PT4/ANNUAL EXAMINATION, 2023-24

CHEMISTRY

Time – 3 hrs. **Class – XI** **M.M. – 70**

Name of the student _____ Section ____ Date - 09.02.2024 (Friday)

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. The 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 not internal choice in this section.)

Q.1 If the density of a solution is 3.12 g mL^{-1}, the mass of 1.5 mL solution in significant figures is _____.

a) 4680×10^{-3}g b) 4.7g c) 47.80g d) 4.680g

Q.2 What is the mass per cent of carbon in carbon dioxide?

a) 0.034% b) 27.27% c) 3.4% d) 28.7%

Q.3 The kinetic energy of the ejected electrons in the photoelectric effect is:

a) directly proportional to the frequency of the incident radiation
b) inversely proportional to the frequency of the incident radiation
c) not related to the frequency of the incident radiation
d) all of the above

Q.4 The number of radial nodes for 3p orbital is _____.

a) 3 b) 4 c) 2 d) 1

Q.5 The hydrogen bond is strongest in:

a) F-H ---- O b) F-H ----- F c) O-H ----- S d) O-H ----- N

Q.6 The bond order and the magnetic characteristics of CN^- are

a) 3, diamagnetic b) 2.5 paramagnetic c) 3, paramagnetic d) 2.5, diamagnetic

Q.7 Which of the following are iso-electronic species?

a) CO_2, NO_2 b) NO_2^-, CO_2 c) CN^-, CO d) SO_2, CO_2

Q.8 The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound is:

a) is never negative. b) may be positive or negative.
c) is always negative. d) is always positive.

Q.9 Enthalpies of formation of CO(g), CO_2(g), N_2O(g), and N_2O_4(g) are –110, –393, 81, and 9.7 kJ mol^{-1} respectively. Find the value of $\Delta_r H$ for the reaction:

$N_2O_4(g) + 3CO(g) \rightarrow N_2O(g) + 3CO_2(g)$

a) – 850 kJ b) –600 kJ c) –778 kJ d) –802 kJ

Q.10 Values of standard electrode potential of three metals X, Y and Z are -1.2V, +0.5V and -3.0V respectively. The reducing power of these metals will be in order

a) X > Y > Z b) Y > Z > X c) Y > X > Z d) Z > X > Y

Q.11 I.U.P.A.C. name of 4-isopropyl-m-xylene is

a) l-Isopropyl-2, 4-Dimethyl benzene b) 4-Iso propyl-m-Xylene

c) l-Isopropyl-3, 5-Dimethyl benzene d) 4-Isopropyl-3, 5-Dimethyl benzene.

Q.12 An aqueous solution of compound A gives ethane on electrolysis. The compound A is?

a) Sodium propionate b) Sodium acetate c) Sodium ethoxide d) Ethyl acetate

Select the most appropriate answer from the options given below -

a) Both A and R is individually true, and R is the correct explanation of A.

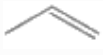
b) Both A and R is individually true, but R is not the correct explanation of A.

c) A is true but R is false

d) A is false but R is true

Q.13 Assertion (A): The resonance structure is hypothetical and individually represents any real molecules.

Reason (R): According to the resonance theory the actual structure of benzene cannot be adequately represented by any of these structures.

Q.14 Assertion (A): Addition of HBr on  in the presence of peroxide give 

as major product.

Reason (R): The addition of HBr on alkene proceeds by carbocation intermediate.

Q.15 Assertion: $N_2 + 3\ H_2 \rightleftharpoons NH_3$; $\Delta H = -92$ kJ. High pressure favours the formation of ammonia.

Reason: An increase of external pressure on the above reaction at equilibrium favours the reaction in the direction in which the number of moles decreases.

Q.16 Assertion: The gas-phase reaction $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ shifts to the right on increasing pressure.

Reason: When pressure increases, equilibrium shifts towards more number of moles.

SECTION – B

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

Q.17 The empirical formula of a compound is CH2O and its molecular weight is 90. What is the molecular formula of the compound?

