

2020

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions**Part-I**

1. Answer the following : 1 × 8
- The designation of an orbital with $n=3$ and $l=2$ is ____
 - The number of electrons in O_2^+ is ____.
 - Among Na, Na^+ , Na^{3+} , the highest value of ionisation energy is in ____.
 - Select the species having the smallest radius ____
Si, P, Cl.
 - Among H_2O , CO_2 , NH_3 , CH_4 ____ has maximum bond angle.
 - Shape of CCl_4 is ____.

- ____ point defect of its crystals decreases the density of a solid.
- The oxidation number of Cr in $K_2Cr_2O_7$ is ____.

Part-II

2. Answer any *eight* of the following : 1½ × 8
- Define Quantisation of energy.
 - State Aufbau principle.
 - p-block elements includes which groups in the periodic table ?
 - Why ionisation energy of Fluorine is more than that of oxygen ?
 - Write the Lewis structure of H_2SO_4 .
 - Why HF is more polar than HCl.
 - Which forces are collectively known as Van der Waal's forces ?
 - Ice floats on water, why ?
 - Define standard electrode potential.
 - Complete and balance the equation
 $S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + I^-$

[3]

Part-III

3. Answer any *eight* of the following : 2×8

- a) Write the significance of ψ .
- b) Explain Heisenberg's uncertainty principle.
- c) Which has more stable configuration and why ?
 $4s^23d^9$ and $4s^13d^{10}$.
- d) Why the effective nuclear charge $>$ Screening effect ?
- e) LiCl has higher boiling point than HCl, why ?
- f) Write the molecular orbital configuration of NO^+ and NO^- .
- g) H_2O is a liquid, where as H_2S is a gas at room temperature. Explain why ?
- h) Discuss the geometry of NH_3 molecule.
- i) NF_3 has less dipole moment than NH_3 . Why ?
- j) Balance the following equation by ion electron method in basic medium.
 $\text{Cr}(\text{OH})_3 + \text{IO}_3^- \rightarrow \text{I}^- + \text{CrO}_4^{2-}$

[4]

Part-IV

4. a) Discuss postulates of Bohr's model of atom. Give its limitations. 6

OR

b) Explain normal wave functions and Orthogonal wave functions.

5. a) What are p-block elements ? Give general characteristics of P-block elements. 6

OR

b) Define electron affinity. How do the electron affinity of elements vary along a period ?

6. a) What is lattice energy ? How can it be determined by using Born-Haber cycle ? 6

OR

b) On the basis of hybridisation discuss the bonding and shape of molecules (i) NH_3 , (ii) H_2O .

7. a) What is Semiconductors ? Briefly explain n-type and p-type semiconductors. 6

OR

b) Define intramolecular and intermolecular Van der Waal's forces. Discuss dipole-dipole and ion-dipole attractions.

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Answer *all* questions**Part-I**

1. Answer the following by fill in the blanks : 1×8
- The velocity possessed by maximum number of molecules of the gas is called ___ velocity.
 - The average distance covered by a molecule between two successive collisions is called ___.
 - The rise of a liquid in a capillary tube is due to the property of ___.
 - The density of ice is ___ than that of water.
 - ___ lattice has points at the corners of the cube with one additional point at the centre of the cube.
 - The approximate composition of glass is ___.
 - A mixture of NH_4^+ and NH_3 is a ___.
 - pH range of methyl orange indicator is ___.

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$
- Define Collision frequency.
 - What is absolute zero ?
 - What is the units of Vander Waal's constant 'a' and 'b'.
 - Define boiling point.
 - Write the unit of viscosity in S.I. unit.
 - Calculate pH of 0.0001 M NaOH.
 - Define common ion effect.
 - Write Brag's equation.
 - Define buffer capacity.
 - What is degree of hydrolysis ?

Part-III

3. Answer any *eight* of the following : 2×8
- What are the causes of deviation of real gases from ideal gas behaviour ?
 - Write two values of 'R'.

[3]

- c) Write the relationship between different types of velocities.
- d) Why are the liquid drops are spherical.
- e) Explain cleansing action of soaps or detergents.
- f) How pure NaCl is recovered from sea water.
- g) Why CsCl lattice is more stable than NaCl ?
- h) What do you mean by Diagonal plane of symmetry ?
- i) Define solubility product.
- j) Acetic acid is less acidic in sodium acetate solution than in sodium chloride solution. Explain.

Part-IV

- 4. a) From the postulates of kinetic theory of gasses, derive kinetic gas equation. $PV = \frac{1}{3}NC^2$ 6
- OR
- b) How do real gases deviate from ideal gas behaviour ? Derive Vander Waal's equation.

[4]

- 5. a) Define viscosity. How it is determined ? 6

OR

- b) Derive degree of ionisation of weak electrolytes and discuss the factors affecting degree of ionisation.

- 6. a) Define (i) Plane of symmetry and (ii) centre of symmetry. 6

OR

- b) Distinguish between Schottky defect and Frenkel defect.

