EURO GROUPS OF SCHOOLS

SESSION: 2024-25	CLASS-11ᵗʰ
HALF YEARLY EXAM	SUBJECT- CHEMISTRY
SET-A	M.M -70
TIME- 3 hours	

EURO GROUP OF SCHOOLS *'Nurturing Talent'*

NAME:

ROLL NO:

General Instructions: Read the following instructions carefully.

(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 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 log tables and calculators is not allowed

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.

Q1 What will be the molarity of a solution, which contains 5.85 g of $NaCl(s)$ per 500 mL?

(i) 4 mol L^{-1} (ii) 20 mol L^{-1} (iii) 0.2 mol L^{-1} (iv) 2 mol L^{-1}

Q2 Orbital which is not possible is

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

Q3 Among halogens, the correct order of amount of energy released in electron gain (electron gain enthalpy) is

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

Q4 Polarity in a molecule and hence the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule. Which of the following has the highest dipole moment?

(i) CO_2 (ii) HI   (iii) H_2O (iv) SO_2

Q5 Which of the following statements is correct?

(i) The presence of reacting species in a covered beaker is an example of open system.

(ii) There is an exchange of energy as well as matter between the system and the surroundings in a closed system.

(iii) The presence of reactants in a closed vessel made up of copper is an example of a closed system.

(iv) The presence of reactants in a thermos flask or any other closed insulated vessel is an example of a closed system.

Q6 We know that the relationship between K_c and K_p is $K_p = K_c(RT)^{\Delta n}$ What would be the value of Δn for the reaction $NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$?

(i) 1   (ii) 0.5   (iii) 1.5   (iv) 2

Q7 If 500 mL of 5M solution is diluted to 1500 mL, what will be the molarity of solution obtained?

(i) 1.5 M   (ii) 1.66 M   (iii) 0.017 M   (iv) 1.59 M

Q8 The principal quantum number of an atom is related to the

(i) size of the orbital   (ii) spin angular momentum

(iii) orbital angular momentum   (iv) orientation of the orbital in space

Q9 The statement that is not correct for periodic classification of elements is

(i) The properties of elements are periodic function of their atomic numbers.

(ii) Non-metallic elements are less in number than metallic elements.

(iii) For transition elements, 3d-orbitals are filled with electrons after 3p-orbitals & before 4s-orbitals.

(iv) The first ionization enthalpies of elements generally increase with increase in atomic number as we go along a period.

Q10 In which of the following substances will hydrogen bond be strongest?

(i) HCl   (ii) H_2O (iii) HI   (iv) H_2S

Q11 Enthalpy of sublimation of a substance is equal to

(i) enthalpy of fusion+enthalpy of vaporization   (ii) enthalpy of fusion

(iii) enthalpy of vaporization   (iv) twice the enthalpy of vaporization

Q12 What will be the correct order of vapor pressure of water, acetone and ether at 30°C? Given that among these compounds, water has maximum boiling point and ether has minimum boiling point.

(i) Water < Ether < Acetone   (ii) Water < Acetone < Ether

(iii) Ether < Acetone < Water   (iv) Acetone < Ether < Water

In the following questions, two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).

c) Assertion (A) is correct, but Reason (R) is incorrect statement.

d) Assertion (A) is incorrect, but Reason (R) is correct statement.

Q13 Assertion (A): The energy of an electron is largely determined by its principal quantum number.
Reason (R): The principal quantum number is a measure of most probable distance of finding the electrons around the nucleus.

Q14 Assertion (A): Ionic compounds tend to be non-volatile.
Reason (R): Ionic compounds are solid.

Q15 Assertion (A): Pi bond is never formed alone. It is formed along with a sigma bond.
Reason (R): Pi bond is formed by head on overlap of p- orbitals only.

Q16 Assertion (A): Enthalpy of graphite is lower than that of diamond.
Reason (R): Entropy of graphite is greater than that of diamond.

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.

Q17 List two differences between orbit and orbitals .

Q18 Explain why the electron gain enthalpy of fluorine is less negative than that of chlorine.

Q19 For the reaction; $2Cl(g) \longrightarrow Cl_2(g)$; what will be the signs of ΔH and ΔS?

Q20 Differentiate between bonding and anti-bonding molecular orbitals.

OR

Write two points of difference between sigma and pi bond.

Q21 What is meant by the statement that "equilibrium is dynamic in nature" ?

SECTION C

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

Q22 Calculate mass percentage composition of the elements in nitric acid. (H=1u, N=14u, O=16u).

