

**KENDRIYA VIDYALAYA SANGATHAN, LUCKNOW REGION**  
**SESSION : 2022-2023**  
**CLASS- XI CUMULATIVE (HALF YEARLY) EXAMINATION**  
**CHEMISTRY THEORY (043)**  
**SET-2**

**MM:70**

**Time: 3 Hours**

**General Instructions. Read the following instructions carefully.**

1. There are 35 questions in this question paper. All questions are compulsory.
2. Section A (Part-I): Q. no. 1 to 14 are MCOs type questions carrying 1 mark each.
3. Section A (Part-II): Q. no. 15 to 18 are Assertion-Reasoning type questions carrying 1 mark each.
4. Section B: Q. No. 19 to 25 are very short answer questions and carry 2 marks each.
5. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
6. Section D: Q. No. 31 & 32 are case-based questions having four MCQs or Reason Assertion type questions based on given passage each carrying 1 mark.
7. Section E: Q. No. 33 to 35 are long answer questions carrying 5 marks each.
8. There is no overall choice. However, internal choices have been provided.
9. Use of calculators and log tables is not permitted.

**SECTION-A (Part-I: MULTIPLE CHOICE QUESTIONS)**

**Following questions (No. 1 -14) are multiple choice questions carrying 1 mark each:**

1. Which of the following element contains the greatest number of atoms

- (i) 1.4 g He
- (ii) 46 g Na
- (iii) 0.40 g Ca
- (iv) 12 g He

2. The empirical formula and molecular mass of a compound are  $\text{CH}_2\text{O}$  and 180g respectively. What will be the molecular formula of the compound?

- (i)  $\text{C}_9\text{H}_{18}\text{O}_9$
- (ii)  $\text{CH}_2\text{O}$
- (iii)  $\text{C}_2\text{H}_4\text{O}_2$
- (iv)  $\text{C}_6\text{H}_{12}\text{O}_6$

OR

16 g of oxygen has same number of molecules as in...?

- (i) 16 g of CO
- (ii) 36 g of  $\text{H}_2\text{O}$
- (iii) 14 g of  $\text{N}_2$
- (iv) 1.5 g of  $\text{H}_2$

3. For which one of the following species, Bohr's theory is not applicable?

- (i)  $\text{He}^{2+}$
- (ii)  $\text{Li}^{2+}$
- (iii)  $\text{Be}^{3+}$
- (iv) H

4. An orbital can have maximum electrons equal to

- (i) 2
- (ii) 10

- (iii) 6
- (iv) 14

OR

Shape of s and p orbitals respectively are-

- (i) spherical, dumb-bell
- (ii) Both are dumb-bell
- (iii) Both are spherical
- (iv) dumb-bell, spherical

5. The angular momentum of an electron is zero. In which orbital may it be present??

- (i) 2s
- (ii) 2p
- (iii) 3d
- (iv) 4f

6. Principal, Azimuthal and magnetic quantum numbers are respectively related to

- (i) Size, shape and orientation
- (ii) Shape, size and orientation
- (iii) Size, orientation and shape
- (iv) None of the above

7. Among halogens the correct order of amount of energy released in electron gain (i.e., electron gain enthalpy) follows:

- (i)  $F > Cl > Br > I$
- (ii)  $F > Cl < Br > I$
- (iii)  $F < Cl > Br > I$
- (iv)  $F < Cl < Br < I$

8. The elements in which electrons are progressively filled in 4f-orbital are called?

- (i) Actinoids
- (ii) Transition elements
- (iii) Halogens
- (iv) Lanthanoids

OR

The order of screening effect of electrons of s, p, d and f orbitals of a given shell of an atom on its outer shell electrons is:

- (i)  $s > p > d > f$
- (ii)  $f > d > p > s$
- (iii)  $p < d < s < f$
- (iv)  $f > p > s > d$

9. The number of sigma and pi bonds in  $CH_3-CH=CH_2$  are...?

- (i) 7 sigma 2 pi
- (ii) 8 sigma 1 pi
- (iii) 7 sigma 1 pi
- (iv) 8 sigma 2 pi

10. Which of the following bonds has maximum ionic character:

- (i) B-H
- (ii) N-H
- (iii) O-H
- (iv) C-H

11. What type of hybridisation is involved in  $SF_6$ ?

- (i)  $sp^3d^3$

- (ii)  $sp^3d^2$
- (iii)  $sp^3d$
- (iv)  $sp^3$

OR

Which of the following angle corresponds to regular tetrahedral geometry?