Q.18 Draw the structure of the following compounds.

a) 2-methyl -3-isopropyl heptane b) Dicyclopropyl methane.

OR

Draw the Newman projection formula for different conformations of ethane.

Q.19 Would you expect the second electron to gain enthalpy of oxygen as positive, more negative or less negative than the first one? Give reason.

Q.20 Write the shape and hybridization of PCl_5 and SF_6 molecules.

Q.21 Calculate the mass of a photon with wavelength 3.6 Å (1 Å = 10^{-10} m)

SECTION – C

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

Q.22 Explain with the help of suitable examples polar and non-polar covalent bonds.

Q.23 Answer the following:

a) Two litres of an ideal gas at a pressure of 10 atm expands isothermally at 25°C into a vacuum until its total volume is 10 litres. How much heat is absorbed and how much work is done in the expansion?

b) Identify the state functions and path functions out of the following.

Enthalpy, entropy, heat, temperature, work, free energy

c) If the enthalpy of fusion and enthalpy of vaporisation of sodium metals are 2.6 & 98.2 kJ mol^{-1} respectively, what is the enthalpy of sublimation of sodium?

Q.24 In the reactions given below, identify the species undergoing oxidation and reduction.

a) $H_2S(g) + Cl_2(g) \rightarrow 2HCl(g) + S(s)$

b) $3Fe_3O_4(s) + 8\ Al(s) \rightarrow 9\ Fe(s) + 4Al_2O_3(s)$

c) $2Na\ (s) + H_2(g) \rightarrow 2NaH(s)$

OR

Write the net ionic equation for the reaction of potassium dichromate (VI), $K_2Cr_2O_7$ with sodium sulphite, Na_2SO_3, in acid solution to give chromium (III) ion and sulphate ion.

Q.25 What are electrophiles and nucleophiles explain with examples?

Q.26 Write IUPAC names of the products obtained by the ozonolysis of the following compounds?

a) Pent-2-ene b) 3,4-Dimethylhept-3-ene c) 2-Ethylbut-1-ene

Q.27 An element 'X' with atomic number 114, has been recently predicted. Write its electronic configuration and predict.

a) its group b) its block in which this element would be placed

Q.28 Commercially available concentrated hydrochloric acid (HCl) contains 38% HCI by mass.

a) What is the molarity (M) of the solution (density of solution = 1.19 g mL^{-1})

b) What volume required of concentrated HCI is to make 1.0 L of a 0.10 M HCI?

SECTION - D

The following questions are case-based questions. Read the passage carefully and answer the questions that follow. Each question carries 4 marks.

Q.29 A process or change is said to be reversible, if a change is brought out in such a way that the process could, at any moment, be reversed by an infinitesimal change. A reversible process proceeds infinitely slowly by a series of equilibrium states such that the system and the surroundings are always in near equilibrium with each other. Processes other than reversible processes are known as irreversible processes.

In thermodynamics, a distinction is made between extensive properties and intensive properties. An extensive property is a property whose value depends on the quantity or size of matter present in the system. For example, mass, volume, internal energy, enthalpy, heat capacity, etc. are extensive properties. Those properties which do not depend on the quantity or size of matter present are known as intensive properties. For example, temperature, density, pressure etc. are intensive properties. A molar property, X_m, is the value of an extensive property X of the system for 1 mol of the substance. Another example is molar volume.

Measurement of ΔU and ΔH: We can measure energy changes associated with chemical or physical processes by an experimental technique called calorimetry. In calorimetry, the process is carried out in a vessel called a calorimeter, which is immersed in a known volume of a liquid. Knowing the heat capacity of the liquid in which the calorimeter is immersed and the heat capacity of the calorimeter, it is possible to determine the heat evolved in the process by measuring temperature changes. Measurements are made under two different conditions:

i) at constant volume, q_V ii) at constant pressure, q_P

1) For adiabatic change, q = 0 then …

a) $\Delta U = w_{ad}$ b) $\Delta U = q+w$ c) $\Delta U = w - q$ d) $\Delta U = w_{rev}$

