APEEJAY SCHOOL PANCHSHEEL PARK

Class – XI
Subject – Chemistry
MIDTERM EXAMINATION (2024-25)

Name of the student:
Time Allowed: 3 hrs.

Date:
M.M.: 70

General Instructions.

Read the following instructions carefully.

i. There are 33 questions in this question paper with internal choice.
ii. SECTION A consists of 16 multiple choice questions carrying 1 mark each.
iii. SECTION B consists of 5 short answer questions carrying 2 marks each.
iv. SECTION C consists of 7 short answer questions carrying 3 marks each.
v. SECTION D consists of 2 case - based questions carrying 4 marks each.
vi. SECTION E consists of 3 long answer questions carrying 5 marks each.
vii. Use of log tables and calculators is not allowed.

Marks

Section – A

1. The number of electrons in 1.6 g of CH_4 is approximately 1
(a) 25×10^{24} (b) 1.5×10^{24} (c) 6×10^{23} (d) 3.0×10^{24}

2. Number of atoms present in 120 a.m.u. of Ca is 1
(a) 3 N_A (b) 6 N_A (c) 3 (d) 6

3. 28 g of N_2 and 6 g of H_2 react to give 34 g of NH_3. This statement illustrates the law of 1
(a) Conservation of mass (b) Definite proportion
(c) Multiple proportion (d) Reciprocal proportion

4. Which of the following molecule has highest percentage of oxygen by mass? 1
(a) H_2O (b) CO_2 (c) $CaCO_3$ (d) C_2H_5OH

5. According to the Bohr Theory, which of the following transitions in the hydrogen atom will give rise to the least energetic photon? 1
(a) n = 6 to n = 5 (b) n = 5 to n = 3
(c) n = 6 to n = 1 (d) n = 5 to n = 4

6. The ion that is isoelectronic with CO is 1
(a) CN^- (b) N_2^+ (c) O_2^- (d) N_2^-

7. Correct order of ionic size is 1
(a) $S^{-2} > P^{-3} > Cl^-$ (b) $Cl^- > P^{-3} > S^{-2}$
(c) $Cl^- > S^{-2} > P^{-3}$ (d) $P^{-3} > S^{-2} > Cl^-$

8. An element with atomic number 34 belongs to 1
(a) s-block (b) p-block (c) d-block (d) f-block

9. Correct order of 1st ionization potential among elements Be, B, C, N, O is 1
(a) B < Be < C < O < N (b) B < Be < C < N < O
(c) Be < B < C < N < O (d) Be < B < C < O < N

10. Which of the following statements is correct with respect to polarization? 1
(a) Maximum polarization is done by a cation of high charge
(b) A large cation is likely to bring large degree of polarization

(c) A smaller anion is likely to undergo a high degree of polarization
(d) Minimum polarization is done by a cation of small size

11. The oxidation state of Mn in K_2MnO_4 is 1
(a) +2 (b) +3 (c) +6 (d) +7

12. Which of the following is not an example of redox reaction? 1
(a) $CuO + H_2 \rightarrow Cu + H_2O$ (b) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
(c) $2K + F_2 \rightarrow 2KF$ (d) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

For the question no. 13 to 16 there are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

13. Assertion: Unlike cathode rays, mass of positively charged particles depends upon the nature of gas present in the discharge tube. 1
Reason: Canal rays are composed of the positively charged gaseous ions.

14. Assertion: Electron gain enthalpy can be exothermic or endothermic. 1
Reason: Electron gain enthalpy provides a measure of the ease with which an atom adds an electron to form anion. a

15. Assertion: Lone pair-lone pair repulsive interactions are greater than lone pair-bond pair and bond pair-bond pair interactions. 1
Reason: The space occupied by lone pair electrons is more as compared to bond pair electrons.

16. Assertion: The reaction, $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ is an example of decomposition reaction. 1
Reason: Above reaction is not a redox reaction. c

Section – B

17. (a) Mention the trend of metallic character in the periodic table. 2
(b) Considering the atomic number and position in the periodic table, arrange the following elements in the increasing order of metallic character: Si, Be, Mg, Na, P.

18. Draw the Strcuture of BrF_5. Calculate its hybridization, geometry, and shape. 2

19. Write Lewis structure of the H_2SO_4 and show formal charge on S atom. 2

20. Identify the oxidizing agent and reducing agent for each of the following reactions: 2
(a) $2AgBr(s) + C_6H_6O_2(aq) \rightarrow 2Ag(s) + 2HBr(aq) + C_6H_4O_2(aq)$
(b) $HCHO(l) + 2[Ag(NH_3)_2]^+(aq) + 3OH^-(aq) \rightarrow 2Ag(s) + HCOO^-(aq) + 4NH_3(aq) + 2H_2O(l)$

OR

Write formulas for the following compounds:
(a) Mercury(II) chloride (b) Nickel(II) sulphate
(c) Tin(IV) oxide (d) Chromium(III) oxide

21. Draw the structure of C_3O_2 and justify its oxidation number. 2

Section – C

22. Find the empirical formula and the molecular formula of an organic compound from the data given: C = 75.92 %, H = 6.32 %, N = 17.76 % if the molecular mass of the compound is 79g/mol. 3
[Given: Atomic mass of C = 12, H = 1, & N = 14].

