

SUBJECT : CHEMISTRY

MEDIUM : ENGLISH

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QUESTION FORMAT & MARKING CRITERIA

SUBJECT : CHEMISTRY

A. Questions Format

In the booklet check that it contains all the **189 questions** and corresponding answer choices are legible. Read carefully the Instructions printed at the beginning of each section.

- 1. Section 1 contains 45 multiple choice questions. Each question has Four choices (A), (B), (C) and (D) out of which only ONE is correct.
- 2. Section 2 contains 41 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE are correct.
- 3. Section 3 contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which Only ONE is correct.
- 4. Section 4 contains 14 paragraphs each describing theory, experiment, data etc. 18 questions related to Fourteen paragraphs with one or two or three questions on each paragraph. Each question of a paragraph has ONLY ONE correct answer among the four choices (A), (B), (C) and (D).
- 5. Section 5 contains 5 questions. Each question contains statements given in two columns which have to be matched. Statements in **Column I** are labelled as A,B,C and D whereas statements in **Column II** are labelled as p,q,r,s and t. The answers to these questions have to be appropriately bubbled as illustrated in the following example.
- 6. Section 6 contains 52 questions. The answer to each question is a single-digit integer, ranging from 0 to 9 (both inclusive).
- 8. Section 7 contains 23 questions. The answer to each question is a double-digit integer, ranging from 00 to 99 (both inclusive).

B. Marking Scheme

- 9. For each question in Section 1, you will be awarded 3 marks if you darken the bubble corresponding to only the correct answer and zero mark if no bubbles are darkened. In all other cases, minus one (-1) mark will be awarded.
- 10. For each question in Section 2, you will be awarded 4 marks if you darken the bubble(s) corresponding to only the correct answer and zero mark if no bubbles are darkened. No negative marks will be awarded for incorrect answers in this section.
- 11. For each question in Section 3, you will be awarded 4 marks if you darken all the bubble(s) corresponding to only the correct answer(s) and zero mark if no bubbles are darkened.
- Section 4 contains 5 paragraphs each describing theory, experiment, data etc. Ten questions related to Five paragraphs with two questions on each paragraph. Each question of a paragraph has ONLY ONE correct answer among the four choices (A), (B), (C) and (D).
- 13. For each question in Section-5, you will be awarded 2 marks for each row in which you have darkened the bubble corresponding to the correct answer. Thus, each question in this section carries a maximum of 8 marks. There is no negative marking for incorrect answer(s) in this section.
- 14. For each question in **Section 6**, you will be awarded **4 marks** if you darken the bubble corresponding to only the correct answer and **zero mark** if no bubbles are darkened. **No negative** marks will be awarded for incorrect answers in this section.
- 15. For each question in **Section 7**, you will be awarded **4 marks** if you darken all the bubble(s) corresponding to only the correct answer(s) and zero mark if no bubbles are darkened. **No negative marks** will be awarded for incorrect answers in this section.

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Atomic masses : [H = 1, D = 2, Li = 7, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, Si = 28, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65, As = 75, Br = 80, Ag = 108, I = 127, Ba = 137, Hg = 200, Pb = 207]

SECTION – 1 : (Only One option correct Type)

This section contains 45 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1.	How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0M HNO_3 ?						
	(A) 90.0 g conc. HNO	$115707611100_3.$	(B) 70.0 g conc. HNO				
	(C) 54.0 g conc. HNO_3		(D) 45.0 g conc. HNO_3				
2.	What is the concentration together :	ation of nitrate ions if eq	ual volumes of 0.1 M Ag	NO ₃ and 0.1 M NaCl are mixed			
	(A) 0.1 M	(B) 0.2 M	(C) 0.05 M	(D) 0.25 M			
3.	4.14 g of pure lead was completely into $(NH_4)_2$ yield of the product is. (Atomic wt. of Pb = 20	dissolved in nitric acid an PbCl _e . However, only 2.2 7)	Id was made to react with 8 g of $(NH_4)_2PbCl_6$ was as	HCl, Cl_2 and NH_4Cl to convert lead ctually produced. The percentage			
	(A) 75	(B) 37.5	(C) 50	(D) 25			
4.	10 ml of KMnO ₄ solution required 20 ml of Na ₂ Na ₂ S ₂ O ₃ solution.	on is mixed with excess $c_{2}O_{3}$ solution for titration.	of KI solution in acidic me If the molarity of KMnO ₄	dium. The iodine hence liberated solution is 0.05, Find molarity of			
	(A) 1	(B) 1.25	(C) 5	(D) 4.5			
5.	When Cr(s) + OH⁻(aq)	\longrightarrow Cr(OH) ₄ ⁻ (aq) + H	$_{2}(g)$ (basic solution) is bal	anced, the sum of the coefficients			
	of all the reactants and	d products is:					
	(A) 14	(B) 15	(C) 17	(D) 9			
6.	Photons emitted when state, whose difference W = 2.3 eV). The max (A) 7.9 eV	n electrons in a H-atom m e in angular momentum is imum possible kinetic en (B) 0.25 eV	hake transition from a hig s h/π , are made to incider ergy of emitted photoeled (C) 10.45 eV	ther energy state to lower energy at on sodium metal (work function, strons is : (D) 9.79 eV			
7.	At 57°C, gaseous dinitrogen tetraoxide is 50% dissociated. Calculate the standard free energy change per mole of N_2O_4 (g) at this temperature and at 1 atm. R = 8.3 JK ⁻¹ mol ⁻¹ , In 10 = 2.3, log 2 = 0.3, log 3 = 0.48						
8	Calculate the nH of a 0	1 M K PO solution The	third dissociation constan	t of phosphoric acid is 10^{-12}			
0.	Given (0.41) ^{1/2}	$^{2} = 0.64$; log 3 = 0.48					
	(A) 12.5	(B) 12.44	(C) 12.25	(D) 12			
9.	Find the pH of a solution $(K_{h} \text{ of } CN^{-} = 5 \times 10^{-5}).$	on after 20 ml of 0.2 M Na (log 2 = 0.3)	aOH is added to 80 ml of	0.15 M HCN.			
	(A) 9	(B) 9.4	(C) 9.7	(D) 10			
_							

Resonance Educating for better tomorrow

The solubility of $Fe(OH)_3$ in a buffer solution of pH = 4 is 4.32×10^{-2} mol/L. How many times is this solubility 10.

greater than its solubility in pure water. (Ignore the hydrolysis of Fe³⁺ ions) Given: $4.32/\sqrt{0.4} = 6.83$

(A) 10¹¹ (B) 6.83 x 10⁶ (C) 2.16 x 10⁹ (D) none of these

- 11. A solution contains 0.01 M Zn²⁺ and Cu²⁺ ions. It is saturated by passing H₂S gas in the solution. The solubility products of ZnS and CuS are 3.0 × 10⁻²² and 8.0 × 10⁻³⁶ respectively. Which of the following is true? $K_1 = 10^{-7}, K_2 = 10^{-14}, [H_2S, aq]_{saturated} = 0.1M$
 - (A) ZnS will precipitate (B) CuS will precipitate (C) Both ZnS and CuS will precipitate (D) Both Zn²⁺ and Cu²⁺ will remain in the solution.
- 12. In the electrolysis of brine (NaCl) using mercury cathode, the mass of amalgam (NaHg) produced is 6.69 g. Find the time for which 9.65 A current is passed. (A) 300 sec (B) 600 sec (C) 100 sec (D) 400 sec
- Which of the following expressions correctly represents the equivalent conductance at infinite dilution of 13. $Al_2(SO_4)_3$. Given that $\mathring{\Lambda}_{Al^{3+}}$ and $\mathring{\Lambda}_{SO_4^{2-}}$ are the equivalent conductances at infinite dilution of the respective ions?
 - (A) $2 \mathring{\Lambda}_{Al^{3+}} + 3 \mathring{\Lambda}_{SO^{2-}}$ (B) $\mathring{\Lambda}_{Al^{3+}} + \mathring{\Lambda}_{SO^{2-}}$ (D) $\frac{1}{3} \mathring{\Lambda}_{A|^{3+}} + \frac{1}{2} \mathring{\Lambda}_{SO_4^{4-}}$ (C) $(\mathring{\Lambda}_{Al^{3+}} + 3\mathring{\Lambda}_{SO_4^{2-}}) \times 6$
- 14. Time after which one millimole of potassium metal is deposited by the passage of 9.65 ampere through aqueous solution of potassium ions is (D) infinite
 - (A) 30 s (B) 10 s (C) 30,000 s
- 15. In the closest packing of atoms,
 - (A) The size of tetrahedral void is greater than that of octahedral void
 - (B) The size of tetrahedral void is smaller than that of octahedral void
 - (C) The size of tetrahedral void is equal to that octahedral void
 - (D) The size of tetrahedral void may be greater or smaller or equal to that octahedral void depending upon the size of atoms.
- The olivine series of minerals consists of crystal in which Fe²⁺ and Mg²⁺ ions may substitute for each-other 16. causing substitutional impurity defect without changing the volume of the unit cell. In olivine series of

mineral, oxide ion exist as fcc with Si⁴⁺ occupying $\frac{1}{4}$ th of octahedral void and divalent ion occupying $\frac{1}{4}$ th of

tetrahedral void. The density of forsterite (Magnesium silicate) is 3.21 g/cc and that of fayalite (Ferrous silicate) is 4.34 g/cc. If density of olivine is 3.88 g/cc, then which of the following statement is INCORRECT. (A) Forsterite = Mg_2SiO_4 ; Fayalite = Fe_2SiO_4

(B) An olivine contains 40.71% Forsterite and 59.29% Fayalite

- (C) Forsterite Mg₂SiO₄ with 59.29% percentage
- (D) (A) & (B)
- 17. Which of the following planes of FCC are identical?





18. Which of the following has been named correctly? (A) $S_2O_3^{2-}$ thiosulphite ion (B) N₂-nitride ion (C) HAsO₃⁻² monohydrogenarsenite ion (D) H₂PO₄⁻ dihydrogenphosphite ion 19. Which of the following is not an ambidentate ligand? (A) CN-(B) SCN-(C) NH₂ (D) NO₂-20. Which of the following is not correctly matched? (A) Sodium (ethylenediaminetetraacetato)chromate(II) - Na₂[Cr(CH₂COO)₄ (en)] (B) Dichloridobis(ethane-1, 2-diamine)cobalt(III) ion - [Co(CI),(en),]+ (C) Tris(bipyridyl)iron(II)ion – [Fe ($NH_{A}C_{5}-C_{5}H_{A}N_{2}$]²⁺ (D) Ammineaquadibromidocopper(II) – [Cu(NH₃)(H₂O)Br₂] 21. Which of the following combination of ions will have highest polarisation : (A) Fe²⁺, Br⁻ (B) Mn+3, I-(C) Ni²⁺, Cl⁻ (D) Fe, Br-22. The calgon process of softening hard water makes use of (A) Sodiumaluminium silicate (B) Sodium hexametaphosphate (C) Calcium hydroxide (D) Washing soda 23. The colour of light absorbed by an aqueous solution of $NiSO_4$ is : (A) orange-red (B) blue-green (C) red-violet (D) yellow 24. Compound 'X' has significant amount of enol 'Y'. 'X' racemises during enolisation. ' X ' can be : CI (A) O = HC - C - CH = O



25. Which of the statement is incorrect about following resonating structures ?



- (A) IInd and IIIrd are resonating structure.
- (B) $I^{\mbox{\tiny st}}$ structure is most stable resonating structure.
- (C) The stability order is $\rm I$ = $\rm II$ > $\rm III$
- (D) The resonance hybrid is more stable then I, II & III
- 26. Which of the following groups exerts significant +M effect as well as -I effect?

