HALF YEARLY EXAMINATION 2016
CHEMISTRY
S-3

SET-2

Time: 3 hours

Max. Marks: 70

General Instruction:

(i) *All question are compulsory.*

(ii) *Questtion no. 1 to 5 are very short answer qustions and carry 1 mark each.*

(iii) *Questtion no. 6 to 10 are short answer qustions and carry 2 marks each.*

(iv) *Questtion no. 11 to 22 are also short answer qustions and carry 3 marks each.*

(v) *Questtion no 23 is value based question and carry 4 marks.*

(vi) *Questtion no. 24 to 26 are long answer questions and carry 5 marks each.*

(vii) *USe log tables if necessary, use of calculators is not allowed.*

Atomic masses:

[H = 1u, C = 12u, O = 16 u, N = 14 u, Mg = 24u, S = 32 u, Na = 23u, Cl = 35.5 u, Fe = 56 u], $h = 6.626 \times 10^{-34}$ kg m^2 s^{-1} or Js, 1 eV = 1.6×10^{-19} J, $c = 3 \times 10^8$ m/s

1. What is the oxidation state of Cl in ClO_2^-?
2. Write down the general outer electronic configuration of 'd' block elements and also state one of their important property.
3. What is the number of unpaired electrons in Cr^{3+} (Z = 24)?
4. State the law of multiple proportions.
5. Calculate the number of 'σ' & 'π' bonds present in the given molecule

6. (a) Which of the following elements will have the greatest difference between their first and second ionisation enthalpy?

   Mg, Si, P, Na

   (b) Give the IUPAC name and identify the group of the periodic table to which the element with Z = 117 belong.

7. Identify the oxidizing and reducing agent in the reaction given below:

   (a) $4Zn + NO_3^- + 7H_2O \rightarrow 4Zn^{2+} + NH_4^+ + 10\ OH^-$

   (b) $Cr_2O_7^{2-} + 3H_2S + 8H^+ \longrightarrow 2Cr^{3+} + 3S + 7H_2O$

8. (a) How many electrons are present in 8 g of SO_2?

   (b) How many molecules of oxygen are present in a cylinder of capacity 5.6 L if the ratio of the gases oxygen and nitrogen present is 1 : 3 by volume?

9. Discuss the shapes of given molecules on the basis of VSEPR theory
   (i) NH_3 (ii) PCl_5
10. (a) What are disproportionation reactions?
   (b) Which of the following species does not show disproportionation reactions?
   ClO_4^-, BrO_3^{-1}, PO_3^{3-}, I_7

OR

(a) Justify that the reaction given below is a redox reaction

$$Cr_2O_7^{2-} + 3SO_2 + 2H^+ \longrightarrow 2Cr^{3+} + 3SO_4^{2-} + H_2O$$

(b) Can F_2 undergo disproportionation? Discuss.

11. (a) Arrange the following in increasing order of the property indicated
   (i) F, O, N, Cl (Electronegativity)
   (ii) Al^{3+}, Na^+, O^{2-}, N^{3-}, Mg^{2+} (Ionic size)
   (b) An atom contains six electrons in 3d subshell. What will be its position in the periodic table (group and period number)?
12. A photon of wavelength 4000Å strikes a metal surface whose work function is 2.31 eV. Calculate
   (a) Energy of the incident photon
   (b) KE of electron emitted
13. A given solution of sulphuric acid is 80% by mass and has a density of 1.8 g/cc calculate
   (a) molality
   (b) molarity
14. (a) Differentiate between a 'σ' and 'π' bond.
   (b) Give reason why CO_2 molecule is linear but SO_2 is bent on the basis of dipole moment.
   (c) Draw all the possible resonance structures for nitrate ion (NO_3^-) showing all the electrons.
15. (a) Which of the following species are isoelectronic?
   K^+, Mg^{2+}, S^{2-}, Ne, Ar, F^{-1}
   (b) What is the number of electrons which has $(n + l)$ value equal to '4' ?
   (c) Draw the boundary surface diagram of the following orbitals.
   (i) $3d_{x^2-y^2}$ (ii) $2p_x$
16. Rajat was given the following data of few elements

Element	$\Delta_i H_1$	$\Delta_i H_2$	$\Delta_g H$
A	520	4300	– 60
B	419	3051	– 44
C	1681	3374	– 348
D	1008	1846	– 295
E	2372	5251	+ 48

What must be the answers given by Rajat to the following questions:

(a) Most reactive metal

(b) Most reactive nonmetal

(c) Metal that can form stable covalent halides MX where X is a halogen

(d) Least reactive non-metal

(e) Element forming the most basic oxide

(f) A noble gas

17. (a) What is the frquency and wavelength of a photon emitted during transition from n = 5 to n = 2 state in a H atom?

