Gujarat Board-2017
28. Describe Schottky defect in crystals.
J&K Board-2020
29. Differentiate between Schottky and Frenkel defect.
Jharkhand Board-2023

Section-E : Long Answer

- Give reasons
(i) In stoichiometric defects, NaCl exhibits Schottky defect and not Frenkel defect.
(ii) Silicon on doping with phosphorus forms n- type semiconductor.
(iii) Ferrimagnetic substances show better magnetism than antiferromagnetic substances.
Dehli 2017
- What is point defect? discuss Schottky defect.
Haryana Board-2017
- Explain Frenkel defect with an example.
Haryana Board-2018
- Explain Schottky defect with an example.
Haryana Board-2018
- Write about the most common point defects.
Tamil Nadu Board-March, 2016
- Write four differences of Schottky and Frenkel defects.
Gujarat Board-2018
- Explain the term Schottky defects with an example.
Haryana Board-2016

I. Electrical and Magnetic Properties

Section-A : Multiple Choice Questions

- Which oxide behave like metallic or insulator depending on temperature?
(a) MgO (b) CrO₂
(c) TiO₃ (d) SiO₂
Gujarat Board 2023 (March)

Ans. (c)

2. Which compound has following schematic alignment of magnetic moments?



- (a) CrO_2 (b) MnO
(c) Fe_3O_4 (d) H_2O

Gujarat Board-2022 (July)

Ans. (d)

3. Which one of the following has the highest dipole moment?

- (a) CHCl_3 (b) CH_3Cl
(c) CH_2Cl_2 (d) CCl_4

Haryana Board 2023

Ans. (b)

4. A ferromagnetic substance becomes a permanent magnet when it is placed in a magnetic field because _____

- (a) All the domains get oriented in the direction of magnetic field.
(b) All the domains get oriented in the direction opposite to the direction of magnetic field.
(c) Domains get oriented randomly.
(d) Domains are not affected by magnetic field.

Manipur Board-2017

Ans. (a)

5. The crystals which are good conductors of heat and electricity are:

- (a) Ionic crystals (b) Molecular crystals
(c) Metallic crystals (d) Covalent crystals

Tamil Nadu Board-2016

Ans. (c)

6. Which of the following will be paramagnetic

- (a) Cr^{3+} (b) Na^+
(c) O_2 (d) Cu^+

Gujarat Board-2019

Ans. (a)

7. Which of the following substance is ferromagnetic?

- (a) CuCl_2 (b) CrO_2
(c) NaCl (d) MnO

Gujarat Board-2016

Ans. (b)

8. Which of the following substance is antiferromagnetic?

- (a) MnO (b) CrO_2
(c) Fe_3O_4 (d) NaCl

Gujarat Board-2017

Ans. (a)

9. Which compound becomes paramagnetic on heating?

- (a) C_6H_6 (b) MnO
(c) Fe_3O_4 (d) NaCl

Gujarat Board-2018

Ans. (c)

10. From the following which type of magnetic substance magnetite is known?

- (a) Diamagnetic (b) Ferromagnetic
(c) Antiferromagnetic (d) Ferrimagnetic

Gujarat Board-2019

Ans. (d)

11. Which of the following is ferromagnetic?

- (a) Calcium metal (b) Iron metal
(c) Sodium metal (d) Zinc metal

MP Board-2013

Ans. (b)

12. Silicon is:

- (a) Good conductor (b) Bad conductor
(c) Semiconductor (d) Ore

MP Board-2013

Ans. (c)

13. To get p-type semiconductor, impurity to be added to silicon should have which of the following numbers of valence electrons?

- (i) 2 (ii) 3
(iii) 1 (iv) 5

Meghalaya Board-2018

Ans. (b)

Section-B : Very Short Answer

- Compare paramagnetism and diamagnetism.
Rajasthan Board 2022
- Why conductivity of silicon increases on doping with phosphorus?
CBSE-2019
- What would be the nature of solid if there is no energy gap between Valence band and Conduction band?
CBSE-2019
- What are semiconductors? What is the effect of increasing temperature on the conductivity of a semiconductor?
ISC Board-2011
- Diamond is hard and a bad conductor of electricity while graphite is soft and a good conductor of electricity. Explain, state the hybridisation of carbon in both substances.
ISC Board-2002
- Explain by giving reasons why ionic solids conduct electricity in molten state but not in solid state.
ISC Board-2014
- Explain the following terms with one suitable example of each.
(i) Ferromagnetism
(ii) Paramagnetism
Delh-2010C
- Describe the two main types of semiconductors and contrast their conduction mechanism.
All India-2009C

9. (i) What change occurs when AgCl is doped with CdCl₂?
(ii) What type of semiconductor is produced when silicon is doped with boron?
All India-2013
10. If NaCl is doped with 10⁻³ mole per cent SrCl₂, What will be the concentration of cation vacancies?
(N_A = 6.02 × 10²³ mol⁻¹)
All India-2013C
11. Explain the following terms with suitable example of each.
(i) Ferromagnetism
(ii) Anti-ferromagnetism
Delh-2011C
12. In terms of band theory, explain the difference between a conductor and a semiconductor and give one suitable example for each.
All India-2011C
13. What type of substances exhibit anti-ferromagnetism?
Delh-2008
14. What type of alignment in crystals makes them ferromagnetic?
Foreign-2008
15. Name an element with which silicon should be doped to give n-type semiconductor.
Delh-2008C
16. What type of semiconductor is obtained when silicon is doped with arsenic?
All India-2010
17. What is meant by intrinsic semiconductor?
Foreign-2011
18. What is meant by anti-ferromagnetism?
All India-2014C
19. What type of substances would make better permanent magnets, ferromagnetic or ferromagnetic?
Delh-2013
20. What are n-type semiconductors?
All India-2012
21. What is meant by 'doping' in a semiconductor?
Delh-2012
22. How may the conductivity of an intrinsic semiconductor be increased?
All India-2012
23. Which stoichiometric defect (point defect) in crystals increases the density of a solid?
All India-2012
Delh-2009, 2011
24. What is meant by the term forbidden zone in reference to band theory of solids?
Foreign-2012
25. Write the type of magnetism observed when the magnetic moments are aligned in parallel and anti-parallel directions in unequal numbers.
All India-2014
26. How do metallic and ionic substances differ in conducting electricity?
All India-2009
27. What is a semiconductor? What are n-type and p-type semiconductors?
Odisha Board-2023
28. Which type of magnetic substances are used in permanent magnets? Write their schematic alignment of magnetic moments (domains).
Karnataka Board-2020
29. Which type of extrinsic semiconductor is formed when silicon is doped with phosphorus? Mention the major charge carrier in it.
Karnataka Board-2019
30. What is doping? Explain n-type and p-type semi-conductors.
Andhra Pradesh Board-2018
31. (a) What is semiconductor? Mention the two main types of semiconductor.
(b) Sodium crystallizes in a body-centred cubic (bcc) unit cell. Calculate the approximate number of unit cells in 9.2 g of sodium. (Atomic mass of Na = 23 u).
Assam Board-2013
32. Fill in the blanks:
(b) Substance which are attracted in Magnetic field are called
33. Fill in the blanks:
(i) The process of adding minute amount of impurity in an element or compound is called
- Section-C : Short Answer**
1. Explain n-type semi-conductor.
Rajasthan Board 2022
2. With the help of suitable diagrams on the basis of band theory, explain the difference between (i) a conductor and an insulator.
(ii) a conductor and a semiconductor.
All India-2008C
3. Explain the following properties giving suitable examples.
(i) Ferromagnetism
(ii) Paramagnetism
(iii) Ferrimagnetism
Delh-2008
Foreign-2008
4. (i) What type of semiconductor is obtained when silicon is doped with boron?
(ii) What type of magnetism is shown in the following alignment of magnetic moments?
(iii) What type of point defect is produced when AgCl is doped with CdCl₂?
All India-2013

5. What is a semiconductor? Describe the two main types of semiconductors and explain mechanism for their conduction.
Delh-2008, 2008C
All India-2008, 2008C
6. (i) Based on the nature of intermolecular forces, classify the following solids: Sodium sulphate, hydrogen
(ii) What happen when CdCl_2 is doped with AgCl?
(iii) Why do ferromagnetic substances show better magnetism than antiferromagnetic substances?
All India-2017
7. Define the following with suitable examples
(a) Anti-ferromagnetism
(b) Frenkel defect
Andhra Pradesh Board-2020
8. Explain in short the Band theory in Metals.
Gujarat Board-2019
9. Explain ferromagnetic substance and anti-ferromagnetic substance.
Jharkhand Board-2019
10. What is paramagnetism? Give one example.
Haryana Board-2017
11. What are semiconductors? How are they classified?
Haryana Board-2018
12. Define Diamagnetic and Ferromagnetic substance.
Haryana Board-2018
13. Electric conductivities of solid (X) is $10^4 - 10^7 \text{ ohm}^{-1} \text{ m}^{-1}$ and solid (Y) is $10^{-20} - 10^{-10} \text{ ohm}^{-1} \text{ m}^{-1}$, identified solid (X) and solid (Y) and write their name.
Rajasthan Board-2017
14. Which type of semiconductor is obtained by doping boron with silicon? Explain.
Rajasthan Board-2015
15. Explain insulator and semiconductor on the basis of conduction of electricity.
Rajasthan Board-2013
16. Give the diagram of n-type semiconductor.
Rajasthan Board-2010
17. (b) Define semiconductor. Classify each of the following as being either a p-type or an n-type semiconductor:
(i) Ge doped with In
(ii) B doped with Si
Assam Board-2020
18. What is meant by ferrimagnetism? Give any two examples.
Gujarat Board-2018
19. Give reason: Electrical conductivity of silicon increases with increase in temperature.
Gujarat Board-2019
20. Define semiconductors. Name the kind of semiconductor formed when Si is doped with Ga.
Assam Board-2016
20. (a) Mention the type of semiconductor, (n-type or p-type) when silicon doped with phosphorus.
(b) Gold metal crystallizes in a face-centred cubic unit cell (fcc). Determine the density of gold. (Atomic mass of gold = 179 u, atomic radius = 0.144 nm, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
Assam Board-2013
21. Define the following properties of solids:
(a) Paramagnetism
(b) Diamagnetism
(c) Ferromagnetism
J & K Board-2021

Section-E : Long Answer

1. Describe the two main types of semi-conductors and contrast their conduction mechanism.
Telangana Board-2017
2. Mention the type of Semiconductor when Si doped with P. A solid compound XY has NaCl structure. If the radius of the cation (X^+) is 100 pm then calculate the radius of the anion(Y^-).
Assam Board-2022
3. What are semiconductors? How electrical conductivity of semiconductors vary with temperature? Give one example of intrinsic semiconductors.
Assam Board-2022
4. What are superconductors? Write about their uses.
Tamil Nadu Board-2011
5. (i) What type of magnetic substances are used to make permanent magnets?
(ii) Draw the schematic alignment of magnetic moments in ferromagnetic and ferrimagnetic substances.
Kerala Board-2021
6. Explain the following:
(a) Ferromagnetism
(b) Paramagnetism
Chhattisgarh Board-2020
7. Explain the following:
(a) Tetrahedral voids
(b) Doping
Chhattisgarh Board-2020
8. Give applications of n-type and p-type semiconductors.
Haryana Board-2018
9. On the basis of molecular band theory, explain conductors and semiconductors.
Rajasthan Board-2010
10. What are semiconductors? How electrical conductivity of semiconductors vary with temperature? Give one example of intrinsic semiconductor.
Assam Board-2018
11. What are paramagnetism and ferromagnetism? What type of substances would make better permanent magnets-ferromagnetic or ferrimagnetic?
Assam Board-2018

A. Types of Solutions

Section-A : Multiple Choice Questions

1. If 5 gm NaOH is dissolved in 450 ml solution, molarity of solution is.....
[Na = 23, O = 16, H = 1 g mol⁻¹]

(a) 27.8 M (b) 0.278 M
(c) 2.78 M (d) 278 M

Gujarat Board-2021

Ans. (b)

2. In which solution, solute is liquid and solvent is gas?

(a) Chloroform mixed with nitrogen gas
(b) Ethanol dissolved in water
(c) Camphor in nitrogen gas
(d) Solution of hydrogen in palladium

Gujarat Board-2021

Ans. (a)

3. The enthalpy change for the chemical reaction $\text{H}_2\text{O}_{(s)} \rightarrow \text{H}_2\text{O}_{(l)}$ is called enthalpy of —.

(a) vapourisation (b) fusion
(c) combustion (d) sublimation

Maharashtra board-2022

Ans. (a)

4. Bredig's arc method is used to prepare which of the following sol?

(a) Silver sol (b) Gelatine sol
(c) CdS sol (d) As₂S₃ sol

Kerala Board-2020

Ans. (a)

5. Molarity of 900 gm of water is:

(a) 50 M (b) 55.5 M
(c) 5 M (d) None of these

Haryana Board-2017

Ans. (b)

6. Isotonic solution are the solutions having same:

(a) Concentration (b) Osmotic pressure
(c) Surface tension (d) Viscosity

Haryana Board-2018

Ans. (b)

7. Choose the correct answer:

When temperature of a solution increases then—

(a) Molarity decreases and molality increases
(b) Molality decreases and molality increases
(c) No change occur for both molarity and molality
(d) Molarity decreases and no change in molality.