(A)
$$-\overset{\oplus}{S}(CH_3)_2$$
 group (B) $-\overset{\oplus}{N}(CH_3)_3$ group (C) $-ONO$ group (D) $-NO_2$ group

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27. Which of the following is not correct for dipole moment ?



28. The most and least stable carbocations among the following are respectively :





32. The rates of decarboxylation (on heating) and dehydration (base catalyzed) are respectively faster in



- (C) C–C π bond breaks
- (D) C–C bond length increases

36. One mole of $V_{\text{NO}_2}^{\text{COCH}_3}$ was treated with NaOH / I₂ and then acidified. The product after acidification has

isolated and then heated with 3 equivalents of NaOH to give a new ionic species. The ionic species formed will be :





37. $\xrightarrow{*}_{D} \xrightarrow{Br_2/h_{U}}$ major product

(Dextrorotatory isomer)

The number (x) of optically active products and number (y) of fractions obtained after distillation of mixture of major products are respectively:

(A) 1, 3 (B) 3, 1 (C) 2, 2 (D) 4, 4

38. Product of given reaction is :





39. The true statement about the given compound is :





(B) It has axis of symmetry(D) It is a meso compound

- 40. The compound of the formula CH₃CO(CH₂)₅CH=CH–COOH would be expected to I : rotate the plane polarised light II : contain chiral centre
 III : Contain three stereocentres
 IV : show geometrical isomerism
 (A) only I, II, III correct (B) only II, IV correct (C) I, II, III, IV correct (D) only IV correct
- 41. The number of fractions on fractional distillation of the mixture of all stereoisomer of the following compound?

42. The most polar form of 1-Nitropropane is :



43. What is not true about the following compoud?

H Me H Et Cis-(1R,3S)-di-sec-butylcyclobutane

- (A) It has a centre of symmetry (inversion centre)
- (B) It has a plane of symmetry.
- (C) It does not have two fold axis (C_2) of symmetry.
- (D) It is an achiral molecule.

44. The most stable form of meso HOOC–CH–CH–COOH in strong basic medium is :

- (A) Anti form(B) Gauche form(C) Fully eclipsed from(D) Partially eclipsed form
- **45.** The incorrect statement about the following reaction is :



- (A) The product mixture is optically active.
- (B) Two optically active products are formed.
- (C) All components of product mixture have different melting point.
- (D) The products have mirror image nonsuperimposable relationship.

SECTION – 2 : (One or more options correct Type)

This section contains 41 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE** or **MORE** are correct.

- 46. 100 ppm (w/w) of He (by mass) is present in an Ar sample at 0°C, in a rigid 22.4 L vessel. Which of the following units remain unchanged as the temperature is raised to 100°C?
 (A) ppm (w/w)
 (B) mole fraction
 (C) molality
 (D) grams per litre
- 47. 10 ml of a sample of H_2O_2 solution liberates 112 ml of O_2 gas at STP upon decomposition. Identify the correct statement(s) :
 - (A) Normality of the above sample of H_2O_2 is 0.5 N
 - (B) 15 ml of the same sample of H_2O_2 solution liberates 224 ml of O_2 gas at 1.5 atm and 273°C

(C) Milliequivalents of hypo required for the titration of liberated I_2 when 10 ml of the same sample of H_2O_2 solution is treated with excess of acidified solution of KI are 20

(D) % (w/v) of given sample of $\rm H_2O_2$ is 3.4 %.

- **48.** Identify the wrong statement (s) :
 - (A) Van der Waal's equation is applicable to liquid state as well.
 - (B) Van der Waal's equation is best applied to vapor-liquid equilibrium zone for a given substance.
 - (C) Van der Waal's constant b is always independent of temperature.
 - (D) Third virial coefficient C is always independent of temperature.
- **49.** According to Maxwell's distribution of molecular speeds, for the below graph drawn for two different samples of gases A and B at temperature T_1 and T_2 respectively, which of the following statements is/are INCORRECT :



- (A) If $T_1 = T_2$, then molecular mass of gas $B(M_B)$ is greater than molecular mass of gas $A(M_A)$.
- (B) If molecular mass of gas A(M_A) is equal to molecular mass of gas B(M_B), then $T_1 > T_2$.
- (C) If $T_1 < T_2$, then molecular mass of gas $B(M_B)$ is necessarily less than molecular mass of gas $A(M_A)$.
- (D) If gas A is O_2 and gas B is N_2 , then considering them to be ideal gases, T_1 is necessarily less than T_2 .
- 50. The P–V isotherm shown here may be applicable for
 - (A) a real gas
 - (B) vapor liquid equilibrium of a pure substance
 - (C) vapor liquid equilibrium of an ideal mixture of volatile liquids
 - (D) azeotropic liquid mixture



51. A certain mass of gas A is kept in a closed container where it undergoes dimerisation, according to the reaction :

 $2A(g) \longrightarrow A_2(g)$

Assuming temperature to remain constant, it was found that the partial pressure of A_2 gas after time t was one-fifth of the initial pressure in container. Then, select the correct statement(s) :

(A) The ratio of initial total pressure to the total pressure at time t is 3 : 2.

(B)The mole fraction of A_2 in the vessel after time t is 0.2.

(C) The percentage dimerisation of A upto time t is 40%.

(D) If each molecule of gas A weighs 10^{-22} g, then the average molecular mass of the mixture in the container after time t is about 75 amu.

- **52.** The thermal dissociation equilibrium of $NH_4HS(s)$ is studied under different conditions. $NH_4HS(s) \longrightarrow NH_3(g) + H_2S(g)$ For this equilibrium, the correct statement(s) is (are) : (A) K depends on temperature
 - (B) K is independent of the initial amount of NH, HS(s)
 - (C) K is dependent on the pressure of NH, and H_2 S at a given T
 - (D) If pressure of NH₂(g) is increased at equilibrium than pressure of H₂S(g) decreases at given temperature.
- **53.** Select correct statements about solubility of CH_3COOAg in a buffer solution of pH < 7.
 - (A) Solubility of CH₃COOAg increases with decrease in pH
 - (B) Solubility of CH₃COOAg decreases with decrease in pH
 - (C) Solubility of CH_3COOAg in a buffer solution of pH = 5 will be greater than that in pure water
 - (D) Solution of CH₃COOAg in a buffer solution of pH = 6 will be smaller than $\sqrt{K_{sp}}$ where K_{sp} is the solubility

product of CH₃COOAg.

- **54.** To 100 ml of an aqueous solution of $0.1M \text{ CH}_3\text{COOH}$ (Ka = 2 × 10⁻⁵), 0.01 mol of HCl(g) is passed. Select correct options regarding the resulting solution.
 - (A) Degree of dissociation of acetic acid in resulting solution is 10⁻⁴
 - (B) pH of resulting solution is nearly 1
 - (C) Degree of dissociation of water in resulting solution is 1.8×10^{-15}
 - (D) Concentration of OH⁻ ions contributed by water is resulting solution is 10^{-7} M.
- 55. The standard reduction potential data at 25°C is given below.

 $\begin{array}{l} \mathsf{E}^{\circ} \; (\mathsf{F} e^{3+}.\mathsf{F} e^{2+}) \; = \; + \; 0.77 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{F} e^{2+}.\mathsf{F} e) \; = \; - \; 0.44 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{C} u^{2+}.\mathsf{C} u) \; = \; + \; 0.34 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{C} u^{+}.\mathsf{C} u) \; = \; + \; 0.52 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{O}_{2}(\mathsf{g}) \; + \; 4\mathsf{H}^{+} \; + \; 4\mathsf{e}^{-} \; \rightarrow \; 2\mathsf{H}_{2}\mathsf{O}) \; = \; + \; 1.23 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{O}_{2}(\mathsf{g}) \; + \; 2\mathsf{H}_{2}\mathsf{O} \; + \; 4\mathsf{e}^{-} \; \rightarrow \; 2\mathsf{H}_{2}\mathsf{O}) \; = \; + \; 1.23 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{O}_{2}(\mathsf{g}) \; + \; 2\mathsf{H}_{2}\mathsf{O} \; + \; 4\mathsf{e}^{-} \; \rightarrow \; 4\mathsf{O}\mathsf{H}^{-}) \; = \; + \; 0.40 \; \mathsf{V} \\ \mathsf{E}^{\circ} \; (\mathsf{C}\mathsf{r}^{3+}.\mathsf{C}\mathsf{r}) \; = \; - \; 0.74 \; \mathsf{V} \; ; \\ \mathsf{E}^{\circ} \; (\mathsf{C}\mathsf{r}^{2+}.\mathsf{C}\mathsf{r}) \; = \; - \; 0.91 \; \mathsf{V} \end{array}$

Which of the following statements is/are correct on the basis of above data :

(A) O_2 is a better oxidising agent in acidic medium.

- (B) Cr²⁺ show disproportionation to Cr and Cr³⁺ in water.
- (C) O_2 oxidises Fe^{2+} to Fe^{3+} in acidic medium.
- (D) Cu^+ oxidises Fe to Fe²⁺ and H₂O to O₂ in acidic medium.
- **56.** CCl₄ and acetone form a non-ideal solution at room temperature in a copper container. For this process, the true statement(s) is (are) :
- **57.** Which of the following is/are correct statement(s).

(A) Pure substance freezes at fixed pressure and temperature until all the liquid has frozen, Where as for a dilute solution the freezing points keeps dropping.

- (B) Boiling point of a pure liquid is always constant and is independent of pressure.
- (C) The correct order of decreasing osmotic pressure of aqueous solution is
 - $0.1 \text{ M NaCl} > 0.1 \text{ M CH}_{3} \text{COOH} > 0.1 \text{ M urea}.$

(D) The higher the molecular weight of the non electrolyte solute, the smaller the freezing point depression produced by one gram of that solute in 1000 g of solvent.