Q23 (i) An atomic orbital has $n = 3$. What are the possible values of l and m_1 ?

(ii) List the quantum numbers (ml and l) of electrons for 3d orbital.

(iii) Which of the following orbitals are possible? 1p, 2s, 2p and 3f

Q24 Answer the following:

(i) Alkali metals do not form dis-positive ions. Why?

(ii) What is the IUPAC name and symbol of the element having atomic number 117.

(iii) Why halogens have very high negative electron gain enthalpy

Q25 Write the difference between reversible and irreversible process.

OR

Differentiate between intensive and extensive property.

Q26 Explain the structure of PCl_5 according to hybridization. Why all P–Cl bonds lengths are not equivalent in PCl_5?
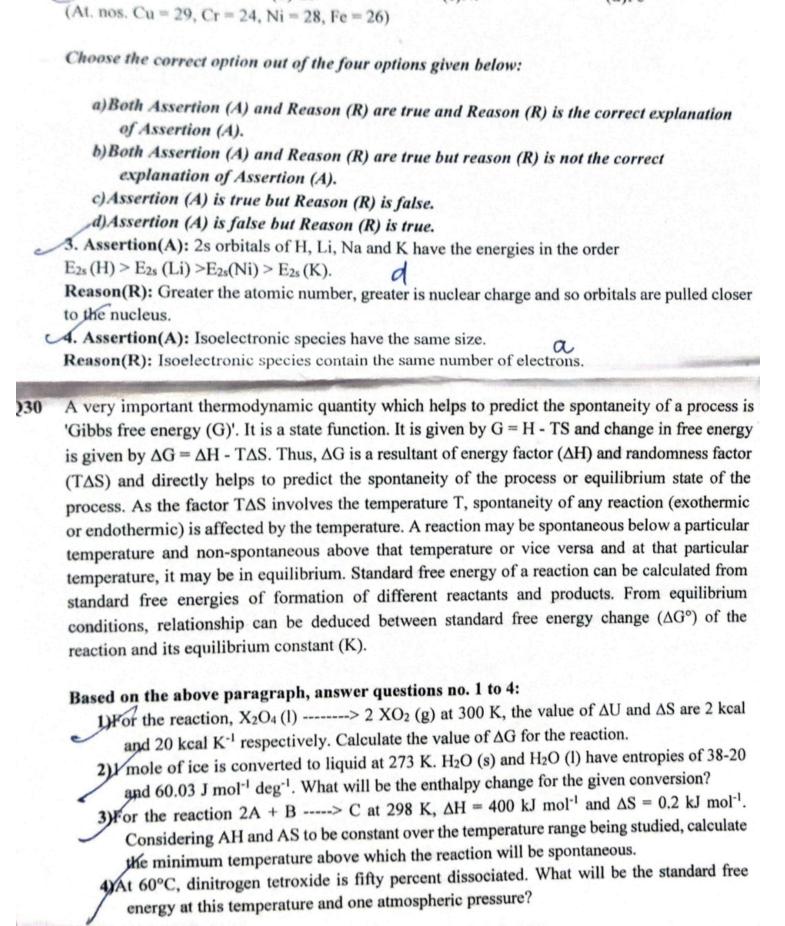
Q27 Explain on the basis of Molecular orbital theory: N_2 is diamagnetic while O_2 is paramagnetic.

Q28 Write the general characteristics of equilibria involving physical processes.

SECTION D

The following questions are case -based questions. It carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

Q29 In case of hydrogen atom or hydrogen like particles (one electron species), the energies of different subshells of the same main shell have the same value but this is not so for multi-electron atoms. This is because in case of hydrogen atom, there is only force of attraction between the only electron and the nucleus but in case of multi-electron atoms, besides forces of attraction, there are forces of repulsion among the electrons. Inner shells produce screening effect on the outer shell electrons. The net positive charge experienced by the electrons is less. This is called effective nuclear charge. Thus, orbitals are arranged in order of energy. The filling of these orbitals with electrons takes place according to Aufbau principle, Pauli exclusion principle and Hund's rule of maximum multiplicity. Following these rules, electronic configurations of atoms can be written. However, exceptions arise with some of the atoms as orbitals of the same subshell try to be exactly half-filled or fully filled to attain stability. The electronic configurations of ions are derived from

those of the atoms by adding or removing electrons equal to the units of positive or negativ
charge on the ions.

Based on the above paragraph, answer questions no. 1 to 4:

1. What is the maximum number of electrons that can be accommodated in an atom in which the
highest principal quantum is 4?