Assam Board-2020

Ans. (d)

8. Which of the following aqueous solution has highest boiling point?

(a) 0.1 m NaCl (b) 0.2 m Ba(NO₃)₂
(c) 0.01 m Na₃PO₄ (d) 0.03 m KNO₃

Gujarat Board-2019

Ans. (b)

9. Calculate Molarity (M) for the solution of 0.1 molal (m) NaOH solution whose density is 1.25 g.mL⁻¹.

(a) 0.135 M (b) 0.125 M
(c) 0.129 M (d) 0.100 M

Gujarat Board-2020

Ans. (b)

10. Which of the following concentration of solution depends on temperature?

(a) molality (b) molarity
(c) mass% (d) mole fraction

Assam Board-2017

Ans. (b)

11. No. of moles of solute present in 1000 gm of solvent is known as:

(a) Normality (b) Molality
(c) Molarity (d) Mole fraction

MP Board-2012

Ans. (b)

12. Liquid in Liquid colloidal system are called

(a) aerosols (b) foams
(c) gels (d) emulsion

Nagaland Board-2020

Ans. (d)

13. Which of the following is aerosol?

(a) Somke (b) Soap lather
(c) Milk (d) Butter

Jharkhand Board-2023

Ans. (a)

14. The process of setting of colloidal particles is called

(a) electrophoresis (b) peptization
(c) coagulation (d) dialysis

Jharkhand Board-2023

Ans. (c)

15. Fog is an example of colloidal system of

(a) liquid dispersed in gas
(b) gas dispersed in gas
(c) solid dispersed in gas
(d) solid dispersed in liquid

Nagaland Board-2018

Ans. (a)

Section-B : Very Short Answer	
1. What are isotonic solutions? Haryana Board 2023	22. What is Osmosis? What are isotonic solutions? Write the biological importance of osmotic pressure. Chhattisgarh Board-2021
2. (a) Write three differences between Lyophobic sol and Lyophilic sol. CBSE-2022	23. What is formalin ? Chhattisgarh Board-2021
3. Write two differences between an ideal solution and a non-ideal solution. CBSE-2019	24. Calculate the molarity of a solution containing 1.0g of NaOH in 250 mL solution. Assam Board-2014
4. What are isotonic solutions? All India 2014, 12	25. What are Isotonic solutions? Given examples. Andhra Pradesh Board-2021
5. What is difference between diffusion and effusion? NIOS Board-2021	26. Number of moles of the solute per kilogram of the solvent is (a) Mole fraction (b) Molality (c) Molarity (d) Molar mass Kerala Board-2016
6. What is Binary Solution? Karnataka Board-2014	27. Write definition of azeotropic mixture. Rajasthan Board-2019
7. Ornamental gold containing copper is an example for what type of solution? Karnataka Board-2016	28. What is the relation of bond order with bond energy and the stability of a bond? Rajasthan Board-2011
8. Name the process usually employed for the purification of Nickel. Karnataka Board-2015	29. Define the following terms: (iii) Mole fraction Assam Board-2020
9. Mention the enthalpy of mixing ($\Delta_{\text{mix}}H$) value to form an ideal solution. Karnataka Board-2014	30. Define the terms: (a) Solute (b) Solution Haryana Board-2016
10. What are cohesive and adhesive forces? How do they govern the wetting and non-wetting properties of liquids? NIOS Board-2016	31. Give the definition of solubility of a substance. Assam Board-2018
11. How is a sol different from an emulsion ? NIOS Board-2015	32. Give one example each of oil in water emulsion and water in oil emulsion. Meghalaya Board-2018
12. Differentiate between lyophilic sols and lyophobic sols. NIOS Board-2014	Section-C : Short Answer
13. Differentiate between diffusion and effusion. NIOS Board-2012	1. Write three difference between lyophobic sol and lyophilic sol. CBSE-2020
14. Among Cheese, cloud, smoke, is Gel. Haryana Board-2022	2. Outer hard shells of two eggs are removed one of the egg is placed in pure water and the other is placed in saturated solution of sodium chloride. What will be observed and why? All India 2010C
15. Define Azeotrope mixture. Haryana Board-2019	3. Define molality of a solution. Assam Board-2022
16. What is observed when electric current passed through a colloidal sol. Haryana Board-2021	4. (a) What are Isotonic, Hypotonic and Hypertonic solution? Uttarakhand Board-2020
17. Give an example for liquid solution in which solute is gas. Karnataka Board-2015	5. What is solid solution? Explain their type with illustration. Gujarat Board-2016
18. Which is the dispersed phase in Emulsion? Karnataka Board-2016	6. What are buffer solution ? Out of the following substances, pick up two pairs of substances such that one pair would make an acidic buffer and the other one a basic buffer. BaCl ₂ , HF, HNO ₃ , (NH ₄) ₂ SO ₄ , NaF, NH ₄ OH, Na ₂ SO ₄ and Al(OH) ₃ NIOS Board-2022
19. In a binary solution. Mole fraction of one component is 0.068. What is the Mole fraction of another component ? Karnataka Board-2018	
20. Write dispersed phase and dispersion medium of milk, a colloidal solution. Jharkhand Board-2019	
21. Briefly explain the different types of emulsions and give example for each. Kerala Board-2019	

7. Calculate :
 (a) Molality
 (b) Molarity
 (c) Mole fraction of KI
 If the density of 20% (mass/mass) aqueous solution of KI is 1.202 gm L^{-1} .

8. Define the following terms:

- (i) Molality
 (ii) Osmotic pressure

Haryana Board-2018

9. Define molality of a solution.

Assam Board-2019

10. State Henry's law and mention its two important applications.

Assam Board-2012

11. Write three differences in solution having positive deviation and negative deviation.

MP Board-2017

12. What are lyophobic and lyophilic sols ? Give their chief characteristics.

J&K Board-2020

13. Identify the positively charged sol:

- (a) Haemoglobin
 (b) As_2S_3
 (c) Clay
 (d) Gold sol

J & K Board-2021

Section-E : Long Answer

1. (a) Predict the nature of the aqueous solutions of the following substances.

- (i) NaCN (ii) Na_2CO_3 (iii) $\text{CH}_3\text{COONH}_4$ (iv) Na_2SO_4 (v) FeCl_3 and (vi) CuCl_2

Odisha Board-2017

2. In a first order reaction, the reactant concentration decreases from 0.8M to 0.4M in 15 min. What is the time taken for the concentration to change from 0.1M to 0.025M?

Odisha Board-2017

3. (i) What are lyophilic and lyophobic sols ? Give one example for each type.

(ii) Explain the different types of emulsions.

Kerala Board-2021

4. Why is boiling point of H_2O higher than H_2S ? Explain with reason.

Rajasthan Board-2010

5. Why is density of ice lower than density of water? Explain with reason.

Rajasthan Board-2010

6. (a) Define the following:

- (i) Molarity
 (ii) Molality

(b) Determine the molarity of a solution of 4.0 gram per litre concentration of NaOH.

MP Board-2014

B. Expression of Concentration of solution

Section-A : Multiple Choice Questions

1. A Molal solution is one that contains one Mole of a solute in-

- (a) 1000 gram of the solvent
 (b) One litre of the solution
 (c) One litre of the solvent
 (d) 22.4 litres of the solution

Uttarakhand Board 2023

Ans. (a)

2. 50 mL of an aqueous solution of glucose $\text{C}_6\text{H}_{12}\text{O}_6$ (Molar mass : 180 g/mol) contains 6.02×10^{22} molecules. The concentration of the solution will be

- (a) 0.1 M (b) 0.2 M
 (c) 1.0 M (d) 2.0 M

CBSE-2020

Ans. (d)

3. If 22 g benzene is dissolved in 222 g carbon tetra chloride, then concentration in W/W is.....

- (a) 9 % (b) 90 %
 (c) 0.9 % (d) 0.09 %

Gujarat Board-2021

Ans. (a)

4. Which unit of concentration value does not change with change in temperature?

- (a) Normality (b) Molarity
 (c) Molality (d) %V/V

Gujarat Board-2019

Ans. (c)

5. Degree of ionization does not depend on :

- (a) Nature of solvent
 (b) Nature of electrolyte
 (c) Dilution
 (d) Molecular weight of the electrolyte

NIOS Board-2022

Ans. (d)

6. 4.4 g of a gas at STP occupies a volume of 2.24 L. The gas can be

- (a) O_2 (b) CO
 (c) NO_2 (d) CO_2

NIOS Board-2023

Ans. (d)

7. The molality of pure water is :

- (a) 20 (b) 18 s
 (c) 10 (d) 55.5

Haryana Board-2021

Ans. (d)

8. In calculating osmotic pressure, the concentration of solute is expressed in —.

- (a) molarity
 (b) molality
 (c) mole fraction
 (d) percentage mass

Maharashtra board-2022

Ans. (a)

9. The pH of weak monoacidic base is 11.2, its OH^- ion concentration is :
- (a) $1.585 \times 10^{-3} \text{ mol dm}^{-3}$
(b) $3.010 \times 10^{-11} \text{ mol dm}^{-3}$
(c) $3.010 \times 10^{-3} \text{ mol dm}^{-3}$
(d) $1.585 \times 10^{-11} \text{ mol dm}^{-3}$

Maharashtra board-2023

Ans. (a)

10. What is the name of the colloidal system in which both the dispersed phase and dispersion medium are liquids?
- (a) Emulsions
(b) Gel
(c) Sol
(d) Foam

Kerala Board-2022

Ans. (a)

11. Mole fraction of a solute in 2.5 molal aqueous solution is:
- (a) 0.43 (b) 0.043
(c) 4.3 (d) 43

Haryana Board-2017

Ans. (d)

12. Full form of CMC is:
- (a) Critical molar Concentration
(b) Critical micelle Concentration
(c) Constant micelle Concentration
(d) Common micelle Concentration

Haryana Board -2016

Ans. (d)

13. 10 gm caustic soda (molar mass = 40) is dissolved in 500 cm^3 solution. Its molarity is
- (a) 2.0 M (b) 1.5 m
(c) 1.0 m (d) 0.5m

Rajasthan Board-2010

Ans. (d)

14. How many gms of glucose are required to prepare 1 kg solution of glucose having concentration 10% w/w?
- (a) 1 (b) 100
(c) 0.1 (d) 10

Gujarat Board-2016

Ans. (b)

15. Which of the following aqueous solution has the highest boiling point having concentration 0.050 m?
- (a) NaCl (b) Urea
(c) $\text{K}_3[\text{Fe}(\text{CN})_6]$ (d) Na_2SO_4

Gujarat Board-2018

Ans. (c) :

16. What is the normality of 0.2 M H_3PO_3 solution?
- (a) 0.2 N (b) 0.1 N
(c) 0.4 N (d) 0.6 N

Gujarat Board-2017

Ans. (c)

17. Which of the following solution is isotonic with 0.1 M aqueous solution of urea?
- (a) 0.05 M NaCl (b) 0.1 M NaCl
(c) 0.025 M NaCl (d) 1M NaCl

Gujarat Board-2017

Ans. (a)

18. How much litre of dihydrogen gas will be produced at STP, in the reaction of ethanol with 12 gram Mg? (Mg=24gram/mole).
- (a) 11.2 litre
(b) 22.4 litre
(c) 2.24 litre
(d) 5.6 litre

Gujarat Board-2019

Ans. (a)

19. What is the weight to volume ppm of 0.05% w/v CaCl_2 aqueous solution?
- (a) 500
(b) 0.05
(c) 50
(d) 5

Gujarat Board-2019

Ans. (a)

20. Increasing the temperature of an aqueous solution will cause
- (a) decrease in molality
(b) decrease in molarity
(c) decrease in mole fraction
(d) decrease in mass percent

Meghalaya Board-2019

Ans. (b) :

21. The molarity of the solution containing 5 g of NaOH in 500 ml of aqueous solution is
- (a) 1 M
(b) 2.5 M
(c) 0.25 M
(d) 0.025 M

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

1. Find molality of pure water ($\text{H}_2\text{O} = 18$).
MP Board 2020
2. Define molarity [M]. How does molarity vary with temperature?

Karnataka board 2023

3. Calculate the Mass percentage of benzene and carbon tetrachloride if 22g of benzene dissolved in 122 g of carbon tetrachloride.

OR

6×10^{-3} g of oxygen dissolved in one liter sea water (1030 g). What is the concentration of oxygen in ppm.

Uttarakhand Board 2022

4. The of the boiling point of solvent by the addition of a solute isproportional to the molality of the solutions.

ISC Board-2009

5. The pressure of an aqueous solution of 0.1 M cane sugar is than that of pure water.
ISC Board-2010
6. Calculate the mole fraction of water in a sodium hydroxide solution which has 80 g of NaOH and 54 g of H₂O. (Relative atomic masses of Na = 23, O = 16, H = 1)
ISC Board-2005
7. If the molality of an aqueous solution of cane sugar is 0.4445, what is the mole fraction of cane sugar?
ISC Board-2008
8. 46 g of ethyl alcohol is dissolved in 18 g of water. Calculate the mole fraction of ethyl alcohol. (Atomic weight of C = 12, O = 16, H = 1)
ISC Board-2011
9. Distinguish between the terms molality and molarity. Under what conditions are the molarity and molality of a solution nearly the same?
All India 2008C
10. State the main advantage of molality over molarity as the unit of concentration.
Delhi 2010, 2009C
11. What is meant by molality of the solution?
All India 2009
12. Define the following terms:
(i) mole fraction (χ)
(ii) molality of a solution (m)
All India 2015C
13. Calculate the molarity of 9.8% (w/w) solution of H₂SO₄ if the density of the solution is 1.02 g mL⁻¹. [Molar mass of H₂SO₄ = 98 g mol⁻¹]
Foreign 2014
14. Differentiate between molarity and molality of a solution. How can we change molality value of a solution into molarity value?
Delhi 2014C; Foreign 2011
15. A solution of glucose (C₆H₁₂O₆) in water is labelled as 10% by weight. What would be the molality of the solution? (Molar mass of glucose = 180 g mol⁻¹)
All India 2013
16. If the density of water of a lake is 1.25 g mL⁻¹ and 1 kg of lake water contains 92 g of Na⁺ ions, calculate the molarity of Na⁺ ions in this lake water. (Atomic mass of Na = 23 g mol⁻¹).
HOTS; Foreign 2012, 2008
17. Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?
Delhi 2011, 2009; Foreign 2011, 2009
18. Define the term mole fraction.
All India 2012, 2010C, 2009; Delhi 2012
19. 2.75 g of Na₂CO₃ is present in 200 ml Na₂CO₃ solution. Calculate the molarity of the solution.
Odisha Board-2020
20. Calculate the mass of NaOH required to prepare 2 litres of 1.02 $\frac{N}{10}$ solution.
Odisha Board-2023
21. How many molecules are present in 100 g sample of NH₃?
NIOS Board-2018
22. The following data were obtained when nitrogen and oxygen react together to form different compounds :
- | | Mass of nitrogen | Mass of oxygen |
|------|------------------|----------------|
| (i) | 14 g | 16g |
| (ii) | 14g | 32g |
- Which law of chemical combination is obeyed by the above experimental data ?
Define this law.
NIOS Board-2019
23. 4 g of copper chloride was found to contain 1.890 g of copper and 2.110 g of chlorine. Calculate the percentage of copper and chlorine in it .
NIOS Board-2021
24. Define Molarity.
Karnataka Board-2014
25. How does the size of blood cells change when placed in an aqueous solution containing more than 0.9% (m/v) sodium chloride?
Karnataka Board-2019
26. How does molarity varies with temperature?
Karnataka Board-2017
27. 10 mL of liquid 'A' is mixed with 10 mL of liquid 'B', the volume of the resultant solution is 19.9 mL. What type of deviation expected from Raoult's Law ?
Karnataka Board-2017
28. How many moles of AgCl will be precipitated when an excess of AgNO₃ solution is added to one molar solution of [CrCl(H₂O)₅]Cl₂ ?
Karnataka Board-2015
29. In the given reaction 2A + 4B → 3C + 4D, when 5 moles of A react with 6 moles of B, then—
(a) write which species is the limiting reagent;
(b) calculate the amount of C formed.
NIOS Board-2016
30. Which reagent is used for oxidizing primary alcohols to aldehydes?
NIOS Board-2016
31. Write the names of two important types of compound lipids.
NIOS Board-2016
32. Calculate the number of carbon-12 atoms in (a) 96 u and (b) 96 moles of carbon-12 sample. [Given, atomic mass of C = 12 u and N_A = 6.022 × 10²³ mol⁻¹]
NIOS Board-2011