- 58. Which of the following is true regarding the following coordination compounds
 - CrCl₃.6NH₃, PtCl₄.4NH₃, Co(NO₂)₃.3KNO₂, PtCl₂.2NH₃
 - (A) $PtCl_2.2NH_3$ shows stereoisomers.
 - (B) PtCl₄.4NH₃ has maximum electrical conductance at infinite dilution.
 - (C) $Co(NO_2)_3$.3KNO₂ is colourless.
 - (D) $CrCl_3.6NH_3$ has the maximum spin only magnetic moment.

Which of the following is/are correct about

Tetraamminedithiocyanato-S-cobalt (III) tris(oxalato) cobaltate (III)?

- (A) Formula of the complex is $[Co(SCN)_{2}(NH_{2})_{1}][Co(ox)_{2}]$
- (B) It is a chelating complex and show linkage isomerism
- (C) It shows optical isomerism

59.

(D) It shows geometrical isomerism

- 60. The compound(s) that exhibit(s) geometrical isomerism or optical isomerism or both is(are): (A) [Ni(en)Br₂] (B) [Pt(en)₂]Cl₄ (C) K₂[NiCl₂Br₂] $(D) [Pt(NH_2)_2(CN)_2]$
- 61. A d-block element forms octahedral complex but its spin magnetic moment remains same either in strong field or in weak field ligand. Which of the following is /are correct?
 - (A) Element always forms colourless compound.
 - (B) Number of electrons in t_{2a} orbitals are higher than in e_a orbitals.
 - (C) It can have either d³ or d⁸ configuration.
 - (D) It can have either d⁷ or d⁸ configuration.
- 62. In the crystal field of the complex $[Fe(CI) (CN)_4(O_2)]^{4-}$ the electronic configuration of metal is found to be
 - $t^{6}_{2\mathfrak{q}}, e^{0}_{\mathfrak{q}}$ then which of the following is true about this complex ion :
 - (A) It is a paramagnetic complex
 - (B) O–O bond length will be less than found in O₂ molecule
 - (C) Its IUPAC name will be chlorotetracyanosuperoxidoferrate (II) ion
 - (D) It is a diamagnetic complex
- 63. Select the correct statement(s) about the compound NO[BF₄]: (A) It has 5σ and 2π bond (B) Nitrogen-oxygen bond length is higher than in nitric oxide (NO) (C) It is a diamagnetic species (D) B—F bond length in this compound is lower than in BF₃
- 64. At least one element in its highest possible oxidation state is present in which of the following ? (D) XeF₆ $(A) ClO_3^{-1}$ (B) HNO (C) F₂
- 65. Which of the following can produce B_2O_3 ? (A) Heating borax with conc. H₂SO₄ (C) Combustion of diborane, B_2H_4 .
- (B) Passing CO₂ through aq. NaBO₂ (D) Warming H₂BO₂ crystals till red hot.

- 66. CO₂ can be liberated by :
 - (A) adding [O] to NaHCO₃
 - (C) Passing CO over red hot carbon
- (D) burning diamond in air.
- 67. Which of the following statements are true?
 - (A) CIO₂ in alkaline solution undergoes disproportionation.
 - (B) Ionisation enthalpy of molecular oxygen is very close to that of xenon.
 - (C) Hydrolysis of XeF₆ may involve a redox reaction.
 - (D) Both P_4O_6 and P_4O_{10} contain 12 P–O bonds
- Pyrolusite is MnO_2 used to prepare $KMnO_4$. Steps are, $MnO_2 \xrightarrow{I} MnO_4^{2-} \xrightarrow{II} MnO_4^{--}$. 68. Steps I and II are respectively :
 - (A) fuse with KOH / air and electrolytic oxidation.
 - (B) fuse with KOH / KNO3 and electrolytic oxidation.
 - (C) fuse with conc. HNO₃ / air and electrolytic reduction.
 - (D) dissolve in H₂O and oxidation.







- 69. A salt (X) is heated in a dry test tube. Reddish brown fumes (Y) are evolved which turn potassium dichromate paper green and starch iodide paper blue (Y) is found to be paramagnetic. Then :
 (A) X may be KNO₃
 (B) X may be ZnBr₂
 (C) X may be Mg(NO₃)₂
 (D) Y turns red litmus blue
- 70. Which of the following molecules have been correctly named as per IUPAC nomenclature ?





3-Cyanophenyl ethanoate



Benzenecarboxylic 3-carbamoylbenzencarboxylic anhydride



1-(3-carbamoylphenyl) pentane-1,3-dione

71. The correct statement(s) concerning the structures P,Q,R & S is/are :



- (A) Q & S are tautomers.
- (B) R & S are resonating structures.
- (C) P & R are tautomers.
- (D) P & Q are resonating structures.





[Basic strength]



[Acidic strength]



[Basic strength]



- 73. Which of the following is / are correctly mathced
 - (A) Teflon Vinyl fluoride
 - (B) Natural rubber chloroprene
 - (C) Bakelite Phenol + Formaldehyde
 - (D) Nylon-6,6 Adipic acid + hexamethylene diamine
- 74. In which of the following reactions correct major product has been mentioned?





The correct statements about (I) and (II) are : (A) The acid catalysed hydrolysis of (I) and (II) yields one product identical.

(B) For Wolff Kishner reduction (I) is the better reactant.

- (C) (II) gives positive haloform reaction.
- (D) Reduction by LiAlH_4 forms a diol in both the cases.
- 76. Consider the following sequence of reaction.



The compound X can be :



- Compound (X) C₄H₆O decolourises Baeyer's reagent. It undergoes hydrolysis on reaction with dil. H₂SO₄ and produces (Y) and (Z). Both (Y) and (Z) give lodoform test positive. Only (Y) gives Tollen's test positive. Choose the correct statements.
 - (A) (Y) <u>aq. NaOH(10%)</u> Δ CH_3 -CH=CH-CHO
 - (B) (Z) Pyridinium chlorochromate (PCC) (Y)

(C) (X)
$$\begin{array}{c} CH_2 - CH - O - CH_2 - CH_3 \\ H_2/CCI_4 & | & | \\ Br & Br \end{array}$$

- (D) (X) $\xrightarrow{(i) O_3}$ (Y) + other product
- 78. Which of the following reactions involve a carbocation intermediate ?



79. In which of the following reactions D-exchange will take place ?



80.

Which statement(s) is/are correct :

(A) Reduced product of P and Q will be metamers to each other.

(B) By dry distillation of hydrolysed products of P with Ca(OH),, gives benzophenone.

(C) Hydrolysed product of Q, reacts with NaNO₂ + HCl followed by reaction with phenol, gives orange red dve.

(D) Electrophile involved in the formation of Q is dichlorocarbene.

81. Primary (1°) amine group is formed in :



- 82. Which isomers are not separable from their mixture by any physical method of separation ? (A) Enantiomers (B) Conformational isomers
 - (C) Geometrical isomers

- (D) Functional isomers
- 83. The correct statement(s) about the compound $H_2C(HO)HC-CH=CH-CH(OH)CH_2(X)$ is(are):
 - (A) The total number of stereoisomers possible for X is 6.
 - (B) The total number of meso isomers possible for X is 2.
 - (C) The number of fractions on fractional distillation of all stereoisomeric mixture of X is 4.
 - (D) If the stereochemistry about the double bond in X is cis, the number of enantiomers possible for X is 2.
- 84. Which statement is incorrect about the following structures :



- (A) II has steric strain zero. (B) I has angle strain. (C) I has zero torsional strain.
- (D) II has maximum van der waal strain between two vicinal hydrogen atoms at $C_2 C_3$ or $C_5 C_6$.

85. Consider the ozonolysis of trans-4, 5-dimethyl cyclohexene having the configuration given below.



Which product(s) possible is/are formed in the above reaction ?



86. Which of the following is/are biomolecular Nucleophilic substitution?



SECTION - 3 (True & False Statement Type)

This Section Contains 5 questions. Each questions contains 4 statements S_1 , S_2 , $S_3 \& S_4$. Each statement is either true (T) or false (F). Each questions has 4 choices (A), (B), (C) and (D) each of which contains whether S_1 , S_2 , $S_3 \& S_4$ are true or false. Exactly one choice contains the correct order of truthness or falseness of S_1 , S_2 , $S_3 \& S_4$ respectively and is the correct choice.

S₁: The IUPAC name of the compound [Cr(NH₃)₅(NCS)] [ZnCl₄] is pentaamminethiocyanato-N-chromate(III) 87. tetrachlorozincate (II). \mathbf{S}_2 : Mohr's salt FeSO₄.(NH₄)₂SO₄.6H₂O is an example of double salt. S_3 : In $[Co(NH_3)_4(NO_2)_2]NO_3$ coordination number of cobalt is 6. \mathbf{S}_{4} : In [Fe(CO)₅] secondary valency of iron is 0. (A) FTTF (B)TTTT (C) FTTF (D)TTTF 88. S₁: There are only 12 bonding electrons available in one molecule of diborane. S_2 : $B_3N_3H_6$ is an electron deficient compound **S**₃: Al₂Cl₆ sublimes on heating **S**₄: In $(Si_2O_5)_n^{2n-}$ anion, three oxygen of a SiO₄⁴⁻ tetrahedran are shared with another SiO₄⁴⁻ tetrahedron. (A) FFFF (B) TTTT (C) TTFF (D) TFTT S_1 : Hybridisation of nitrogen atom is sp² in pyrrole. 89. S₂: Positive charge in anilinium ion is not delocalised. S_3 : Buta-1,3-diene has all equivalent resonating structure. S₄: Carbonate dianion has all carbon oxygen bond lengths equivalent. (A) TFFT (B) T T F F (C) T F T F (D) TTFT

90.	 90. S₁: Chiral molecules are never superimposable over their mirror image. S₂: Diastereomers have different physical properties. S₃: A meso compound is always superimposable over its mirror image. 									
	S_{4} : Enantiomers have same physical properties.									
	(A) T T T F	(В) ТТТТ	(C) FTTF	(D) F F T F						
91.	S ₁ : The chair forr	\mathbf{S}_1 : The chair form of cyclohexane has no angle strain.								
	S_2 : The boat form of cyclohexane has maximum torsional strain.									
	S ₃ : The twist boa	S ₃ : The twist boat form of cyclohexane is chiral.								
	$\mathbf{S}_{\mathbf{A}}$: Half chair form of cyclohexane is least stable conformation.									
	(A) T T T F	(B) T T T T	(C) F T T F	(D) F F T F						

SECTION - 4 : (Paragraph Type)

This section contains 14 **paragraphs** each describing theory, experiment, data etc. **Eighteen questions** relate to two paragraphs with **one or two or three questions** on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph for Question Nos. 92

Colligative properties i.e., the properties of solution which depend upon the number of particles present in solution are osmotic pressure, depression in freezing point, elevation in boiling point and lowering in vapour pressure. Experimental values of colligative properties for electrolytes are always higher than those obtained theoretically because electrolytes dissociate to furnish more ions in solution. On the other hand experimentally obtained values of colligative properties for associating nature of solute are lower than those obtained theoretically. The ratio of experimental colligative properties to theoretical colligative properties is called as vant Hoff factor (i).

