West Bengal -2016 Grade 12 CHEMISTRY

[Total Time: 3 Hours 15 minutes] [Total Marks: 70]

Instructions to the candidates:

- i. Special credit will be given for answers which are brief and to the point.
- ii. Marks will be deducted for spelling mistakes, untidiness and bad handwriting.
- iii. Figures in the margin indicate full marks for the questions.

PART-A

1. Write the correct answer choosing from the options given against each question: (1 x 14=14)

[i] Which of the following is a constituent of soap?

(a) Sodium stearate

(b) Sodium salicylate

- (c) Sodium butyrate
- (d) Sodium benzenesulphonate

Ans. (a) Sodium stearate

[ii] Which of the following is an antibiotic?

(a) Aspirin

- (b) Chloramphenicol
- (c) Veronal
- (d) Foristal

Ans. (a) Aspirin

[iii] Which of the following is a natural polymer?

- (a) Polyethylene
- (b) Nylon
- (c) Protein
- (d) Terylene

Ans. (c) Protein

[iv] Which of the following bases is not present in DNA?

- i. Uracil
- ii. Thymine
- iii. Guanine
- iv. Cytosine

Ans. (a) Uracil

[v] Which of the following compounds will be formed when aniline reacts with H_2SO_5 ?







[vi] Which of the following compounds is obtained when calcium acetate is dry distilled?

- (1) Formic acid
- (2) Formaldehyde
- (3) Acetone
- (4) Butanone

Ans. (c) Acetone

[vii] Which of the following compounds will respond to iodoform test?

- (a) $CH_2CH_2CH_2OH$
- (b) CH₃CH(OH)CH₃
- (c) CH₃OCH₂CH₃
- (d) CH₃OH

Ans. (b) CH₃CH(OH)CH₃

[viii] Which of the following is an example of freon?

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i) BrCH<sub>2</sub>CH<sub>2</sub>Cl
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ii)CCl₂F₂

- iii) CCl₂Br₂
- iv) ICH₂CH₂F

Ans. (b) CCl_2F_2

[ix] What is the state of hybridization of Fe in [FeF_6]³⁻ ion?

- (a) d^2sp^3 (b) dsp^3 (c) sp^3d^2
- (d) sp^3d

Ans. (a) d^2sp^3

[x] Which of the following free gaseous ions of 3d elements has the highest paramagnetic moment? (The atomic numbers of Mn, Fe, Ni and Cu are 25, 26, 28 and 29 respectively)

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

Ans. (b) Mn^{2+}

[xi] Which of the following gases has odour but no colour?

- i. NO₂
- ii. SO₂
- iii. N₂
- iv. Cl_2

Ans. (d) Cl₂

[xii] Which of the following colloidal solutions does correctly represent fog?

- (a) Gas dispersed in a liquid
- (b) Gas dispersed in a gas
- (c) Solid dispersed in a gas
- (d) Liquid dispersed in a gas

Ans. (d) Liquid dispersed in a gas

[xiii] Which one is the SI unit of molar conductivity?

- (a) S m² mol⁻¹
- (b) S m^{-1}
- (c) S cm² mol⁻¹
- (d) S cm mol⁻¹

Ans. (a) S m² mol⁻¹

[xiv] What is the number of particles per unit cell in a face centered cubic lattice?

i. 1 ii. 2 iii. 3 iv. 4

Ans. (d) 4

2. Answer the following questions (Alternatives are to be noted):

 $(1 \times 4 = 4)$

[i] What is observed when visible light is passed through a hydrophobic colloidal solution?

Ans. When the light is passed through a hydrophobic colloidal solution scattering of light takes place and its path is visible, this effect is called Tyndall effect.

[ii] By what type of reaction do the common antacids destroy the excess acid of the stomach?

Ans: his type of reaction is called Neutralization reaction in this reaction acid and bases neutralize each others effect.

 $MgCO_3(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + cH_2O(l)$

[iii] Write down the relation among the conductance and specific conductance of an electrolyte solution and the cell constant of the conductivity cell.

Ans: $k = C \times L/A$

Where, k= specific conductance, C=conductivity, and L/A= cell constant.

Or, Write down the relation between the emf of a galvanic cell and the Gibbs energy for the chemical reaction occurring in the cell.

Ans $\Delta_r G^{\circ} = -nFE^{\circ}$.