- 7. a) What is buffer solution ? Derive Henderson's equation for acidic and the basic buffer mixtures. 6

OR

- b) Discuss the theory of Acid-Base indicators using phenolphthalein indicator.

SEMESTER-I

PAPER-CC-I (INORGANIC CHEMISTRY)

ONE MARK QUESTION

- For each value of l , the number of m values are:
(a) $2l$ (b) nl (c) $2l+1$ (d) $n-1$
- The designation of an orbital with $n=4$ and $l=3$ is :
(a) $4p$ (b) $4s$ (c) $4f$ (d) $4d$
- The number of d -electrons retained in Fe^{+2} ion is :
(a) 5 (b) 6 (c) 3 (d) 4
- According to Bohr's theory the angular momentum of an electron in 5th orbit is-
(a) $25 h/\pi$ (b) h/π (c) $10 h/\pi$ (d) $2.5 h/\pi$
- An element M has an atomic mass 19 and atomic number 9, its ion is represented by
(a) M^+ (b) M^{2+} (c) M^- (d) M^{2-}
- The number of nodal plane in a P_x orbital is
(a) 1 (b) 2 (c) 3 (d) 0
- The number of radial nodes of $3s$ and $2p$ orbitals are,
(a) 2, 0 (b) 0, 2 (c) 1, 2 (d) 2, 1
- If uncertainty in position of an electron is zero, the uncertainty in its momentum would be :
(a) zero (b) h/π (c) $h/2\pi$ (d) Infinite
- The total number of atomic orbitals in the fourth energy level of an atom is
(a) 8 (b) 16 (c) 32 (d) 10
- Number of unpaired electrons in Ni^{2+} is
(a) 0 (b) 2 (c) 4 (d) 8
- For $5s$ -orbital, the magnetic quantum number has the value:
(a) 2 (b) 4 (c) -1 (d) 0
- The maximum number of electrons in a sub shell is given by the relation:
(a) $2l+1$ (b) $2l-2$ (c) $4l+2$ (d) $2n^2$
- A sub shell with $n=5$, $l=2$ can accommodate maximum electrons:
(a) 10 (b) 12 (c) 36 (d) 54
- Which quantum number distinguishes the two electrons occupying the same orbital?
(a) Azimuthal quantum number (b) spin quantum number
(c) principal quantum number (d) magnetic quantum number
- Which of the following is not possible?
(b) $n=4$, $l=3$, $m=-3$ (b) $n=3$, $l=3$, $m=2$ (c) $n=1$, $l=0$, $m=0$ (d) $n=2$, $l=1$, $m=0$
- The family of elements with the highest ionisation enthalpy:
(a) He, Ne, Ar (b) Li, Na, K (c) F, Cl, Br (d) Mg, Ca, Sr
- Oxidation state of oxygen in H_2O_2 is:
(a) -1 (b) +2 (c) $1/2$ (d) -2
- Magic number is:
(a) 3 (b) 54 (c) 20 (d) 190
- The pair of atomic numbers represents p -block elements?

- (a) 12, 37 (b) 11, 56 (c) 15, 54 (d) 24, 42
20. What is the general outer electronic configuration of the coinage metals?
 (a) ns^2np^6 (b) $(n-1)d^{10}ns^1$ (c) $(n-1)d^{10}ns^2$ (d) $(n-1)d^9ns^2$
21. (a) The recently discovered elements, Flerovium ($Z=114$) belongs to:
 (a) s-block (b) p-block (c) d-block (d) f-block
22. Which of the following has maximum ionic radius?
 (a) Li^+ (b) Na^+ (c) Cs^+ (d) Rb^+
23. What is the oxidation number of Cl in ClO_3^- ?
 (a) +5 (b) +3 (c) +4 (d) +2
24. E.N is a measure of the capacity of an atom to
 (a) Attract electrons (b) Attract protons (c) Repel electrons (d) Repel protons
25. The EA of F is less than Cl because
 (a) Decrease in nuclear charge (b) compact size of F
 (b) inter electronic repulsion (d) screening effects
26. Which has least IP?
 (a) Li (b) Cs (c) Cl (d) I
27. Which of the following is not a periodic property?
 (a) Atomic mass (b) Atomic volume (c) Covalent radii (d) Electronegativity
28. Which of the following has the highest 2nd ionisation potential?
 (a) N (b) C (c) O (d) F
29. The 1st attempt to classify elements was made by
 (a) Newland (b) Dobernier (c) Mendeleev (d) Mosley
30. The elements belonging to second period are called:
 (a) Normal elements (b) rare earth elements
 (c) Transition elements (d) Inner transition elements
31. The set representing the correct order of first ionisation potential is:
 (a) $N > O > C$ (b) $O < S < Se$ (c) $Ne < F < O$ (d) $P < S < As$
32. In which of the following structures, the anion has maximum coordination number?
 (a) NaCl (b) ZnS (c) CaF_2 (d) Na_2O
33. For octahedral co-ordination, the radius ratio (r^+/r^-) should be
 (a) 0.155-0.255 (b) 0.255-0.414 (c) 0.414-0.732 (d) 0.732-1
34. Of the following species, which has the shortest bond length?
 (a) NO (b) NO^- (c) NO^+ (d) NO^{2+}
35. Which of the following is not possible covalency of chlorine in the molecule?
 (a) $HClO_3 = 3$ (b) $Cl_2O_7 = 7$ (c) $HCl = 3$ (d) $ClF_3 = 3$
36. Identify the pair which does not represent correct order of the species.
 (a) $O_2 = 2$ (b) $O_2^+ = 2.5$ (c) $O_2^- = 3$ (d) $O_2^{2-} = 1$
37. The appearance of colour in solid alkali metal halides is generally due to
 (a) Frenkel defect (b) Schottky defect (c) Metal deficiency defects (d) F-centres
38. Electrical conductivity decreases with increasing temperature in a
 (a) Super conductor (b) Insulator (c) Semi-conductor (d) Metallic conductor
39. Which of the following is not correct representation of oxidation number of chlorine in the compound ?
 (a) $ClO_4^- : Cl = +7$ (b) $ClO_3^- : Cl = +5$ (c) $ClO_2^- : Cl = +2$ (d) $OCl^- : Cl = +1$

