SS3

Set-II

Subject - CHEMISTRY

TIME DURATION : 3 hours   **MM : 70**

General Instructions:

- This question paper comprises five Sections - A, B, C, D and E.
- There are 33 questions in the question paper
- All questions are compulsory.
- Section A contains 16 questions, Section B contains 5 questions of two marks each, Section C contains 7 questions of three marks each, Section D contains 2 case study based questions of four marks each and Section E contains 3 long answer questions of five marks each.
- There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

	SECTION-A	
1.	The following quantum numbers are possible for how many orbitals ? $n=3, l=2, m=+2$ (i) 1 (ii) 4 (iii) 3 (iv) 2	1
2.	16 g of oxygen has same number of molecules as in (Atomic mass of O=16, C=12, N=14, H 1u) (i) 16 g of CO (ii) 28 g of N_2 (iii) 14 g of N_2 (iv) 1.0 g of H_2	1
3.	Principal, azimuthal and magnetic quantum numbers are respectively related to (i) Size, orientation and shape (ii) Size, shape and orientation (iii) Shape, size and orientation (iv) None of these	1
4.	The orbital having two radial as well as two angular node is (i) 5d (ii) 4f (iii) 3p (iv) 4d	1

5.	The average atomic mass of a sample of an element X is 16.2u. What are the percentages of isotopes ^{16}X and ^{18}X in the sample (i) 90, 10 (ii) 80, 20 (iii) 10, 90 (iv) 20, 80	1
6.	Calculate the Oxidation number of Mn in MnO_4^{-1} (i) +8 (ii) +6 (iii) -3 (iv) +7	1
7.	The correct order of bonds length for N_2, O_2, F_2 (i) $N_2 < O_2 < F_2$ (ii) $N_2 < F_2 < O_2$ (iii) $F_2 < O_2 < N_2$ (iv) $F_2 < N_2 < O_2$	1
8.	4d,5p,5f and 6p orbitals are arranged in the order of decreasing energy. The correct option is (i) $5f > 6p > 4d > 5p$ (ii) $5f > 6p > 5p > 4d$ (iii) $6p > 5f > 5p > 4d$ (iv) $6p > 5f > 4d > 5p$	1
9.	The number of σ and π bonds in $CH_2=CH-CH_2-CH=CH_2$ (i) σ=12 , π=2 (ii) σ=10, π=2 (iii) σ=8, π=2 (iv) σ=9, π=1	1
10.	What is the bond angle in BF_3? (i) 109° (ii) 120° (iii) 104.5° (iv) 90°	1
11.	Screening effect is not observed in? (i) Be^{+3} (ii) H^+ (iii) Li^{+2} (iv) in all of these	1

12.	Match the following		1
	a) Copper	p) non-metal	
	b) Fluorine	q) Transition metal	
	c) Silicon	r) Lanthonoid	
	d) Cerium	s) Metalloid	

(i)   a)-r). b)-s). c)-p) . d)-q)
(ii) a)-p). b)-s). c)-r) . d)-q)
(iii) a)-q). b)-p). c)-s) . d)-e) r)
(iv) a)-r). b)-p). c)-q) . d)-s)

For Questions 13 to 16, two statements are given—one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
   a. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
   b. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
   c. If Assertion is true but Reason is false.
   d. If both Assertion and Reason are false.

13.	ASSERTION: The free gaseous Cr atom has six unpaired electrons	1
	REASON: Half filled s-orbital has greater stability	
14.	ASSERTION : The ionic size of O^{-2} is bigger than that of F^- ion.	1
	REASON : O^{-2} and F^- are isoelectronic ions	
15.	ASSERTION : CO_2 is a linear molecule and has two types of bond lengths.	1
	REASON : In CO_2, C atom is sp^2 hybridized.	
16.	ASSERTION : Sulphur compounds like SF_6 and H_2SO_4 have 12 valence electrons around S atom	1
	REASON : All sulphur compounds do not follow octet rule.	