[iv] Between Eu and Ce which one exhibits +2 oxidation state?

Ans Ce.

Or, Write down the name and formula of an oxide of a transition metal which acts as a catalyst.

Ans NiO (nickel oxide).

PART B

1. Answer the following questions (Alternatives are to be noted) $(2 \times 5 = 10)$

(a) Two solutions are isotonic. What is meant by the statement?(2 marks)

Ans Two solution are said to be isotonic when they have equal osmotic pressure i.e., there is no net flow of water on either side through the semi-permeable membrane.

Or, When a little amount of common salt is dissolved in water, the boiling point increases. Explain why? (2 marks)

Ans. When a non-volatile solute is added to a solvent then its vapour pressure decreases which results in the elevation of boiling point of the solution.

(b) Write two differences between physiorption and chemisorption.(2 marks)

Ans.

Physiorption					Chemisorption				
Van	der	Waals	'forces	are	There	are	strong	valence	bond
weak.					forces.				
Decreases		with	increase	in	First	inc	creases	and	then
temperature.					decrea	ses	with	increas	e in
					temperature.				

OR

Explain why the solid catalyst is used in a finely divided form in case of heterogeneous catalysis.

(2 marks)

Ans. Heterogeneous catalysis is a surface phenomenon and involves the chemisorption of reacting gases on the surface of the solid catalyst. The solid catalyst provides a number of free valencies at its surface through which chemisorption of gases on the surface takes place. To increase the number of free valencies by maximizing the surface area, it is used in finely divided form.

(c) First ionization enthalpies group 15 elements are, in general, greater than those of group 16 elements—explain.

(2 marks)

Ans. Group 15 element possesses half-filled p-subshell in its valence shell which is more symmetrical and more stable. Due to extra stability of half-filled configuration, more energy is required to remove an electron from the valence shell of an atom of group 15. That's why ionization enthalpies group 15 elements are, in general, greater than those of group 16 elements.

Or, state with balanced chemical equation what happens when sulphur trioxide gas is passed through conc. sulphuric acid. (1 + 1 marks)

Ans. When sulphur trioxide gas is dissolved in conc. sulphuric acid then oleum (fuming H_2SO_4) is formed. $SO_3 + H_2SO_4 ---->$ $H_2S_2O_7$ (oleum)

(d) An aqueous solution of a complex compound of formula $Co(NH_3)_5Br(SO_4)$ reacts readily with aqueous AgNO₃ to give a yellowish white precipitate. Write down the structural formula of the complex and mention the reaction involved.

(1 + 1 marks)

Ans.



 $[Co(NH_3)_5Br]SO_4 + AgNO_3 -----> [Co(NH_3)_5Br]NO_3 + AgSO_4$

(e) (i) Identify the two monomers in the following polymer



Ans. This polymer is Nylon-66. The two monomers are: -

- (a) Hexamethyllenediamine
- (b) Adipic acid (each having 6 C atoms)
- (ii) What is condensation polymerization reaction?

(1 + 1 marks)

Ans. The condensation polymerization reaction takes place only when the monomers are bifunctional or polyfunctional, the condensation process stops after only one or two steps and no polymer is formed. It involves the elimination of small molecules like H₂O, NH₃, etc.

2. Answer the following questions (Alternatives are to be noted):

 $(3 \times 9 = 27)$

(a) Silver crystallizes in face centered cubic lattice. If edge length of the unit cell is 4.07×10^{-4} cm and density of silver is 10.48 g cm⁻³, determine the relative atomic mass of silver. (3 marks)

Ans. Density(D)= 10.48 g cm⁻³ $E^{dge \ length(a)=} 4.07 \times 10^{-4} \text{ cm}$ Atomic mass(M)= ? Avogadro number= 6.022×10^{23} D=ZM/Na³ =4M/ $6.022 \times 10^{23} \times (4.7 \times 10^{-8})^{3}$ M= 107.9g/mol

OR

What is Schottky defect? Find out the packing efficiency in a simple cubic lattice. (1 + 2 marks)

Ans. This defect arises when some of the lattice points in a crystal are unoccupied. This defect is usually shown in ionic solids.