40. In the reaction: $\text{SnCl}_2 + 2\text{HgCl}_2 \rightarrow \text{SnCl}_4 + \text{Hg}_2\text{Cl}_2$, which of the species act as reducing agent.

(a) SnCl_2 (b) HgCl_2 (c) SnCl_4 (d) Hg_2Cl_2

41. Name two species which are isoelectronic with Cl^- .

42. Write the quantum number of an electron present in 3P-orbital.

43. What is the electron affinity of $\text{Na}^+(\text{g})$ ion, if its ionisation potential is 5.1eV ?

44. Write the name of the element which shows 4th ionisation energy ($I.E_4$) and present in the third period of the periodic table.

1.5 MARKS QUESTION

45. An atom has its K and L shells completely filled and six electrons in the M-shell. How many P electrons are there in the atom?

46. What is screening effect or shielding effect? How does this effect affect the trend of ionisation energy?

47. State Pauli's Exclusion Principle.

48. Calculate the number of elements present in 4th period if each orbital can accommodate maximum three electrons.

49. Write the electronic configuration of an element of group-IB and group-IVB of 4th period?

50. Calculate the E.N of carbon from the following data: $E_{\text{H-H}} = 104.2 \text{ Kcal/mol}$, $E_{\text{C-C}} = 83.1 \text{ kcal/mol}$, $E_{\text{C-H}} = 98.8 \text{ Kcal/mol}$.

51. What is dipole moment?

52. Write Fajan's rule.

53. Describe Hydrogen bonding.

54. What is solvation energy?

55. Write the general characteristics of ionic bond.

56. What is Madelung constant?

57. Write Hund's rule of maximum multiplicity.

58. What is shielding effect ?

59. What is resonance energy?

2 MARKS QUESTION

60. Distinguish between sigma bond and Pi bond.

61. What is bond order? Find the bond order of N_2 .

62. What are equivalent and non-equivalent hybrid orbitals?

63. Write the electronic configuration of Cr and Cu.

64. Write de Broglie equation and its applications.

65. What are ψ and ψ^2 .

66. Write radius ratio rule and its limitations.

67. Distinguish between polarizing power and polarizability.

68. Explain redox reaction with an example.

69. Write Aufbau's rule and its limitations.

70. A compound of Vanadium has a magnetic moment 1.73 BM. Workout the electronic configuration of Vanadium ion in this compound.

71. Why Mg^{2+} ion is smaller than O^{2-} although both have the same electronic configuration?
72. Calculate the electronegativity of arsenic atom having covalent radius, 1.21 \AA .
73. How percentage ionic character is calculated from dipole moment?

6 MARKS QUESTION

74. What are the postulates of Bohr's theory of atom? Write its limitations.
75. Derive Schrodinger's wave equation and write its significance.
76. Discuss the shape of s,p,d and f orbitals.
77. Describe quantum numbers and their significance.
78. Define Electronegativity? What are the various factors that affect it?
79. Explain the term electron affinity. What are the various factors that affect it? Why are E.A of the halogens so high?
80. Define ionisation energy? On what factors does it depend? The I.E of Na^+ is more than that of Ne although both have the same electronic configuration. Explain.
81. Discuss Valence Bond Theory. Write its applications and limitations.
82. Discuss the main points of Molecular orbital theory.
83. Draw and describe the molecular orbital energy level diagram of F_2 .
84. Draw and describe the molecular orbital energy level diagram of CO.
85. Draw and describe the molecular orbital energy level diagram of NO.
86. Describe sp^3 hybridisation with a suitable example.
87. Describe sp^2 hybridisation with a suitable example.
88. Describe sp hybridisation with a suitable example.
89. Discuss VSEPR theory and its applications.
90. Write a short note on metallic bonding.
91. Describe the various types of weak chemical forces with suitable examples.
92. Derive Born Lande equation.
93. Describe Born-Haber cycle. Write its applications.