23. Consider the following two unbalanced reactions: 3
$KClO_3 \longrightarrow KCl + O_2$
$Mg + O_2 \longrightarrow MgO$
Calculate the number of moles of MgO produced when oxygen produced by 1 mole of $KClO_3$ is completely reacted with Mg.

24. (a) State de – Broglie's equation. 3
(b) The velocity associated with a proton moving in a potential difference of 1000 V is 4.37×10^5 ms^{-1}. If the hockey ball of mass 0.1 kg is moving with this velocity, calculate the wavelength associated with this velocity.

OR

Emission transitions in the Paschen series end at orbit n = 3 and start from orbit n and can be represented as $\nu = 3.29 \times 10^{15}$ (Hz) $[1/3^2 - 1/n^2]$. Calculate the value of n if the transition is observed at 1285 nm. Find the region of the spectrum.

25. The first (Δ_iH_1) and the second (Δ_iH_2) ionization enthalpies (in kJ mol^{-1}) and the ($\Delta_{eg}H$) electron gain enthalpy (in kJ mol^{-1}) of a few elements are given below: 3

Elements	Δ_iH_1	Δ_iH_2	ΔegH
I	520	7300	– 60
II	419	3051	– 48
III	1681	3374	– 328
IV	1008	1846	– 295
V	2372	5251	+ 48
VI	738	1451	– 40

Which of the above elements is likely to be:

(a) the metal which can form a stable binary halide of the formula MX_2(X=halogen).
(b) the metal which can form a predominantly stable covalent halide of the formula MX (X=halogen)?
(c) the least reactive non-metal.

26. (a) Write any two drawbacks in Mendeleev's periodic table that led to its modification. 3
(b) Discuss the variation of electron gain enthalpy in the periodic table.

27. Draw the orbital picture diagrams showing the formation of a double bond and a triple bond between carbon atoms in C_2H_4 and C_2H_2 molecules. 3

28. Permanganate(VII) ion MnO_4^-, in basic solution oxidizes iodide ion I^-, to produce molecular iodine (I_2) and manganese (IV) oxide (MnO_2). Balance the ionic equation by oxidation number method to represent this redox reaction. 3

Section – D

29. ***Quantum mechanical model of atom***: 4
Quantum mechanical model of atom is the picture of the structure of the atom, which emerges from the application of the Schrödinger equation to atoms. Some of the important features of the quantum mechanical model of atom are as follows:

- The energy of electrons in atoms is quantized.
- Both the exact position and exact velocity of an electron in an atom cannot be determined simultaneously (Heisenberg uncertainty principle). One can talk of only probability of finding the electron at different points in an atom.
- An atomic orbital is the wave function ψ for an electron in an atom.
- The probability of finding an electron at a point within an atom is proportional to the square of the orbital wave function i.e., $|\psi|^2$ at that point. $|\psi|^2$ is known as probability density and is always positive
- From the value of $|\psi|^2$ at different points within an atom, it is possible to predict the region around the nucleus where electron will most probably be found.
- Atomic orbitals are precisely distinguished by what are known as quantum numbers. Each orbital is designated by three quantum numbers labelled as n, l and ml.
- The principal quantum number determines the size and to large extent the energy of the orbital.
- Azimuthal quantum number defines the three-dimensional shape of the orbital.
- Magnetic orbital quantum number 'm_l' gives information about the spatial orientation of the orbital with respect to standard set of co-ordinate axis.

Answer the following questions

(a) State Heisenberg's uncertainty principle?

