BUDHA DAL PUBLIC SCHOOL, PATIALA
First Term Examination (16 September 2024)
Class XI (Science)
Subject - Chemistry
(Set - A)

Time: 3hrs. M.M. 70

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. Section A consists of 16 multiple-choice questions carrying 1 mark each.
3. Section B consists of 5 short answer questions carrying 2 marks each.
4. Section C consists of 7 short answer questions carrying 3 marks each.
5. Section D consists of 2 case-based questions carrying 4 marks each.
6. Section E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

Section - A

Q1. 1 mole of CH_4 contains

a) 6.02×10^{23} atoms of H b) 4 gram-atoms of hydrogen

c) 1.81×10^{23} molecules of CH_4 d) 3 g of carbon

Q2. Which of the following is dependent on temperature?

a) Molarity b) Molality c) Mole fraction d) Mass percentage

Q3. If travelling at same speeds, which of the following matter waves have the shortest wavelength?

a) Election b) Alpha particle (He^{2+}) c) Neutron d) Proton

Q4. 4d, 5d, 5f and 6p orbitals are arranged in the order of decreasing energy. The correct option is

a) 6p > 5f > 4d > 5p b) 5f > 6p > 4d > 5p c) 5f > 6p > 5p > 4d d) 6p > 5f > 5p > 4d

Q5. The period number in the long form of the periodic table is equal to

a) magnetic quantum number of any element of the period

b) atomic number of any element of the period

c) maximum Principal quantum number of any element of the period.

d) maximum Azimuthal quantum number of any element of the period

Q6. In periodic table, on moving along a period, the ionization potential

a) Increases from left to right b) Remains unchanged

c) First increases then decreases d) Decreases from left to right

Q7. The correct order of metallic character of the elements B, Al, Mg and K

a) B > Al > Mg > K b) Al > Mg > B > K c) Mg > Al > K > B d) K > Mg > Al > B

Q8. Which of the following compounds has zero dipole moment

a) CCl_4 b) $CHCl_3$ c) HF d) NH_3

Q9. In the structure of ClF_3, the number of lone pairs of electrons on central atom 'Cl' is?

a) one b) two c) four d) three

Q10. Which of the following angle corresponds to sp^2 hybridisation?

a) 90^0 b) 120^0 c) 180^0 d) 109^0

Q11. Which of the following is not an example of redox reaction?

a) $CuO + H_2 \rightarrow Cu + H_2O$ b) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

c) $2K + F_2 \rightarrow 2KF$ d) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

Q12. Identify the correct statement(s) in relation to the following reaction:

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

a) Zinc is acting as an oxidant

b) Chlorine is acting as a reductant

c) Hydrogen ion is acting as an reductant

d) Zinc is acting as a reductant

In these questions (Q.No. 13 to 16), two statements are given – one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to the questions from the codes (a), (b), (c) and (d) as given below:

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true and R is not the correct explanation of A.
c) A is true but R is false.
d) A is false and R is true.

Q13. Assertion (A) : Combustion of 16g of methane gives 18 g of water.

Reason (R) : In the combustion of methane, water is one of the products.

Q14. Assertion (A) : It is impossible to determine the exact position and exact momentum of an electron simultaneously.

Reason (R) : the path of an electron in an atom is clearly defined.

Q15. Assertion (A) : Out of all the halogens, fluorine is most electronegative element.

Reason (R) : Fluorine has most negative electron gain enthalpy.

Q16. Assertion (A) : Copper sulphate solution is not stored in zinc vessel.

Reason (R) : Zinc forms complex with $CuSO_{4+}$

Section - B

Q17. Calculate the mass percent of different elements present in sodium sulphate (Na_2SO_4). [At masses : Na = 23, S = 32, O = 16]

OR

Define (i) Limiting Reagent (ii) Molality

Q18. Using s, p, d notations, describe the orbital with the following quantum numbers.

a) n = 3 ; l = 1 b) n = 4 ; l = 2

Q19. Write the electronic configuration of the following ions : (a) Na^+ (b) F^-

Q20. Using s, p, d notations, name the orbitals with the following quantum numbers

a) n = 4, l = 3 b) n = 1, l = 0

Q21. a) State Mendeleev's Periodic Law

b) Define electronegativity

Section - C

Q22. In three moles of ethane (C_2H_6), calculate the following:

a) Number of moles of carbon atoms

b) Number of moles of hydrogen atoms

c) Number of molecules of ethane

Q23. Electrons are emitted with zero velocity from a metal surface when it is exposed to radiation of wavelength 6800 $\AA$. Calculate threshold frequency (ν_o) and work function (W_o) of the metal.

