Max Marks: 70

Time: 3 hrs

General Instructions:

a) There are 33 questions in this question paper.
b) Section A: Q. No 1 to 16 are objective type questions carrying 1 mark each.
c) Section B: Q. No. 17 to 21 are short answer questions and carry 2 marks each.
d) Section C: Q. No. 22 to 28 are short answer questions and carry 3 marks each.
e) Section D :Q. No. 29and 30 are case based questions carrying 4 marks each.
f) Section E :Q. No. 31 to 33 are long answer questions carrying 5 marks each.
g) There is no overall choice. However, internal choices have been provided.
h) Use of calculator is not permitted.

SECTION A

Q1 Formula of cane sugar is $C_{12}H_{22}O_{11}$. No. of molecules present in 34.2g of cane sugar is:

(a) 6.022×10^{21} (b) 6.022×10^{20} (c) 6.022×10^{22} (d) 6.022×10^{18}

Q2 Any p-orbital can accommodate upto:

(a) four electrons   (b) two electrons with parallel spin

(c) six electrons   (d) two electrons with opposite spin

Q3 The formation of the oxide ion, $O^{2-}(g)$ from oxygen atom requires first an exothermic and then endothermic step as shown below:

$O(g) + e^- \rightarrow O^-(g)$; $\Delta_f H^\circ = -141$ kJ/mol

$O^-(g) + e^- \rightarrow O^{2-}(g)$; $\Delta_f H^\circ = +780$ kJ/mol
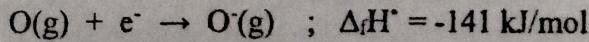
Thus the process of formation of $O^{2-}(g)$ is unfavourable even though O^{2-} is isoelectronic with neon. It is due to the fact that:

(a) $O^-(g)$ has comparatively smaller size than oxygen atom

(b) Oxygen is more electronegative

(c) addition of electron in oxygen results in larger size of the ion

(d) electron repulsion outweighs the stability gained by achieving noble gas configuration

Q4 Which of the following set of quantum numbers is not possible?

(a) $n = 4$ $l = 0$ $m = 0$ $s = +\frac{1}{2}$ (b) $n = 5$ $l = 3$ $m = 0$ $s = -\frac{1}{2}$

(c) $n = 3$ $l = 2$ $m = -2$ $s = +\frac{1}{2}$ (d) $n = 3$ $l = 2$ $m = -3$ $s = \frac{1}{2}$

Q5 What is the common between given cations and anions:

$O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}$?
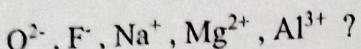
(a) All have same ionic radii.
· (b) All are isoelectronic species having 10 electrons.
(c) All of them belong to third period.
(d) Oxides of all the ions are basic.

Q6 Which elements are present in f-block series:

(a) Lanthanoids
(b) Actinoids
· (c) Lanthanoids and Actinoids
(d) Lipids

Q7 Which of the following is linear?

(a) C_2H_2 (b) CH_4 (c) H_2O (d) NH_3

Q8 What will be the molarity of a solution which contains 5.85 g of NaCl(s) per 500mL of the solution?

(a) 4 mol/L   (b) 20mol/L   (c) 2 mol/L   (d) 0.2 mol/L

Q9 One molal solution contains 1 mole of a solute in :

· (a) 1000g of solvent   (b) one litre of solvent

(c) one litre of solution   (d) 22.4 litre of the solution

Q10 The values of 'n' and 'l' for valence electron of Na(11) respectively are:

(a) 0, 3   . (b) 3, 0   (c) 3, 1   (d) 3, 2

Q11 Which one of the following does not match with respect to the shape of the molecule?

(a) NH_3 - Trigonal pyramidal
(b) SF_4 - Tetrahedral
(c) H_2S - Bent
· (d) ClF_3 - T- Shape

Q12 For the molecules CH_4, NH_3, and H_2O ; Which of the following statements is false?

(a) The H-O-H bond angle in H_2O is smaller than the H-N-H bond angle in NH_3

(b) The H-C-H bond angle in CH_4 is larger than the H-N-H bond angle in NH_3

(c) The H-C-H bond angle in CH_4, the H-N-H bond angle in NH_3 and H-O-H bond angle in H_2O are all greater than 90°

(d) The H-O-H bond angle on H_2O is larger than the H-C-H bond angle in CH_4

In the questions 15 to 18, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

(a) Both Assertion and Reason are true and reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true and reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Assertion is false but Reason is true.

Q13 Assertion: Equal masses of He, O_2 and SO_2 contain equal number of molecules.

Reason: Equal volume of He, O_2 and SO_2 contain equal number of molecules at same temperature and pressure.

Q14 Assertion: The 19th electron in potassium atom enters 4s- orbital and not 3d orbital.

Reason: The energies of the orbitals can be compared with the help of (n + l) rule.

Q15 Assertion: The first ionisation enthalpy of aluminium is lower than that of magnesium.

Reason: Ionic radius of aluminium is smaller than that of magnesium.

Q16 Assertion: The addition of electron in antibonding M.O. decreases bond order.

Reason: Antibonding electrons tend to bring the atoms close together.

SECTION B

Q17 (a) What is photoelectric effect?

(b) What type of metals are used in photoelectric cells? Give one example.

Q18 Write the four characteristic properties of d-block elements.

Q19 Draw the shapes of the following covalent molecules on the basis of hybridisation:

(a) C_2H_4 (b) PCl_5

Q20 (a) Define ionisation enthalpy.