Model Question
SEMESTER-I
SUBJECT-CHEMISTRY
PAPER-CC-II

PART-I
Questions of 1 mark:

1. Write kinetic gas equation.
2. What is the average kinetic energy of one molecule of an ideal gas?
3. Define most probable velocity.
4. Define average velocity.
5. What is RMS velocity?
6. What is collision number?
7. Define degree of freedom.
8. State the law of equipartition of energy.
9. Write van der Waals equation of state.
10. Define critical temperature, critical pressure and critical volume.
11. State the principle of corresponding states.
12. Between benzene and chlorobenzene, which will have higher boiling point and why?
13. What are London forces?
14. Define vapour pressure.
15. What is polarizability?
16. What are dipole-dipole and dipole-induced dipole interactions?
17. Why H_2S is a gas and but H_2O is a liquid?
18. What are micelles?
19. Name the seven basic crystal systems.
20. Define space lattice and unit cell?
21. What are isotropic and anisotropic solids?
22. What are Miller indices?
23. What is a liquid crystal?
24. Give two examples of strong electrolytes and weak electrolytes.
25. What is degree of ionization?

26. Give one example of a dibasic and a tribasic acid.
27. What is the pH of human blood and saliva?
28. What is a buffer solution?
29. What is buffer capacity?
30. Name two acid-base indicators.

PART-II

Questions of 1.5 marks:

31. Define compressibility factor. Write its significance.
32. What are ideal and real gases? What is the cause of deviation of real gases from ideal behavior?
33. How does the most probable velocity vary with increase in temperature?
34. Write the relation among most probable velocity, average velocity and rms velocity.
35. How does the coefficient of gas vary with temperature and pressure?
36. What is mean free path? How does it vary with temperature and pressure?
37. What is surface tension? Write its unit.
38. What are the effects of addition of various solutes on surface tension.
39. Define coefficient of viscosity. Write its unit.
40. What is H-bonding? Explain the types of H-bonding with examples.
41. Evaporation results in cooling. Explain
42. The dissociation constants of acid A and acid B are 1.5×10^{-4} and 1.8×10^{-8} respectively. Calculate the relative strengths of the two acids.
43. Find the pH of 10^{-2} M HCl and 10^{-2} M H_2SO_4 .
44. State the law of rational indices.
45. What are plane of symmetry, axis of symmetry and centre of symmetry?
46. Write three applications of liquid crystals.
47. What is the advantage of powder method in comparison to Bragg's method?
48. Why X-rays are used to study diffraction pattern of crystals?
49. State the law of constancy of interfacial angles.
50. Explain the law of symmetry.
51. Describe Bravais lattice.
52. Define the following terms: hydrolysis, degree of hydrolysis and hydrolysis constant.

53. What is buffer action? Give one example of an acidic buffer and a basic buffer.
54. Predict the nature (acidic / basic /neutral) of the following aqueous solutions: NaCl, KBr, NH_4NO_3 .
55. What are indicators? How the indicators are selected for a particular acid-base titration? Name the indicator which can be used for titration of a weak acid with a strong base.

PART-III
Questions of 2 marks:

56. Find the S.I units of van der Waal's constant a and b. Write the significance of 'a' and 'b'.
57. Calculate the vibrational, rotational and translational degrees of freedom of HCl, He, H_2 and CO_2 .
58. What is collision frequency? How does it vary with temperature and pressure?
59. Calculate the kinetic energy of an ideal gas per molecule and per mole at 32°C ?
60. The van der Waal's constants of a gas are: $a=1.502 \text{ dm}^6 \text{ atm mol}^{-2}$ and $b=0.0452 \text{ dm}^3 \text{ mol}^{-1}$. Calculate its critical constants.
61. Explain why water acts as a universal solvent?
62. Define co-efficient of viscosity. Discuss the factors affecting viscosity of a liquid.
63. Explain cleansing action of soaps and detergents.
64. Define vapour pressure. Discuss the factors on which vapour pressure of a liquid depends?
65. Differentiate between intermolecular and intramolecular H-bonding.
66. What is the difference between evaporation and boiling?
67. What is common ion effect? Explain any two applications of it.
68. State Ostwald's dilution law. Write its limitation?
69. State the difference between crystalline and amorphous solid?
70. Write Bragg's equation and explain the symbols involved in it.
71. Mention the important characteristics of ionic and covalent crystals.
72. Differentiate between Schottky and Frenkel defect.

73. Distinguish between isomorphism and polymorphism with examples.
74. What are glasses? Write the properties of glasses.
75. Differentiate between smectic and nematic liquid crystals.
76. Describe the factors which affect the degree of ionization?
77. Differentiate between ionic product and solubility product.
78. What is a buffer solution? Write its applications.
79. Why an aqueous solution of NaCl does not act as a buffer?
80. What is the difference between solubility and solubility product? If the molar solubility of AgCl is S, what will be the solubility product of AgCl?

