Roll No. ⬚⬚⬚⬚⬚⬚⬚

DAV PUBLIC SCHOOLS, ODISHA ZONE
Half-Yearly Examination (2023-24)

- Please check that this question paper contains **5** printed pages.
- Check that this question paper contains **33** questions.
- Write down the Serial Number of the question in the left side of the margin before attempting it.
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed 15 minutes prior to the commencement of the examination. The students will read the question paper only and will not write any answer on the answer-book during this period.

CLASS - XI
SUB: CHEMISTRY THEORY (043)

Time Allowed: 3 hours   **Maximum Marks: 70**

General Instructions:
(a) There are **33** questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
(c) SECTION B consists of 5 very short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case- based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of calculators and log tables are not permitted.

SECTION-A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Which of the following elements contains the greatest number of atoms? (1)
   (a) 36g Mg   (b) 46g Na   (c) 0.40 g Ca   (d) 12 g He

2. According to Bohr's theory, the angular momentum for an electron of 5th orbit is: (1)
   (a) $5h/\pi$ (b) $2.5h/\pi$ (c) $5\pi/h$ (d) $25h/\pi$

3. Mole fraction of ethanol in ethanol-water mixture is 0.25. Hence, percentage concentration of ethanol (C_2H_6O) by weight of mixture is (1)
   (a) 25   (b) 75   (c) 46   (d) 54

4. Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons? (1)
   (a) Pauli's exclusion principle   (b) Heisenberg's uncertainty principle
   (c) Hund's rule of maximum multiplicity   (d) Aufbau principle

5. What will be the mass % of nitrogen in hydrazinium sulphate $(N_2H_5)_2SO_4$? (MM =162.2 g/ mol) (1)
   (a) 10.8   (b) 17   (c) 34.52   (d) 51.2

6. What is the momentum of a particle which has a de- Broglie wavelength of 0.1 nm? (1)
   (a) 6.63×10^{-24} Kg m sec^{-1} (b) 7.00×10^{-24} Kg m sec^{-1}
   (c) 6.63×10^{-30} Kg m sec^{-1} (d) 7.5×10^{-24} Kg m sec^{-1}

7. Which of the following pair is not an example of intensive property? (1)
   (a) Temperature   (b) Molar volume
   (c) Density   (d) Heat capacity

8. The correct decreasing order of the boiling points of above compounds is (1)
   (a) $HF>H_2O>NH_3$ (b) $H_2O>HF>NH_3$
   (c) $NH_3>HF>H_2O$ (d) $NH_3>H_2O>HF$

9. The paramagnetic behaviour of B_2 is due to the presence of (1)
   (a) 2 unpaired electrons in π_b MO   (b) 2 unpaired electrons in $\pi^\star$ MO
   (c) 2 unpaired electrons is $\sigma^\star$ MO   (d) 2 unpaired electron in σ_b MO

10. Which of the following element has the highest –ve electron gain enthalpy? (1)
    (a) O   (b) S   (c) Se   (d) Te

11. For the reaction, $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$; $\Delta_r H^0 = -92.4$ kJ mol^{-1}. The standard enthalpy of formation of NH_3 gas is (1)
    (a) 92.4kJ   (b) -46.2kJ   (c) -92.4 kJ   (d) 46.2 kJ

12. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are expected to be (1)
    (a) sp, sp^3 and sp^2 (b) sp, sp^2 and sp^3 (c) sp^2, sp and sp^3 (d) sp^2, sp^3 and sp

13. Given below are two statements labelled as Assertion (A) and Reason (R) (1)
    Assertion (A) : Molality is preferred over molarity in expressing concentration of solution .
    Reason (R) : Molality depends on temperature while molarity is independent of temperature .
    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.

14. Given below are two statements labelled as Assertion (A) and Reason (R) (1)
    Assertion(A): An orbital cannot have more than 2 electrons and their spin must be opposite.
    Reason(R): No two electrons in an atom can have same set of all four quantum numbers as per pauli's exclusion principle
    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.