SECTION-B

17.	(a) One of the spectral lines in caesium has a wavelength of 456 nm. Calculate the frequency of this line ($c = 3.0 \times 10^8$ m s^{-1})	2
	(b) Draw the shape of the orbital which has four lobes along the possible axis.	
18.	(a) Which of the following species can act as an oxidizing agent only? Cl_2, Cl^-, ClO_2^-, ClO_4^-	2
	(b) Identify the oxidizing agent and the reducing agent in the following redox reaction :-- $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$	
19.	1 M solution of $NaNO_3$ has a density 1.25 g cm^{-3}. Calculate its molality (Molecular weight of $NaNO_3$ = 85 gmol^{-1})	2

20.	How many grams of Cl_2 are required to completely react with 0.4 g of H_2 to yield HCl ? Also Calculate the amount of HCl formed. $H_2 + Cl_2 \rightarrow 2HCl$ (Atomic mass Cl=35.5, H=1)	2
21.	Give geometry and shapes of the following species: (a) NH_3 (b) ClF_3 **OR** Draw lewis dot structure of (a) NO_2^- (b) PO_4^{-3}	2

SECTION-C

22.	(a) Balance $NO_3^- + Zn \longrightarrow Zn^{+2} + NH_4^+$ in basic medium (b) What is the oxidation number of "Br" in BrO_3^- ? Or (a) H_2S can act as only reducing agent whereas SO_2 can act as both oxidizing as well as reducing agent. Why? (b) Balance the following Ionic equation $MnO_2 + Cl^- \longrightarrow Mn^{+2} + Cl_2$ (Acidic medium	2 1 1 2
23.	(a) Give the IUPAC name and symbol of the element with atomic number Z = 120. (b) Assign the position of elements in periodic table having outer electronic configuration: (i) $ns^2 np^4$ for n =3 (ii) $(n-1)d^2 ns^2$ for n=4 (c) Write name of one acidic oxide.	1 1 1
24.	(a) Explain why BeH_2 molecule has a zero dipole moment although the Be–H bonds are polar (b) Explain why PCl_5 is trigonal bipyramidal whereas IF_5 is square pyramidal.	3
25.	Potassium superoxide, KO_2 is used for rebreathing gas masses to generate oxygen $4KO_2(s) + 2H_2O(l) \rightarrow 4KOH(s) + 3O_2(g)$ (Atomic mass K = 39, O= 16, H=1) If the reaction vessel contains 0.15 mol KO_2 and 0.10 mol H_2O, what is the limiting reactant ? How many moles of oxygen can be produced ?	3
26.	Draw all possible resonating structures of SO_4^{-2}. Also calculate the formal charge on the S atom .	3

27.	(a)	What is mass percent silicon in 100 g of sodium silicate, $NaSiO_3$? (Atomic mass of Na= 23, Si= 28, O=16u)	1
	(b)	If 3.01×10^{20} molecules are removed from 98 g of H_2SO_4, then the number of moles of H_2SO_4 left are ? (Atomic mass of S= 32, H= 1,O=16u)	2
28.	(a)	Arrange the following in increasing order of number of unpaired electrons V^{3+}, Fe^{2+}, Zn^+ (Atomic Number,Z V = 23, Fe= 26, Zn = 30)	3
	(b)	Write the name of a non-directional orbital ?	
	(c)	Out of Zn^{+2} and Fe^{+2} which one will be most stable ? (Atomic Number Z, Fe= 26, Zn = 30)	

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SECTION-D
CASE STUDY BASED QUESTIONS

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29.		**Electron gain enthalpies (in kJ/mol)**	

Group 1	Δeg^H	Group 16	Δeg^H	Group 17	Δeg^H	Group 0	Δeg^H
H	- 73					He	+ 48
Li	- 60	O	- 141	F	-328	Ne	+ 116
Na	- 53	S	- 200	Cl	-349	Ar	+ 96
K	- 48	Se	- 195	Br	-325	Kr	+ 96
Rb	- 47	Te	- 190	I	-295	Xe	+ 77
Cs	- 46	Po	- 174	At	-270	Rn	+ 68

Study the table of electron gain enthalpies of some main group elements and answer the questions that follow based on table and related concepts

a.	Why do group 1 elements have low electron gain enthalpy ?		1
b.	Why noble gases have the highest positive electron gain enthalpy ? Why ?		1
c.	Arrange S, P, Cl in increasing order of electron gain enthalpy. Give reason		1+
	OR		1
c.	Arrange group 16 elements in increasing order of electronegativity? Give reason		