2) The technique for measuring energy changes associated with chemical or physical processes by an experimental technique called …

a) colourimetry b) calorimetry c) titration d) photometry

3) A property whose value depends on the quantity or size of matter present in the system is known as …

a) Extensive b) Intensive c) Reversible d) Irreversible

4) The enthalpies of all elements in their standard states are equal to –

a) unity b) zero c) < 0 d) different of each element

Q.30 Organic compounds are formed by covalent bonding. The nature of covalent bonding can be described with the help of hybridisation, sp, Sp^2 and sp^3. The structure and reactivity depend upon the type of bonds present in organic compounds. The organic compound can be represented by various structural formulae, Wedge and Dash's formula is a 3-D representation. Organic compounds can be classified based on functional groups. Organic reaction mechanisms are based on the structure of the substrate and the attacking reagent.

The intermediate formed can be free radical, carbocation, carbanion or carbene. The attacking reagent can be electrophile or nucleophile. The inductive, electromeric, resonance and hyper conjugative effects may help in the polarisation of covalent bonds. Organic reactions may be considered substitution, addition, elimination and rearrangement, oxidation and reduction reactions.

After the compound is obtained in the pure state, qualitative analysis helps to detect elements present in organic compounds whereas quantitative analysis helps to find the percentage of various elements. Dumas and Kjeldahl's method helps to determine the percentage of nitrogen, and Carius's method for halogens and sulphur. Carbon and hydrogen are estimated by the amount of CO_2 and H_2O formed. Phosphorus estimation is done by oxidising it to $H_3 PO_4$, and sulphur to $H_2 SO_4$, The percentage of oxygen is determined by taking the difference of 100 and the percentage of all elements. Empirical formula gives simple ratios of elements whereas molecular formula gives an exact number of atoms of each element present in a compound.

a) What are free radicals?

b) Write the decreasing order of stability of carbocations. (1^0, 2^0, 3^0)

c) In the estimation of sulphur, which compound of sulphur is formed as precipitate.

d) In the Carius method of estimation of halogen, 0.15 g of an organic compound gave 0.12 g of AgBr. What is the percentage of bromine in the compound?

(Given molar mass of AgBr = 187.78 g/mol)

SECTION - E

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

Q31. Answer the following:

a) What happens to the equilibrium constant when temperature increases for a reaction?

b) State Le Chatelier's principle.

c) Classify the following into lewis acids and lewis bases:

(i) H_2O (ii) NH_3 (iii) H^+ (iv) BF_3

(v) AlH_3 (vi) ROH (vii) CH_3NH_2 (viii) CN^-

(ix) CH_3^+

OR

a) What is common ion effect?

b) What is the difference between ionic product and solubility product?

c) pk_a of acetic acid and pk_b of ammonium hydroxide are 4.76 and 4.75 respectively. Calculate the pH of the ammonium acetate solution.

Q.32 Write the structure of the following compound :

a) 3– Oxopentanal.

b) 3-Hydroxybutanal

c) 2-Hydroxycyclopentane carbaldehyde

d) Which of the two structures CH_3COOH and CH_3COO^- is more stabilized by resonance? Explain.

e) Will CCl_4 give a white precipitate of AgCl on heating it with Ag. Explain.

OR

a) How will you convert benzene into

(i) p–nitrobromobenzene (ii) p – nitrotoluene (iii) Acetophenone

b) Arrange the following in decreasing order of acidic behaviour. Also give reason for this.

benzene, n-hexane and ethyne

Q.33 a) What is de Broglie wave equation? How did de Broglie explain the dual behaviour of matter?

b) If the position of the electron is measured within an accuracy of ±0.002 nm, calculate the uncertainty in the momentum of the electron. Suppose the momentum of the electron is $\frac{h}{4\pi m} \times 0.05\,\text{nm}$, is there any problem in defining this value?

OR

(a) How many sub-shells are associated with n = 4

(b) How many electrons will be present in the sub-shells having m_s value of -1/2 for n = 4 ?

(c) What are Quantum Numbers?

(d) Calculate- (i) frequency and (ii) wave-number of yellow radiation having wavelength 5800 Å.