92. For 1 M solution of HA, the dissociation constant K_a in terms of vant Hoff factor (i) can be written as (where

$$K_a = \frac{C\alpha^2}{1-\alpha}$$
 , $C \rightarrow$ concentration) :

(A) $\frac{(i-1)^2}{i}$ (B) $\frac{(i+1)^2}{i}$ (C) $\frac{i}{(i-1)^2}$ (D) $\frac{(i-1)^2}{(2-i)}$

Paragraph for Question Nos. 93

Consider the given plots for four gases at 300 K :



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93. If the slope of line B is –0.10 Lmol⁻¹, what is the relationship between vander Waal's constants 'a' and 'b'? (Ignore the higher terms of Virial equation)

(A)
$$a = \left(b + \frac{1}{10}\right) \frac{1}{24.6} \text{ atm } L^2 \text{ mol}^{-2}$$
 (B) $b = \left(a - \frac{1}{10}\right) \times 24.6 \text{ L mol}^{-1}$
(C) $a = \left(b + \frac{1}{10}\right) \times 24.6 \text{ atm } L^2 \text{ mol}^{-2}$ (D) $b = \left(a + \frac{1}{10}\right) \times 24.6 \text{ L mol}^{-1}$

Paragraph for Question Nos. 94

Dehydration of salts is an important class of heterogenous reaction. The salt hydrates often dissociate in steps to form a number of intermediate hydrates according to the prevailing pressure of moisture in contact with the solid hydrates. Thus copper sulphate pentahydrate on dissociation yields trihydrates, monohydrates and then the anhydrous salts in the above order as follows.



94. The ratio of equilibrium constant between pentahydrate and trihydrate and equilbrium between trihydrate and monohydrate is :

(A) 1.9 (B) 2.9 (C) 8.6 (D) 5.6

Paragraph for Question Nos. 95

The cell potential for the unbalanced chemical reaction :

 $Hg_2^{2+} + NO_3^{-} + H_3O^+ \longrightarrow Hg^{2+} + HNO_2 + H_2O$ under standard state conditions is $E_{cell}^o = 0.02 V$

Given : $NO_3^- + 3H_3O^+ + 2e^- \longrightarrow HNO_2^- + 4H_2O$, $E^\circ = 0.94 V$ and $\frac{2.303RT}{F} = 0.06$.

95. At what pH will the cell potential be zero if the concentration of other components are equal to one ?

(A)
$$\frac{1}{6}$$
 (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) $\frac{2}{9}$

Paragraph for Question Nos. 96

Addition of a non-volatile solute to a solvent lowers its vapour pressure. Therefore, the vapour pressure of a solution (i.e., V.P. of solvent in a solution) is lower than that of pure solvent, at the same temperature. A higher temperature is needed to raise the vapour pressure upto one atmosphere pressure, when boiling point is attained. However, increase in b.pt. is small. For example, 0.1 molal aqueous sucrose solution boils at 100.05° C. Sea water, an aqueous solution, which is rich in Na⁺ and Cl⁻ ions, freezes about 1° C lower than frozen water. Temperature at which vapour pressure of solid becomes equal to vapour pressure of liquid is called freezing point of liquid or melting point of solid.

96. When 250 mg of eugenol is added to 100 g of camphor ($k_f = 39.7 \text{ K}$ molality⁻¹), it lowered the freezing point by 0.62° C. The molar mass of eugenol which an nonelectrolyte is : (A) 1.6 × 10² g/mol (B) 1.6 × 10⁴ g/mol (C) 1.6 × 10³ g/mol (D) 200 g/mol

Paragraph for Question Nos. 97

Complex compounds are molecular compounds which retain their identities even when dissolved in water. They do not give all the simple ions in solution but instead furnish complex ions. The complex compounds are often called coordination compounds because certain groups called ligands are attached to the central metal ion by coordinate or dative bonds. Coordination compounds exhibit isomerism, both structural and stereoisomerism. The structure, magnetic property, colour and electrical properties of complexes are explained by various theories.

97. In which of the following pairs, both complexes have the same geometry?

(A) $[NiCl_4]^{2-}$, $[Ni(CN)_4]^{2-}$ (C) $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$ (B) $[Cu(NH_3)_4]^{2+}$, $[AuCl_4]^-$ (D) $[Cu(NH_3)_4]^+$, $[Ni(NH_3)_4]^{2+}$

Paragraph for Question Nos. 98

Curcumin (pronounced "Kur kyoo min") is the principal curcuminoid of the popular Indian spice turmeric, which is a member of the ginger family (Zingiberaceae). The curcuminoids are natural phenols that are responsible for the yellow color of turmeric. Curcumin is bright yellow colored and may be used as a food coloring.

Curcumin can exist in several tautomeric forms, including a 1,3-diketo form and two equivalent enol forms. The enol form is more energetically stable in the solid phase and in solution.



98. Curcumin can be used for boron quantification in the curcumin method. It reacts with boric acid to form a redcolored compound, rosocyanine.



The entire skeleton of curcumin is in resonance with the 1,3-dicarbonyl section, making the backbone an extended cojugated system. Investigations of the structure have shown that the positive charge is distributed used throughout the molecule. In rosocyanine, the two curcumin groups are :

- (A) coplanar
- (B) perpendicular relative to one another
- (C) free to rotate about tetracoordinate boron
- (D) at an angle of 109.5 degrees to each other, approximately

Paragraph for Question Nos. 99

Observe the following sequence of reaction and answer the related questions.



99.The product P will shows positive test with :
(A) Tollen's reagent(B) I2/NaOH(C) 2,4.D.N.P(D) All A, B & C

Paragraph for Questions 100

Observe the given compound.



100. This compound is a :

(A) Tripeptide

101.

(B) Tetrapeptide (C) A single α -amino acid

(D) Pentapeptide

Paragraph for Questions 101



Paragraph for Question Nos. 102

An unsaturated compound X ($C_5H_{10}O$) exists as four stereoisomers. Y, (structural isomer of X) is neither unsaturated nor shows any stereoisomerism. X and Y have same functional group. The third isomer (Z) is a positional isomer of X, and has only two stereoisomers.

102. The compound Z cannot be ?
(A)
$$CH_2 = CH - CH - CH_2 CH_3$$

(B) $H_2C = CH - CH_2 - CH - CH_3$
OH
(C) $CH_3 - CH = CH - CH_2 - CH_2 - OH$
(D) $H_2C = C - CH - CH_3$
OH

Paragraph for Question Nos. 103 to 104

Concentration of a solution can be represented in many ways. Some of the important concentration terms are as follows :

Molarity of solution = $\frac{\text{number of moles}}{\text{volume of solution in litre}}$

Let a solution is prepared by dissolving w gm of solute of mol.wt. M in V ml water.

$$\therefore$$
 Number of moles of solute dissolved = $\frac{W}{M}$

molality = $\frac{\text{number of moles of solute}}{\text{mass of solvent in gram}} \times 1000$

% w/v = $\frac{\text{mass of solute in gm}}{\text{mass of solution in ml}} \times 100$

103. Equal volume of 1M NaOH, 10% w/v NaOH and 1m NaOH (d = 1.2 g/ml) are mixed then what will be M of final solution. (All aqueous)

(A) $\frac{121}{78}$	(B) $\frac{310}{617}$	(C) $\frac{39}{17}$	(D) None of these
× / 78	× 7 617	`´ 1 <i>1</i>	

104.120 gm of 1 M aqueous NaOH solution (d = 1.2 g/ml) is mixed with x ml of 9.8% w/v H $_2$ SO $_4$ solution. pH of
resulting solution is 13 then value of x will be :
(A) 50.92(B) 75.27(C) 15.75(D) 42.85

Paragraph for Question Nos. 105 to 106

6 gm of magnesium (Mg) is burnt with insufficient amount of oxygen. The residue is treated with 100 ml of H_2SO_4 solution (30% by mass, 1.4 gm/ml density), resulting in an evolution of 3.36 litre of H_2 gas at STP. After the reaction, density of H_2SO_4 solution is found to be 1.25 gm/ml. Assume no change in volume of H_2SO_4 solution.

105.	Percentage w/w of final H_2SO_4 solution is :								
	(A) 15	(B) 18	(C) 14	(D) 9					
106.	Mass of oxygen used is :								
	(A) 3.2 g	(B) 1.2 g	(C) 2.4 g	(D) 1.6 g					

Paragraph for Question Nos. 107 to 109

An aromatic compound $P(C_8H_7OD)$ looses optical activity in $\overset{\Theta}{O}H/H_2O$ (very dilute solution) At equilibrium the product mixture is resolvable. When P is kept in $\overset{\Theta}{O}D/D_2O$ then also it looses optical activity but the product (R) is non resolvable. 'Q' another isomer of P forms terephthalic acid (benzene–1,4–dicarboxylic acid) on KMnO₄ oxidation.

107. The compound 'P' is :





SECTION - 5 Matrix - Match Type

This section contains 5 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column-I** are labelled A, B, C and D, while the statements in **Column-II** are labelled p, q, r, s and t. Any given statement in **Column-I** can have correct matching with **ONE OR MORE** statement(s) in **Column-II**. The appropriate bubbles corresponding to the answers to these questions have to be drakened as illustrated in the following example. If the correct matches are A-p, s and t ; B-q and r; C-p and q; and D-s and t; then the correct darkening of bubbles will look like the following :



110. Column - I

(A) In a sample of H–atom for $5 \rightarrow 2$ transition sample

- (B) In a sample of He $^{\scriptscriptstyle +}$ ion for 5 \rightarrow 1 transition
- (C) In a sample of H–atom for $7 \rightarrow 3$ transition
- (D) In a sample of He⁺ ion for $7 \rightarrow 4$ transition

Column - II

(p) Maximum 6 spectral lines will be observed from the

(q) A photon of wavelength $\lambda = \frac{36}{5R}$ can be emitted.

(r) A photon of wave number $\overline{v} = \frac{7R}{144}$ can be emitted

(s) When single isolated atom/ion is considered, maximum 4 spectral lines are observed for given transition.

(t) At least one photon is visible.