Let the edge length in simple cubic lattice be a and radius of the atom be r. It has only one atom in its lattice. The spheres at the two corners of the lattice touch each other

Therefore, a=2r(1)

Volume of the atom= $4/3\pi r^3$ (2)

Volume of unit cell=a³=8r³

Packing fraction=Volume occupied by atoms/Volume of unit cell = $(4/3)\pi r^3/8r^3=0.524$

Hence, the packing fraction of the simple cubic unit cell is 52.4%.



(b) What is meant by the molality of a solution? What would be the osmotic pressure of a 0.02 molar aqueous solution of urea at 27 °C? $(R=0.082 \text{ L atm } \text{K}^{-1}\text{mol}^{-1})$ (1 + 2 marks)

Ans. Molality of the solution is defined as the number of moles of solute dissolved in 1 kg of the solvent. It is denoted by m. Its unit is mol kg⁻¹.

Molality=Number of moles of solute/Mass of the solvent in kg

(c) Arrange the following solutions in order of decreasing specific conductance:

(i) 0.01M NaCl (ii) 0.05M NaCl (iii) 0.1M NaCl (iv) 0.5M NaCl

Ans. (iv) 0.5M NaCl > (iii) 0.1M NaCl > (ii) 0.05M NaCl > (i) 0.01M NaCl

Resistance of a conductivity cell filled with 0.1 M KCl solution is 80 Ω . The conductivity cell has a cell constant of 1.0 cm⁻¹. Find out the molar conductance of the KCl solution. (1 + 2 marks)

Ans. Molar conductance $(\land m) = k/C_m$

k= conductance x cell constant

$$= 1/80 \text{ x} 1 = 0.125 \text{ S} \text{ m}^{-1}$$

= 0.125/0.1

 $= 1.25 \text{ S} \text{ m}^2 \text{ mol}^{-1.}$

Or, Determine ΔG° and the value of the equilibrium constant for the following reaction occurring in an electrochemical cell at 25 °C:

Cu(s) + $2Ag^{+}(aq) = Cu^{2+}(aq) + 2Ag(s)$ Given that, $E^{o}_{Cu}^{2+}_{/Cu} = 0.34$ V and $E^{o}_{Ag^{+}/Ag} = 0.80$ V

Ans. $E^{o}_{cell} = E_{right} - E_{left} = 0.80V - (+0.34)V = 0.46V$.

Equilibrium constant is given by, $Kc = antilog_{10}nE^{\circ}_{cell}/0.059 \dots (1)$

 $\Delta G^{o}_{r} = -2.303 \text{ RT} \log_{10} K_{c}$

 $K_c = 3.89$

 $\Delta G^{o}_{r} = -277.63 \text{ JK}^{-1} \text{ mol}^{-1}$

(d) (i) Why is zinc blende ore roasted before carbon reduction? Answer with balanced chemical equation.

(ii) What is malachite? Write down its formula.

(2 + 1 marks)

Ans. Roasting of zinc blende (zinc sulphide) converts it into metal oxides which after carbon reduction, yields pure metal.

(Roasting) $2ZnS + 3O_2 - 2ZnO + 2SO_2$

(Carbon reduction) 2ZnO + 2C ----> 2Zn + 2CO

Ans. Malachite is the copper carbonate hydroxide mineral. Its chemical formula is $[Cu_2CO_3(OH)_2]$. It is formed by the weathering of copper ore bodies in the vicinity.

(e) (i) Explain why Cu⁺ ion is not stable in aqueous solution.

(ii) State what happens when a solid mixture of KCl and K₂Cr₂O₇ is heated with conc. sulphuric acid. Give balanced chemical equation.

Ans. Stability depends on the hydration energy (enthalpy) of the ions when they bond to water molecules. Cu^{2+} forms bond with water much more easily than Cu^{+} hence it is unstable in aqueous solution.

Ans. When potassium dichromate reacts with potassium chloride and sulphuric acid it produces chromyl chloride, potassium sulphate and water. This reaction takes place in boiling solution of oleum.

 $K_{2}Cr_{2}O_{7} + 4KCl + 3H_{2}SO_{4} ----Heat----> 2CrO_{2}Cl_{2} + 3K_{2}SO_{4} + 3H_{2}O$

OR

(i) Write the number of unpaired electron(s) present in Na₂[FeO₄].(Atomic number of Fe is 26)

(ii) Explain the cause of chemical similarly between the compounds of Nb and Ta.