(b) Differentiate between ψ and ψ^2

OR

(a) Calculate the wave number for the longest wavelength transition in Balmer series for H-atom.

(b) Differentiate between absorption and emission spectrum.

18. Balance the following ionic equation

(a) $I^- + MnO_4^- \rightarrow Mn^{2+} + I_2$ (acidic medium)

(b) $Cr(OH)_4^- + OCl^{-1} \longrightarrow CrO_4^{2-} + Cl^{-1}$ (basic medium)

19. (a) 100 mL solution of NaOH containing 5g of it is mixed with 200 mL of M/5 NaOH solution. What is the resultant Molarity?

(b) An organometallic compound contains C = 64.4%, H = 5.5 % and the rest of it is Iron by mass. Determine the empirical formula of the compound.

20. Account for the following:

(a) Second electron gain enthalpy for sulphur is less positive than that of oxygen.

(b) Oxygen form O^- more easily than Nitrogen

(c) Ionization energy and electron gain enthalpy are both positive for an inert gas.

21. Calcium carbonate reacts with HCl according to the following reaction:

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

(a) What mass of $CaCl_2$ is formed if 250 mL of 0.50 M HCl reacts with 1000 g of calcium carbonate?

(b) Identify the limiting reagent

(c) What is the volume of CO_2 released at STP?

22. (a) Calculate the formal charge an all the atom in O_3.

(b) LiF is insoluble in water despite being ionic but LiI readily dissolves in organic solvent. Explain.

23. A teacher asked the students to predict the geometry of NH_4^+ molecule based on their knowledge of hybridisation. Kusum predicted the shape to be square planer while Kiran predicted it to be tetrahedral.
    (a) Who predicted the correct shape?
    (b) Giving reason explain the shape on the basis of hybridisation.
    (c) What human value did you learn?
24. (a) State Pauli's exclusion principle.
    (b) Why is electronic energy negative?
    (c) List two important drawbacks of Bohr's theory.
    (d) Calculate the de Broglie wavelength for a coin weighing 1 g moving with a velocity of 80 m/s.

OR

    (a) State Hund's rule of maximum multiplicity.
    (b) Illustrate how copper has an exceptional configuration.
    (c) List two important drawbacks of Rautherford's model.
    (d) Calculate the uncertainty in the position of an electron whose momentum is determined with an accuracy of ± 0.02%.
25. Explain the following:
    (a) SF_6 violate octet rule
    (b) Structure of PCl_5 allows it to behave like a chlorinating agent.
    (c) MgO has a higher lattice enthalpy than CaO.
    (d) H_2O has a smaller bond angle than NH_3.
    (e) $AlCl_3$ is more covalent than NaCl.

OR

    (a) All five P – Cl bonds in PCl_5 not equal in length. Explain.
    (b) Draw the Lewis dot structure of NO_2^-.
    (c) Define dative bond
    (d) NO violate Lewis octet rule. Explain
    (e) H_2O and H_2S have different value of bond angle. Explain.
26. (a) Draw the shape of ethene (C_2H_4) molecule and identify its state of hybridization.
    (b) Calculate the number of bond pairs and lone pair of electrons in CO_2.
    (c) Does the state of hybridisation change for Al in the following reaction? Mention

$$AlCl_3 + Cl^- \rightarrow [AlCl_4]^-$$

OR

    (a) Draw the shape of ethyne(C_2H_2) molecule and mention the total no of σ and π bonds in it.
    (b) NH_3 has a higher value of the dipole moment than NF_3. Explain.
    (c) What is the nature of bond formed between BF_3 and NH_3. Does the hybridization state change for Boron during the reaction.

$$BF_3 + NH_3 \rightarrow BF_3.NH_3$$