- (i)  $120^\circ$
- (ii)  $90^\circ$
- (iii)  $180^\circ$
- (iv)  $109^\circ 28'$

12. Third law of thermodynamics provides a method to evaluate which property?

- (i) Absolute Entropy
- (ii) Absolute Enthalpy
- (iii) Absolute Energy
- (iv) Absolute Free Energy

OR

In which of the following process, a maximum increase in entropy is observed?

- (i) Dissolution of Salt in Water
- (ii) Condensation of Water
- (iii) Sublimation of Naphthalene
- (iv) Melting of Ice

13. For an ideal gas,  $C_V$  and  $C_P$  are related as :

- (i)  $C_V - C_P = R$
- (ii)  $C_V + C_P = R$
- (iii)  $C_P - C_V = RT$
- (iv)  $C_P - C_V = R$

14. Which of the following is correct for the reaction with  $\Delta H = +ve$  and  $\Delta S = +ve$ ?

- (i) Spontaneous at high temperature
- (ii) Spontaneous at low temperature
- (iii) Non-spontaneous at high temperature
- (iv) Non-spontaneous at all temperatures

### SECTION-A (Part-II: ASSERTION REASONING QUESTIONS)

**In the following questions (Q. No. 15 - 18) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.**

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement.
- e) Both assertion and reason are false.

15. Assertion: In a gaseous reaction, the ratio of volumes of reactants and gaseous products is in agreement with their molar ratio.

Reason: Volume of gas is inversely proportional to its moles at particular temperature and pressure.

16. Assertion: Black body is an ideal body that emits and absorbs radiations of all frequencies.

Reason: The frequency of radiation emitted by a body goes from a lower frequency to higher frequency with an increase in temperature.

17. Assertion: Boron has a smaller first ionisation enthalpy than beryllium.

Reason: The penetration of a 2s electron to the nucleus is more than the 2p electron, hence 2p electron is more shielded by the inner core of electrons than the 2s electrons.

OR

Assertion: First ionisation energy for nitrogen is lower than that of oxygen.

Reason: Across a period effective nuclear charge decreases.

18. Assertion: Though the central atom of both  $\text{NH}_3$  and  $\text{H}_2\text{O}$  molecules are  $\text{sp}^3$  hybridised, yet H-N-H bond angle is greater than that of H-O-H.

Reason: Nitrogen has one lone pair in  $\text{NH}_3$  and oxygen has two lone pairs in  $\text{H}_2\text{O}$  and order of electron pair repulsion follows-  $\text{lp-lp} > \text{lp-bp} > \text{bp-bp}$ .

### SECTION-B

**The following questions, Q. No. 19 – 25 are Very Short Answer Type and carry 2 marks each.**

19. How many moles of methane are required to produce 22 g  $\text{CO}_2$  (g) after combustion?

OR

Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% dioxygen by mass. [Atomic mass : Fe = 55.85, O = 16.00]

20. Calcium carbonate reacts with aqueous HCl according to the reaction:



What mass of  $\text{CaCO}_3$  is required to react completely with 25 mL of 0.75 M HCl?

21. The mass of an electron is  $9.1 \times 10^{-31}$  kg and its kinetic energy is  $3 \times 10^{-25}$  J. Calculate its wavelength. (Given  $h=6.62 \times 10^{-34}$ )

22. Explain the following terms:

(i) Electron gain Enthalpy.