(1 + 2 marks)

Ans. The number of unpaired electron is 4.

Ans. The chemical similarity between the compounds of Nb and Ta is due to lanthanide contraction— steady decrease of atomic or ionic radii from left to right in lanthanide series.

f. (i) What will happen when bromomethane reacts with an aqueous solution of sodium hydroxide? Write the mechanism of the reaction.

Ans (i) When bromomethane reacts with (aq.) NaOH, then the bromine atom gets replaced by OH group and methanol is formed. The mechanism followed here is $S_N 2$.

CH3-CH2-Br + NaOH = CH3-CH2-OH + NaBr

(ii) What will happen when chlorobenzene reacts with a mixture of conc. HNO_3 and conc. H_2SO_4

(2 + 1 marks)

Ans: (ii) When chlorobenzene is treated with the mixture of conc. sulphuric and nitric acid (nitration mixture), nitration occurs resulting in the formation of two products- i) o-Nitrochlorobenzene and, ii) p-Nitrochlorobenzene.



(g) Identify A, B, C, D, E and F in the following reactions:(i)



(ii)



(iii)



Ans. (i)



Ans. (ii)



Ans. (iii)





An organic compound A (C_2H_6O) reacts with sodium to form compound B and hydrogen gas. When heated with conc. H_2SO_4 at 413 K, A produces C ($C_4H_{10}O$). C on reaction with conc. HI at 373 K forms D. C is also obtained when B is heated with D. Identify A, B, C and D and write chemical equations for the formation of B from A and the formation of C from B and D.

Ans. A is CH₃CH₂OH,

B is CH₃CH₂—O⁺Na⁻,

C is CH₃CH₂—O—CH₂CH₃,

D is CH₃—CH₂—I

Chemical reactions are:-

(a) CH_3CH_2 —OH (A) + Na -----> CH_3CH_2 —O'Na⁺(B) + H_2

(ii) CH_3CH_2 —O⁻Na⁺ + CH_3CH_2 —I -----> CH_3CH_2 —O— CH_2CH_3

(h) (i) Arrange the following compounds in decreasing order of their basicity:



(ii) Write the arrow-head equation for the following reaction:

(2 + 1 marks)

Aniline is refluxed with glacial acetic acid.

Ans



OR

Write the organic products in the following reactions: (3)

(i)



Ans



(ii)



Ans



Benzylidene aniline

(iii)



Ans



Phenyl iso cyanide

(iv)



(v)



(i) (x) What is a polysaccharide? Explain with an example

Ans.. Polysaccharide

* Long chains of monosaccharides that they are polysaccharide which linked by glycosidic bonds.

* Eg:- Polysaccharide are the three important ways : starch, glycogen, and cellulose, are composed of glucose.

* In plants and animals short-term energy stores in Starch and glycogen.

* Linear to highly branched that they are range in structure.

(y) What is meant by primary structure of a protein? (2+1 marks)

Ans. All proteins are polymers of α -amino acids. When these amino acids are arranged linearly, then the structure formed is primary structure of protein.



3. Answer the following questions (Alternatives are to be noted):

 $(5 \times 3 = 15)$

(a) What is meant by a zero order reaction? Give an example of such a reaction. Establish the integrated rate equation for a zero order reaction involving a single reactant. How can the rate constant be determined using this equation? (1 + 1 + 2 + 1)

Ans. Zero order reaction is the reaction in which the rate of reaction is independent of the concentration of the reactants and remains unchanged even if the concentration of the reactants is changed. The reaction proceeds with a constant rate. E.q., $H_2 + Cl_2 = 2HCl$ (in the presence of sunlight). The unit of rate constant for a zero order reaction is <u>mol L⁻¹ s⁻¹</u>.

Consider the reaction: R -----> P

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Rate= -d[R] / dt = k[R]^0 = k * 1
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(a) [R] = -k dt
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(b) Integrating both sides
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(c) [R] = -kt + C \dots (1)
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Where C is the constant of integration.

At t=0, let the conc. of reactant be $R=[R]_I$ (initial conc.)