Q24. Assign the position of the element having outer electronic configuration

(i) $ns^2\ np^1$ for n = 3 (ii) $(n-1)\ d^2\ ns^2$ for n = 4 and (iii) $(n-2)\ f^7\ (n-1)\ d^1\ ns^2$ for n = 6, in the periodic table.

Q25. Discuss the shape of the following molecules using the VSEPR model?

$BaCl_2$, XeF_4, PH_3

OR

Draw resonance structure of CO_3^{2-} (carbonate ion). Calculate formal charge on each atom.

Q26. Which out of NH_3 and NF_3 has higher dipole moment and why?

Q27. Balance the following redox reactions by ion-electron method:/ oxidation number method

$MnO_4^-(aq) + I^-(aq) \rightarrow MnO_2(s) + I_2(s)$ (in basic medium)

Q28. Discuss the following redox reactions:

a) Combination reactions

b) Decomposition reactions

c) Displacement reactions

Given one example in each case.

Section - D

Q29. **Read the passage given below and answer the following questions:**

By the beginning of XIX century, scientists from various countries found various chemical elements and studied their atomic weights (masses), valence, chemical and physical properties. In this regard. there was an urgent need for classification of the studied elements. The German chemist Johnn Wolfgang Döbereiner in 1817 observed that some elements would be grouped into triads based on their chemical properties. For example, calcium, strontium and barium form a triad of alkaline-earth metals. Later this researcher extended a "triads law" to other elements and found several more triads such as lithium, sodium and potassium; sulphur, selenium, tellurium, chlorine, bromine and iodine, etc. Döbereiner also discovered that the atomic weight of the second element of a triad should be approximately equal to the arithmetic average of the atomic weights of the first and third members of this triad.

The English chemist John Alexander Newlands in 1864 proposed to subdivide the elements with increasing atomic weights into octaves. However, such systemization was unsuccessful because elements with completely different chemical properties fell into the same octave. Many other attempts were made to systematize the chemical elements, but only Russian chemist Dmitri Mendeleev succeeded in this field and formulated the periodic law of elements.

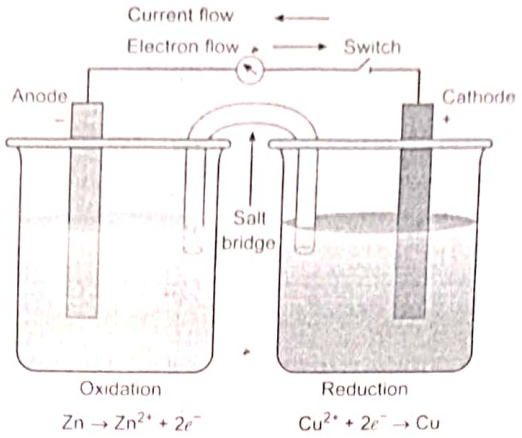
a) What is Deobereiner law of triads?
b) Name the elements given by Mendeleev for which he left the gap under aluminium and silicon.
c) Why was Newland's law of octaves unsuccessful?

OR

What is the drawback of Mendeleev's periodic law?

Q30. **Read the following passage and answer the questions that follow:**

In the Daniel cell shown below, the transfer of electrons does not take place directly from Zn to Cu^{2+} but through the metallic wire connecting the two rods as is apparent from the arrow which indicates the flow of current. The electricity from solution in one beaker to solution in the other beaker flows by the migration of ions through the salt bridge. We know that the flow of current is possible only if there is a potential difference between the copper and zinc rods known as electrodes here.