(ii) Inert gas radii

23. Although the electronegativity of F is highest but net dipole moment of  $\text{NF}_3$  is less than that of  $\text{NH}_3$ . Give reason.

OR

Calculate formal charge on each O-atom of ozone molecule and draw its resonating structures.

24. Give the shapes of following covalent molecules using VSEPR theory :

(a)  $\text{ClF}_3$  (b)  $\text{XeF}_4$

25. Give one point to differentiate the following thermodynamic terms:

(a) Extensive properties and intensive properties.

(b) Isothermal process and isobaric process.

### SECTION-C

**Q. No. 26 -30 are Short Answer Type carrying 3 marks each.**

26. Define limiting reagent. In the reaction-  $2A + 4B \rightarrow 3C + 4D$ , when 5 moles of A reacts with 6 moles of B, then- (i) which is the limiting reagent? (ii) calculate the amount of C formed.

OR

Calculate the concentration of nitric acid in moles per litre in a sample which has density  $1.40 \text{ g mL}^{-1}$  and the mass percent of nitric acid in it being 69%. (Atomic mass: N=14u, H=1u, O=16u).

27. Give the name and electronic configuration of the elements of 3d- series of transition metals which violate Aufbau's principle. Give reason for the same.

28. Compare the relative stability and magnetic nature of the following species on the basis of molecular orbital theory:  $O_2^+$ ,  $O_2^-$ ,  $O_2^{2-}$

OR

Use the molecular orbital energy level diagram to show that  $N_2$  would be expected to have a triple bond and  $Ne_2$ , no bond.

29. Write the equation showing relationship between  $\Delta G$ , enthalpy change and entropy change. How does the sign of  $\Delta G$  help in predicting the spontaneity/non-spontaneity of a process? Explain.

30. State the first law of thermodynamics. Write its mathematical expression. In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system. Determine the change in internal energy.

**SECTION- D**

**Q. No. 31 & 32 are Case Based Questions carrying 4 marks each.**

**31. Read the passage given below and answer the following questions: (4 x 1= 4)**

A large number of orbitals are possible in an atom. Qualitatively these orbitals can be distinguished by their size, shape and orientation. An orbital of smaller size means there is more chance of finding the electron near the nucleus. Similarly, shape and orientation mean that there is more probability of finding the electron along with certain directions than along others. The principal quantum number determines the size and to large extent the energy of the orbital. Azimuthal quantum number, 'l' is also known as orbital angular momentum or subsidiary quantum number. It defines the three-dimensional shape of the orbital. Each shell consists of one or more subshells or sub-levels. The number of sub-shells in a principal shell is equal to the value of 'n'. Magnetic orbital quantum number- 'm<sub>l</sub>' gives information about the spatial orientation of the orbital with respect to a standard set of co-ordinate axis. The fourth quantum number is known as the electron spin quantum number (m<sub>s</sub>). An electron spins around its own axis, much in a similar way as the earth spins around its own axis while revolving around the sun.

**In the following questions, a statement of assertion followed by the statement of reason is given.**

**Choose the correct answer out of the following choices:**

- (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
- (b) Assertion and reason both are correct statements and reason is not the correct explanation for assertion.
- (c) Assertion is the correct statement but reason is wrong statement.
- (d) Assertion is the wrong statement but reason is correct statement.

**(1) Assertion:** Each orbital is designated by three quantum numbers labelled as n, l and m<sub>l</sub>.

**Reason:** 'n' is a positive integer with value of n = 1,2,3.

**(2) Assertion:** The principal quantum number identifies the shell.

**Reason:** Size of an orbital decrease with the increase of principal quantum number 'n'.

**OR**

**Assertion:** The energy of an electron is largely determined by its principal quantum number.

**Reason:** The principal quantum number n is a measure of the most probable distance of finding the electron around the nucleus.