(a) 10   (b) 18   (c) 36   (d) 54

2. Which of the following has maximum number of unpaired electrons?

(a) Cu^{2+} (b) Cr^{3+} (c) Ni^{2+} (d) Fe^{3+}

(At. nos. Cu = 29, Cr = 24, Ni = 28, Fe = 26)

Choose the correct option out of the four options given below:

    a) *Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation
        of Assertion (A).*

    b) *Both Assertion (A) and Reason (R) are true but reason (R) is not the correct
        explanation of Assertion (A).*

    c) *Assertion (A) is true but Reason (R) is false.*

    d) *Assertion (A) is false but Reason (R) is true.*

3. **Assertion(A):** 2s orbitals of H, Li, Na and K have the energies in the order
E_{2s} (H) > E_{2s} (Li) > E_{2s}(Ni) > E_{2s} (K).   d
Reason(R): Greater the atomic number, greater is nuclear charge and so orbitals are pulled closer
to the nucleus.

4. **Assertion(A):** Isoelectronic species have the same size.   a
Reason(R): Isoelectronic species contain the same number of electrons.

Q30 A very important thermodynamic quantity which helps to predict the spontaneity of a process is
'Gibbs free energy (G)'. It is a state function. It is given by G = H - TS and change in free energy
is given by $\Delta G = \Delta H - T\Delta S$. Thus, ΔG is a resultant of energy factor (ΔH) and randomness factor
($T\Delta S$) and directly helps to predict the spontaneity of the process or equilibrium state of the
process. As the factor $T\Delta S$ involves the temperature T, spontaneity of any reaction (exothermic
or endothermic) is affected by the temperature. A reaction may be spontaneous below a particular
temperature and non-spontaneous above that temperature or vice versa and at that particular
temperature, it may be in equilibrium. Standard free energy of a reaction can be calculated from
standard free energies of formation of different reactants and products. From equilibrium
conditions, relationship can be deduced between standard free energy change ($\Delta G°$) of the
reaction and its equilibrium constant (K).

Based on the above paragraph, answer questions no. 1 to 4:

1) For the reaction, X_2O_4 (l) --------> 2 XO_2 (g) at 300 K, the value of ΔU and ΔS are 2 kcal
and 20 kcal K^{-1} respectively. Calculate the value of ΔG for the reaction.

2) 1 mole of ice is converted to liquid at 273 K. H_2O (s) and H_2O (l) have entropies of 38-20
and 60.03 J mol^{-1} deg^{-1}. What will be the enthalpy change for the given conversion?

3) For the reaction 2A + B -----> C at 298 K, ΔH = 400 kJ mol^{-1} and ΔS = 0.2 kJ mol^{-1}.
Considering ΔH and ΔS to be constant over the temperature range being studied, calculate
the minimum temperature above which the reaction will be spontaneous.

4) At 60°C, dinitrogen tetroxide is fifty percent dissociated. What will be the standard free
energy at this temperature and one atmospheric pressure?

SECTION E

The following questions are long answer type and carry 5 marks each.

Q31 (i) Define Molality and its units

(ii) The Molarity of a solution of sulphuric acid is 1.35 M. Calculate its molality. (The density of acid solution is 1.02 g cm^{-3}) (1)

(iii) If the density of methanol is 0.793kgL^{-1}, what is its volume needed for making 2.5 L of its 0.25 M solution? (2)

(2)

Q32 a) What do you understand by isoelectronic species? Name a species that will be iso electronic with each of the following atoms or ions. (2)

(a) F$^-$ (b) Ar   (c) Mg^{2+} (d) Rb$^+$

b) What does atomic radius and ionic radius really mean to you? (2)

c) State the Mendeleev's period law. (1)

Q33 **Answer the following questions:**

(i) PCl$_5$, PCl$_3$ and Cl$_2$ are at equilibrium at 500 K and having concentration 1.59M PCl$_3$, 1.59M Cl$_2$ and 1.41 M PCl$_5$. Calculate Kc for the reaction, PCl$_5 \rightleftharpoons$ PCl$_3$ + Cl$_2$ (2)

(ii) For the chemical equilibrium A+2B$\leftrightarrow$2C, the value of the equilibrium constant, K, is 10. What is the value for the equilibrium constant for the reaction written in reverse?

2C$\leftrightarrow$A+2B (1)

(iii) Why does the solubility of CO$_2$ decrease with rise in temperature ? (2)