15. Given below are two statements labelled as Assertion (A) and Reason (R) (1)
    Assertion(A): Among the two O–H bonds in H_2O molecule, the energy required to break the first O–H bond and the other O–H bond is not the same.
    Reason(R): This is because the electronic environment around oxygen is the same even after breakage of one O–H bond.
    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.

16. Given below are two statements labelled as Assertion (A) and Reason (R). (1)
    Assertion(A): Alkali metals have least value of ionization energy within a period.
    Reason(R): They precede alkaline earth metals in periodic table.
    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.

SECTION-B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Write the **IUPAC** name of the element whose atomic number is 118 and predict the position of the element in the modern periodic table. (2)

18. Account for the following: (2)
   (a) BF_3 molecule has a zero dipole moment although B-F bonds are polar.
   (b) The structure of NH_3 molecule is pyramidal.

OR

   Give correct reason for the following
   (a) All the carbon to oxygen bonds in CO_3^{2-} are equivalent.
   (b) Bond angle in NH_3 is more than in H_2O.

19. Show by a chemical reaction with water that Na_2O is a basic oxide and Cl_2O_7 is an acidic oxide. (2)

20. 3 grams of H_2 react with 29 grams of O_2 to yield water, then (2)
   (i) Which is the limiting reagent?
   (ii) Calculate the maximum amount of water that can be formed.

21. How many Sigma bonds and pi bonds are present in the following compound? (2)
   $CH_3 - C \equiv C - COOH$.

SECTION-C

This section contains 7 questions with internal choice in one question. The following questions are very short answer type and carry 3 marks each.

22. Calculate the standard enthalpy of formation of CH_3OH (l), from the following data: (3)
   (i) $CH_3OH_{(l)} + 3/2\ O_{2\ (g)} \rightarrow CO_{2\ (g)} + 2H_2O_{(l)}$; $\Delta_r H^\Theta = -726$ kJmol^{-1}
   (ii) $C_{(s)} + O_{2(g)} \rightarrow CO_{2\ (g)}$; $\Delta_c H^\Theta = -393$ kJ mol^{-1}
   (iii) $H_{2(g)} + 1/2\ O_{2(g)} \rightarrow H_2O_{\ (l)}$; $\Delta_f H^\Theta = -286$ kJ mol^{-1}

23. (a) Although both CO_2 and H_2O are triatomic molecules, the shape of H_2O molecule is bent while that of CO_2 is linear. Explain this on the basis of dipole moment.
   (b) Is there any change in the hybridisation of B and N atoms as a result of the following reaction?
      $BF_3 + NH_3 \rightarrow [F_3B.NH_3]$
   (c) Draw and name the shape of SF_4. (3)

24. (a) A 25 watt bulb emits monochromatic yellow light of wavelength of 0.57µm. Calculate the rate of emission of quanta per second.
   (b) State Hund's Rule of maximum multiplicity (2+1)

25. A Compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96g. What are its empirical and molecular formulas? (3)

26. Give the possible reasons for **any three** of the following observations: (3)
   (i)   Noble gases have high ionization enthalpy.
   (ii) N is non metal but it has positive electron gain enthalpy.
   (iii) The position of Hydrogen in the modern periodic table is not fixed.
   (iv) Electronegativity of elements increases on moving from left to right in the periodic table.

27. (a) For a reaction at 298 K (2+1)
      $2A + B \rightarrow C$
      $\Delta H = 400$ kJ mol^{-1} and $\Delta S = 0.2$ kJ K^{-1} mol^{-1}.
      At what temperature will the reaction become spontaneous considering ΔH and ΔS to be constant over the temperature range?

   (b) For the reaction; $2Cl(g) \rightarrow Cl_2(g)$; what will be the signs of ΔH and ΔS?

28. (a) Consider the following species: (2+1)

   $N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}$

   (i) What is common in them?

   (ii) Arrange them in order of increasing ionic radii.

   (b) Explain why cations are smaller than their parent atoms?