111. Column – I

(A) $\pi_1 : 0.2$ M KCI, $\pi_2 : 0.2$ M NaCI (B) $\pi_1 : 0.2$ M ZnSO₄, $\pi_2 : 0.1$ M Glucose (C) $\pi_1 : 0.1$ M Sucrose, $\pi_2 : 0.1$ M Urea (D) $\pi_1 : 0.1$ M KCI, $\pi_2 : 0.1$ M Na₂SO₄

Column – II

- (p) π_1 is hypertonic to π_2 .
- (q) π_1 is hypotonic to π_2 .
- (r) π_1 and π_2 are isotonic.
- Across the SPM (semi permeable membrane) no net migration of solvent in these solutions.
- (t) $\pi_1 < \pi_2$

112.	Column-I (A) NO_2 (B) SOF_2 (C) XeF_4 (D) ICI_5		CHEMISTRY Column-II (p) Hydrolysis occurs through redox reaction (q) Hydrolysed products have no hydra acid. (r) All hydrolysed products are acids (s) Hybridisation of central atom remains same in final hydrolysed product (t) One of the hydrolysed product react with glass.				
113.		Column - I Compounds		Column - II Properties of compounds			
	(A)	CH ₃ H INFO CH ₃ Br	(p)	Optically active			
	(B)	Br CH ₃ H	(q)	Plane of symmetry			
	(C)	CH ₃ Br H Br H H	(r)	Centre of symmetry			
	(D)		(s)	Axis of symmetry (Besides C ₁)			
			(t)	Optically inactive			
114.	Colum	I n - I		Column - II Central atom has one lone pair			
	(B)	$[SiF_6]^{-2}$	(P) (q)	Central atom has two lone pair.			
	(C)	BrF ₃	(r)	Central atom is sp ³ d ² hybridised.			
	(D)	[Pl ₄]+	(s) (t)	All possible bond angles are identical. Central atom is sp ² hybridised.			

SECTION – 6 : (Integer value correct Type)

This section contains 52 **questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

115. If the sum of mole fraction of NaOH in its aqueous solution and the mole fraction of H_2O in an another aqueous solution of KOH is equal to one, find the molality of KOH solution if the molality of NaOH solution is 'm'.

Report your answer as 'Y' where Y = (Molality of KOH solution) ÷ (Molality of NaOH solution)

- **116.** Due to partial corrosion of a piece of copper into cuprous sulphide Cu_2S , it gains weight. If the % of total copper that has undergone corrosion is 31.75%, then % gain in weight of piece of copper is :
- **117.** A mercury column of length 10 cm is in the middle of a horizontal tube of length 1 m closed at both ends containing same amount of a gas in both columns. If the tube is placed vertically, the mercury

column will shift through a distance of $\frac{225}{13}$ cm from its initial position. Find the final pressure of gas

in upper column (in cm of Hg) when the tube is placed vertically.

118. For the reaction A $\underbrace{K_{f}}_{K_{h}}$ C, the concentration and time is shown as



Calcualte the value of K_C for the reaction $2C \implies 2A$

- **119.** $[Au(CN)_2]^-$ is a very stable complex under certain conditions and K_f of $[Au(CN)_2]^-$ is 4×10^{28} . $x \times 10^{-y}$ M concentration of cyanide ion is required to maintain the equilibrium at which 99 mol % of the gold is in the form of the cyanide complex then (y x) will be :
- **120.** To 1L solution, which is 0.1 M in AgNO₃ and 0.2 M in CuSO₄, a 1L 0.4 M NaCl solution is added. If the final concentration of Cu⁺ in the solution is $x \times 10^{-y}$ (x and y are natural numbers) then (x + y) is. (K_{sp} (AgCl) = 1.6 × 10⁻¹⁰, K_{sp} (CuCl) = 10⁻⁶)
- **121.** 32 g of hydrated magnesium sulphate $MgSO_4 x H_2O$, when dissolved in 84 g of water, the solution freezes at -4.836 °C. If $K_f = 1.86 \text{ K kg mol}^{-1}$ and $MgSO_4$ is a strong electrolyte, what is the value of x ?



Arrangement -I

Arrangement -II

The difference in height of the mercury column in two arms of U tube manometer in arrangement–I is $h_1 = 660$ mm. In another arrangement–II at same temperature, 222 gm of CaCl₂ is dissolved in 324 gm of water and difference in height of mercury column in two arms is found to be $h_2 = 680$ mm. If the value of degree of dissociation for CaCl₂ in arrangement–II is α then the value of 6.4 α is : [Atmospheric pressure = 1 atm]

123. Vapour pressure of an equimolar mixture of benzene and toluene at a given temperature was found to be 80 mm Hg. If vapour above the liquid phase is condensed in a beaker, vapour pressure of this condensate at the

same temperature was found to be 100 mm Hg. If the pure state vapour pressure of benzene and toluene is respectively x and y. Then determine value of $\frac{x+2y}{50}$:

124. 1.0 gram of a monobasic acid HA in 100 gram H₂O lower the freezing point by 0.155 K. 0.45 gram of same

acid require 15 ml of $\frac{1}{5}$ M KOH solution for complete neutralisation. If the degree of dissociation of acid is α , then value of '20 α ' is : (K, for H₂O = 1.86 K.Kg/mole)

- **125.** How many of the following statements is/are true ?
 - (1) Silica gel absorbs water molecule from moist air.
 - (2) The entropy of gas decreases when it gets adsorbed on charcoal.
 - (3) Heterogeneous catalysts like Ni(s) in the hydrogenation of vegetable oil function by chemisorption.
 - (4) The enthalpy of physisorption is smaller in magnitude than enthalpy of chemisorption.
 - (5) As temperature increase, the extent of physisorption decrease but it can get converted to chemisorption at higher temperature.



Graph A represent chemisorption and graph B represent physisorption.

126. Consider the following cell reaction : $2AgCI(s) + H_2(g) \longrightarrow Ag(s) + 2H^+(aq) + 2CI^-(aq) \quad E^\circ = 0.19 \text{ V.}$ At $[CI^-] = 10^{-3} \text{ M}$ and $P(H_2) = 0.01 \text{ atm}$, find the pH, if the cell potential is 0.43 V at 25°C.

(Take
$$\frac{2.303 \,\text{R} \,(298)}{\text{F}} = 0.06$$
)

- 127. The sum of number of hexagonal and triangular faces that are present in a truncated tetrahedron is :
- **128.** How many type of isomerism is exhibited by the complex $[Co(NH_3)_4 (NO_2)_2]CI$?
- **129.** Coordination number of underlined or mentioned atom is greater than or equal to 4 in how many of the following?
 - (i) Na₂ <u>Si</u>F₆ (ii) Silicon in Silica (iii) Ca<u>Si</u>O₃ (where the silicate unit is cyclic trisilicate) (iv) Silicon (v) [Ag(S₂O₃)₂]³⁻ (vi) <u>SO₃²⁻</u> (vii) H₃<u>P</u>O₃ (viii) N₂O₅ (ix) <u>B</u>₂H₆
- **130.** If for $[FeF_6]^{3-}$ EAN (effective atomic number) is xy then value of x + y is :

- **132.** In how many of the following salts, IUPAC name ends with 'ate'. $KCIO_2$ $Ca(H_2PO_2)_2$, $CaCO_3$ $Na_2S_2O_3$, CaC_2O_4 , KSCN K_3HPO_2 , $Ca_2(PO_4)_2$, Na_2ZnO_2
- **133.**How many of the following contain all or some iron in +2 oxidation state?
(a) FeS_2
(b) Haematite
(c) Magnetite
(e) $Na_2[Fe(CN)_5(NO)]$ (d) Brown ring complex
(f) $Fe[Fe(CN)_6]$
 - (g) K_2 Fe[Fe(CN)₆] (h) Ferrocene ([Fe(C₅H₅)₂]) (i) FeWO₄
- **134.** In how many of the following molecules/ions, the number of electrons in σ molecular orbital (both $\sigma \& \sigma$) are more than or equal to 9. (In ground state)

(a) N ₂	(b) N ₂ ⁺	(c) Be ₂ ⁺	(d) B ₂ ⁻	(e) B ₂	(f) C_2^{2-}
(g) C ₂	(h) H ₂	(i) Li_2^+	(j) O ₂ ⁺	(k) F_2^+	

- **135.** The number of equivalent contributing structures possible for XeO_6^{4-} is m. The bond order of Xe O bond is n. Find (m × n) × 0.2. Round off your answer to the nearest integer.
- **136.** In how many of the following species the central atoms have two lone pairs of electrons ?

XeF ₄	XeF ₅ ⁻	$F_2 SeO_2$
XeF ₃ ⁺	XeOF ₄	$CIOF_{_3}$
ICl ₄ ⁻	SCI ₂	OSF_4

137. Adding H[⊕] to a given anion may significantly change the bond length between existing atoms of the original anion due to change in their bond order. This is observed on addition of H[⊕] to how many of the following anions ?

 ${\sf TeO_6^{\ 6-}}$, ${\sf IO_6^{\ 5-}}$, ${\sf XeO_6^{\ 4-}}$, ${\sf C_2^{\ 2-}}$, ${\sf O_2^{\ 2-}}$, ${\sf N_3^{\ -}}$, ${\sf I_3^{\ -}}$

138. How many of the following species have exactly four equally contributing resonance structures ?

 CIO_{4}^{-} , PO_{4}^{3-} , XeO_{6}^{4-} , oxalate : $| COO^{-}$, CH_{3} - COO^{-} , SF_{4} , N_{3}^{-} , HCO_{3}^{-}

139. How many of the following elements have +3 as their most stable oxidation state in their compounds. Al, TI, Mn, Bi, P, Cr, Cu, Sc, Si

140.	How many of the following produce N ₂ on being heated ?								
	(a) (NH ₄) ₂ SO ₄	(b) NH ₄ NO ₂	(c) NH ₄ NO ₃	(d) Ba(N ₃) ₂					
	(e) NaN ₃	(f) NH ₄ ClO ₄	(g) (NH ₄) ₂ Cr ₂ O ₇	(h) Pb(NO3)2					

- **141.** In a study of the equilibrium, $H_2(g) + I_2(g) = 2HI(g)$ 1 mole of H_2 and 3 moles of I_2 gives x mole of HI. Addition of a further 2 moles of H_2 gave an additional x mole of HI at equilibrium. calculate value of '10x'.
- (i) Ti is purified by Van Arkel method. In it formula of metal iodide vapour formed is TiI_p.
 (ii) Oxidation state of Fe in Fool's gold is q.
 (iii) In the test of Ni²⁺ rosy red ppt. of [Ni(dmg)₂] is formed.
 In it r five membered rings and s six membered. H-bonding having ring are formed.

Value of
$$\left(\frac{p+q+r+s}{2}\right)$$
 is

144. If the number of compounds amongs the following where $d_{x^2-y^2}$ orbitals will not take part in hybridisation is (A). Determine value of (A).