33. Find molarity if 0.0580 moles of a compound dissolve in 200 ml of its solution.
Punjab Board-2019
34. Explain the dependence of molecular speed on the molar mass of the gas.
NIOS Board-2022
35. What is molar mass of substance ? How many elementary entities are present in it ?
NIOS Board-2022
36. Define molar volume On which factors does it depend? How is it related to density?
NIOS Board-2023
37. What is molar volume? How it is related with density? What are the STP conditions at which molar volume is measured?
NIOS Board-2023
38. If 5 g NaOH dissolved in 500 ml solution the molality of solution will be
Haryana Board-2022
39. Molal Elevation constant is also known as.....
Haryana Board-2022
40. If the density of some lake water is 1.25 g ml⁻¹ and contains 92 g of Na⁺ ions per Kg of water, calculate the molality of Na⁺ ions in the lake.
Haryana Board-2019
41. Define molality.
Karnataka Board-2020
42. Write the unit of molality of a solution.
Karnataka Board-2019
43. How many faradays of electricity are required to produce 6 g of Mg from MgCl₂ ?
Maharashtra board-2019
44. Calculate the mole fraction of solute, if the vapour pressure of pure benzene at certain temperature is 640 mmHg and vapour pressure of solution of a solute in benzene is 600 mmHg.
Maharashtra board-2023
45. In a solution of component 'A' and 'B' at molecular level, A – B interactions are weaker than those between A – A or B – B interactions. Then the type of deviation shown by this solution is called _____.
Kerala Board-2019
46. 0.63 gram oxalic acid (equivalent weight = 63) is dissolved in 250 ml of solution. Find out the normality of solution.
Chhattisgarh Board-2021
47. Explain the following– [1+1 = 2]
(a) Molality
(b) Parts Per million (ppm)
OR
4g of Caustic soda (molar mass 40) is dissolved in water and solution is made to 200 gm. Calculate the molality of the solution.
Uttarakhand Board-2019
48. What happens when a raw mango placed in concentrated salt solution?
Rajasthan Board-2016
49. Write the formula to calculate the mole fraction?
Rajasthan Board-2016
50. Write one example of the solution in which total volume of the solution is equal to the sum of the volumes of solute and solvent
Rajasthan Board-2010
51. Why does the molality of a solution remain unchanged with temperature?
Assam Board-2013
52. Arrange the following in increasing order of their pK_b values in aqueous solution :
(C₂H₅)₃ N , NH₃ , (C₂H₅)₂NH, C₂H₅NH₂
Assam Board-2023
53. Calculate the molarity of each of the following solution.
(a) 30 g of Co(NO₃)₂ 6H₂O (Atomic mass 291 g mol⁻¹) in 4.3L of solution.
(b) 30 ml of 0.5 M H₂SO₄ diluted in 500 ml.
Nagaland Board-2021
54. 0.75g of sodium bicarbonate (molar mass = 84g mol⁻¹) are dissolved in 250 ml of a solution. Calculate its molarity and normality.
Nagaland Board-2018
55. Give three points of differences between lyophobic and lyophilic sols.
Nagaland Board-2017

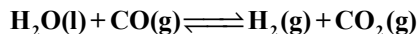
Section-C : Short Answer

1. Calculate the Molarity of a solution containing 4g NaOH in 200 ml of solution.
Haryana Board 2023
2. Calculate the molarity of 250 mL solution formed by dissolving 5g of NaOH in water.
Rajasthan Board 2022
3. A 35% (V/V) solution of ethylene glycol is used in vehicle for cooling the engine. Determine the volume of water in millilitre.
Rajasthan Board 2023
4. Define the following terms
(a) Normality (b) Molarity
(c) Molar fraction
Uttarakhand Board 2023
5. (i) The cryoscopic constant of water is 1.86 K mol⁻¹ kg⁻¹. An aqueous solution of cane sugar freezes at -0.372°C. Calculate molality of the solution.
(ii) The molecular weights of potassium chloride and glucose are determined by the depression in freezing point method. As compared to their theoretical molecular weights, what do you expect are their molecular weights determined by this experiment ? Why?
ISC Board-2000
6. Calculate the mass of a non-volatile solute (molar mass = 40 g mol⁻¹), which should be dissolved in 114 g of octane to reduce its vapour pressure to 80%. (Molar mass of octane = 114 g mol⁻¹).
Foreign 2008

7. calculate the mass of ascorbic acid ($C_6H_8O_6$) to be dissolved in 75 g of acetic acid to lower its melting point by $1.5^\circ C$ (K_f for acetic acid is $3.9 K kg mol^{-1}$).
All India 2010C
8. A solution is prepared by dissolving 10 g of non-volatile solute in 200 g of water. It has a vapour pressure of 31.84 mm of Hg at 308 K. Calculate the molar mass of the solute. (Vapour pressure of pure water at 308 K = 32 mm Hg)
All India 2015
9. A 5% solution (by mass) of cane sugar (M.W 342) is isotonic with 0.877% solution of substance X. Find the molecular weight of X.
HOTS; All India 2015C
10. A solution of glucose (molar mass = $180 g mol^{-1}$) in water is labelled as 10% (by mass). What would be the molality and molarity of the solution? (Density of solution = $1.2 g mL^{-1}$).
Delhi 2014
11. What concentration of nitrogen should be present in a glass of water at room temperature? Assume a temperature of $25^\circ C$, a total pressure of 1 atmosphere and mole fraction of nitrogen in air is 0.78. (K_H for nitrogen = $8.42 \times 10^{-7} M/mm Hg$).
All India 2009
12. 8 gm Caustic Soda (Molar Mass 40) is dissolved in water and solution is made to $800 cm^3$. Calculate the molarity of the solution.
Uttarakhand Board-2020
13. Define mole fraction Calculate the mole fraction of H_2SO_4 in a solution containing 98% (w/w) H_2SO_4 by mass.
Telangana Board-2023
14. How many moles of H_2O are formed when 4.5 moles of H_2 are burnt in 3.3 moles of O_2 in a closed vessel? What would be present in the vessel after the reaction?
NIOS Board-2015
15. By the electrolysis of H_2SO_4 (50% W/W) followed by distillation compound (A) is obtained. Compound (A) reacts with $MnCl_2$ in alkaline medium to give a brown coloured compound (B). Identify (A) and (B) and also write the chemical equation for the reaction of (A) with $MnCl_2$.
NIOS Board-2021
16. (a) Explain as to why there is an increase in temperature observed on mixing water – sulphuric acid.
(b) Calculate molarity of an aqueous solution of KI having density $1.202 g/cm^3$ containing 20% KI by mass.
[At mass : K = 39.0 u, I = 127.0 u]
NIOS Board-2015
17. How many molecules of acetylene gas, C_2H_2 , would be produced in the reaction of 10.0 g of calcium carbide with excess of water?
 $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$
- How much volume would the C_2H_2 gas occupy at STP (273 K, 1 bar)? [Molar mass of $CaC_2 = 64.0 g mol^{-1}$]
NIOS Board-2013
18. If 20 g of calcium carbonate is added to a solution containing 20 g of HCl, what substances will be present when the reaction is over and how many grams of each of them will be there?
 $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
[Atomic mass : Ca = 40 u, C = 12 u, H = 1 u, Cl = 35.5 u, O = 16 u]
NIOS Board-2011
19. Concentrated HNO_3 used in laboratory work is 68% HNO_3 by mass in aqueous solution. What should be the molarity of such a sample of acid if density of solution is $1.504 g mL^{-1}$?
Haryana Board-2021
20. (a) State Henry's law.
(b) 22.22 gram of urea was dissolved in 300 grams of water. Calculate the number of moles of urea and molality of the urea solution. (Given : Molar mass of urea = $60 g mol^{-1}$)
Maharashtra board-2018
21. Calculate the pH of buffer solution composed of 0.01 M weak base BOH and 0.02 M of its salt BA.
[$k_b = 1.8 \times 10^{-5}$ for weak base]
Maharashtra board-2022
22. A weak monobasic acid is 10% dissociated in 0.05 M solution. What is percent dissociation in 0.15 M solution ?
Maharashtra board-2023
23. 2.82 gm of glucose (Molecular Mass = 180) is dissolved in 30 gm of water. Calculate molarity of the solution.
Chhattisgarh Board-2022
Chhattisgarh Board-2020
24. 30 gm of ethanoic acid present in 100 gm of water, determine molality of ethanoic acid in water.
Rajasthan Board-2017
25. Write the formula to calculate the molality.
Rajasthan Board-2015
26. 5g of NaOH are dissolved in 500 ml water. Find the molarity of the solution.
Rajasthan Board-2013
27. Calculate the molarity of a solution containing 14 gm of KOH in 750 ml of solution.
Haryana Board-2016
28. (c) Calculate molarity of a solution containing 11.7g NaCl in 2.0L solution. ($M_{NaCl} = 58.5 g mol^{-1}$)
Assam Board-2016
29. If 4 gm. NaOH is present in 500 ml solution then determine the normality of the solution.
MP Board-2017
30. Explain the following terms:
(i) Formality (ii) Parts per million
(iii) Osmotic pressure
MP Board-2017

Section-E : Long Answer

1. (a) If one mole of water one mole of CO are taken in a 10 litre vessel and heated to 986°C, 40% of water reacts with CO as in



Calculate the equilibrium constant for the reaction at the temperature mentioned.

Odisha Board-2017

2. (a) Calculate the normality of a solution of NaOH, if 0.4 g of NaOH is dissolved in 100 mL of the solution.
(b) The relative lowering of vapour pressure produced by dissolving 7.2 g of a substance in 100 g of water is 0.00715. What is the molecular mass of the substance?

NIOS Board-2016

3. Define Normality, Molality, Molarity, Mole fraction and mass fraction.

J&K Board-2019

4. An antifreeze solution is prepared from 222.6 g of ethylene glycol, $\text{C}_2\text{H}_4(\text{OH})_2$ and 200 g of water. Calculate the molality of the solution. If the density of the solution is 1.072 g ml^{-1} then what shall be the molarity of the solution?

Jharkhand Board-2020

5. Calculate the mole fraction of CH_3OH in solution containing 30% by mass in water.

Haryana Board-2018

6. If 5.6 gm of KOH dissolved in 500 ml of solution, then what will the molarity of the solution.

Haryana Board-2018

7. 4.0 gm of NaOH, dissolved in 500 ml of solution, calculate molarity of the solution.

Haryana Board-2018

8. (iii) Calculate the normality and molarity of a solution of compound (M_2CO_3) of which 10.35 gm dissolve in 250 ml aqueous solution. (Atomic weight of metal (M) = 39)

Rajasthan Board-2011

C. Solubility**Section-A : Multiple Choice Questions**

1. The solubility of $\text{Ca}(\text{OH})_2$ is $s\text{ mol L}^{-1}$. The K_{sp} under the same conditions is:
(a) $4s^3$ (b) $3s^4$
(c) $4s^2$ (d) s^3

Odisha Board-2017

Ans. (a)

2. Which of the following 0.1 M aqueous solutions is likely to have the highest depression in freezing point?

- (a) Na_2SO_4 (b) NaCl
(c) Glucose (d) Na_3PO_4

Odisha Board-2020

Ans. (d)

3. Solubility of Ag_2CrO_4 is decreased in presence of

- (a) AgNO_3 (b) AgCl
(c) BaCrO_4 (d) PbCrO_4

NIOS Board-2019

Ans. (a)

4. The concentration of Ag^+ ions in a given saturated solution of AgCl at 25°C is $1.06 \times 10^{-5}\text{ g ion per litre}$. The solubility product of AgCl is

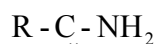
- (a) 0.353×10^{-10}
(b) 0.53×10^{-10}
(c) 1.12×10^{-10}
(d) 2.12×10^{-10}

NIOS Board-2016

Ans. (d)

5. During reduction of aldehydes with hydrazine and $\text{C}_2\text{H}_5\text{ONa}$ the product formed is:

- (a) $\text{R}-\text{CH}=\text{N}-\text{NH}_2$ (b) $\text{R}-\text{C}=\text{N}$



- (c) $\begin{array}{c} \parallel \\ \text{O} \end{array}$ (d) $\text{R}-\text{CH}_3$

Tamilnadu Board, March-2016

Ans. (d)

6. The solubility of gaseous solute in liquid solvent with increase in temperature.

- (a) decreases
(b) increases
(c) first increases then decreases
(d) remains constant

Gujarat Board-2017

Ans.(a)

7. The solubility of a gases in liquids increases with increase of

- (a) temperature
(b) pressure
(c) volume
(d) density

Nagaland Board-2017

Ans. (b)

Section-B : Very Short Answer

1. (i) State Henry's law and give two applications.
(ii) Why do gases always tend to be less soluble in liquids as the temperature is raised?

Haryana Board 2023

2. State Henry's law. Write any one application of it.

Kerala Board 2023

3. At constant temperature, different gases have different K_H – value. What does this statement suggest?

Karnataka board 2023

4. State Henry's law and mention its two important applications.

All India 2010 C; Delhi 2008C

5. State Henry's law correlating the pressure of a gas and its solubility in a solvent and mention two applications for the law.

Delhi 2008; Foreign 2008

6. Explain the Henry's law about dissolution of a gas in a liquid.

All India 2012, 2011;
Delhi 2011; Foreign 2011

7. What is diffusion?

NIOS Board-2015

8. State Henry's law.

Karnataka Board-2018

9. Name the law behind the dissolution of CO₂ gas in soft drinks under high pressure.

Karnataka Board-2016

10. What role does the Molecular interaction play in a solution of alcohol and water ?

Haryana Board-2021

11. What is a weak electrolyte ?

Haryana Board-2021

12. What is the effect of rise in temperature on the solubility of gasses in liquids?

Karnataka Board-2016

13. State Henry's law.

Karnataka Board-2018

14. Why does the conductivity of a solution decrease with dilution?

Karnataka Board-2018

15. Define : Acidic buffer solution. Write the relationship between solubility and solubility product for PbI₂ .

Maharashtra board-2023

16. State Henry's law and mention any one of its application.

Kerala Board-2022

17. (a) Differentiate between dispersed phase and dispersed medium on the basis of interaction with an example.

Nagaland Board-2021

18. Define vant- Hoff's factor.

Nagaland Board-2017

Section-C : Short Answer

1. An aqueous solution containing 12.48 g of barium chloride in 1.0 kg of water boils at 373.0832 K. Calculate the degree of dissociation of barium chloride (Given, K_b for H₂O = 0.52 K mol⁻¹, molar mass of BaCl₂ = 208.34 g mol⁻¹).