The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unity (if any gas appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to be the Standard Electrode Potential. By convention, the standard electrode potential (E) of hydrogen electrode is 0.00 volts. The electrode potential value for each electrode process is a measure of the relative tendency of the active species in the process to remain in the oxidised/ reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple. A positive E° means that the redox couple is a weaker reducing agent than the H^+/H_2 couple.

The standard electrode potentials are very important and we can get a lot of other useful information from them.

1. What is the direction of current in a cell?

   OR

   What is the standard electrode potential of hydrogen electrode?
2. What are the important information provided by the value of Standard electrode potential?
3. (i) If $E^0_{Sn^{2+}/Sn} = 0.41\ V$, what would be the value of $E^0_{Sn/Sn^{2+}}$?

   (ii) If $E^0_{Li^{2+}/Li} = -3.05\ V$, and $E^0_{Ca^{2+}/Ca} = -2.87\ V$, state which is a better reducing agent Li or Ca?

Q31. a) How many significant figures are present in following : (i) 5005 (ii) 500.0

b) Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation :

$N_2(g) + H_2(g) \rightarrow 2NH_3\ (g)$

i) Calculate the mass of ammonia produced if 2.00×10^3 g dinitrogen reacts with 1.00×10^3 g of dihydrogen.

ii) Will any of the two reactants remain unreacted?

iii) If yes, which one and what would be its mass?

OR

a) Calculate the molarity of NaOH in the solution prepared by dissolving its 4gm in enough water to form 250 ml of the solution. (Na = 23)

b) How are 0.50 mol Na_2CO_3 and 0.50 M Na_2CO_3 different?

Q32. a) Calculate energy of one mole of photons of radiation whose frequency is 5×10^{14} Hz.

b) Define (i) Isobars (ii) Heisenberg's Uncertainty Principle

OR

a) What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 ms^{-1}?

b) Define (i) Isotopes (ii) Aufbau's Principle

Q33. Write molecular electronic configuration of N_2 molecule. Draw molecular orbital energy level diagram of N_2 molecule and calculate its bond order. Predict its magnetic character.

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Section - A

Q1. Which of the following pairs have the same number of atoms?

a) 16 g of $O_2(g)$ and 4 g of $H_2(g)$ b) 16 g of $O_2(g)$ and 44 g of $CO_2(g)$

c) 28 g of $N_2(g)$ and 32 g of $O_2(g)$ d) 12 g of C(s) and 11 g of Na(s)

Q2. Molecular mass of glucose is

a) 342 u b) 110 u c) 90 u d) 180 u

Q3. The total number of atomic orbitals in fourth energy level of an atom is

a) 4 b) 8 c) 16 d) 32

Q4. Two electrons occupying the same orbital are distinguished by:

a) Magnetic quantum number b) Azimuthal quantum number

c) spin quantum number d) Principal quantum number

Q5. The maximum tendancy to form unipositive ion is for the element with the following electronic configuration:

a) $Is^2\ 2s^2\ 2p^6\ 3s^1$ b) $Is^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ c) $Is^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ d) $Is^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

Q6. The order of screening effect of electrons s^-, p^-, d^- and f^- orbitals of a given shell of an atom on its outer shell electrons is:

a) s > p > d > f b) f > d > p > s c) p > d > s > f d) f > p > s > d

Q7. The correct order of non-metallic character of the elements F, Cl, O and N

b) F > O > Cl > N b) F > Cl > O > N c) O > F > N > F d) Cl > F > O > N

Q8. Predict the correct order among the following:

a) lone pair– lone pair > bond pair-bond pair > lone pair – bond pair

b) bond pair– bond pair > lone pair-bond pair > lone pair – bond pair

c) lone pair– bond pair > bond pair-bond pair > lone pair – loan pair

d) lone pair– lone pair > loan pair-bond pair > bond pair – bond pair

Q9. On hybridization of one s and two p-orbitals, we get:

a) Two mutually perpendicular orbitals

b) Two orbitals at 180^0

c) Four orbitals directed tetrahedrally

d) Three orbitals in a plane

Q10. Which of the following options represents the correct bond order?

a) $O_2^- > O_2 > O_2^+$ b) $O_2^- < O_2 < O_2^+$ c) $O_2^- > O_2 < O_2^+$ d) $O_2^- < O_2 > O_2^+$