Putting the value of R in eq. (1)

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=> [R]_{I} = -k * 0 + C
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\Rightarrow [R]<sub>i</sub> = C
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Putting the value of C in eq (1), we have

 $=> [R] = -kt + [R]_{I}$

=> Therefore,
$$k = [R]_I - [R] / t \dots (2)$$

Plotting the graph of eq (2), we have:



Variation in the concentration vs time plot for a zero order reaction

Eq. $2NH_3(g)$ ----pt catalyst, 1130 K----> $N_2(g) + 3H_2(g)$

OR

Write down the Arrhenius equation relation the rate constant of a reaction with temperature, mentioning what the terms indicate.

If k_1 and k_2 be the rate constants of a reaction at temperatures $t_1^{o}C$ and $t_2^{o}C$ respectively, find out the relation between k_1 , k_2 , t_1 and t_2 . Given that the activation energy (E_a) of the reaction remains unchanged within the temperature range mentioned.

The rate constants of a reaction at 400 K and 500 K are 0.02 s⁻¹ respectively. Determine the activation energy (E_a) of the reaction.

(1 + 2 + 2)

Ans. The Arrhenius equation is:

 $\underline{\mathbf{k}} = \mathbf{A} \mathbf{e}^{-\mathbf{E}\mathbf{a}/\mathbf{R}\mathbf{T}} \cdots (1)$

Where, k= rate constant

A= frequency factor- gives the frequency of binary collisions of reactant molecules per second litre.

E_a= activation energy

R= gas constant (8.314 JK⁻¹ mol⁻¹)

T= temperature in Kelvin

Taking log on both sides in eq.(1), we have:

 $log_e k = log_e A - E_a/RT$

 $\Rightarrow 2.303 \log 10k = E_a/RT + 2.303 \log_{10}A$

 $\Rightarrow \log_{10} k = -E_a/2.303RT + \log_{10} A \dots (2)$

If k_1 and k_2 are the rate constants measured at temperatures T_1 and T_2 respectively, then according to eq.(2), we have:

 $\log_{10}k_1 = -E_a/2.303RT_1 + \log_{10}A \dots(3)$

 $\log_{10}k_2 = -E_a/2.303RT_2 + \log_{10}A \dots (4)$

Subtracting eq.(3) from eq.(4), we get:

 $\frac{\log_{10}k_2/k_1}{E_a/2.303R(1/T_1 - 1/T_2)}$

(b) (i) Explain why moist chlorine can bleach dry coloured articles but dry chlorine cannot.

(ii) Write down the structure of SO_2 and state with reason whether it is polar or non-polar.

(iii) Write down the name and formula of the stable paramagnetic allotrope among the allotropes of oxygen and sulphur.

(2+2+1)

Ans. (i) Moist chlorine releases nascent oxygen which acts as a powerful bleaching agent. Dry chlorine does not release nascent oxygen.

Ans. (ii)



SO₂ molecule is not symmetrical as there is a region of unequal sharing of electrons. The bent shape means that the top (where the

lone pair of electrons is) less electronegative. The oxygen atoms at the bottom of the structure are then more negative. Therefore, SO_2 is a polar molecule.

Ans. (iii) The stable paramagnetic allotropes of oxygen is O_2 and that of sulphur is S_2 .

(c) (i) Give examples of the following reactions:

(m) Gattermann-Koch reaction

Ans.



(n) Kolbe-Schmidt reaction

Ans.



(o) Wolff-Kishner reduction.

Ans.



(ii) Identify A, B, C and D in the following reactions:

(p)



Ans



OR

(i) An organic compound A, of molecular formula $C_6H_{14}O_2$ on acidhydrolysis produces one molecule of ethanol and two molecules of ethanol from one molecule of A. Identify A. How can A be prepared?

(ii) How would you convert?

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CH<sub>3</sub>CHO -----> CH<sub>3</sub>CH=CHCHO
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Ans. This aldehyde has alpha-hydrogen so it will undergo aldol condensation in the presence of dilute alkali catalyst.



(iii) Write the appropriate reagents for the following two conversions:

(r)



Ans. The appropriate reagent is Grignard reagent.

(s)

Ans. The appropriate reagent is Grignard reagent (R-Mg-X).

(iv) Distinguish between formic acid and acetaldehyde by a suitable chemical test.

(2+1+1+1)

Ans. A suitable chemical test will be Tollen's reagent. Tollen's reagent oxidizes aldehydes to corresponding acids and in the process gets reduced to silver. It will give a silver coating. Formic acid will not give Tollen's test.