PART-IV
Questions of 6 marks:

81. Derive kinetic gas equation.
82. Derive van der Waal's equation of state.
83. Discuss Maxwell's distribution of molecular velocities and explain with a neat diagram, the effect of temperature on this distribution.
84. Differentiate between real gas and ideal gas? What is the cause of deviation of real gas from ideal behavior?
85. Define critical constants. Derive the relation between critical constants and van der Waals constants.
86. State and explain the principle of corresponding states. Derive an expression correlating π , ϕ and θ of a substance.
87. Explain the drop number method for determination of surface tension of a liquid.
88. Describe Ostwald's method for determination of coefficient of viscosity of a liquid?
89. Discuss the types of intermolecular forces and how these forces affect the physical properties of liquids?
90. Compare viscosity of liquids with gases. Explain the effect of temperature and pressure on the viscosity.
91. What are liquid crystals? Discuss the classification and applications of liquid crystals.
92. Describe the stoichiometric and non-stoichiometric defects in crystals.

93. Draw and explain the following with examples: simple cubic lattice, face centred cubic lattice and body centred cubic lattice.
94. Draw and explain the structures of NaCl and KCl.
95. Describe the powder method for determination of crystal structure.
96. Discuss the powder diffraction pattern of NaCl and KCl.
97. Derive Bragg equation. Explain the terms involved in it and write the application of this equation.
98. Discuss the hydrolysis of a salt of strong acid and weak base. Find K_h and h
99. Derive Henderson-Hasselbalch equation. Write its applications.
100. Explain the theories of acid base indicators.

SUBJECT: CHEMISTRY
PAPER: CC-II
MULTIPLE CHOICE QUESTIONS

1. The average distance travelled by a molecule between two successive collisions is called-
 - a) average free path
 - b) partial free path
 - c) mean free path
 - d) None of these

2. Deviation of gases from ideal behavior arise at _____
 - a) high pressure and high temperature
 - b) low pressure and low temperature
 - c) high pressure and low temperature
 - d) low pressure and high temperature

3. The pressure of real gases is ----- the pressure of ideal gases
 - a) equal to
 - b) less than
 - c) none of these
 - d) greater than

4. Which conditions are required for the ideal gas behavior?
 - a) Molecules in gaseous state should not attract or repel
 - b) Volume of the gas should be negligible
 - c) Both (a) and (b)
 - d) None of these

5. The product of pressure and volume of a given mass of gas is constant at constant temperature. This law is known as _____? .
 - a) Boyle's law
 - b) Charles's law
 - c) Avogadro's law
 - d) Dalton's law

6. Real gases behave ideally at -----
 - a) Low temperature and high pressure
 - b) Low temperature and low pressure
 - c) High temperature and high pressure
 - d) High temperature and low pressure

7. According to the kinetic theory, the collisions between gas molecules are -----

- a) elastic
- b) inelastic
- c) plastic
- d) all of these

8. Vander Waals' equation reduces to _____ at high pressure.

- a) $PV=RT$
- b) $PV = RT+ Pb$
- c) $PV = RT - a/V$
- d) $PV = RT - a/V^2$

9. For an ideal gas the Joule-Thomson coefficient is _____?

- a) 0
- b) +ve
- c) -ve
- d) None of these.

10. The unit of constant 'a' in vander Waals' equation is _____?

- a) $\text{dyne cm}^4 \text{ mol}^{-2}$
- b) $\text{Newton m}^4 \text{ mol}^{-2}$
- c) $\text{atm litre}^2 \text{ mol}^{-2}$
- d) All of these

11. The unit of constant 'b' in Vander Waals' equation is _____?

- a) $\text{cm}^3 \text{ mol}^{-1}$
- b) $\text{m}^3 \text{ mol}^{-1}$
- c) litre mol^{-1}
- d) all of these

12. Which of the following conditions make carbon dioxide obey the ideal gas laws.

- a) High temperature and low pressure
- b) Low temperature and a high pressure
- c) High temperature and a high pressure
- d) Low temperature and low pressure

13. All gases except He and H₂ exhibit _____ at a lower temperature.

- a) Positive deviation
- b) Positive deviation and negative deviation
- c) Negative deviation
- d) None of these

14. What happens to the mean free path with an increase in pressure?

- a) Increases.
- b) Decreases.
- c) Remains the same.
- d) Becomes zero.

15. When ____ is passed through diluted blood, it imparts a cherry-red colour to it.

- a) CO
- b) NH₃
- c) CO₂
- d) COCl₂

16. _____ is the numerical value of $C_p - C_v$.

- a) R
- b) M/R
- c) R/M
- d) None of these

17. Which of these is Vander Waals' equation for a real gas?

- a) $(P + a/V^2)(V - b) = RT$
- b) $P = nRT / (V - nb - an^2/V^2)$
- c) $(P - n^2a/V^2)(V - nb) = nRt$
- d) All of these

18. _____ can be readily liquefied when 'a' for NH₃ is 4.17, SO₂ is 6.71, CO₂ is 3.59 and Cl₂ is 6.49.