Q11. The oxidation number of an element in a compound is evaluated on the basis of certain rules. Which of the following rules is not correct in this respect?

a) The oxidation number of hydrogen is always +1

b) The algebraic sum of all the oxidation numbers state bears oxidation number zero

c) An element in the free or the uncombined state bears oxidation number zero

d) In all its compounds, the oxidation number of fluorine is - 1

Q12. Identify disproportionation reaction

a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ b) $CH_4 + 4Cl_2 \rightarrow CCl_4 + 4HCl$

c) $2F_2 + 2OH^- \rightarrow 2F^- + 2F_2 + H_2O$ d) $2NO_2 + 2OH^- \rightarrow NO_2^- + NO_3^- + H_2O$

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b) Both A and R are true and R is not the correct explanation of A.

c) A is true but R is false.

d) A is false and R is true.

Q13. **Assertion (A) :** A solution of table salt in a glass of water is homogeneous.

Reason (R) : A solution having same composition throughout is heterogeneous.

Q14. **Assertion (A) :** During a-particles scattering experiment, 99% of the a-particles get deflected through very large angles.

Reason (R) : The nuclei of Gold atoms are positively charged and repel a-particles which are also positively charged.

Q15. **Assertion (A) :** The elements of s and p-block are called as representative elements.

Reason (R) : They have incomplete valence shells.

Q16. **Assertion (A) :** HNO_2 acts as an oxidizing as well as reducing agent.

Reason (R) : The O.N. of N can increase above +3 and can decrease below +3.

Section - B

Q17. Determine the empirical formula of an oxide of iron, which has 69.9% iron and 30.1% dioxygen by mass. (Atomic mass is Fe = 56, O = 16)

OR

a) State law of constant proportion.

b) Define mole.

Q18. Using s, p, d notations, describe the orbital with the following quantum numbers.

a) n = 1 ; l = 0 b) n = 4 ; l = 3

Q19. Write the electronic configuration of the following ions : (a) H^- (b) O^{2-}

Q20. a) State Modern Periodic Law

b) Define Ionization Enthalpy

Q21. Give any two significances of hydrogen bond.

Section – C

Q22. Calculate the amount of carbon dioxide that could be produced when

a) 1 mole of carbon is burnt in air

b) 1 mole of carbon is burnt in 16g of dioxygen

c) 2 moles of carbon are burnt in 16 g of dioxygen

Q23. a) The energy associated with the first orbit in the hydrogen atom is -2.18×10^{-18} J atom^{-1}. What is the energy associated with the fifth orbit?

b) Calculate the radius of Bohr's fifth orbit for hydrogen atom.

Q24. Write the general outer electronic configuration of s-, p-, d- and f- block elements.

Q25. Discuss the shape of the following molecules using the VSEPR model. (alongwith diagrams)

BF_3, CH_4, H_2O

OR

Draw resonance structure of ozone molecule (O_3). Calculate formal charge on each atom.

Q26. Explain why BeH_2 molecule has a zero dipole moment although the Be-H bonds are polar.

Q27. Balance the following redox reactions by ion-electron method:

$H_2O_2(aq) + Fe^{2+}(aq) \rightarrow Fe^{3+} + H_2O(l)$ (in acidic solution)

Q28. a) Define cell potential

b) Write two functions of salt bridge

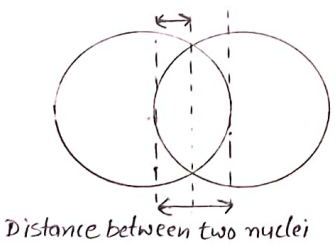
c) Identify substance acting as oxidicing agent & reducing agent

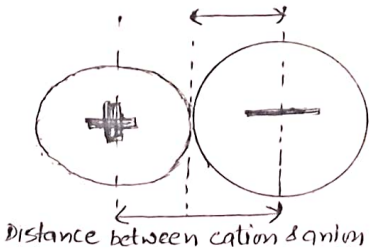
$$Fe_2O_3(s) + 3\,CO_{(s)} \xrightarrow{\Delta} 2Fe_{(s)} + 3CO_2\,(g)$$