(b) Discuss the variation of ionisation enthalpy down the group and across the period in periodic table.

OR

(a) Define electron gain enthalpy.

(b) Discuss the factors which affect the electron gain enthalpy.

Q21 (a) What is Modern periodic law ?

(a) Why do elements in the same group have similar physical and chemical properties?

∴

SECTION C

Q22 (a) Which of the following orbitals are degenerate?

$3d_{xy}$, $4d_{xy}$, $3d_z^2$, $3d_{yz}$, $4d_{yz}$, $4d_z^2$
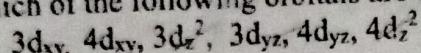
(c) Draw the shapes of the following orbitals:

(i) $d_{x^2-y^2}$ (ii) d_z^2
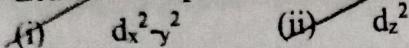
OR

(a) Write the electronic configuration of the following species:

(i) $_{28}X^{2+}$ (ii) $_{35}Y$
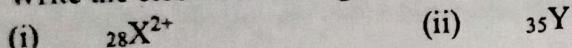
(b) Why do not we see a car moving as a wave on road?

Q23 3g of H_2 react with 29g O_2 to yield H_2O.

(a) Which is the limiting reagent?

(b) Calculate the maximum amount of water that can be formed.

(c) Calculate the amount of one of the reactants which remains unreacted.

Q24 Give reasons:

(a) Ionisation enthalpy increases with the loss of each successive electron.

(b) Be has higher first ionisation enthalpy than B

(c) Electron gain enthalpy of chlorine is unexpectedly higher than that of fluorine.

Q25 Enlist the main postulates of VSEPR theory.

Q26 What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transition from an energy level with n= 4 to an energy level with n=2?

Q27 (a) State the following:

(i) Gay Lussac's law of gaseous volumes.

(ii) Law of multiple proportions.

(b) 32g of sulphur will react with 32g of oxygen, even if more than 32g of sulphur is available. Which law of chemical combination does it illustrate?

Q28 Write the IUPAC name and symbol for the elements with atomic numbers(Z) :

(a) 107   (b) 115   (c) 127

SECTION D

Q29 **Read the given passage and answer the following questions:**

An ionic compound has 3D crystal lattice in which positive and negative charges are equal. The crystal lattice is stabilised by enthalpy of lattice formation, bond length, bond angle, bond order and bond polarity have significant effect on properties of compounds.

Dipole moment depends upon polarity and shapes of molecules. Shape of molecules can be determined by VSEPR theory as well as hybridisation sp, sp^2, sp^3, sp^3d and sp^3d^2.

Hydrogen bond is formed between hydrogen and F, O, N. H-Bonding may be intramolecular or intermolecular.

(a) Why does CO_2 has zero dipole moment?
(b) Give one example each of intermolecular and intramolecular H-Bonding.
(c) What is hybridisation of 'S' in SF_6 and its shape?

Q30 **Read the given passage and answer the following questions:**

Stoichiometry involves calculations based on chemical equations and mole concept. Chemical equations are governed by laws of chemical combinations like law of conservation of mass, law of constant composition, law of multiple proportion Avogadro's law and Gay Lussac's law of gaseous volumes.

Mole is a counting unit, equal to 6.022×10^{23} particles. One mole is also equal to molar mass expressed in grams.

In chemical reactions, the reactant which get used up completely is called limiting reactant and decides the amount of product formed.

(a) How many atoms are present in 1 mole of CH_4?
(b) Define mole fraction of solute.
(c) If 50g of $CaCO_3$ is treated with 50g of HCl, how many grams of CO_2 will be produced according to equation:

$$CaCO_3(s) + 2HCl(dil) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$
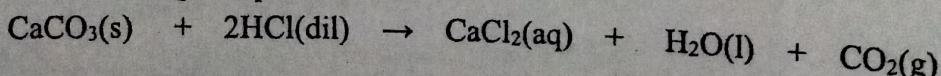
SECTION E

Q31 (a) A compound on analysis was found to contain C = 57.8%, H = 3.6% and rest is oxygen. Vapour density of the compound was found to be 83. Find the molecular formula of the compound.

OR

A compound of C, H and N contains three elements in the ratio 9: 1: 3.5. Molecular mass of the compound is 108u. Calculate the molecular formula of the compound.

Q32 (a) Arrange 4f , 5p and 6d sub shells in increasing order of filling of electrons.

(b) Write m_l and l value for last electron of Mg. (Atomic Number = 12)

(c) State Hund's Rule of maximum multiplicity.

(d) Why half-filled and fully-filled configurations are more stable?

OR

(a) State Heisenberg uncertainty principle.
(b) List the quantum numbers m_l and l for the electrons of 3d orbitals.
(c) Using s , p , d , f notations, designate the orbital with the following quantum numbers:
   (i) n = 1 , l = 0   (ii) n = 3 , l = 1 (iii) n = 4 , l = 2   (iv) n =4 , l = 3
(d) What is the physical significance of Ψ^2?

Q33 (a) Draw the Molecular Orbital diagram for N_2 molecule.

(b) Deduce the bond order and magnetic behaviour of N_2^- using MO diagram.

OR

(a) Draw the Molecular Orbital diagram for O_2 molecule.

(b) Compare the relative stabilities of O_2^{2-}, O_2^- and O_2^+ and predict their magnetic behaviour.