- a) CO₂
- b) NH₃
- c) Cl₂
- d) SO₂

19. If the pressure of a given mass of gas is reduced to half and temperature is doubled simultaneously the volume will be

- a) Same as before
- b) Twice as before
- c) 1/4 the as before
- d) None

20. The molecules of a gas A travel four times faster than the molecules of gas B at same temperature. The ratio of molecular weights (M_A/M_B) is

- a) 1/16
- b) 4
- c) 1/4
- d) 16

21. The ratio of rms velocity to average velocity of gas molecules at a particular temperature is

- a) 1.086 : 1
- b) 1 : 1.086
- c) 2 : 1.086
- d) 1.086 : 2

22. The compressibility factor for an ideal gas is

- a) 1.5
- b) 1
- c) 2
- d) 3

23. On increasing temperature, the fraction of total gas molecule which has acquired most probable velocity will

- a) increase
- b) decrease
- c) remains constant
- d) cant say without knowing pressure

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

- a) CO₂ and N₂O
- b) CO₂ and NO
- c) CO₂ and CO
- d) N₂O and NO

25. The temperature at which a real gas obeys the ideal gas laws at fairly wide range of pressure is

- a) Critical temperature
- b) Inversion temperature
- c) Boyle's temperature
- d) Reduced temperature

26. NH₃ is liquefied more easily than N₂. Hence

- a) a and b of NH₃ > that of N₂
- b) a(NH₃) > a(N₂) but b (NH₃) < b(N₂)
- c) a(NH₃) < a(N₂) but b (NH₃) > b(N₂)
- d) None

27. A gas cylinder containing cooking gas can withstand a pressure of 14.9 atm. The pressure gauge of cylinder indicates 12 atm at 27°C. Due to sudden fire in building the temperature starts rising. The temperature at which the cylinder will explode is.

- a) 42.5°C
- b) 67.8°C
- c) 99.5°C
- d) 25.7°C

28. A container with a pin-hole contains equal moles of $\text{H}_2(\text{g})$ and $\text{O}_2(\text{g})$. Find the fraction of oxygen gas escaped at the same time when one-fourth of hydrogen gas escapes

- a) 1/16
- b) 1/4
- c) 1/2
- d) 1/8

29. If the temperature is doubled, the average velocity of a gaseous molecule increases by

- a) 4
- b) 1.4
- c) 2
- d) 2.8

30. The rate of diffusion methane is twice that of X. The molecular mass of X is

- a) 64.0
- b) 32.0
- c) 40
- d) 80

31. The value of universal gas constant R depends on

- a) Temperature of Gas
- b) Volume of Gas
- c) Number of Moles of Gas
- d) Units of Volume, Temperature and Pressure

32. The critical volumes of four gases A, B, C, D are respectively 0.025 L, 0.312 L, 0.245 L, 0.432 L, the gas with highest value of van der Waals constant b is

- a) A
- b) B
- c) C
- d) D

33. In van der Waal equation of state of gas laws, the constant b is a measure of

- a) Intermolecular collisions per unit volume
- b) Intermolecular attraction
- c) Volume occupied by the molecules
- d) Intermolecular repulsions

34. The volume of 2.8 g of carbon monoxide at 27°C and 0.0821 atm is

- a) 30 L
- b) 3 L
- c) 0.3 L
- d) 1.5 L

35. If helium and methane are allowed to diffuse out of the container under the similar conditions of temperature and pressure, then the ratio of rate of diffusion of helium to methane is:

- a) 2 : 1
- b) 1 : 2
- c) 3 : 5
- d) 4 : 1

36. What is the boiling point at pressure 1 atm known as?

- a) Standard boiling point
- b) Normal boiling point
- c) Van der Waal boiling point
- d) Saturated boiling point

37. 1 poise = _____

- a) $0.1 \text{ kgm}^{-1}\text{s}^{-1}$
- b) $1 \text{ kgm}^{-1}\text{s}^{-1}$
- c) $10 \text{ kgm}^{-1}\text{s}^{-1}$
- d) $100 \text{ kgm}^{-1}\text{s}^{-1}$

38. Viscosity of liquid _____ with rise in temperature.

- a) Increases
- b) Decreases
- c) Remains constant
- d) Is independent

39. In a liquid, the force required to maintain the flow of layers is 5N, velocity gradient in du/dz , area of contact is 20m^2 . Then what is the value of viscosity?