Delhi 2011C

2. State Henry's Law. Give two applications of it.

Kerala Board-2021

3. Generally solubility of gases in liquids is decreases as increasing temperature. Give reason.

Rajasthan Board-2018

4. How is nitric acid prepared by Ostwald's process? Give the reaction involved.

Nagaland Board-2020

Section-E : Long Answer

1. Briefly explain the effects of temperature on the solubility of solids in liquids.

Haryana Board-2017

d. Colligative Properties and Determination of Molar Mass

Section-A : Multiple Choice Questions

1. Elevation in boiling point of the aqueous solution of 0.01 M BaCl₂ compare to 0.01 M urea is _____.
(a) approximately half
(b) equal
(c) approximately three times
(d) approximately twice

Gujarat Board 2023 (March)

Ans. (c)

2. The aqueous solution having maximum boiling point is
(a) 0.015 M glucose
(b) 0.01 M KNO₃
(c) 0.015 M urea
(d) 0.01 M Na₂SO₄

UP Board 2019

Ans. (d)

3. The concentration unit independent of temperature is –
(a) Normality
(b) Mass-volume percentage
(c) Molality
(d) Molarity

UP Board 2023

Ans. (c)

4. Assertion (A) : Elevation in boiling point is a colligative property.
Reason (R) : Elevation in boiling point is directly proportional to molarity.
(a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is correct, but Reason (R) is wrong statement.
(d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (d)

5. 18 g of glucose is dissolved in 1kg of water at what temp will the water boil , k_b for water is 0.52 K kg mol⁻¹
(a) 373.2 K
(b) 378.2 K
(c) 381.5 K

Punjab Board-2021

Ans. (a)

6. Which of the following aqueous solutions should have the highest boiling point :
(a) 1.0 M NaOH
(b) 1.0 M Na₂SO₄
(c) 1.0 M NH₄NO₃
(d) 1.0 M KNO₃

Punjab Board-2021

Ans. (b)

7. Colligative properties depends upon :
- Nature of solute particles present in the Solution.
 - Number of solute particles present in the solution
 - Physical properties of the solute particles
 - Nature of the solvent particles

Punjab Board-2021

Ans. (b)

8. Temperature increases, the value of K_H increases, thus the value of solubility of gaseous solute will be.....
- Remains constant
 - Decreases
 - Increases
 - Cannot say

Gujarat Board-2019

Ans. (b)

9. Colligative properties of solution depends on :
- Molarity
 - Number of moles of solute
 - Number of moles of solvent
 - Mole fractions

Haryana Board-2016

Ans. (b)

10. What is the concentration of solution in ppm when 5.0×10^{-5} gm CO_2 is dissolved in 100 ml solution.
- 500
 - 0.5
 - 5
 - 5.0×10^{-5}

Gujarat Board-2018

Ans.(b) :

11. Which of the following is an example for interstitial solid solution.
- Tic
 - Li_2C_2
 - Sic
 - Al_4C_3

Gujarat Board-2018

Ans.(a) :

12. Which of the following is a colligative property?
- Osmotic pressure
 - Melting point
 - Boiling point
 - None of these

Haryana Board-2016

Ans. (a)

13. Colligative properties are those properties which depend on
- shapes of the particles
 - nature of the particles only
 - nature of the solvent only
 - number of particles only

Meghalaya Board-2019

Ans. (d) :

14. Relative lowering in vapour pressure is equal to
- molarity of solution
 - molality of solution
 - mole fraction of solute
 - mole fraction of solvent

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

- Explain mole fraction.
(or)
Define Molarity.
MP Board 2020
- (i) What are Colligative properties?
Kerala Board 2023
- Write any two colligative properties
Kerala Board 2023
- Define Osmotic pressure. How will you show that Osmotic pressure is a colligative property ?
UP Board 2023
- 45 g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}$) is mixed with 600 g of water. Calculate the Freezing point depression (ΔT_F) of solution.
Uttarakhand Board 2022
- Calculate the amount of calcium chloride (Molar mass = 111 g mol^{-1}) which must be added to 500 g of water to lower its freezing point by 2 K, assuming calcium chloride is completely dissociated [K_f for water = $1.86 \text{ K kg mol}^{-1}$]
CBSE-2020
- Why does a solution containing non-volatile solute have a higher boiling point than pure solvent ? Why is elevation of boiling point a colligative property ?
CBSE-2020, 2019
- A solution of lactose containing 8.45 g of lactose in 100 g of water has a vapour pressure of 4.559 mm of Hg at 0°C . If the vapour pressure of pure water is 4.579 mm of Hg, calculate the molecular weight of lactose.
ISC Board-2012
- The osmotic pressure of 0.01 molar solution of an electrolyte is found to be 0.65 atm at 27°C . Calculate the van't Hoff factor. What conclusion can you draw about the molecular state of the solute in the solution ?
ISC Board-2011
- An aqueous solution containing 0.2 g of compound A in 21.7 g of water freezes at 272.914 K. If the value of K_f for water is $1.86 \text{ K kg mol}^{-1}$, calculate molecular weight of compound A.
ISC Board-2004
- What is a colligative property ? Give two examples.
ISC Board-2003
- Why does soda water fizz when the bottle is opened ? Name the law that explains this phenomenon.
ISC Board-2004
- A decinormal solution of sodium chloride exerts an osmotic pressure of 4.82 atm at 27°C . Calculate the degree of dissociation of sodium chloride.
ISC Board-2007

14. An aqueous solution containing 1.70 g of cane sugar in 100 mL water begins to freeze at -0.093°C . The cryoscopic constant (molal depression constant) of water is $1.86 \text{ K kg mol}^{-1}$. Calculate the molecular weight of cane sugar.
ISC Board-2007
15. The freezing point of a solution containing 0.3 g of acetic acid in 30 g of benzene is lowered by 0.45 K. Calculate the van't Hoff factor. (Atomic weight of C = 12, H = 1, O = 16, K_f for benzene = $5.12 \text{ K kg mol}^{-1}$)
ISC Board-2013
16. A solution of urea in water has a boiling point of 100.18°C . Calculate the freezing point of the solution. (K_f for water is $1.86 \text{ K kg mol}^{-1}$ and K_b for water is $0.512 \text{ K kg mol}^{-1}$)
ISC Board-2012
17. The boiling point of pure water is 373 K. Calculate the boiling point of an aqueous solution containing 18 g of glucose ($W = 180$) in 100 g of water. Molal elevation constant of water is $0.52 \text{ K kg mol}^{-1}$.
ISC Board-2009
18. Correct the given statement : "Osmotic pressure and boiling point are colligative properties".
ISC Board-2004
20. Which is colligative property among the following: Polysaccharide, osmotic pressure, aldol condensation, polarimeter?
ISC Board-2013
21. What is meant by colligative properties?
All India 2009
22. Define the following terms:
(i) Colligative properties
(ii) Molality (m)
Delhi 2017
23. Explain boiling point elevation constant for a solvent or ebullioscopic constant.
All India 2012; foreign 2012
24. Explain Tyndall effect.
Odisha Board-2020
25. Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180 g mol^{-1}) in 250 g of water. (K_f of water = $1.86 \text{ K kg mol}^{-1}$).
UP Board-2018
26. State Kohlrausch's law.
Manipur Board-2018
27. Why are lyophilic sols more stable than lyophobic sols?
Manipur Board-2018
28. Calculate the molar mass of argon if the mass of single argon atom is $6.634 \times 10^{-26} \text{ kg}$.
NIOS Board-2023
29. What is molar mass of a substance? How many entities are present in it?
NIOS Board-2023
30. Define molar volume of a substance. What is the molar volume of an ideal gas at S.T.P.? What values of standard temperature and pressure are taken in this case?
NIOS Board-2021
31. What is meant by molar volume? How is it related with density? What are the STP conditions at which molar volume is measured?
NIOS Board-2021
32. In an experiment 5.0 g of CaCO_3 on heating gave 2.8 g CaO and 2.2 g CO_2 . Show that these results are in accordance with the law of conservation of mass.
NIOS Board-2019
33. Calculate the molar mass of argon atoms, if the mass of a single argon atom is $6.634 \times 10^{-26} \text{ kg}$.
NIOS Board-2018
34. On mixing equal volumes of acetone and ethanol. What type of deviation from Raoult's law is expected?
Karnataka Board-2015
35. Define molar mass of a molecular substance.
NIOS Board-2015, 2011
36. What is relative lowering of vapour pressure?
Andhra Pradesh Board-2019
37. On what factor the value of colligative property depends?
Karnataka Board-2015
38. Derive the relation between elevation of boiling point and molar mass of solute.
Maharashtra board-2018
39. Derive van't Hoff general solution equation.
Maharashtra board-2019
40. Calculate the elevation in boiling point when 300g of urea, $\text{CO}(\text{NH}_2)_2$ is dissolved in 2500g of water. (Given : K_b for water = $0.52 \text{ K Kg mol}^{-1}$)
Manipur Board-2019
41. Define the following terms:
(i) Kraft temperature
(ii) Van't Hoff factor
Assam Board-2020
42. Colloidal dispersion of a liquid in a gas is called
43. The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute, K_b for benzene is $2.53 \text{ K kg mol}^{-1}$.
Meghalaya Board-2021

Section-C : Short Answer

1. At 20°C , on dissolving 10 g of a non volatile non-electrolyte substance in 100 g of water, vapour pressure decreases from 17.535 mm to 17.235 mm. Calculate the molecular weight of solute.
UP Board 2019

2. At 20°C the osmotic pressure of 45 g per litre solution of a substance is 3.2 atmosphere. Calculate the value of solution constant. The molecular weight of the substance is 342.
UP Board 2019
For Questions number 3 to 6, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false
(d) Assertion (A) is false, but Reason (R) is true.
3. Assertion (A) : When NaCl is added to water, a depression in freezing point observed.
Reason (R) : The vapour pressure of solution is increased which causes depression in freezing point.
Gujarat Board 2023 (July)
4. Establish the relationship between the relative lowering of vapour pressure of a solution and mole fraction of the solute in it when the solvent alone is volatile.
Manipur Board 2020
5. Concentrated aqueous ammonia contains 1.00 mol NH₃ dissolved in 2.44 mol H₂O. Calculate the molal concentration of the ammonia solution?
Manipur Board 2023
6. A 0.01 m aqueous solution of AlCl₃ freezes at -0.068 °C. Calculate the percentage of dissociation. [Given : K_f for Water = 1.86 K kg mol⁻¹]
CBSE-2020
7. The freezing point of a solution containing 5g of benzoic acid (M = 122 g mol⁻¹) in 35g of benzene is depressed by 2.94 K. What is the percentage association of benzoic acid if it forms a dimer in solution?
(K_f for benzene = 4.9 K kg mol⁻¹)
CBSE-2020
8. An antifreeze solution is prepared by dissolving 31 g of ethylene glycol (Molar mass = 62 g mol⁻¹) in 600 g of water. Calculate the freezing point of solution. (K_f for water = 1.86 K kg mol⁻¹)
CBSE-2020
9. Calculate the mass of ascorbic acid (Molar mass = 176 g mol⁻¹) to be dissolved in 75 g of acetic acid, to lower its freezing point by 1.5°C (K_f = 3.9 K kg mol⁻¹)
CBSE-2020
10. A 0.01 m aqueous solution of AlCl₃ freezes at -0.068 °C. Calculate the percentage of dissociation. [Given : K_f for Water = 1.86 K kg mol⁻¹]
CBSE-2020
11. (b) (i) Write the dispersed phase and dispersion medium of 'milk'.
(ii) What is the cause of Brownian movement in colloidal particles ?
(iii) Why does physisorption decrease with increase in temperature ?
CBSE-2022
12. (a) (i) Define coagulation.
(ii) State Hardy-Schulze rule.
(iii) What is Electrophoresis ?
CBSE-2022
13. A solution containing 8 g of substance in 100 g of diethyl ether boils at 36.86°C whereas pure ether boils at 35.60°C. Determine the molar mass of the solute. [For ether K_b = 2.02 K kg mol⁻¹]
CBSE-2019
14. (a) Out of 0.1 molal aqueous solution of glucose and 0.1 molal aqueous solution of KCl, which one will have higher boiling point and why ?
(b) Predict whether van't Hoff factor, (i) is less than one or greater than one in the following :
(i) CH₃COOH dissolved in water
(ii) CH₃COOH dissolved in benzene
CBSE-2019
15. (i) A solution containing 0.5 g of KCl dissolves in 100 g of water and freezes at -0.24°C. Calculate the degree of dissociation of the salt. (K_f for water = 1.86°C). (Atomic weights of K = 39, Cl = 35.5)
(ii) If 1.71 g of sugar (molar mass = 342) are dissolved in 500 mL of an aqueous solution at 300 K, what will be its osmotic pressure ?
(iii) 0.70 g of an organic compound when dissolved in 32 g of acetone produces an elevation of 0.25°C in the boiling point. Calculate the molecular mass of organic compound.
(K_b for acetone = 1.72 K kg mol⁻¹)
ISC Board-2015
16. (i) Determine the freezing point of a solution containing 0.625 g of glucose (C₆H₁₂O₆) dissolved in 102.8 g of water.
(Freezing point of water = 273 K, K_f For water = 1.87 K kg mol⁻¹, at wt.)
(C = 12, H = 1, O = 16)
(ii) A 0.15 M aqueous solution of KCl exerts an osmotic pressure of 6.8 atm at 310 K. Calculate the degree of dissociation of KCl. (R = 0.0821 L atm K⁻¹ mol⁻¹).
(iii) A solution containing 8.44 g of sucrose in 100 g of water has a vapour pressure 4.56 mm of Hg at 273 K. If the vapour pressure of pure water is 4.58 mm of Hg at the same temperature, calculate the molecular weight of sucrose.
ISC Board-2017