30.		Chemical bonds are the forces that hold atoms together to form molecules and compounds. The primary types of chemical bonds are ionic and covalent, and metallic. Ionic bonds occur when one atom transfers electrons to another, resulting in oppositely charged ions that attract each other. Covalent bonds, on the other hand, involve the sharing of electron pairs between atoms. Ionic compounds are formed when atoms of different elements transfer electrons between them, creating positive (cation) and negative (anion) ions. These ions are held together by strong electrostatic forces in a lattice structure. Valence Shell Electron Pair Repulsion (VSEPR) theory is a model used to predict the shape of molecules based on the repulsion between electron pairs in the valence shell of the central atom. A dipole moment occurs in a molecule when there is an uneven distribution of electron density, resulting in partial positive and negative charges at different ends of the molecule.	
a.		CO_2 and SO_2 are not isostructural. Give reason	1
b.		Arrange them increasing bond angle $CH_2=CH_2$, CH_3-CH_3, $CH\equiv CH$	1
c.	(i)	Arrange NaCl, NaBr, NaI, NaF in increasing order of ionic character. Give reason for the order predicted.	2
		OR	
	(i)	In which of the following molecules or ions all the bonds are not equal ? PF_5, SiF_4, C_2H_4, CO_2	
	(ii)	Which one of the following will have a regular tetrahedral geometry ? BF_4^-, CO_3^{-2}, NH_2^-, H_3O^+	

SECTION-E

31.	(i)	State one drawback of bohr's theory.	1
	(ii)	Calculate the energy associated with the first orbit of He^+.	1
	(iii)	Calculate the wave number for the smallest wavelength transition in the series of Hydrogen atom? (Given $R_H = 1.097 \times 10^7 \, m^{-1}$)	1
	(iv)	If the uncertainty in the velocities of two particles A and B with masses of 1.0×10^{-27} kg and 1.0×10^{-31} kg, respectively, is the same, what will be the ratio of uncertainty in their positions?	2

OR

31.	(i)	State Aufbau principle.	1
	(ii)	Define a node.	1
	(iii)	A photon of wavelength 680 $\overset{o}{A}$ strikes a metal surface. a) Calculate the threshold frequency, v_o b) Also calculate work function(W_O) of the metal (Given $h = 6.6 \times 10^{-34} \, Js^{-1}$, $c = 3 \times 10^8 \, m/s$)	3

32.	a.	What is general electronic configuration of group 13 elements ?	1
	b.	Arrange the following in order as indicated :--	
		(i) Be, B, N, O (increasing order of electron gain enthalpy energy)	
		(ii) O^{-2}, N^{-3}, F^-, Na^+, Mg^{+2}, Al^{+3} (decreasing order of the ionic size)	2
	c.	The Wavelength of de-broglie is 2 µm(micrometer), then its momentum is ($h = 6.6 \times 10^{-34}$ Js^{-1})	2

<div align="center">OR</div>

32.	(a)	Give reason : electronegativity increases from left to right	1
	(b)	Lithium shows diagonal relationship with which element and why ?	1
	(c)	Correct increasing order first ionization enthalpy of Be, B, N, O	1
	(d)	If the momentum of a photon is "p", then its frequency is	2

33.	a.	(i) Give an example of a molecule which is an exception to the octet rule.	1
		(ii) Give an example of odd electron molecules and draw its lewis structure.	1
		(iii) Which has the most electronegativity of carbon ? why	1
		$CH_2=CH_2$, CH_3-CH_3, $CH\equiv CH$	
	b.	Elements X,Y and Z belong to second period have 4,5 and 7 valence electrons respectively	2
		(i) Write the molecular formula of the compounds formed by these elements individually with hydrogen	
		(ii) Which of these compound will have the highest dipole moment ?	

<div align="center">OR</div>

33.	a.	(i) Differentiate between sigma and pi bonds.	1
		(ii) Why is $BeCl_2$ linear whereas $SnCl_2$ angular molecule?	1
		(iii) Find the lone pair of electrons in the following: ClF_3, XeF_2	1
	b.	(i) Compare and justify bond angle in the following molecules or ions NH_3, NH_4^+, NH_2^-	2