- a) 6.25 dz/du
- b) 0.15 dz/du
- c) 0.2 dz/du
- d) 0.25 dz/du

40. Path in liquid in which layers do not meet each other is _____

- a) laminar flow
- b) tubular flow
- c) viscosity
- d) straight path

41. What is S.I. unit of Surface Tension?

- a) Dyne/meter
- b) Newton-meter
- c) Newton/meter
- d) Dyne-meter

42. If the angle of contact between the liquid and container is 90 degrees then? (C is the cohesive and A is the Adhesive force)

- a) $C > A$
- b) $C = A$
- c) $C < A$
- d) C is not equal to A

43. A water drop is spherical in shape due to _____

- a) Viscosity
- b) Poise
- c) Surface tension
- d) Reflection

44. Higher the viscosity, the slower the liquid flows.

- a) True
- b) False

45. Which of the following has strongest intermolecular forces of attraction?

- a) Hydrogen (H_2)
- b) Chlorine (Cl_2)
- c) Iodine (I_2)
- d) Methane (CH_4)

46. Which has strongest bonding in the solid state?

- a) Hydrogen Chloride (HCl)
- b) Chlorine (Cl_2)
- c) Xenon (Xe)
- d) Sodium Chloride (NaCl)

47. When the atoms of third layer are arranged in such a way that they directly lie above the atoms of first layer then this arrangement is called _____ ?

- a) ABAB (hexagonal)
- b) ABCABC (Cubic)
- c) Orthorhombic
- d) Rhombohedral

48. Vapour pressure of water at 100°C is _____ ?

- a) 55 mm Hg
- b) 760 mm Hg
- c) 355 mm Hg
- d) 100 mm Hg

49. Which one of the following does not show hydrogen bonding ?

- a) Water
- b) Ethyl alcohol
- c) Phenol
- d) Diethyl ether

50. The boiling point increases down the zero group element due to _____ ?

- a) Ion dipole forces
- b) London forces
- c) Hydrogen bonding
- d) Dipole dipole forces

51. The phenomenon in which a compound exists in two or more crystalline forms is called _____ ?

- a) Isomorphism
- b) Polymorphism
- c) Anisotropy

d) Isomerism

52. The molecules which have partial positive charge at one end and a partial negative charge at the other are called

- a) ion-pairs
- b) charged molecules
- c) dipoles
- d) electric molecules

53. The momentary attractions between the molecules of a liquid caused by instantaneous dipole and induced-dipole attractions are called

- a) van der Waals forces
- b) polar forces
- c) French forces
- d) London forces

54. The liquid crystals have

- a) properties of super cooled liquid
- b) properties of amorphous solids
- c) the fluidity of a liquid and optical properties of a solid
- d) none of these

55. p-Oxyanisole is an example of

- a) semi conductor
- b) super conductor
- c) liquid crystal
- d) none of these

56. The strength of H-bonding is about _____ as that of a covalent bond

- a) $1/2$
- b) $1/3$
- c) $1/10$
- d) $1/100$

57. What type of inter particle forces holds liquid N₂ together?

- a) ionic bonding
- b) London forces
- c) hydrogen bonding
- d) dipole-dipole interaction

58. Dipole interactions exist in -----molecules.

- a) non-polar
- b) polar
- c) metallic
- d) ionic molecules

59. Which of the following states of matter has a definite volume but not definite shape

- a) solid
- b) Liquid
- c) gas
- d) none of these

60. Which of the following statement is correct about smectic liquid crystals?

- a) they flow readily than smectic liquid crystals
- b) they have liquid like character
- c) their viscosity is lower than that of liquids
- d) all of these

61. Liquid crystals are usually composed of

- a) circular molecules
- b) rod like molecules
- c) oval molecules
- d) triangular molecules

62. Which of the following statements is not true about smectic liquid crystals?

- a) They have limited mobility
- b) They do not flow as normal liquids

- c) The concept of viscosity is applicable to them
- d) They show X-ray diffraction patterns.

63. Cholesteryl benzoate is an example of -----crystal

- a) smectic
- b) nematic
- c) cholesteric
- d) solid

64. Which is not true about the solid state?

- a) they have definite shape and volume
- b) they have high density and low compressibility
- c) they have high attractive forces among molecules
- d) they have high vapour pressure

65. Amorphous solids do not have

- a) sharp melting point
- b) characteristic geometrical shapes
- c) regularity of the structure
- d) all of these

66. A crystalline solid has

- a) definite geometrical shape
- b) flat faces
- c) sharp edges
- d) all of these

67. Amorphous substances are isotropic because

- a) they have same value of any property in all directions
- b) they have different values of physical properties in different directions
- c) they have definite geometrical shape
- d) none of the above

68. Which of the following properties is not shown by a crystalline solid?

- a) anisotropy
- b) sharp melting points
- c) isotropy
- d) definite and regular geometry

69. The Bragg's equation for diffraction of X-rays is

- a) $n \lambda = 2 d \sin \theta$
- b) $n \lambda = 2 d \sin^2 \theta$
- c) $n \lambda = 2 d \sin \theta$
- d) $n \lambda = d \sin \theta$

70. In Bragg's equation $n \lambda = 2 d \sin \theta$, 'n' represents

- a) the number of moles
- b) the principal quantum number
- c) the Avogadro's number
- d) the order of reflection