17. Calculate the depression in freezing point of water when 20.0 g of $\text{CH}_3\text{CH}_2\text{CH}(\text{COOH})$ is added to 500 g of water. (Given, $K_a = 1.4 \times 10^{-3}$, $K_f = 1.86 \text{ K kg mol}^{-1}$).
HOTS; Delhi 2008C
18. A 5% solution (by mass) of cane sugar in water has a freezing point of 271 K. Calculate the freezing point of 5% (by mass) solution of glucose in water. The freezing point of pure water is 273.15 K (Molar mass of cane sugar = 342 g mol^{-1} and molar mass of glucose = 180 g mol^{-1}).
Foreign 2008
19. Calculate the freezing point depression expected for 0.0711 m aqueous solution of Na_2SO_4 . If this solution actually freezes at -0.320°C , what would be the value of van't Hoff factor? (K_f for water is $1.86^\circ\text{C mol}^{-1}$).
Delhi 2009; Foreign 2009
20. Calculate the freezing point of a solution containing 18 g glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ and 68.4 g sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ in 200 g of water. The freezing point of pure water is 273 K and K_f for water is 1.86 K mol^{-1} .
HOTS; All India 2009C
21. What mass of ethylene glycol (molar mass 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from 0°C to -10.0°C ? (K_f for water = $1.86 \text{ K kg mol}^{-1}$).
All India 2010
22. 0.1 mole of acetic acid was dissolved in 1 kg of benzene. Depression in freezing point of benzene was determined to be 0.256 K. What conclusion can you draw about the state of the solute in solution? (Given, K_f for benzene = 5.12 K mol^{-1}).
Delhi 2010C
23. Phenol associates in benzene to a certain extent to form a dimer. A solution containing 20 g of phenol in 1.0 kg of benzene has its freezing point lowered by 0.69 K. Calculate the fraction of phenol that has dimerised (Given, K_f for benzene = 5.1 K mol^{-1}).
HOTS; Delhi 2011C
24. Calculate the freezing point of an aqueous solution containing 10.50 g of MgBr_2 in 200 g of water (molar mass of $\text{MgBr}_2 = 184 \text{ g}$, K_f for water is $1.86 \text{ K kg mol}^{-1}$).
Delhi 2011
25. Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.0 g of water. (K_b for water = $0.512 \text{ K kg mol}^{-1}$, molar mass of NaCl = 58.44 g mol^{-1}).
Delhi 2011
26. What would be the molar mass of a compound if 6.21 g of it dissolved in 24.0 g of chloroform form a solution that has a boiling point of 68.4°C . The boiling point of pure chloroform is 61.7°C and the boiling point elevation constant, K_b for chloroform is 3.63°C/mol .
Delhi 2011
27. A 5% solution (by mass) of cane-sugar in water has freezing point of 271 K. Calculate the freezing point of 5% solution (by mass) of glucose in water of the freezing point of pure water is 273.15 K. [Molecular masses glucose $\text{C}_6\text{H}_{12}\text{O}_6 = 180 \text{ amu}$ cane-sugar $\text{C}_{12}\text{H}_{22}\text{O}_{11} = 342 \text{ amu}$]
All India 2013C
28. Calculate the boiling point elevation for a solution prepared by adding 10 g of CaCl_2 to 200 g of water. (K_b for water = $0.52 \text{ K kg mol}^{-1}$, molar mass of $\text{CaCl}_2 = 111 \text{ g mol}^{-1}$).
Foreign 2014
29. Some ethylene glycol, $\text{HOCH}_2\text{CH}_2\text{OH}$, is added to your car's cooling system along with 5 kg of water. If the freezing point of water-glycol solution is -15.0°C , what is ($K_b = 0.52 \text{ K kg mol}^{-1}$ and $K_f = 1.86 \text{ K kg mol}^{-1}$ for water)
Delhi 2014C
30. The depression in freezing point of water observed for the same molar concentrations of acetic acid, trichloroacetic acid and trifluoroacetic acid increases in the order as stated above. Explain.
Delhi 2008C
31. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water, if freezing point of pure water is 273.15 K. Given : Molar mass of sucrose = 342 g mol^{-1} and Molar mass of glucose = 180 g mol^{-1} .
All India 2017
32. Calculate the boiling point of solution when 4 g of MgSO_4 ($M = 120 \text{ g mol}^{-1}$) was dissolved in 100 g of water assuming MgSO_4 undergoes complete ionisation. (K_b for water = $0.52 \text{ K kg mol}^{-1}$)
All India 2016
33. Calculate the mass of NaCl (molar mass = 58.5 g mol^{-1}) to be dissolved in 37.2 g of water to lower the freezing point by 2°C , assuming that NaCl undergoes complete dissociation. (K_f for water = $1.86 \text{ K kg mol}^{-1}$)
Foreign 2015
34. What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.50°C ? The freezing point depression constant (K_f) for water is 1.86°C/mol . Assume van't Hoff factor for NaCl is 1.87. (molar mass of NaCl = 58.5 g mol^{-1}).
All India 2011, 2010; foreign 2010
35. 45 g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) is mixed with 600 g of water. Calculate
(i) the freezing point depression and
(ii) the freezing point of the solution.
(Given, K_f of water = $1.86 \text{ K kg mol}^{-1}$)
Delhi 2015C
36. Find the boiling point of a solution containing 0.520 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) dissolved in 80.2 g of water [Given, K_b for water = $0.52 \text{ K kg mol}^{-1}$].

37. Find the freezing point of a solution containing 0.520 g glucose ($C_6H_{12}O_6$) dissolved in 80.2 g of water [Given, K_f for water = $1.86 K m^{-1}$].
All India 2010C
38. The molecular masses of polymers are determined by osmotic pressure method and not by measuring other colligative properties. Give two reasons.
All India 2011C
39. Define the terms: osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.
Delhi 2011
40. Why does a solution containing non-volatile solute have higher boiling point than the pure solvent? Why is elevation of boiling point a colligative property?
All India 2015
41. Calculate the mass of compound (molar mass = $256 g mol^{-1}$) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K ($k_f = 5.12 K kg mol^{-1}$).
All India 2014
42. An aqueous solution of sodium chloride freezes below 273 K. Explain the lowering in freezing point of water with the help of a suitable diagram.
Delhi 2013C
43. 18 g glucose, $C_6H_{12}O_6$ (molar mass = $180 g mol^{-1}$) is dissolved in 1 kg of water in a sauce pan. At what temperature, will this solution boil? (K_b for water = $0.52 K kg mol^{-1}$, boiling point of pure water = 373.15 K).
Delhi 2013
44. Differentiate between positive deviation and negative deviation from Raoult's law, exhibited by binary solutions. (any two points)
Goa Board-2023
45. What happens when
(a) a freshly prepared precipitate of $Fe(OH)_3$ is shaken with a small amount of $FeCl_3$ solution?
(b) persistent dialysis of a colloidal solution is carried out?
(c) an emulsion is centrifuged?
UP Board-2018
46. 2 g of benzoic acid (C_6H_5COOH) is dissolved in 25g benzene shows a depression in freezing point equal of 1.64 K. What is the percentage association of benzoic acid if it forms double molecule in solution?
(Molar mass of benzoic acid = $122 g mol^{-1}$, K_f for benzene = $4.9 K kg mol^{-1}$)
NIOS Board-2023
47. A solution of sucrose (molar mass $342 g mol^{-1}$) is prepared by dissolving 68.4 g in 1000 g of water find.
(a) Boiling point of solution
(b) Freezing point of solution.
(For water $K_b = 0.52 K kg mol^{-1}$ and $k_f = 1.86 K kg mol^{-1}$)
NIOS Board-2019
48. When 1.80 gm of non volatile compound is dissolved in 25 g of acetone, the solution boils at 56.86 C While pure acetone boils at 56.38 C under the same atmospheric pressure calculate the molar mass of the compound K_b for acetone is $1.72 K kg mol^{-1}$
Punjab Board-2021
49. What is specific conductance of a solution? How it varies with dilution?
Punjab Board-2021
50. Elevation of boiling point is a colligative property.
a) What are colligative properties?
(b) Elevation of boiling point (ΔT_b) is directly proportional to molality (m) of solution.
Thus $\Delta T_b = K_b m$, K_b is called the molal elevation constant. From the above relation derive an expression to obtain molar mass of the solute.
(c) The boiling point of benzene is 353.23 K. When 1.80 g of a non volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is $2.53 K kg mol^{-1}$
Kerala Board-2013
51. What are colligative properties? Give any one.
Andhra Pradesh Board-2020
52. A 5% solution (by mass) of cane sugar ($C_{12}H_{22}O_{11}$) in water has a freezing point of 271 K. Calculate the freezing point of 5% (by mass) solution of glucose ($C_6H_{12}O_6$) in water. Freezing point of pure water is 273.15 K.
Kerala Board-2019
53. How much electricity in coulombs is needed to discharge 0.5 mole of Cr^{3+} ions? ($F = 96500 C$)
Goa Board-2019
54. A solution containing 8.44 g of sucrose in 100 g of water has a vapour pressure 4.56 mm of Hg at 273K. If the vapour pressure of pure water is 4.58 mm of Hg at the same temperature, calculate the molecular weight of sucrose
ISC Board-2017
55. 18g of glucose, $C_6H_{12}O_6$, is dissolved in 1 kg of water in a sauce pan. At what temperature will water boil at 1.013 bar?
(K_b for water is $0.52 K kg mol^{-1}$, boiling point of water = 373.15 K)
Kerala Board-2022
56. What do you mean by elevation in boiling point? Explain with the help of graph.
Chhattisgarh Board-2020
57. Draw a labeled diagram of dialysis method, for purification of colloidal solutions.
Rajasthan Board-2018
58. Which colligative property is preferred for the molar mass determination of macromolecules?
Rajasthan Board-2014
59. What are colligative properties? Give one example of such properties.
Rajasthan Board-2010

60. (a) A solution is obtained by mixing 300g of 25% solution and 400g of 40% solution by mass. Calculate the mass percentage (w/w) of water in solution.
Assam Board-2020
61. (b) A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C . Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = $0.512\text{K kg mol}^{-1}$).
Assam Board-2020
62. What is molal elevation constant? Derive its equation and give its unit.
Gujarat Board-2017
63. The boiling point of benzene is 353.23K when 1.80g of non-volatile solute was dissolved in 90g of benzene, the boiling point is raised to 354.11K . Calculate the molar mass of the solute. K_b for benzene is 2.53K kg mol^{-1} .
Nagaland Board-2020
64. Derive a relation between relative lowering of vapour pressure and mole fraction of the solute.
Meghalaya Board-2019
65. (a) What are colligative properties?
(b) Define osmosis and osmotic pressure.
Meghalaya Board-2021
66. Answer the following questions :
(a) The elevation in boiling point for 1 molal solution of non-volatile solute A is 3K and the depression in freezing point for 2 molal solution of A in the same solvent is 6K . What is the ratio of K_b and K_f ?
(b) A gaseous mixture of two substance A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. If the mole fraction of substance A is 0.5 in the vapour phase and 0.2 in the liquid phase, then calculate the vapour pressure of pure liquid A.
Assam Board-2023
67. (a) 45g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) is mixed with 600g of water. Calculate (a) the freezing point depression and (b) the freezing point of the solution:
Nagaland Board-2021
68. Ethylene glycol (molar mass = 62 gmol^{-1}) is used as an antifreeze for water to be used in car radiators in cold places. How much ethylene glycol should be added to 1 kg of water to prevent it from freezing at 10°C ? [K_f for water = $1.86\text{ K Kg mol}^{-1}$].
Nagaland Board-2018
69. (a) Calculate the amount of sodium chloride (electrolyte) which must be added to one kilogram of water so that the freezing point is depressed by 3K . Given K_f for water = 1.86K kg mol^{-1} .
Nagaland Board-2017
70. A solution containing 4.2g of an organic compound in 50 g of acetone shows an elevation of boiling point by 1.8K . Determine the molar mass of the organic compound. K_b of acetone = 1.71K kg mol^{-1} .
Nagaland Board-2017
- 71.(a) The freezing point of 0.1 molal solution of CH_3COOH in benzene is 0.256K ($K_f = 5.12\text{ K m}^{-1}$). What conclusion will you draw about molecular state of CH_3COOH in C_6H_6 ?
(b) A solution containing 18 g of a non-volatile solute in 200 g of H_2O freezes at 272.07 K . Find the molecular mass of the solute. ($K_f = 1.86\text{ K m}^{-1}$)
Meghalaya Board-2018

Section-D : Case Based Study

1. Calculate the depression in the freezing point of water when 10 g of Calculate the depression in the freezing point of water when 10 g of $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ is added to 250 g of water.
 $K_a = 1.4 \times 10^{-3}$, $K_f = 1.86\text{ K kg mol}^{-1}$
[Atomic mass : H = 1, C = 12, O = 16, Cl = 35.5]
Gujarat Board 2023 (March)
2. 2g of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) dissolved in 25g of benzene shows a depression in freezing point equal to 1.62K molal depression constant for benzene is 4.9K kg mol^{-1} . What is the percentage association of acid if it forms dimer in solution? (Molecular mass of benzoic acid is 122 gmol^{-1})
Gujarat Borad-2022 (July)
- 3.(a) The concentration of the solution of the solution of glucose in water is 10% (w/w). If the density of this solution is 1.20 g mL^{-1} , then calculate –
(i) Molality
(ii) Molarity
(iii) Mole fraction of each component in solution
UP Board 2023
4. Assertion: True solution shows scattering of light.
Reason: In true solution, size of solute particles is much smaller than the wavelength of light used.
(a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
(b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
(c) Assertion is a correct statement, but Reason is a wrong statement.
(d) Assertion is a wrong statement, but Reason is a correct statement.
CBSE-2021

		Section-E : Long Answer
<p>5. Assertion: Lyophilic sols are more stable than Lyophobic sols. Reason: Lyophilic sols are highly solvated in the solution.</p> <p>(a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion. (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion. (c) Assertion is a correct statement, but Reason is a wrong statement. (d) Assertion is a wrong statement, but Reason is a correct statement.</p> <p style="text-align: right;">CBSE-2021</p>	1.	<p>(a) When 19.5 g of F – CH₂ – COOH (Molar mass = 78 g mol⁻¹) is dissolved in 500 g of water, the depression in freezing point is observed to be 1^o C. Calculate the degree of dissociation of F – CH₂ – COOH. [Given : K_f for water = 1.86 K kg mol⁻¹] (b) Give reasons : (i) 0.1 M KCl has higher boiling point than 0.1 M Glucose. (ii) Meat is preserved for a longer time by salting.</p> <p style="text-align: right;">CBSE-2020</p>
<p>6. Assertion: Colloidal solutions are purified by dialysis. Reason: Colloidal particles pass through a suitable membrane in dialysis.</p> <p>(a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion. (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion. (c) Assertion is a correct statement, but Reason is a wrong statement. (d) Assertion is a wrong statement, but Reason is a correct statement.</p> <p style="text-align: right;">CBSE-2021</p>	2.	<p>A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K. (Given molar mass of sucrose = 342g mol⁻¹ and molar mass of glucose = 180g mol⁻¹) Delhi 2017; All India 2017</p>
<p>7. Assertion: A positively charged sol is obtained when KI is added to AgNO₃. Reason: This is due to preferential adsorption of Ag⁺ ions.</p> <p>(a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion. (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion. (c) Assertion is a correct statement, but Reason is a wrong statement. (d) Assertion is a wrong statement, but Reason is a correct statement.</p> <p style="text-align: right;">CBSE-2021</p>	3.	<p>State Henry's law. At the same temperature, CO₂ gas is more soluble in water than O₂ gas. Which one of them will have higher value of K_H?</p> <p style="text-align: right;">Assam Board-2022</p>
<p>8. Assertion: Colloidal solution shows Brownian Movement. Reason: Colloid is not a substance but a state of substance.</p> <p>(a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion. (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion. (c) Assertion is a correct statement, but Reason is a wrong statement. (d) Assertion is a wrong statement, but Reason is a correct statement.</p> <p style="text-align: right;">CBSE-2021</p>	4.	<p>(a) Calculate the molality of 2.5 g of ethanoic acid (CH₃COOH) in 75 g of benzene. (b) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is 2.53 K kg mol⁻¹. NIOS Board-2018</p>
<p>5. a) 31 g of an unknown molecular material is dissolved in 500 g of water. The resulting solution freezes at 271.14 K. Calculate the molar mass of the material. Given: K_f for water = 1.86 K kg mol⁻¹ T_r of water = 273 K. b) What is reverse osmosis? Mention its use.</p> <p style="text-align: right;">Karnataka Board-2019</p>	5.	<p>a) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile, non-ionisable solute was dissolved in 90 g of benzene, the boiling point raised to 354.11 K. Calculate molar mass of the solute. [K_b for benzene = 2.53 K kg mol⁻¹] b) Define: i) Molality of a solution. ii) Isotonic solutions.</p> <p style="text-align: right;">Karnataka Board-2018</p>
<p>6. a) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile, non-ionisable solute was dissolved in 90 g of benzene, the boiling point raised to 354.11 K. Calculate molar mass of the solute. [K_b for benzene = 2.53 K kg mol⁻¹] b) Define: i) Molality of a solution. ii) Isotonic solutions.</p> <p style="text-align: right;">Karnataka Board-2018</p>	6.	<p>a) 1.0g of a non-electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.4K. Find the molar mass of the solute. [Given: Freezing point depression constant of benzene = 5.12 K kg mol⁻¹]. b) How solubility of a gas in liquid varies with i Temperature and ii) Pressure?</p> <p style="text-align: right;">Karnataka Board-2017</p>
<p>7. a) 1.0g of a non-electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.4K. Find the molar mass of the solute. [Given: Freezing point depression constant of benzene = 5.12 K kg mol⁻¹]. b) How solubility of a gas in liquid varies with i Temperature and ii) Pressure?</p> <p style="text-align: right;">Karnataka Board-2017</p>	7.	<p>a) 1.0g of a non-electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.4K. Find the molar mass of the solute. [Given: Freezing point depression constant of benzene = 5.12 K kg mol⁻¹]. b) How solubility of a gas in liquid varies with i Temperature and ii) Pressure?</p> <p style="text-align: right;">Karnataka Board-2017</p>