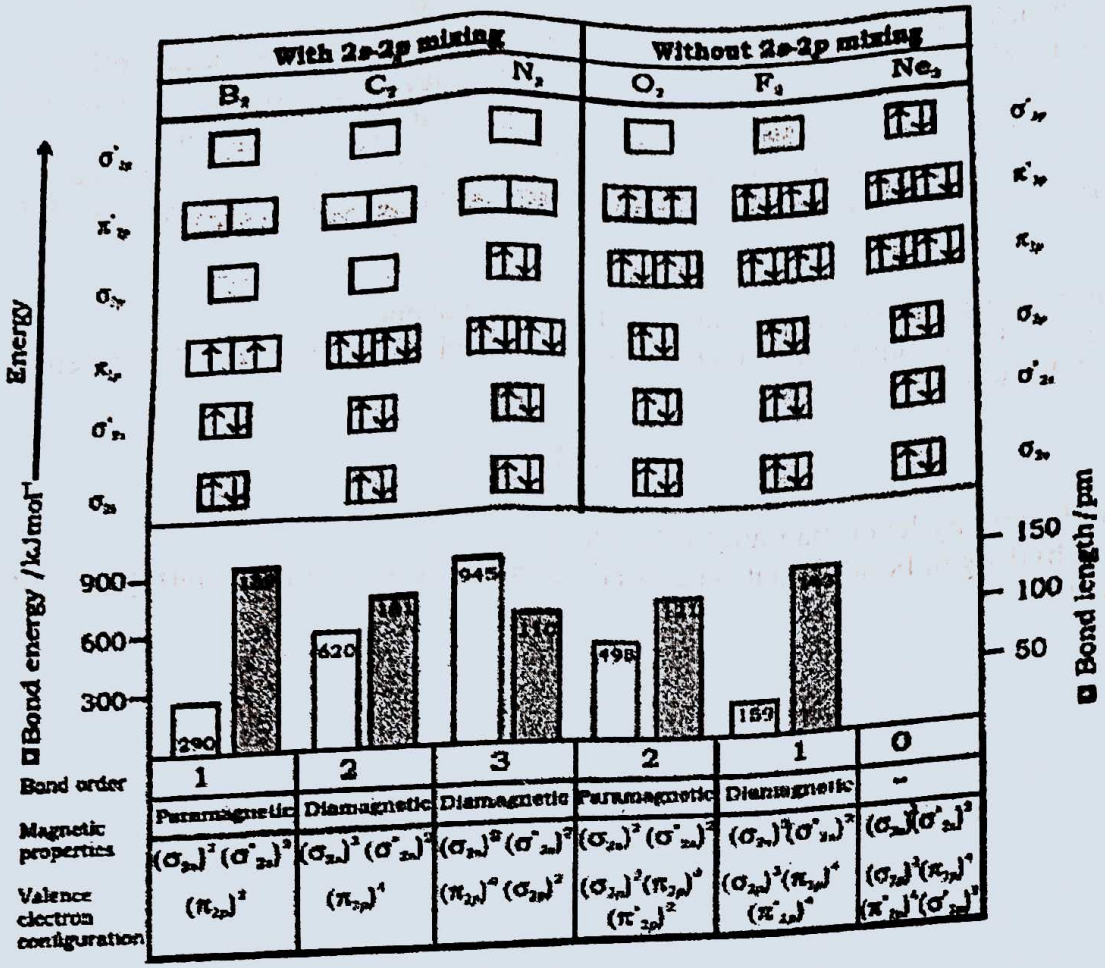
(b) Using s, p, d, f notations, describe the orbital with the following quantum numbers
(i) $n = 2, l = 1$, (ii) $n = 4, l = 0$

(c) What is the lowest value of n that allows g orbitals to exist? Also, predict the number of orbitals in g subshell.

OR

(c) Draw the graph b/w variation of probability density $\psi^2(r)$ as a function of distance r of the electron from the nucleus for 1s and 2s orbitals.

30. Table shows the molecular orbital occupancy and molecular properties for B_2, C_2, N_2, O_2, F_2, and Ne_2. Observe this figure and answer the questions based on this diagram and related studied concepts. 4



(a) Why does bond enthalpy of N_2 is higher than O_2?
(b) Why is Ne_2 not formed according to M.O. theory?
(c) Why F_2 is diamagnetic whereas O_2 is paramagnetic?
(d) Arrange B_2, C_2, N_2, O_2 & F_2 in increasing order of stability.

OR

(d) Arrange B_2, C_2, N_2, O_2 & F_2 in increasing order of bond length.

Section – E

31. (a) Concentrated aqueous Sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 gmL^{-1}. Calculate the volume of acid required to make one litre of 0.1 M H_2SO_4 solution. 5

(b) Calculate the molarity of a solution of ethanol in water, in which the mole fraction of ethanol is 0.040 (assume the density of water to be one).

OR

(a) Ammonia gas is passed into water, yielding a solution of density 0.93 g/cm^3 and containing 18.6 % NH_3 by weight. Calculate the mass of NH_3 per cc of the solution.

(b) The density of 3 M solution of NaCl is 1.25 g mL^{-1}. Calculate the molality of the solution.

32. Answer **any five questions** from the followings: 5

(a) Write one major drawback in Rutherford's model.

(b) State Planck's quantum theory.
(c) Which parameter decides the number of electrons ejected in photoelectric effect?
(d) A rainbow forms in the sky is example of continuous or discontinuous spectra. Why?
(e) What does the negative electronic energy (E_n) for hydrogen atom mean?
(f) Why the energy of interaction between, the nucleus and electron (that is orbital energy) decreases (that is more negative) with the increase of atomic number (Z)?

5

33. (a) Discuss the significance/ applications of dipole moment.
(b) Represent diagrammatically the bond moments and the resultant dipole moment in CO_2, NF_3 and $CHCl_3$.

OR

(a) Draw the energy level diagram for N_2 and F_2.
(b) Define hydrogen bond. What type of H – bonding is present in o – nitrophenol and methanol?