71. Glass, rubber and plastics are-----

- a) crystalline solids
- b) amorphous solids
- c) isomorphous
- d) polymorphous

72. A cubic crystal possesses a total of ----- elements of symmetry.

- a) 20
- b) 23
- c) 22
- d) 12

73. There are ----- crystal systems.

- a) 7

b) 5

c) 9

d) 3

74. The indices which denote the direction of a plane of a crystal are-----

a) rational indices

b) Miller indices

c) Bragg's indices

d) none of the above

75. The diffraction of X-rays by crystal was discovered by-----,

a) Braggs

b) Laue

c) Bebye-Scherrer

d) None of these

76. "The intercept of any face of a crystal along the crystallographic axes are either equal to unit intercepts (a, b, c) or simple whole number multiples of them." It is the statement of -----

a) law of symmetry

b) law of constancy of interfacial angles

c) law of rational indices

d) Bragg's law

77. The reciprocals of the intercepts made by a plane with crystallographic axes are called-

a) Weiss indices

b) Miller indices

c) Bragg indices

d) Laue indices

78. Bravais lattices depend on the shapes of -----

a) lattice

b) cubic crystal

c) unit cell

d) none of these

79. Though NaCl and KCl have similar structure, their powder diffraction patterns are different because

a) The size of K^+ is larger than Na^+

b) Ionization energy of NaCl is more than KCl

c) K^+ and Cl^- have the same number of electrons.

d) None of these

80. In CsCl each Cs^+ is surrounded by

a) $4Cl^-$

b) $6Cl^-$

c) $8Cl^-$

d) $12Cl^-$

81. The crystal system having the highest symmetry is:

a) Cubic

b) Triclinic

c) Hexagonal

d) Tetragonal

82. Na_3PO_4 and Na_3AsO_4 are

a) isomorphous

b) polymorphous

c) alloys

d) allotropes

83. For a simple cubic lattice the ratios of $d_{100} : d_{110} : d_{111}$ is given by

a) 1:0.707:0.577

b) 1:0.707:1.154

c) 1:1.414 :0.577

d) 1: 0.307:0.154

84. For a Face centred cubic lattice the ratios of $d_{200} : d_{220} : d_{111}$ is given by

a)1:0.707:0.577

b)1:0.707:1.154

c)1:1.414 :0.577

d)1: 0.307:0.154

85. For a Body centred cubic lattice the ratios of $d_{200} : d_{110} : d_{222}$ is given by

a)1:1.744:0.577

b)1:0.707:1.154

c)1:1.414 :0.577

d)1: 0.307:0.154

86. $a = b \neq c$ and $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ represents which crystal system?

a)Cubic

b)Tetragonal

c)Hexagonal

d)Triclinic

87. Which of the following lattice shows a diffraction pattern consisting of a set of equally spaced six lines followed by a gap.

a)Simple cubic

b)Body centred Cubic

c)Face centred Cubic

d)All of these

88. d_{100} NaCl : d_{100} KCl is given by

a)1:1.11

b)1:2.51

c)0.1:1.01

d)0.5:1.51

89. Which of the following defect arises when same number of cations and anions are missing from their normal lattice sites ?

a)Schottky Defect

b)Frenkel Defect

c) Non-stoichiometric defect

d) None of these

90. Non-Newtonian flow is observed in which of the following?

a) Smectic Liquid Crystals

b) Nematic Liquid Crystals

c) Normal Liquids

d) None of these

91. If the pH of a solution is 2, its $[H^+]$ is =?

a) 2M

b) 10^2 M

c) 10^{-2} M

d) 12 M

92. If the pH of a solution is 3, its $[OH^-]$ is =?

a) 3M

b) 10^{-11} M

c) 10^{-3} M

d) 11 M

93. $pH + pOH = ?$

a) 10

b) 12

c) 14

d) 0

94. The value of K_w at $25^\circ C$ is

a) $1.0 \times 10^{-14} M^2$

b) $1.0 \times 10^{14} M$

c) 14M

d) $14 M^2$

95. Who introduced pH scale?

- a) Sorenson
- b) Dalton
- c) Henry
- d) Avogadro

96. pH scale ranges from :

- a) 1-14
- b) 0-14
- c) 1-7
- d) 7-14

97. The pH of human blood is :

- a) 6.8
- b) 5.8
- c) 7.0
- d) 7.4

98. Which one of the following is a salt of weak acid and strong base?

- a) NaCl
- b) NH_4Cl
- c) $\text{CH}_3\text{COONH}_4$
- d) CH_3COONa

99. The aqueous solution of salt of a weak acid and a strong base is :

- a) Acidic
- b) Alkaline
- c) Neutral
- d) Amphoteric

100. Which of the following equation represents Henderson-Hasselbalch equation?

- a) $\text{pH} + \text{pOH} = 14$

b) $\text{pOH} = \text{pK}_b + \log \left(\frac{[\text{Salt}]}{[\text{Base}]}\right)$

c) $\text{pH} = \text{pK}_a + \log \left(\frac{[\text{Salt}]}{[\text{Acid}]}\right)$

d) Both b and c