8. a) 5.8 of a non volatile solute was dissolved in 100 g of carbon disulphide (CS_2). The vapour pressure of the solution was found to be 190 mm of Hg. Calculate the molar mass of the solute given the vapour pressure of pure CS_2 is 195 mm of Hg.
[Molar mass of $\text{CS}_2 = 76 \text{ g mol}^{-1}$].
b) Mention any two difference between Ideal and non-Ideal solutions.
Karnataka Board-2016
9. a) A solution containing 18g of non-volatile non-electrolyte solute is dissolved in 200g of water freezes at 272.07 K. Calculate the molecular mass of solute.
Given $K_f = 1.86 \text{ kg/mol}$ and freezing point of water = 273 K
b) Define isotonic solution, What happens when the blood cell is dipped in a solution containing more than normal saline concentration?
3 + 2
Karnataka Board-2015
10. a) On dissolving 2.34g of solute in 40g of benzene, the boiling point of solution was higher than that of benzene by 0.81K. K_b value for benzene is $2.53 \text{ K kg mol}^{-1}$. Calculate the molar mass of the solute.
b) State Henry's law. Write its mathematical form.
3 + 2
Karnataka Board-2014
11. Draw a graph depicting the deviation from Raoult's law exhibited by a solution prepared by mixing ethanol and acetone.
Calculate the molar mass of a non volatile solute 1.8 grams of which have been dissolved in 25 grams of acetone and the solution boils at 56.86°C . Pure acetone boils at 56.38°C . The molal elevation constant for acetone is $1.72 \text{ K kg mol}^{-1}$.
Goa Board-2018
12. What are colligative properties? Name the various colligative properties? Derive a relation between relative lowering in vapour pressure and mole fraction of the solute?
J&K Board-2019
13. (i) What are colligative properties?
(ii) 400 cm^3 of an aqueous solution of a protein contain 1.26 g of the protein. The osmotic pressure of such solution at 300K is found to be $2.57 \times 10^{-4} \text{ atm}$. Calculate molar mass of protein ($R = 0.0821 \text{ L atmK}^{-1} \text{ mol}^{-1}$)
Kerala Board-2021
14. Draw a neat labelled diagram to show the elevation in boiling point of a solvent when a non-volatile solute is added to it.
The vapour pressure of a 5% aqueous solution, by mass, of a non-volatile organic substance at 373 K is 745 mm of Hg. Calculate the molar mass of the solute.
(Given vapour pressure of water at 373 K is 760 mm Hg.)
Goa Board-2019
15. The existence of charge on colloidal particles is confirmed by electrophoresis experiment.
(a) What is meant by electrophoresis?
(b) In the coagulation of a negative sol, the coagulating power is in the order $\text{Al}^{3+} > \text{Ba}^{2+} > \text{Na}^+$. Name and state the rule behind this.
Kerala Board-2020
16. For ethanol-acetone mixture solute-solvent interaction is weaker than solute-solute and solvent-solvent interaction.
(a) Does this solution obey Raoult's law?
(b) Give the vapour pressure-mole fraction graph for this solution.
Kerala Board-2020
17. What is relative lowering in vapour pressure and show that it is a Colligative Property?
Haryana Board -2016
18. What is elevation in boiling point and show that it is a Colligative property?
Haryana Board -2016
19. Define elevation in B.P. How can you calculate the molecular mass of a non-volatile solute with it?
J & K board-2023
20. Define Osmotic Pressure. How is it determined by Berkeley-Hartley method?
J & K board-2023
21. What are colligative properties? Derive the relationship between the elevation in boiling point and molecular mass of a non-volatile solute in solution.
J&K Board-2020
22. Define molarity and molality. Calculate molality of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of Benzene.
J&K Board-2020
23. The boiling point of benzene is 353.23 K. When 1.80 g of a nonvolatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. (K_b for benzene is $2.53 \text{ K kg mol}^{-1}$).
Meghalaya Board-2019

E. Vapour Pressure of Liquid Solutions

Section-A : Multiple Choice Questions

1. 1.00 g of a non electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.40. The freezing point depression constant of benzene is $5.12 \text{ K kg mol}^{-1}$. Find the molar mass of the solute.
(a) 280 g mol^{-1} (b) 356 g mol^{-1}
(c) 562 g mol^{-1} (d) 256 g mol^{-1}
Gujarat Board-2021

Ans. (d)

2. The value of Henry's constant :
- Increases with increase in temp
 - decreases with increase in temp
 - remains constant
 - first increases then decreases

Punjab Board-2021

Ans. (a)

3. Correct expression for elevation in boiling point is:

- $\Delta T_b = K_b \cdot m$
- $\Delta T_f = K_f \cdot m$
- $\pi = CRT$
- None of these

Haryana Board-2017

Ans. (a)

4. What will be boiling point, (in K) of 0.1 m aqueous solution of urea? ($k_b = 3.2 \text{ K kg mole}^{-1}$)

- 373.32
- 100.32
- 0.32
- 405.2

Gujarat Board-2018

Ans. (a)

Section-B : Very Short Answer

1. State Henry's law. Calculate the solubility of CO_2 in water at 298 K under 760 mm Hg. (K_H for CO_2 in water at 298 K is $1.25 \times 10^6 \text{ mm Hg}$)

CBSE-2020

2. Identify which liquid will have a higher vapour pressure at 90°C if the boiling points of two liquids A and B are 140°C and 180°C , respectively.

CBSE-2020

3. State Henry's law and write its two applications.

CBSE-2019

4. Calculate the amount of CaCl_2 (molar mass 111 g mol^{-1}) which must be added to 500 g of water to lower its freezing point by 2 K assuming CaCl_2 is completely dissociated. K_f for water = $1.86 \text{ K kg mol}^{-1}$

CBSE-2019

5. 0.5 g of a non-volatile solute is dissolved in 100 g of ethyl acetate at 20°C . The vapour pressure of the solution and pure ethyl acetate are 72.0 torr and 72.8 torr, respectively at -28°C . Calculate molecular weight of the solute.

ISC Board-2001

6. (i) The freezing point of nitrobenzene is 278.8 K. A 0.25 molal solution of a substance (molecular weight : 120) in nitrobenzene has a freezing point of 276.8 K. Calculate the molal depression constant of nitrobenzene.
(ii) Calculate osmotic pressure of a solution containing 3.42 g of sucrose in 1 L of water at 400 K.

ISC Board-2002

7. What will be the vapour pressure of a solution containing 5 moles of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) in 1 kg of water, if the vapour pressure of pure water is 4.57 mm of Hg? ($C = 12, H = 1, O = 16$)

ISC Board-2014

8. Which of the following solutions will have a lower vapour pressure and why?

- A 5% solution of cane sugar ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$).
- A 5% solution of urea (NH_2CONH_2). (Relative atomic masses of $H = 1, C = 12, O = 16, N = 14$)

ISC Board-2009

9. Correct the given statement : "Freezing point of a solution is directly proportional to its molality."

ISC Board-2001

10. A 2 molal solution of sodium chloride in water causes an elevation in the boiling point of water by 1.88 K. What is the value of van't Hoff factor? What does it signify? ($K_b = 0.52 \text{ K kg mol}^{-1}$)

ISC Board-2014

11. Correct the given statement : "Addition of sodium chloride lowers the boiling point and freezing point of water".

ISC Board-2003

12. Correct the following statement by changing the underlined part of the sentence.

Water boils below 100°C by the addition of NaCl.

ISC Board-2008

13. Define cryoscopic constant.

ISC Board-2013

14. What is the unit of molal depression constant?

ISC Board-2014

15. The van't Hoff factor of acetic acid solution is than one and the value of normal colligative property is than the observed colligative property of this solution.

ISC Board-2014

16. Why the freezing point depression (ΔT_f) of 0.4 M NaCl solution is nearly twice than that of 0.4 M glucose solution?

ISC Board-2017

17. What is the mass of a non-volatile solute (molar mass 60) that needs to be dissolved in 100 g of water in order to decrease the vapour pressure of water by 25%? What will be the molality of the solution?

ISC Board-2010

18. A solution is prepared by dissolving 2.0 g of sucrose and 2.0 g of urea in 100 g of water at 298 K. Calculate the vapour pressure of the solution, if the vapour pressure of pure water at 298 K is 23.56 torr. (Molecular weight of urea = 60 and sucrose = 342)

ISC Board-2006

19. How is the vapour pressure of a solvent affected when a non-volatile solute is dissolved in it?
Delhi 2014C
20. State how the vapour pressure of a solvent is affected when a non-volatile solute is dissolved in it?
Foreign 2008
21. Some liquids on mixing form azeotropes. What are azeotropes?
Delhi 2014
22. Define the term azeotrope.
All India 2013
23. What will be the impact on K_f when the molality of a solution is doubled?
Assam Board-2022
24. The boiling point of benzene is 353.2 K. When 1.8 g of a non-volatile solute was dissolved in 90 g benzene the boiling point was raised to 354.1 K. Calculate the molecular mass of the solute. (K_b of benzene = $2.53 \text{ K kg mol}^{-1}$)
Odisha Board-2020
25. Why does vapour pressure of a liquid decrease when a non - volatile solute is added into it?
Manipur Board-2017
26. The vapour pressure of 2.1% of an aqueous solution of a non electrolyte at 373 K is 755 mm calculate the molar mass of solute
Punjab Board-2021
27. The K_H values for Nitrogen gas (N_2) at 293K and 303K are 76.48 K bar and 88.84 K bar respectively. Among these two given temperatures, at which temperature Nitrogen gas is more soluble in water
Karnataka Board-2020
28. At a given temperature, oxygen gas is more soluble in water than Nitrogen gas. Which one of them has higher value of K_H ?
Karnataka Board-2019
29. (i) Define :
(a) Enthalpy of atomization
(b) Enthalpy of vaporization
Maharashtra board-2018
30. Define minimum boiling azeotropes with example.
Kerala Board-2018
31. Why is Henry's law not applicable to dissolution of hydrogen chloride gas in water ?
Manipur Board-2019
32. Vapour pressure of water at 293 K is 17.535 mm Hg. Calculate the vapour pressure of the solution at 293 K when 25 g of glucose is dissolved in 450 g of water.
Andhra Pradesh Board-2021
33. The vapour pressure of pure benzene at a certain temperature is 0.850 bar . A non - volatile, non - electrolyte solid weighing 0.5 g when added to 39 gm of benzene (molar mass 78 g mol^{-1}), vapor pressure become 0.845 bar. What is the molar mass of the solid substance?
Kerala Board-2016
34. What happens to vapour pressure of water if a tablespoon of sugar is added to it ?
Rajasthan Board-2014
35. The boiling point of CHCl_3 is 61.5°C Calculate the molar heat of vaporization of the liquid, assuming ideal behaviour.
Tamilnadu Board, Sep.-2016
36. State Henry's law and write its important application.
Nagaland Board-2020

Section-C : Short Answer

1. Suggest a liquid that could be added to water so that the mixture boils below 100°C at the same pressure.
Manipur Board 2023
2. Vapour pressure of water at 293 K is 17.536 mm Hg. Calculate the vapour pressure of aqueous solution when 20 g of glucose (Molar mass = 180 g mol^{-1}) is dissolved in 500 g of water.
CBSE-2021
3. Vapour pressure of water at 293 K is 17.536 mm Hg. Calculate the vapour pressure of aqueous solution when 20g of glucose (Molar mass = 180 g mol^{-1}) is dissolved in 500 g of water.
CBSE-2021
4. What is Relative Lowering of vapour pressure? How is it useful to determine the molar mass of a solute?
Telangana Board-2017
5. A 4% solution(w/w) of sucrose ($M = 342 \text{ g mol}^{-1}$) in water has a freezing point of 271.15 K. Calculate the freezing point of 5% glucose ($M = 180 \text{ g mol}^{-1}$) in water. (Given : Freezing point of pure water = 273.15 K)
CBSE-2019
6. (a) 1.0 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is $5.12 \text{ K kg mol}^{-1}$. Find the molar mass of the solute.
(b) What is the significance of Henry's law constant, K_H ?
(c) What leads to anoxia ?
CBSE-2019
7. At 25°C , the saturated vapour pressure of water is 3.165 k Pa (23.75 mm Hg). Find the saturated vapour pressure of a 5% aqueous solution of urea (carbamide) at the same temperature. (molar mass of urea = 60.05 g mol^{-1}).
Foreign 2012
8. Define azeotropes. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.
Foreign 2015

9. Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law? Give an example.
Delhi 2015
10. Henry's law constant for CO_2 dissolved in water is 1.67×10^8 Pa at 298 K. Calculate the quantity of CO_2 in 1 L of soda water when packed under 2.5 atm CO_2 pressure at 298 K.
HOTS; Delhi 2008C
11. If N_2 gas is bubbled through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 L of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48 K bar.
All India 2012C
12. State Henry's law. Why do gases nearly always tend to be less soluble in liquids as the temperature is raised?
Assam Board-2022
13. Vapour pressure of water at 293K is 17.535 mm Hg. Calculate the vapour pressure of water at 293K when 25g of glucose is dissolved in 450g of water.
Uttarakhand Board-2020
14. Vapour pressure of water at 293 K is 17.535 mmHg. Calculate the vapour pressure of the solution at 293 K when 25 g of glucose is dissolved in 450 g of water ?
Andhra Pradesh Board-2019
15. (a) 18 g of glucose (molar mass = 180 g mol^{-1}) is dissolved in 1000g of water in sauce pan. At what temperature will this solution boil ?
(K_b for water = $0.52 \text{ K Kg mol}^{-1}$, boiling point of pure water = 373.15 K)
(b) State and explain briefly Henry's law.
Punjab Board-2019
16. (a) What is Henry's law? What is relationship between partial pressure and mole fraction?
(b) Calculate the vapour pressure lowering caused by the addition of 50 g sucrose (Molecular mass = 342) to 500 g of water if the vapour pressure of pure water 25°C is 23.8 mm Hg.
NIOS Board-2023
17. Calculate the mass of a non-volatile (Molar-mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%.
Haryana Board-2021
18. a) On dissolving 2.34g of solute in 40 g of benzene, the boiling point of solution was higher than that of benzene by 0.81 K. K_b value for benzene is 2.53 kg mol^{-1} Calculate the molar mass of the solute.
b) i) State Henry's law.
ii) How solubility of a gas in liquid changes with increase in temperature?
Karnataka Board-2019
19. Mixture of two liquids A and B form an ideal solution. Draw the vapour pressure-composition curve for this solution.
Kerala Board-2021
20. Mixing acetone and chloroform occurs with reduction in volume. Name the type of deviation from Raoult's law shown by the above mixture and state whether the process is endothermic or exothermic.
Goa Board-2019
21. Why the freezing point depression (ΔT_f) of 0.4M NaCl solution is nearly twice than that of 0.4M glucose solution?
ISC Board-2017
22. State Raoult's law.
Assam Board-2014
23. What is meant by positive deviation from Raoult's law? Explain why this deviation is observed.
Assam Board-2014
24. State Henry's law.
Assam Board-2014
25. Define the terms:
(a) Freezing point
(b) Molal depression constant
Haryana Board-2017
26. (a) State Henry's law. [1]
(b) Define the following terms—
(i) Mole fraction (ii) Molarity
Uttarakhand Board-2019
27. Define the following:
(i) Henry's Law
(ii) Raoult's Law
Haryana Board-2018
28. Will the elevation in boiling point be same if 0.1 mole of sodium chloride or 0.1 mole of sugar is dissolved in 1 L of water?
Rajasthan Board-2014
29. Write two uses of Henry's law.
Rajasthan Board-2011
30. State and prove Raoult's law for non-volatile solute in volatile solvent. Also give any two limitations of Raoult's law.
Gujarat Board-2018
31. (b) Urea [$(\text{NH}_2)_2\text{CO}$] forms an ideal solution in water. Calculate the vapour pressure of an aqueous solution containing 5% by mass of urea at 298 K. At 298K, vapour pressure water is 23.75 mm Hg.
Assam Board-2015
32. A solution of sucrose (molecular mass 342 u) is prepared by dissolving 6.84 g in 100 g of water at 298 K
(i) Calculate the boiling point of the solution. (K_b for water, 0.52 kg mol^{-1}).
(ii) calculate the freezing point of the solution (k_f for water, 1.86 kg mol^{-1})
(iii) Calculate the osmotic pressure of the solution at 298 K (Density of water at 298K = 1 g mL^{-1})
Assam Board-2012