(1)
$$[Pt(NH_{3}Cl(H_{2}O)Br]]$$
(2) SF_{4} (3) $[Cu(NH_{3})_{4}]^{2+}$ (4) $[XeO_{3}F_{2}]$ (5) $[XeO_{2}F_{2}]$ (6) $[Co(en)_{3}]^{3+}$ (7) $[Fe(CO)_{5}]$ (8) $POCl_{3}$ (9) PCl_{5} (10) XeO_{6}^{4-}

145. How many enol form are possible for $CH_3-C-CH_2-CH_2-CH_3$?

146. How many acids (given below) react with $NaHCO_3$ and liberate CO_2 ?

CH₃-CH₂-

CCl₃-COOH





147. How many p-orbitals are parallel to each other in the following conjugated system?



148. How many of the following groups an exert –M effect?



149. $CH_2=CH-CH_2-C\equiv C-CH=CH-C-H$

The maximum number of π -electron pairs in direct conjugation with each other is :

150. The number of deuterium atoms found in the tautomer of I

when it is kept in OD^{Θ}/D_2O for a long

period of time?



151. Number of carbocations which are more stable than $CH = CH - \tilde{CH}_2$ from the following is :



152. How many compounds are more reactive than ethene towards electrophilic addition?

$$\begin{array}{c} & & & \\ & \blacksquare \\ CH_3-CH=CH_2, & H_-C_-CH=CH_2, \\ I & II & III & IV & V \\ Ph_-CH=CH_2, & CH_2=CH_-CH=CH_2 \\ VI & VII \end{array}$$



The sum of total number of moles of PhNHNH, used with A & B _____.

154.	How many of these amino acid are negatively charged at pH = 7.0?								
	Alanine	Lysine	Cysteine	Glumatic acid					
	Glycine	Leucine	Aspartic acid	Arginine					

155. How many compounds are more reactive than benzene towards Nitration?



156. How many aldol products are possible (structural only) when mixture of HCHO, CH₃CHO and

$$H_{II}$$

CH₃-C-CH₃ are reacted in dilute NaOH ?

Et

- **157.** Total number of β -Keto monocarboxylic acids (including stereoisomers) which on heating give \int
- **158.** Rearrangement of carbon skeleton of substrate is possible in which of the following reactions ? EAS (Electrophilic aromatic substitution), electrophilic addition on alkenes, free radical substitution of alkanes, $S_N 1$, $S_N 2$, E1, E2, E1cB, $S_N 2$ Th, $S_N 2$ Ar
- 159. Find the number of products (stereoisomers) formed in the following reaction (consider only major product)?



Find the value of (Z).

- **161.** A mixture of 1° amides (benzenoid) having molecular formula (C₈H₉NO) reacted with Br₂/NaOH. The number of 1° amines products formed will be :
- 162. Number of meso compounds from the following is :



- **163.** The total number of structural isomers which can show geometrical isomerism with molecular formula $C_{3}H_{7}N$ is :
- **164.** In the following sequence of reaction number of Nucleophilic substitution is :



- **165.** A compound(P) with formula $C_4H_6O_2$ has a fruity smell. It produces no color with phenolphthalein. On adding NaOH to (P) and phenolphthalein mixture, a pink color is seen. But this color of phenolphthalein fades away slowly on reaction with (P). Number of possible structural isomers for (P) is:
- **166.** The compound 'X' is composed of carbon, Hydrogen and Oxygen. It has 2 geometrical isomers. It has 4 stereoisomers. All 4 stereoisomers are optically active. If X is the smallest alkenoic acid which satisfies all these conditions then calculate total number of carbon present in compound X.

SECTION – 7 : (Integer value correct Type)

This section contains 23 **questions.** The answer to each question is a **Two digit integer**, ranging from 00 to 99 (both inclusive).

- **167.** A mixture of O_2 and gas "Y" (mol. wt. 80) in the mole ratio a : b has a mean molecular weight 40. What would be mean molecular weight, if the gases are mixed in the ratio b : a under identical conditions ? (gases are non-reacting) :
- **168.** 1 mole of each of the following acids exactly neutralize a maximum of how many moles of NaOH, under required favourable conditions?

 $\mathsf{HCI},\ \mathsf{HNO}_3,\ \mathsf{H}_2\mathsf{SO}_4,\ \mathsf{H}_2\mathsf{SO}_3,\ \mathsf{H}_3\mathsf{PO}_4,\ \mathsf{H}_3\mathsf{PO}_3,\ \mathsf{H}_3\mathsf{PO}_2,\ \mathsf{H}_4\mathsf{P}_2\mathsf{O}_5,\ \mathsf{H}_3\mathsf{BO}_3,\ \mathsf{H}_3\mathsf{P}_3\mathsf{O}_9$

- **169.** 2 moles of a mixture of O_2 and O_3 is reacted with excess of acidified solution of KI. The iodine liberated require 1L of 2M hypo solution for complete reaction. The weight % of O_3 in the initial sample is x. Find x.
- **170.** Consider the following equilibrium in a closed container.

$$PCl_{_{5}}(g) \longrightarrow PCl_{_{3}}(g) + Cl_{_{2}}(g)$$

 PCI_{s} gas at a certain pressure is introduced in the container at 27°C. However, the total pressure at equilibrium at 207°C was found to be double the initial value. The % dissociation of PCI_{s} at 207°C is :

171. A sparingly soluble salt MX is dissolved in water to prepare 1 lit. saturated solution. Now 10^{-6} mol NaX is added into this. Conductivity of this solution is 29×10^{-6} S/m. If K_{sp} of MX is a $\times 10^{-b}$ then find value of (a + b)?

$$\begin{array}{ll} \mbox{Given} & \lambda^0_{x^-} = 4 \times 10^{-3} \mbox{ S } m^2 \mbox{ mol}^- \\ & \lambda^0_{Na^+} = 5 \times 10^{-3} \mbox{ S } m^2 \mbox{ mol}^- \\ & \lambda^0_{M^+} = 6 \times 10^{-3} \mbox{ S } m^2 \mbox{ mol}^- \end{array}$$

172. A solute'S' undergoes a reversible trimerization when dissolved in a certain solvent. The boiling point elevation of its 0.1 molal solution was found to be identical to the boiling point elevation in case of a 0.08 molal solution of a solute which neither undergoes association nor dissociation. To what percent had the solute 'S' undergone trimerization?



- **173.** A complex compound is represented as $CoCl_3.xNH_3$. Its 0.1 M solution in water shows depression in freezing point equal to 0.558K. Assuming 100% ionisation of complex and coordination number of Co to be six, calculate the value of '3x'. K_f for H₂O is 1.86 K kgmol⁻¹.
- **174.** How many next nearest neighbours are present for Zn^{+2} ions in FCC arrangement of ZnS.
- **175.** If for complex $[Cr(H_2O)_6]^{2+}$ CFSE is $(-R\Delta_0)$ calculated from general formula of CFSE than determine value of 100 R.
- 176. How many of the following molecules or ions may act as a multidentate ligand ?

CO ₃ ²⁻	NO_3^-	edta	[N(CH ₂ -COO) ₃] ³⁻
C ₂ O ₄ ²⁻	SO4 ²⁻	$CH_{3}COCHCOCH_{3}^{-}$	gly
CH ₂ C≡N	SCN ⁻	dmg	dipy

- 177. (i) Number of P–P bonds in P₄S₃ is (A).
 (ii) Amongs the following number of planar species is (B). XeF₂, ClF₃, H₂O, [XeF₅]⁻, I₃⁻, BCl₃, XeF₄, SF₄, PCl₅, SF₆, IF₇. Determine the value of (A + B).
- **178.** How many of the following species have been correctly matched with their property (Give your answer by multiplying with two).
 - (i) Cl₂O : bond angle greater than 109°28'.
 - (ii) O_3^{-} : Paramganetic.
 - (iii) $H_2S_2O_8$: Contains a peroxy linkage.
 - (iv) XeF_4 : $d_{x^2-y^2}$ orbitals involved in hybridisation of central atom.
 - (v) N_2H_4 : NN bond length greater than expected.
 - (vi) $P_3O_{10}^{5-}$: 3 different types of P–O bond length are observed.
- 179. How many of the following produce a characteristic coloration/ppt with neutral FeCl₃?



180. How many aromatic diazonium chlorides of xylene can be reduced to meta-xylene by H₃PO₂?



181. Many aromatic compounds can be drawn with molecular formula $C_8H_8O_2$. Find out the no. of aromatic compounds which can be drawn with this molecular formula and which also contains an -O – (ether) linkage.



Total number of organic products formed (major, minor all).

183.
$$\begin{array}{c} \mathsf{CH}_{2} - \mathsf{Br} \\ | \\ \mathsf{CH}_{2} - \mathsf{Br} \end{array} \xrightarrow{\mathsf{CH}_{2}(\mathsf{COOEt})_{2}/\mathsf{OH}^{\Theta}/\Delta} \xrightarrow{\mathsf{OH}^{\Theta}/\Delta} \xrightarrow{\mathsf{ester hydrolysis}} \xrightarrow{\mathsf{-CO}_{2}} \xrightarrow{\mathsf{NaOH/CaO}} \xrightarrow{\mathsf{NaOH/CaO}} (\mathsf{P}) \end{array}$$

Find out the molecular weight of end product (P).

184.
$$\xrightarrow{\text{Cl}_{n_{n_{1}}}} Br \xrightarrow{O_{3}} \xrightarrow{\text{NH}_{2}\text{OH}/H^{\oplus}} \xrightarrow{\text{NH}_{2}\text{OH}/H^{\oplus}}$$

The total number of isomeric products (including stereomers) formed at the end of the reaction is :

- **185.** An aromatic tetracarboxylic acid $(C_{10}H_6O_8)$ can form two type of monoanhydrides on heating with P_2O_5 . The sum of locants of all carboxylic groups in this compound will be :
- **186.** In the following sequence of reactions all stereoisomers of (X) have been taken.

$$\begin{array}{c} \mathsf{CH}_{3} - \mathsf{CH} - \mathsf{CH} = \mathsf{CH} - \mathsf{CH} - \mathsf{CH}_{3} \xrightarrow{(i) \ \mathsf{O}_{3}} (ii) \ \mathsf{Zn}/\mathsf{H}_{2}\mathsf{O} \\ \downarrow & \downarrow \\ \mathsf{D} & \mathsf{D} \\ (X) \end{array}$$
(X)

Here P = Total number of stereoisomers of X Q = Total number of stereoisomers of Y R = Total number of stereoisomers of ZWhat is sum of P, Q and R in the above reaction.

187. Sum of total number of optically active and optical inactive isomers of following compound.



- **188.** The total number of isomers for the alkyne with molecular formula C_3 HDCIBr is :
- **189.** How many position isomers of dibromonaphthalene is possible if each ring of naphthalene has one halogen?