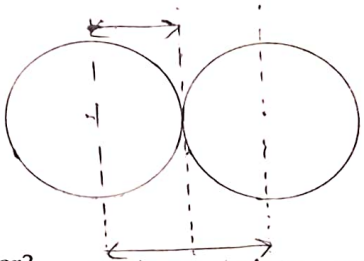
Section – D

Q29. **Read the passage given below and answer the following questions:**

We can never determine the atomic radius of an atom because there is never a zero probability of finding an electron, and thus never a distinct boundary to the atom. All that we can measure is the distance between two nuclei (internuclear distance). A covalent radius is one-half the distance between the nuclei of two identical atoms. An ionic radius is one-half the distance between the nuclei of two ions in an ionic bond. The distance must be apportioned for the smaller cation and larger anion. A metallic radius is one-half the distance between the nuclei of two adjacent atoms in a crystalline structure. The noble gases are left out of the trends in atomic radii because there is great debate over the experimental values of their atomic radii. The SI units for measuring atomic radii are the nanometer (nm) and the picometer (pm). 1 nm = 1×10^{-9} m and 1 pm = 1×10^{-12} m







a) Out of van der Waals radius and covalent radius, which one is larger?

b) Why is the size of a cation smaller than that of a neutral atom?

c) How do atomis radii vary along a period and down a group of the periodic table?

OR

Which of the following pairs of atoms/ ions is smaller in size and why?

(a) Na or Mg (b) Mg^{2+} and Al^{3+}

Read the following passage and answer the questions that follow:

Oxidation-reduction was primarily used to describe the reaction(s) of combination and/or removal of oxygen with or from chemical substances, respectively. Simultaneously, the removal and/or the addition of hydrogen were also used to differentiate among oxidation and reduction, respectively. The definitions were extended to a broader level, and the changes in the oxidation number or were considered to define oxidation and reduction. The increase in the oxidation number leads to oxidation state of elements oxidation and its alternative process yields reduction. This vast definition encompasses the recent and exact interpretation of "redox" reactions that is acceptance and donation of the electrons(s) between the reacting entities. Consequently, the redox phenomenon indicates a simple reaction, formation of carbon dioxide as a consequence of the oxidation of carbon and/or formation of methane by the reduction of carbon, for example, and the complex reaction consisting of a number of electron transfer reactions during the oxidation of sugar in the human body to produce energy.

The redox reaction(s) involves an oxidant or oxidizing agent and a reductant or reducing agent. The oxidant takes the electron(s) and oxidizes the reductant. The reductant, however, donates the electron(s) and reduces the oxidant.

1. Identify the type of following redox reaction
   $3ClO^- \rightarrow ClO_3^- + 2Cl^-$
2. Calculate the oxidation number of Fe in $[Fe(CN)_6]^{4-}$ ion
3. Find out the oxidant and reductant in the given reaction
   $I_2(g) + H_2S(g) \rightarrow 2HI(g) + S(s)$

OR

Give two examples of redox reactions.

Q31. a) Define limiting reactant.

b) Calculate the mass of sodium acetate (CH3COONa) required to make 500 mL of 0.375 molar aqueous solution. Molar mass of sodium acetate is 82.0245 g mol^{-1}. (Na=23, C=12, O=16)

c) How much copper can be obtained from 100 g of copper sulphate ($CuSO_4$)? (Cu=63.5, S=32, O=16)

OR

a) How many significant figures are present in the following: (i) 0.0025 (ii) 208

b) Calculate the concentration of nitric acid in moles per litre in a sample which has a density, 1.41 g mL^{-1} and the mass percent if nitric acid in it being 69%. (N=14)

Q32. a) Write two differences between orbit & orbital.

b) What is the number of photons of light with a wavelength of 4000 pm that provide 1J of energy?

OR

a) State Hunds rule with one example.

b) Calculate the uncertainty in momentum of an electron if uncertainly in the position is 1Å (10^{-10} m).

Q33. Draw molecular orbital diagram of oxygen molecule.

Write its molecular orbital configuration

Calculate bond order

Predict its magnetic character