**(3) Assertion:** For n = 2, the possible value of l can be 0 and 1.

**Reason:** For a given value of n, l can have values ranging from 0 to n – 1.

**(4) Assertion:** Each electron in an atom has either + ½ or – ½ spin quantum number.

**Reason:** Spin quantum numbers are obtained by solving Schrodinger wave equation.

**32. Read the passage given below and answer the following questions:**

(4 x1=4)

Modern periodic law states that, "The physical and chemical properties of elements are the periodic function of their atomic numbers." In modern periodic table, the elements are arranged in order of increasing atomic numbers. The so-called "long form" of the Periodic Table of the elements is the most convenient and widely used. The horizontal rows are called "periods" and the vertical columns are called "groups". There are altogether seven periods and eighteen groups. Elements having similar outer electronic configurations in their atoms are arranged in vertical columns, referred to as groups or families. Critical examination of the electronic configuration of the various elements clearly indicates that with a gradual increase in atomic number there occurs a repetition of similar electronic configuration and therefore, repetition of similar properties after certain regular intervals. These regular intervals being 2,8,8,18,18 and 32. These numbers are also sometimes called magic numbers.

(1) The smallest ion among the following is..?

(i) Na<sup>+</sup>

(ii) Al<sup>3+</sup>

(iii) Mg<sup>2+</sup>

(iv) Si<sup>4+</sup>

(2) Considering the elements B, C, N, F and Si, the correct order of their non-metallic character is:

(i) F > N > C > B > Si

(ii) Si > C > B > N > F

(iii) B > C > Si > N > F

(iv) F > N > C > Si > B

**OR**

In a group of the periodic table the Ionization enthalpies of the elements decreases from top to bottom because of ....?

(i) increase in densities

(ii) decrease in chemical reactivities

(iii) increase in electronegativities

(iv) decrease in atomic sizes

(3) The element with atomic number 26 will be found in group :

(i) 2

(ii) 8

(iii) 6

(iv) 10

(4) The elements with atomic numbers 9, 17, 35, 53, 85 are all....?

(i) Alkaline earth metals

- (ii) Noble gases
- (iii) Halogens
- (iv) Transition metals

**SECTION- E**

**Q. No. 33 to 35 are Long Answer Type carrying 5 marks each.**

33. (a) State Heisenberg's Uncertainty Principle and give its mathematical expression. Calculate the uncertainty in the momentum of an electron if it is confined to a linear region of length of  $1 \times 10^{-10} \text{ m}$ .

(b) Derive de-Broglie's equation. [3+2]

OR

(a) Write outer electronic configuration of Cr atom. Why half-filled orbitals more stable.  
(b) State the following with suitable examples- (i) Pauli's exclusion principle. (ii) Hund's rule.  
(iii) Aufbau rule [2+3]

34. (a) Define the term "hybridisation". Using the concept of hybridisation, explain the shapes of  $\text{PCl}_5$  and  $\text{BF}_3$ .

(b) Arrange  $sp$ ,  $sp^2$  and  $sp^3$  hybridisations in increasing order of their electronegativities with appropriate reason of your answer. [3+2]

OR

(a) Write two points of differences between sigma and pi bonds.  
(b) What is hydrogen bonding? What requirements should a molecule fulfil for the formation of H-bond?  
(c) Why boiling point of HCl is lower than the boiling point of HF as well as HBr? [2+2+1]

35. (a) Distinguish between state function and path function.

(b) Identify the state functions and path functions out of the following: enthalpy, entropy, heat, temperature.

(c) Change in internal energy is a state function while work is not, why? [2+2+1]

OR

(a) State Hess Law of constant heat summation. Calculate enthalpy change for the reaction:



The enthalpy of formation of  $\text{CH}_4(\text{g})$ ,  $\text{CO}_2(\text{g})$  and  $\text{H}_2\text{O}(\text{l})$  are  $-74.8 \text{ kJmol}^{-1}$ ,  $-393.5 \text{ kJmol}^{-1}$  and  $-285.8 \text{ kJmol}^{-1}$  respectively.

(b) What do you mean by thermochemical reactions? Give an example. [3+2]

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