33. On dissolving 4gm urea in 100 gm water, 1.24°C depression in freezing point of the solution is obtained. Calculate molecular mass of urea. ($K_f = 1.86 \text{ K mol}^{-1}$)
MP Board-2018
34. (a) Define the following:
(i) Henry's law
(ii) Normality
(b) If 2 gram NaOH in 250 ml solution, then determine the normality of the solution.
MP Board-2014
35. Vapour pressure of water at 293K is 17.535 mmHg. Calculate the vapour pressure of water at 293K, when 25g of glucose is dissolved in 450g of water.
Nagaland Board-2020
36. What is meant by negative deviation from Raoult's law? What type of non-ideal solution is formed when ethanol is mixed with water?
Assam Board-2023
37. How is nitric acid prepared by Ostwald's process? Give the reactions involved in it.
Nagaland Board-2017
- Section-D : Case Based Study**
1. Vapour pressure of Chloroform (CHCl_3) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively
i) Calculate the vapour pressure of the solution prepared by mixing 50g of CHCl_3 and 30 g of CH_2Cl_2 at 298 K.
ii) Calculate mole fractions each component in vapour phase [Atomic mass : H = 1, C = 12 Cl = 35.5]
Gujarat Board 2023 (March)
- Section-E : Long Answer**
1. The vapour pressure of pure liquids A and B are 450 and 700 mm of Hg respectively at 350K. find out the composition of the liquid mixture if total vapour pressure is 600 mm of Hg. Also, find the composition of the vapour phase.
All India 2013C
2. (i) 18 g of glucose $\text{C}_6\text{H}_{12}\text{O}_6$, is dissolved in 1kg of water in a saucepan. At what temperature will the solution boil at 1.013 bar? K_b for water is $0.52 \text{ k kg mol}^{-1}$. [C = 12, H = 1, O = 16 g mol^{-1}].
Gujarat Board-2021
3. (a) Why is the vapour pressure of a solution containing a non-volatile solute always less than that of the pure solvent ?
(b) Calculate the boiling point of a solution containing 0.456 g of camphor (molar mass = 152 g mol^{-1}) dissolved in 31.4 of acetone. [Given : Boiling point of pure acetone = 392.3 K, K_b of acetone = $1.72 \text{ K kg mol}^{-1}$]
NIOS Board-2019
4. (a) 1 g of a non-volatile solute was dissolved in 100 g of acetone (molecular mass = 58 u) at 298 K. The vapour pressure of the solution was found to be 192.5 mm Hg. Calculate the molecular mass of the solute. The vapour pressure of pure acetone at 298 K is 195 mm Hg.
(b) Define:
(i) Molality
(ii) Molarity
NIOS Board-2011
5. (i) what is the vapour pressure of pure water of 100°C temperature ?
(ii) 12 gm of a solid solute is dissolved in 90 gm pure water. Vapour pressure of the resulting solution is 750 mm Hg at 100°C temperature. Calculate molecular mass of the solute. [Solute does not undergo any dissociation or association in its aqueous solution.]
West Bengal Board-2019
6. State Henry's law. Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g of octane to reduce its vapour pressure to 80%
Andhra Pradesh Board-2020
7. Find the degree of association (X) when 1.0 gm benzoic acid, dissolved in 25 gm benzene is having depression in freezing point 0.81 K. The molal depression constant for solvent is $4.9 \text{ K kg mol}^{-1}$.
Gujarat Board-2019
8. a) 1.00 g of a non-electrolyte solute is dissolved in 50 g of benzene lowers the freezing point of benzene by 0.4K. The freezing point depression constant for benzene is $5.12 \text{ K kg mol}^{-1}$. Find the molar mass of the solute.
b) State Henry's law. Write its mathematical form.
Karnataka Board-2020
9. Vapour pressure of water at 293 K is 17.535 mm Hg. Calculate the vapour pressure of water at 293 K when 25 g of glucose is dissolved in 450 g of water.
OR
Draw the structures of the following compounds :
Jharkhand Board-2019
10. Briefly discuss elevation in boiling point.
Haryana Board-2017
11. (d) Ethylene glycol is used as antifreeze in car radiator water. Calculate the minimum molal concentration of ethylene glycol solution that will protect the car radiator from freezing at -1.90°C ?
(e) The partial pressure of carbon dioxide gas inside a bottle of a carbonated soft drink is 4 atm at 25°C . How many moles of CO_2 are dissolved in a 355 mL can ?
(The Henry's law constant for CO_2 dissolved in water is $3.30 \times 10^{-2} \text{ mol L}^{-1} \text{ atm}^{-1}$ at 25°C).

- (f) The boiling point of 0.1m aqueous NaCl solution is higher than that of 0.1 m aqueous glucose solution. Give reason.
Manipur Board-2022
12. Give two application of Henry's Law.
Haryana Board-2018
13. Calculate the depression in the Freezing point of water when 10 g of $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ is added to 250 g of water.
 $K_f = 1.4 \times 10^{-3}$, $K_f = 1.86 \text{ K kg mol}^{-1}$.
Gujarat Board-2020
14. What is Henry's law and mention its some important applications?
Haryana Board-2016
15. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K ($K_f = 5.12 \text{ K kg mol}^{-1}$)
Assam Board-2019
16. Show that total vapour pressure over the solution of two liquids 1 and 2 at a particular temperature varies linearly with the mole fraction of a component.
Assam Board-2018
17. 1.8g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) is dissolved in 100g of water in a beaker. At what temperature will water in the solution boil at 1.013 bar? Given boiling point of pure water at 1.013 bar is 373.15 K and K_b for water is $0.052 \text{ K kg mol}^{-1}$.
Assam Board-2018
18. Calculate the mass of a non-volatile solute of molar mass 40 g mol^{-1} , which when dissolved in 114 g octane to reduce its vapour pressure to 80%.
Assam Board-2017
19. The vapour pressures of pure liquids A and B are 450 mm Hg and 700 mm Hg respectively at 350K. If the total vapour pressure of the mixture of the two liquids at 350 K is 600 mm Hg, calculate the mole fractions of the two components in the solution. Also, calculate the partial pressures of the two components in the vapour phase.
Assam Board-2015
20. 0.52 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) is dissolved in 80.2 g of water. Calculate the boiling point of the solution. (K_b for water is $0.52 \text{ K kg mol}^{-1}$).
Assam Board-2013
21. (i) Boiling point of water at 750 mm of Hg is 99.63°C . How much sucrose (molecular mass 342u) is to be added to 500g of water such that it boils at 100°C ? Molal elevation boiling point constant. (K_b) for water is $0.52 \text{ K kg mol}^{-1}$.
(ii) 2.5 g ethanoic acid (CH_3COOH) is dissolved in 75g benzene Calculate the molality of the solution.
(molecular mass of $\text{CH}_3 \text{COOH} = 60\text{u}$)
Assam Board-2012
22. What do you understand by elevation of boiling point and molal elevation constant, with the help of this constant how can you find the molecular mass of non volatile solute?
MP Board-2016

23. What is molal depression constant?
An aqueous solution freezes at -0.385°C if $K_f = 3.85 \text{ K Kg mol}^{-1}$ and $K_b = 0.712 \text{ K Kg mol}^{-1}$ then determine the elevation in its boiling point?
MP Board-2012

F. Osmotic Pressure

Section-A : Multiple Choice Questions

1. Which solution is isotonic with 0.2M H_2SO_4 ?
(a) 0.4M HCl (b) 0.3M HCl
(c) 0.1M HNO (d) 0.2M HNO_3
Gujarat Borad-2022 (July)
- Ans. (b)
2. Isotonic solutions are those solutions which have same :
(a) Concentration (b) Osmotic Pressure
(c) Surface Tension (d) Viscosity
Haryana Board 2023
- Ans. (b)
3. Assertion (A) : Osmotic pressure is a colligative property.
Reason (R) : Osmotic pressure is directly proportional to molarity.
(a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is correct, but Reason (R) is incorrect statement.
(d) Assertion (A) is incorrect, but Reason (R) is correct statement.
CBSE-2020
- Ans. (a)
4. The pressure required for the reverse osmosis is quite high. For this.....membrane is used.
(a) Cellophane (b) Parchment
(c) Cellulose acetate (d) Pig's bladder
Gujarat Board-2021
- Ans. (c)
5. Which of the following processes is used for getting drinking water from saline sea water ?
(a) Reverse osmosis (b) Osmosis
(c) Filtration (d) Distillation
NIOS Board-2022
- Ans. (d) :
6. The rise of a liquid in a capillary tube is due to:
(a) Viscosity (b) Osmosis
(c) Diffusion (d) Surface Tension
NIOS Board-2023
- Ans. (d)

7. The rate of diffusion of methane at a given temperature is twice that of a gas X. The molecular weight of X is
 (a) 4.0 (b) 8.0
 (c) 32.0 (d) 64.0

NIOS Board-2022, 2018

Ans. (a) :

8. The degree of dissociation of a weak electrolyte increase
 (a) on increasing pressure
 (b) on decreasing dilution
 (c) on increasing dilution
 (d) on increasing concentration

NIOS Board-2023

Ans. (c)

9. Which of the following gases will have highest rate of diffusion?
 (a) O₂
 (b) CO₂
 (c) NH₃
 (d) N₂

NIOS Board-2023

Ans. (c)

10. What is the value of Van' t Hoff factor (i) for $K_4[Fe(CN)_6]$?
 (a) 6 (b) 5
 (c) 4 (d) Zero

Haryana Board-2022

Ans. (b) : j

11. Which of the following 0.1M aqueous solutions will exert highest osmotic pressure ?
 (a) Al₂(SO₄)₃
 (b) Na₂SO₃
 (c) MgCl₂
 (d) KCl

Maharashtra board-2018

Ans. (a)

12. What is the value of Van't-Hoff factor i for 0.1m ideal solution?
 (a) 1 (b) 0
 (c) 0.1 (d) 0.01

Gujarat Board-2017

Ans.(a)

13. Which solution has highest osmotic pressure under identical condition?
 (a) 0.1 M FeCl₃ (b) 0.1 M BaCl₂
 (c) 0.1 M NaCl (d) 0.1 M glucose

Gujarat Board-2018

Ans. (a)

Section-B : Very Short Answer

1. Which of 0.1 M urea and 0.1 M NaCl will have more osmotic pressure ? Explain with reason.

UP Board 2023

2. Calculate the osmotic pressure of 5% aqueous urea solution (w/v) at 27°C. Molecular weight of urea is 60.
 (R = 0.0821 litre atm K⁻¹ mol⁻¹)

UP Board 2023

3. State the anti-osmosis with example.

UP Board 2023

4. What is reverse osmosis? Mention one important practical utility of reverse osmosis.

Kerala Board 2023

5. Mention one practical utility of reverse osmosis.

Karnataka board 2023

6. State Raoult's law for a solution containing volatile components. What is the similarity between Raoult's law and Henry's Law ?

CBSE-2020

7. What happens when

- (i) a pressure greater than osmotic pressure is applied on the solution side separated from solvent by a semipermeable membrane
 (ii) acetone is added to pure ethanol ?

CBSE-2020

8. For a 5% solution of urea (Molar mass = 60 g/mol), calculate the osmotic pressure at 300 K. [R = 0.0821 L atm K⁻¹ mol⁻¹]

CBSE-2020

9. (a) Draw the graph between vapour pressure and temperature and explain the elevation in boiling point of a solvent in solution.

- (b) Determine the osmotic pressure of a solution prepared by dissolving 25 mg of K₂SO₄ in 2 litres of water at 25°C assuming it to be completely dissociated. (Atomic masses K = 39 u, S = 32 u, O = 16 u)

CBSE-2019

10. State Raoult's law for a solution containing volatile components. Write two characteristics of the solution which obeys Raoult's law at all concentrations.

CBSE-2019

11. A solution 0.1 M of Na₂SO₄ is dissolved to the extent of 95%. What would be its osmotic pressure at 27°C? (R = 0.0821 L atm K⁻¹ mol⁻¹)

CBSE-2019

12. Albumins are the most abundant proteins in blood. At 25°C, 3.5g of albumin in 100 mL of water produces an osmotic pressure of 0.014 atm. What is the molecular weight of albumin ?

ISC Board-2008

13. The osmotic pressure of blood is 7.65 atm at 27°C. How much glucose should be used per litre to prepare an intravenous injection that has the same osmotic pressure as blood ?