Resonance CRITICAL QUESTION BANK

							VER						
1.	(D)	2.	(C)	3.	(D)	4.	(B)	5.	(B)	6.	(D)	7.	(A)
8.	(B)	9.	(B)	10.	(A)	11.	(B)	12.	(A)	13.	(B)	14.	(B)
15.	(B)	16.	(C)	17.	(C)	18.	(C)	19.	(C)	20.	(A)	21.	(B)
22.	(B)	23.	(C)	24.	(B)	25.	(C)	26.	(C)	27.	(A)	28.	(C)
29.	(D)	30.	(D)	31.	(C)	32.	(D)	33.	(C)	34.	(B)	35.	(C)
36.	(D)	37.	(C)	38.	(B)	39.	(B)	40.	(D)	41.	(D)	42.	(A)
43.	(A)	44.	(A)	45.	(D)	46.	(ABCD)	47.	(BCD)	48.	(BD)	49.	(ABCD)
50.	(ABD)	51.	(CD)	52.	(ABD)	53.	(AC)	54.	(BC)	55.	(AC)	56.	(BCD)
57.	(ACD)	58.	(AD)	59.	(BCD)	60.	(BD)	61.	(BC)	62.	(AC)	63.	(AC)
64.	(BC)	65.	(ACD)	66.	(AD)	67.	(ABCD)	68.	(AB)	69.	(CD)	70.	(ABC)
71.	(BCD)	72.	(AD)	73.	(CD)	74.	(ACD)	75.	(AB)	76.	(ABC)	77.	(ABC)
78.	(ABD)	79.	(ABD)	80.	(BCD)	81.	(ABD)	82.	(AB)	83.	(ABCD)	84.	(ABD)
85.	(ACD)	86.	(ABCD)	87.	(C)	88.	(D)	89.	(D)	90.	(B)	91.	(B)
92.	(D)	93.	(C)	94.	(A)	95.	(D)	96.	(A)	97.	(B)	98.	(B)
99.	(D)	100.	(B)	101.	(B)	102.	(D)	103.	(A)	104.	(D)	105.	(C)
106.	(D)	107.	(B)	108.	(D)	109.	(C)						
110.	(A–p, q, r	, t), (B	8–s, t), (C–r,	s), (E	D—p, q, t)	111.	(A– r , s),	(B –	p); (C – r,	s) ; (D	– q, t)		
112.	(A – p, q,	r, s),	(B – r, s, t),	(C –	p, t), (D -	- r, t)	113.	(A –	p,s), (B – q,	r, t), ((C – p,s), (D – p	s)
114.	(A−p),	(B <i>—</i> r), (C–q), (D-	-s)									
115.	(1)	116.	(8)	117.	(8)	118.	(4)	119.	(9)	120.	(6)	121.	(7)
122.	(4)	123.	(4)	124.	(5)	125.	(5)	126.	(2)	127.	(8)	128.	(3)
129.	(6)	130.	(8)	131.	(5)	132.	(6)	133.	(6)	134.	(5)	135.	(4)
136.	(5)	137.	(3)	138.	(3)	139.	(4)	140.	(5)	141.	(15)	142.	(6)
143.	(5)	144.	(6)	145.	(7)	146.	(6)	147.	(7)	148.	(6)	149.	(3)
150.	(3)	151.	(5)	152.	(4)	153.	(4)	154.	(6)	155.	(6)	156.	(6)
157.	(6)	158.	(3)	159.	(1)	160.	(4)	161.	(04)	162.	(5)	163.	(3)
164.	(2)	165.	(6)	166.	(6)	167.	(72)	168.	(18)	169.	(60)	170.	(25)
171.	(18)	172.	(30)	173.	(15)	174.	(12)	175.	(60)	176.	(10)	177.	(10)
178.	10	179.	(05)	180.	(03)	181.	(07)	182.	(06)	183.	(42)		
184.	(04)	185.	(10)	186.	(12)	187	(05)	188.	(08)	189.	(06)		

- A Resonance

八





CRITICAL QUESTION BANK

\mathbf{O}

 $2 = \frac{\text{Mass}}{22} \times \frac{1000}{100}$ 1. 250 63

mass =
$$\frac{63}{2}$$
 gm

mass of acid × $\frac{70}{100} = \frac{63}{2}$ mass of acid = 45 gm

2.
$$[NO_3^-] = \frac{0.1V + 0}{2V} = \frac{0.1}{2} = 0.05 \text{ M}$$

 $NH_4CI \rightarrow (NH_4)PbCI_6$ HNO_3 Pb -3. Cl₂ (4.14 g) (2.28 g) Applying POAC on Pb : $1 \times n_{Pb} = 1 \times n_{(NH_4)_2 PbCl_6}$

$$\Rightarrow 1 \times \frac{4.14}{207} = 1 \times \frac{m(NH_4)_2 PbCl_6 (exp ected)}{456}$$

 \therefore m(NH₄)₂PbCl₆ (expected) = 9.12 g

:. % yield of product =
$$\frac{2.28}{9.12} \times 100 = 25\%$$
.

- $MnO_4^- + H^+ + I^- \longrightarrow I_2 + Mn^{2+}$ 4. $I_2 + \tilde{S}_2 O_3^{2-} \longrightarrow I^- + \tilde{S}_4 O_6^{2-}$ milliequivalents of MnO₄ = 5 × 0.5 × 10 = 25 milliequivalents of I_2 formed = 25 Milliequivalents of $\tilde{S}_2 O_3^{2-}$ = milliequivalents of I_2 . \Rightarrow M × 20 × 1 = 25. \Rightarrow M = 1.25
- 5. $2Cr(s) + 2OH^{-}(aq) + 6H_2O \longrightarrow 2Cr(OH)_4^{-}(aq) + 3H_2(g)$ 2 + 2 + 6 + 2 + 3 = 15
- h Difference in angular momentum = 6.

$$\therefore (n_2 - n_1) \frac{h}{2\pi} = \frac{h}{\pi} \therefore n_2 - n_1 = 2 \text{ (Difference in shell no.)}$$

For photoelectric effect to be observed,

- Energy of photon > Work function (2.3 eV)
- \therefore Two photons are possible in H–atom where difference in shell number is 2 and energy > 2.3 eV \therefore E_{photon} = 12.09 eV (From 3 \rightarrow 1 transition)

& 2.55 eV (From 4 \rightarrow 2 transition)

Max KE of photoelectron will correspond to max energy of incident photon.

∴ (KE)_{max} = 12.09 – 2.3 = 9.79 eV

7. $N_2O_4(g) \implies 2NO_2(g)$ 0 t = 0 1 1 – 0.5 2×0.5 t = eq.

$$P_{N_2O_4} = \frac{0.5}{1.5}$$
 atm $P_{NO_2} = \frac{1}{1.5}$ atm

$$K_{P} = \frac{\left(\frac{1}{1.5}\right)^{2}}{\left(\frac{0.5}{1.5}\right)} = \frac{4}{3}$$

$$\Delta G^{\circ} = -2.3 \times 8.3 \times 330 \times \log\left(\frac{4}{3}\right)$$

 $= -2.3 \times 8.3 \times 330 \times (0.6 - 0.48)$ = - 756 J mol⁻¹

8.
$$K_h = \frac{K_w}{K_{a_3}} = \frac{10^{-14}}{10^{-12}} = 10^{-2}$$

$$K_{h} = \frac{Ch^{2}}{(1-h)}$$

as
$$1 - h = 1$$
, $h = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{10^{-2}}{0.1}} = 0.316$

as $h > 0.1 \implies 1 - h \neq 1$

$$\therefore 10^{-2} = \frac{10^{-1} \times h^2}{(1-h)} \text{ or } 0.1 (1-h) = h^2$$

or, 0.1 - 0.1 h = h²
or, h² + 0.1 h - 0.1 = 0
or, h = $\frac{-0.1 + \sqrt{(0.1)^2 + 4 \times 0.1}}{2} = 0.27$

as, $PO_4^{3-} + H_2O \implies HPO_4^{2-} + OH^$ c(1 – h) ch ch ∴ [OH⁻] = ch = 0.1 × 0.27 = 27 × 10⁻³ $pOH = 3 - \log 27 = 3 - \log 3^3 = 3 - 3 \log 3$ $= 3 - 3 \times 0.48$ = 1.56pH = 14 - 1.56 = 12.44

9.
$$K_{a}(HCN) = \frac{K_{W}}{K_{b}(CN^{-})} = \frac{10^{-14}}{5 \times 10^{-5}} = 2 \times 10^{-10}$$

 $\Rightarrow HCN + NaOH \longrightarrow NaCN + H_{2}O$
Initially $80 \times 0.15 = 20 \times 0.2$
 $= 12 = 4 = 4 = 0 = 0$
final $8 = 0 = 4 = 4$
solution is buffer

$$pH = pK_a + \log \frac{[CN^-]}{[HCN]}$$
$$= 10 - \log 2 + \log \frac{4}{8}$$
$$= 10 - \log 2 + \log \frac{1}{2}$$
$$= 10 - 2 \log 2$$
$$= 10 - 2 \log 2$$
$$= 10 - 2 \times 0.3 = 9.4$$

- **10.** Fe(OH)₃ S' 10⁻¹⁰ S' = 4.32 × 10⁻² mol/L. ∴ K_{sp} = [Fe³⁺] [OH⁻]³ = 4.32 × 10⁻² (10⁻¹⁰)³ = 4.32 x 10⁻³² Let S = solubility in pure water. Now, K_{sp} = [Fe³⁺] [OH⁻]³ 4.32 x 10⁻³² = S × (10⁻⁷)³ ∴ S = 4.32 × 10⁻¹¹ mol/L. Ratio = $\frac{S'}{S} = 10^{11}$
- Only the ionic product of CuS exceeds its K_{sp} and hence, it is 11. precipitated.
- **12.** Na⁺ + e⁻ → Na $Na + Hg \longrightarrow NaHg$ $n_{NaHg} = \frac{6.69}{223} = 0.03$

moles of electron (e^{-}) = 0.03 Charge = 0.03 × 96500 = 9.65 × t. t = 300 sec.

13. At infinite dilution, when dissociation is complete, each ion makes a definite contribution towards molar conductance of the electrolyte irrespective of the nature of the other ion with which it is associated.

Hence
$$\mathring{\Lambda}_{Al_2(SO_4)_3} = \mathring{\Lambda}_{Al^{3+}} + \mathring{\Lambda}_{SO_4^{2-}}$$

14. w = zit

t

$$39 \times 1 \times 10^{-3} = \frac{39}{96500} \times 9.65 \times t$$

t = 10 s.