SECTION-D

The following questions are case based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. Chemical reactions are invariably associated with the transfer of energy either in the form of heat or light. In the laboratory, heat changes in physical and chemical processes are measured with an instrument called calorimeter. Two types of calorimeters are used to calculate the heat change involved in a chemical reaction. The heat of reaction at constant volume and the heat of the reaction at constant pressure are measured separately using these calorimeters. Bomb calorimeter and simple or water calorimeter are used for such measurements.

   Answer the following questions.

   (a) Establish relationship between C_P and C_V for 1 mole of an ideal gas.

   (b) Define molar heat capacity.

   (c) What amount of heat is required to raise the temperature of 1 kg water by 20^0 C? Specific heat of water is 4.185 JK^{-1} g^{-1}.

   OR

   ΔH for the following reaction is -92.38 kJ at 298 K. calculate ΔU.

   $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$
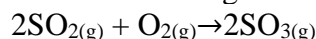
30. A physicist was performing experiments to study the effect of varying voltage on velocity and wave length of electrons on the basis when electric potential is applied, electrons get accelerated, If the accelerating potential V is applied to an electron beam, the energy acquired by the electron is expressed in electron-volt (eV) which is equal to the charge in coulomb × potential applied in volts. This energy become the kinetic energy of the electron. In first case the electron was accelerated through a potential difference of 1 KV and second case was accelerated through the potential difference of 2 KV.

   Answer the following questions.

   (a) What is the relationship between the wavelength (λ) and velocity (v) of an electron?

   (b) Is the above relationship significant for macroscopic objects? Explain.

   (c) The mass of an electron is 9.1×10^{-31} kg. If its K.E. is 3.0×10^{-25} J, calculate its wavelength.

   OR

   (c) A moving particle is associated with wavelength 5×10^{-8} m. If its momentum is reduced to half of its value, then calculate the new wavelength.

SECTION-E

The following questions are long answer type and carry 5 marks each. All the questions have an internal choice.

31. Answer any five of the following questions. (1x5)

   (a) If the concentration of glucose ($C_6H_{12}0_6$) in the blood is 0.9 g L^{-1}, what will be the molarity of glucose in the blood?

   (b) When 10 g $CaCO_3$ is heated, then 5.6 g CaO and 2.24 litre CO_2 gas (at S.T.P.) are formed. Prove that data follows the law of mass conservation.

   (c) How are 0.5 mol Na_2CO_3 and 0.5 M Na_2CO_3 different from each other?

   (d) Calculate the mole fraction of solute in 2.5m aqueous solution.

   (e) Calculate the mass of hydrochloric acid is needed to decompose 50 g of limestone?

   (f) Among the following which occupies higher volume at NTP

   14g of N_2 and 10^{21} Molecules of O_2

32. (a) Define the Octet rule. Mention any two limitations of the octet rule. (3+2)

    (b) Draw the lewis dot structure of the Ozone molecule and calculate the formal charge on each O- atom.

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

    (a) Write the molecular orbital electronic configurations of N_2, O_2, O_2^+, O_2^- and predict their bond orders. Arrange them in increasing order of their stability.

    (b) Write any two differences between sigma and pi bond. (3+2)

33. (a)(i) What is the lowest value of 'n' which allows the 'g' orbital to exist? (2+2+1)
      (ii) Draw the shape of the d-orbital which does not have four lobes.

    (b) Write the electronic configuration of following ions & assign the number of unpaired electrons in them.
      (i) Ca^{2+} (ii) Cr^{3+}

    (c) Find the number of spectral lines observed when an electron travels from n=7 to n=2 in a hydrogen atom.

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

(a) How much energy is required to ionize a hydrogen atom if an electron occupies n = 5 orbit?

(b) **Calculate:**
    (i) Total number of spherical nodes in a 3p orbital.
    (ii) Total number of angular nodes in a 4d orbital.

(c) In Which among the following orbitals an electron will have the lower energy and why ?
    n = 4, l = 3 **or** n = 5, l = 2. (2+2+1)