ISC Board-2003, 2001

14. Ethylene glycol is used as an antifreeze agent. Calculate the amount of ethylene glycol to be added to 4 kg of water to prevent it from freezing at -6°C . (K_f for $\text{H}_2\text{O} = 1.85 \text{ K mol}^{-1} \text{ kg}$)
ISC Board-2013
15. The depression in the freezing point of a sugar was found to be 0.402°C . Calculate pressure of the sugar solution at 27°C . ($K_f = 1.86 \text{ K kg mol}^{-1}$)
ISC Board-2007
16. The molecular weights of sodium chloride and glucose are determined by the depression of freezing point method. Compared to their theoretical molecular weight, when determined by the above method? Justify your answer.
ISC Board-2007
17. Equal weights of two substances X and Y are dissolved in equal volumes of water. The osmotic pressure of the solution containing Y is five times the osmotic pressure of the solution containing X. What is the molecular weight of X if that of Y is 60?
ISC Board-2009
18. The molecular weight of sodium chloride determined by measuring the osmotic pressure of its aqueous solution is
(a) double the theoretical value
(b) same as the theoretical value
(c) half the theoretical value
(d) three times the theoretical value
ISC Board-2009
19. The osmotic pressure of 0.25 M urea solution is 2.67 atm. What will be the osmotic pressure of a 0.25 M solution of potassium sulphate?
ISC Board-2010
20. The elevation in boiling point produced by dilute equimolar solution of three substances are in the order
 $A > \text{glucose} > B$. Suggest a reason for this observation.
ISC Board-2010
21. Out of the following solutions, the one having the highest boiling point will be
(a) 0.1 M NaCl
(b) 0.1 M BaCl_2
(c) 0.1 M KNO_3
(d) 0.1 M $\text{K}_4[\text{Fe}(\text{CN})_6]$.
ISC Board-2011
22. 0.1M urea solution shows less depression in freezing point than 0.1 M MgCl_2 solution. Explain.
ISC Board-2011
23. A solution X is prepared by dissolving 3 moles of glucose in one litre of water and a solution Y is prepared by dissolving 1.5 moles of sodium chloride in one litre of water. Will the osmotic pressure of X be higher, lower or equal to that of Y?
Give a reason for your answer.
ISC Board-2012
24. Define Raoult's law for the elevation in boiling point of a solution.
ISC Board-2014
25. Solutions which strictly obey law are called solutions.
ISC Board-2012
26. Define osmotic pressure of a solution. How is the osmotic pressure related to the concentration of a solute in a solution?
Delhi 2015C
27. Define the term osmotic pressure.
All India 2013; Delhi 2010C, 2009C
28. State Raoult's law.
Foreign 2012
29. Define Raoult's law in its general form in reference to solutions.
Delhi 2011; All India 2011; Foreign 2011
30. State Raoult's law for a solution of volatile liquids.
Delhi 2010C; Foreign 2009C
31. Define osmotic pressure and derive van't Hoff equation for dilute solutions. State the condition leading to reverse osmosis.
Manipur Board-2018
32. Define the following :
(i) Graham's law of diffusion
(ii) Critical temperature of a gas
NIOS Board-2019
33. Calculate the ratio of rates of diffusion of hydrogen and oxygen gases under similar conditions of temperature and pressure. [Atomic mass : H = 1.0 u, O = 16.0 u]
NIOS Board-2022
34. 10 mL of liquid A is mixed with 10 mL of liquid B, the volume of the resultant solution is 19.9 mL. What type of deviation is expected from Raoult's law?
Karnataka Board-2020
35. Define Dalton's law of partial pressure.
NIOS Board-2014
36. State Raoult's law of a binary solution for two volatile liquid components.
Karnataka Board-2017
37. Derive an expression to calculate molar mass of non volatile solute by osmotic pressure measurement.
Maharashtra board-2022
38. What is reverse osmosis? Write any one of its applications.
Kerala Board-2019
39. Two solutions having same osmotic pressure at a given temperature are called —
Kerala Board-2022
40. Draw structural formula of 3-chlorohexanoic acid.
Chhattisgarh Board-2020
41. Define Osmotic Pressure.
Andhra Pradesh Board-2018

42. State Raoult's Law.
The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5g when added to 39.0 g of benzene (molar mass 78 g mol^{-1}). Vapour pressure of the solution, then is 0.845 bar. What is the molar mass of the solid substance ?
Andhra Pradesh Board-2016
43. Define osmotic pressure.
Andhra Pradesh Board-2016
44. Differentiate between positive deviation and negative deviation from Raoult's law, exhibited by binary solutions. (any two points)
Goa Board-2019
45. Write definition of Osmosis.
Rajasthan Board-2020
46. Define the following terms:
(iv) Isotonic solutions
Assam Board-2020
47. Define the following:
(i) Osmotic pressure
(ii) Van't Hoff factor
(iii) Molal freezing depression constant
MP Board-2018

Section-C : Short Answer

1. 1.25 g protein is present in 300 mL aqueous solution of a protein. The osmotic pressure of such a solution at 300 K is found to be 2.50×10^{-3} bar. Calculate the molar mass of protein. ($R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$)
Rajasthan Board 2022
2. Write definition of osmosis. Write name of method used in desalination of sea water.
Rajasthan Board 2023
3. What type of deviation from Raoult's law is observed by mixing chloroform and acetone? Why is a decrease in vapour pressure observed on mixing chloroform and acetone?
CBSE-2021
4. A solution containing 1.9 g per 100 mL of KCl ($M = 74.5 \text{ g mol}^{-1}$) is isotonic with a solution containing 3 g per 100 mL of urea ($M = 60 \text{ g mol}^{-1}$). Calculate the degree of dissociation of KCl solution. Assume that both the solutions have same temperature.
CBSE-2019
5. (a) A 5% solution (by mass) of cane sugar in water has a freezing point of 271 K. Calculate the freezing point of 5% solution (by mass) of glucose in water. The freezing point of pure water is 273.15 K.
(b) Why is osmotic pressure of 1 M KCl higher than 1 M urea solution ?
(c) What type of liquids form ideal solutions ?
CBSE-2019
6. At 300 K, 30 g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of a glucose solution is 1.52 bar at the same temperature, what would be its concentration ?
CBSE-2019
7. Define osmotic pressure. Arrange the following in increasing order of osmotic pressure and give reasons in support of your answer.
(i) 34.2 g per litre of sucrose (Molecular weight = 342).
(ii) 90.0 g per litre of glucose (Molecular weight = 180).
(iii) 5.85 g per litre of sodium chloride (Molecular weight = 58.5).
ISC Board-2004
8. (i) A 10% aqueous solution of cane sugar (mol.wt. = 342) is isotonic with 1.754% aqueous solution of urea. Find the molecular mass of urea.
(ii) The molecular weight of an organic compound is 58 g mol^{-1} . What will be the boiling point of a solution containing 48 g of the solute in 1200 g of water ? [K_b for water = $0.513^\circ\text{C kg mol}^{-1}$; boiling point of water = 100°C]
(iii) What will be the value of van't Hoff factor (i) of benzoic acid, if it dimerises in aqueous solution ? How will the experimental molecular weight vary as compared to the normal molecular weight ?
ISC Board-2016
9. At 300 K, 36 g of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ present per litre in its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another glucose solution is 1.52 bar at the same temperature, calculate the concentration of the other solution.
HOTS; All India 2011C
10. Calculate the boiling point of one molar aqueous solution. Density of KBr solution is 1.06 g mL^{-1} (K_b for $\text{H}_2\text{O} = 0.52 \text{ K kg mol}^{-1}$, atomic mass of K = 39, Br = 80).
HOTS; All India 2011C
11. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C . Assuming the gene fragment is non-electrolyte, determine its molar mass.
Delhi 2011; all India 2011
12. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2 L of water at 25°C , assuming that it is completely dissociated.
($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$, molar mass of $\text{K}_2\text{SO}_4 = 174 \text{ g mol}^{-1}$)
Delhi 2013
13. Define the term osmotic pressure. Describe how the molecular mass of a substance can be determined by a method based on measurement of osmotic pressure?
Delhi 2008; all India 2008; Foreign 2008
14. Define the terms osmosis and osmotic pressure. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solutions?
All India 2010

15. Explain why a solution of chloroform and acetone shows negative deviation from Raoult's law?
HOTS; Delhi 2011C
16. State Raoult's law for solutions of volatile liquids. Taking suitable examples, explain the meaning of positive and negative deviations from Raoult's law.
Delhi 2008; Foreign 2008; All India 2008
17. State Raoult's law for a solution containing volatile components. How does Raoult's law become a special case of Henry's law?
Delhi-2014, All India 2013
18. What is meant by negative deviation from Raoult's law? Give an example. What is the sign of $\Delta_{\text{mix}} H$ for negative deviation?
Foreign 2015
19. What is meant by positive deviation from Raoult's law? Give an example. What is the sign of $\Delta_{\text{mix}} H$ for positive deviation?
Delhi 2015
20. Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.
All India 2011, 2010;
Delhi 2010; foreign 2010
21. What is meant by negative deviation from Raoult's law? Draw a diagram to illustrate the relationship between vapour pressure and mole fraction of components in a solution to represent negative deviation.
All India 2008C
22. The solubility of pure nitrogen gas at 25°C and 1 atm is $6.8 \times 10^{-4} \text{ mol L}^{-1}$. What is the concentration of nitrogen dissolved in water under atmospheric conditions? The partial pressure of nitrogen gas in the atmosphere is 0.78 atm.
HOTS; Delhi 2008
23. The partial pressure of ethane over a saturated solution containing $6.56 \times 10^{-2} \text{ g}$ of ethane is 1 bar. If the solution contains $5.0 \times 10^{-2} \text{ g}$ of ethane, then what will be the partial pressure of the gas?
Delhi 2013; All India 2012C
24. (b) The Osmotic pressure of a solution, containing 45gm of sucrose dissolved per liter of solution at 20°C, is 3.2. Calculate the value of constant R. (molecular weight of sucrose = 342)
Uttarakhand Board-2020
25. Give reasons for the following :
(a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.
(b) Aquatic animals are more comfortable in cold water than in warm water.
(c) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.
UP Board-2018
26. What is Raoult's law? The vapour pressure of a 5% aqueous solution of a non - volatile organic substance at 373K is 745 mm. Calculate the molar mass of the solute.
Manipur Board-2017
27. What is meant by positive deviation from Raoult's law? Give one example of such a solution.
NIOS Board-2018
28. X and Y are two completely miscible liquids and the intermolecular forces vary as $Y-Y < X-X < X-Y$.
Explain-
(a) Which one of the two liquids will boil at a higher temperature;
(b) When the two liquids are mixed, what type of deviations would the solution show from the Raoult's law.
NIOS Board-2013
29. KBr undergoes 80% dissociation in its 0.5 (M) aqueous solution. Calculate osmotic pressure of the solution at 27°C temperature.
West Bengal Board-2019
30. (i) Prove that osmotic pressure is a colligative property.
(ii) Calculate the molar concentration of urea solution if it exerts an osmotic pressure of 2.45 atmosphere at 300K. [$R = 0.0821 \text{ L atm mol}^{-1}\text{K}^{-1}$]
Punjab Board-2017
31. a) 300 cm³ of aqueous solution of a protein contains 2.12 g of the protein, The osmotic pressure of such a solution at 300 K is found to be $3.89 \times 10^{-3} \text{ bar}$. Calculate the molar mass of the protein. ($R = 0.0823 \text{ L bar mol}^{-1}\text{K}^{-1}$)
b) i) State Henry's law
ii) Soda water bottles are sealed under high pressure.
Karnataka Board-2016
32. What is Raoult's law ? Explain its mathematical expression.
Chhattisgarh Board-2022
33. A solution contains 15g urea (molar mass = 60 g mol⁻¹) per liter of solution in water has the same osmotic pressure as a solution of glucose (molar mass = 180 g mol⁻¹) in water. Calculate the mass of glucose present in one liter of its solution.
Kerala Board-2018
34. Osmotic pressure is a colligative property.
(a) What is osmotic pressure?
(b) 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is 5.12 K kg/mol. Find the molar mass of solute.
Kerala Board-2016

35. A 0.15 M aqueous solution of KCl exerts an osmotic pressure of 6.8 atm at 310 K. Calculate the degree of dissociation of KCl. ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
ISC Board-2017
36. What is osmotic pressure? Show that it is a colligative property.
Haryana Board-2017
37. Why is osmotic pressure considered to be a colligative property?
Haryana Board-2016
38. (a) State Kohlrausch's law. [1]
(b) Write short note on following—
(i) Strong Electrolyte (ii) Weak Electrolyte
Uttarakhand Board-2019
39. (a) Among the following which is not a colligative property?
(i) Osmotic pressure
(ii) Elevation of boiling point
(iii) Vapour pressure
(iv) Depression of freezing point
(b) (i) 200 cm^3 of aqueous solution of a protein contains 1.26 g of protein. The osmotic pressure of solution at 300 K is found to be $8.3 \times 10^{-2} \text{ bar}$. Calculate the molar mass of protein. ($R = 0.0831 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
(c) (ii) What is the significance of Van't Hoff factor?
Kerala Board-2015
40. State Raoult's law. The vapour pressure of pure Benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5 g when added to 39.0 g of benzene (molar mass 78 g mol^{-1}). Vapour pressure of the solution, then is 0.845 bar. What is the molar mass of the solid substance?
Andhra Pradesh Board-2018
41. Calculate the osmotic pressure of 0.01 M solution of urea at 27°C temperature. ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
Rajasthan Board-2020
42. 0.05M solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$ at 300K is 92% dissociated. Calculate the osmotic pressure of the solution ($R=0.0821 \text{ atm. LK}^{-1}\text{mol}^{-1}$)
Rajasthan Board-2019
43. Write definition of osmotic pressure.
Rajasthan Board-2018
44. What is the difference between diffusion and osmosis? Give one example of each. Exhibit diffusion and osmosis through labelled diagrams.
Rajasthan Board-2010
45. (a) Mention a method used for desalination of sea water.
(b) Define the term 'osmotic pressure'. How osmotic pressure of a solution vary with temperature?
Assam Board-2016
46. Define the following :
(i) Azeotropic mixtures
(ii) Isotonic solution
(iii) Semipermeable membrane
MP Board-2018
47. Calculate osmotic pressure of the solution which contains 68.4 gram sucrose in 1000 ml of solution at 293 K.
($R = 0.082 \text{ litre atm. K}^{-1} \text{ mol}^{-1}$).
MP Board-2018
48. Calculate the osmotic pressure of 5% solution of glucose at 25°C (Molecular weight of Glucose = 180 and $R = 0.0821 \text{ liter atm K}^{-1} \text{ mol}^{-1}$)
MP Board-2013
49. What is reverse osmosis ? Mention one of its applications.
Meghalaya Board-2018

Section-E : Long Answer

1. (a) A solution contains 5.85 g NaCl (Molar mass = 58.5 g mol^{-1}) per litre of solution. It has an osmotic pressure of 4.75 atm at 27°C . Calculate the degree of dissociation of NaCl in this solution.
Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$
(b) State Henry's law. Why is air diluted with helium in the tanks used by scuba divers?
CBSE-2020
2. (i) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?
(ii) What happens when we place the blood cell in water (hypertonic solution)? Give reason.
All India 2015
3. (ii) 200 cm^3 of aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 k is found to be $2.57 \times 10^{-3} \text{ bar}$. Calculate the molar mass of the protein.
Gujarat Board-2021
4. Define the following terms :
(a) Isotonic solution
(b) Osmosis
(c) Gold crystallises into face-centred cubic cells. The edge length of unit cell is $4.08 \times 10^{-8} \text{ cm}$. Calculate the density of gold.
[Molar mass of gold = 197 g mol^{-1}]
Maharashtra board-2022
5. 200 cm^3 of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300K is found to be $2.57 \times 10^{-3} \text{ bar}$. Calculate the molar mass of the protein.
Assam Board-2014
6. Osmotic pressure of a solution is 0.0821 atm at a temperature of 400 k . Calculate the concentration of solution in mol/litre.
[$R = 0.0821 \text{ L atm k}^{-1} \text{ mol}^{-1}$]
Rajasthan Board-2015