16. According to given data :

$$O^{2-} = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$$

Si⁴⁺ = $\frac{1}{4} \times \text{octahedral void} = \frac{1}{4} \times 4 = 1$
M⁺⁺ = $\frac{1}{4} \times \text{tetrahedral void} = \frac{1}{4} \times 8 = 2.$
 \therefore Forsterite = Mg₂SiO₄ Fayalite = Fe₂SiO₄
Let the forsterite is x% and fayalite is (100-x) % then

$$\frac{x \times 3.21 + (100 - x) \times 4.34}{122} = 3.88$$

- 19. Ligands which can ligate through either of two different atoms present in it are called ambidentate ligands. Examples of such ligands are the CN-, NO2- and SCN ions. NH3 is not an ambidentate ligand
- 20. Na₂[Cr (EDTA)] is correct representation.
- 21. Due to large charge on cation and big size of anion.
- **22.** $Na_2[Na_4(PO_3)_6] + 2Ca^{2+} \longrightarrow Na_2[Ca_2(PO_3)_6] + 4Na^{+}$ calgon
- 23. NiSO₄ will be absorbing red-violet colour & hence will be of green colour.

24. 1.
$$O = HC - C - CH = O$$
 optically inactive



enol form exists due to carbanion stability.

no significant enol form.

- 25. I, II & III are resonating structures in which I is most stable.
- **31.** The aryl diazonium ion (ArN_2^+) functions as electrophile, so presence of electron withdrawing group (-SO₃H) increases its electrophilicity. Diazocoupling is possible only in strongly activated rings.





Resonance Educating for better tomorrow

CHEMISTRY



Two fractions ≻ Distillation

- 40. It show geometrical isomerism due to double bond.
- 43. It is a meso achiral compound and it is no centre of symmetry and no axis of symmetry but plane of symmetry.
- In strong basic medium $\stackrel{\ominus}{\operatorname{OOC-CH-CH-COO}}$ will be stable 44. . Ме Ме in its anti form to minimise e-repulsion.
- ď 45. d + l ightarrow dd' + ld' (optically active mixture of diastereomers
- **47.** 10 ml of H₂O₂ solution liberates 112 ml O₂ at STP ∴ 1 L of H₂O₂ solution liberates 11.2 L O₂ at STP ∴ volume strength of H₂O₂ solution = 11.2 V

$$\therefore N = \frac{V}{5.6} = \frac{11.2}{5.6} = 2 \qquad \% \text{ w/v} = \frac{N \times 17}{10} = 3.4\%$$

15 ml of same H₂O₂ solution liberates $\frac{15 \times 112}{10}$ ml O₂ at STP

$$= \frac{15 \times 112}{10} \times \frac{2}{3} \times 2 \text{ ml } O_2 \text{ at } 1.5 \text{ atm and } 273^{\circ}\text{C}$$

49. At constant temperature, decrease in molecular mass causes flattening of the graph. For same molecular mass of gas, increase in temperature causes flattening of the graph. $(V_{mp})_{T_1} < (V_{mp})_{T_2}$

$$\frac{T_1}{M_A} < \frac{T_2}{M_B} \qquad \therefore \frac{T_2}{T_4} > \frac{M_B}{M_A}$$

 M_B But, can be less than or greater than 1

Similarly ,
$$\frac{M_A}{M_B} > \frac{T_1}{T_2}$$

51.

If gas A is O_2 and gas B is N_2 , then $M_A > M_B$.

$$2A \longrightarrow A_{2}$$

$$t = 0 \qquad n \qquad 0$$

$$t = t \qquad n-x \qquad x/2$$

$$\therefore P \propto \text{moles} \therefore \frac{P_{i}}{n} = \frac{P_{f}}{n - \frac{x}{2}} \qquad \dots \dots \dots (1)$$

Also, from Dalton's law, $P_{A_2} = X_{A_2} \times P_f \therefore P_{A_2}$

$$= \left(\frac{\frac{x}{2}}{n - \frac{x}{2}}\right) \times P_{f} \quad \dots \dots (2)$$

And, $PA_2 = \frac{1}{5} \times P_i$(3)

From equations (1), (2) and (3),

$$x = \frac{2n}{5} \therefore \frac{P_i}{P_f} = \frac{n}{n - \frac{x}{2}} = \frac{n}{n - \frac{n}{5}} = \frac{5}{4}$$

$$X_{A_2} = \left(\frac{\frac{x}{2}}{n - \frac{x}{2}}\right) = \frac{n/5}{4n/5} = 0.25$$

% dimerisation = $\frac{x}{n} \times 100 = \frac{2n/5}{n} \times 100 = 40\%$ Mol. mass of A = $10^{-22} \times 6 \times 10^{23} = 60$ amu

$$M_{\text{avg.}} = \frac{n_{\text{A}} \times M_{\text{A}} + n_{\text{A}_2} \times M_{\text{A}_2}}{n_{\text{A}} + n_{\text{A}_2}}$$

$$= \frac{\frac{3n}{5} \times 60 + \frac{n}{5} \times 120}{\frac{3n}{5} + \frac{n}{5}} = 75 \text{ amu.}$$

- 52. (A) Equilibrium constant depends on temperature. (B) Equilibrium constant is a constant.
 - (C) P_{NH_3} and P_{H_2S} depend on K.
 - (D) $K = P_{NH_3} \times P_{H_2S}$

so if at equilibrium $P_{\text{NH}_3}\,$ is increased, then automatically

P_{H₂S} will decrease.

CHEMISTRY

me

54. $^{n}CH_{3}COOH = 0.1 \times 0.1 = 0.01 \text{ mol.}$ $^{n}HCl = 0.01 \text{ mol}$

 $[H^*]_f = \frac{0.01}{0.1} = 0.1M$ pH = 1

 $CH_{3}COOH \rightleftharpoons CH_{3}COO^{-} + H^{+}$ 0.1 - x x (x + 0.1)

$$2 \times 10^{-5} = \frac{X \times 0.1}{0.1}$$

x = 2 × 10⁻⁵

C

(C)

$$\alpha \text{ CH}_{3}\text{COOH} = \frac{2 \times 10^{-5}}{0.1} = 2 \times 10^{-4}$$

 $H_2O \implies H^+ + OH^-, 10^{-14} = 0.1 \times [OH^-]$ [OH⁻] = 10⁻¹³ M

$$\alpha (H_2 O) = \frac{10^{-13}}{\frac{1000}{18}}$$
$$= 18 \times 10^{-16} = 1.8 \times 10^{-15}$$

- **55.** (A) As $E^{\circ}_{O_2/H_2O;H^+} > E^{\circ}_{O_2/OH^-}$
 - So, O_2 is better oxidising agent in acidic medium. (B) $3Cr^{2+} \longrightarrow 2Cr^{3+} + Cr$

$$\begin{array}{c} Cr^{3^{+}} \xrightarrow{xV} Cr^{2^{+}} \xrightarrow{-0.91V} Cr \\ \xrightarrow{-0.74V, 3e^{-}} Cr \\ \xrightarrow{-0.74V, 3e^{-}} \\ \Rightarrow x \times 1 + 2(-0.91) = -0.74 \times 3 \\ \Rightarrow x = -2.22 + 1.82 = -0.40 \text{ V.} \\ E^{0}_{\text{cell}} = E^{0}_{\text{Cr}^{2^{+}}/\text{Cr}} - E^{0}_{\text{Cr}^{3^{+}}/\text{Cr}^{2^{+}}} \\ = -0.91 - (-0.40) \\ = -0.51 \text{ V.} \\ \text{As this is negative,} \\ \text{So reaction is non spontaneous.} \\ \text{As SRP of } O_{2} \text{ in acidic medium is more than SRP of Fe}^{3^{+}} \\ \text{So, } O_{2} \text{ oxidises Fe}^{2^{+}} \text{ to Fe}^{3^{+}}. \end{array}$$

(D) As SRP of Cu⁺/Cu is more than SRP of Fe²⁺/Fe, Cu⁺ oxidises Fe. But SRP of Cu⁺/Cu is less than SRP of O_2/H_2O in acidic medium. So Cu⁺ do not oxidise H_2O to O_2 in acidic medium. This does not take place.

- $\begin{array}{lll} \textbf{56.} & \Delta G = \text{ ve}, \ \Delta S_{\text{system}} = + \text{ ve} & \text{Always for solution formation.} \\ & \Delta S_{\text{surr.}} < 0 & \text{Heat absorbed by solution from surrounding.} \\ & \Delta H > 0 & \text{For this solution as } \text{CCl}_4 \text{ is non-polar but} \\ & \text{acetone is polar} \end{array}$
- $\begin{array}{l} \textbf{58.} \quad PtCl_2.2NH_3 \, is \, [Pt(NH_3)_2Cl_2] \\ \quad CrCl_3.6NH_3 \, is \, [Cr(NH_3)_6]Cl_3 \\ \quad PtCl_4.4NH_3 \, is \, [Pt(NH_3)_4Cl_2]Cl_2 \\ \quad Co(NO_2)_3.3KNO_2 \, is \, K_3[Co(NO_2)_6] \end{array}$



(B) $[Pt(en)_3]Cl_4$: en Pt optically active

(C) [NiCl₂Br₂]²⁻ = tetrahedral, no, GI, no optical isomerism

(D) $[Pt(NH_3)_2(CN)_2]$: Pt is in +2 oxidation state having 5d⁸ configuration. Hence the hybridisation of complex is dsp² and geometry is square planar.



62. The given complex is actually

$$\left[\frac{\text{Fe}(\text{CI})}{\frac{1}{2} - 1} (\frac{\text{CN}}{-4}, \frac{1}{-4}) \right]^4$$

hence Fe(II) is t_{2g}^{6} , e_{g}^{0} due to effect of strong ligands but it is paramagnetic due to O_2^{-1} ligand.

63. NO⁺ [BF₄]⁻

$$\begin{bmatrix} F \\ B \\ F \end{bmatrix}$$
 No. of σ bonds in $[BF_4]^- = 4$

B.O. of NO⁺ = 3.0, i.e., one sigma bond and two π bonds \therefore No. of π bonds = 2

No. of
$$\sigma$$
 bond = 5
B.O. of NO⁺ = 3.0

and B.O. of NO = 2.5

 \Rightarrow NO⁺ is diamagnetic and BF₄⁻ is also diamagnetic

B—F bonds are longer in BF_4^- than in BF_3 due to absence

of $p\pi$ - $p\pi$ back bonding in [BF₄⁻].

67. CIO₂ is powerful oxidising agent, also strong chlorinating agent. Its bleaching power is almost 30 times stronger than Cl₂. In alkaline solution undergoes disproportionation.

 $2\text{CIO}_2 + 2\text{NaOH} \longrightarrow \text{NaCIO} + \text{NaCIO}_3 + \text{H}_2\text{O}$

68. Fuse with KOH in presence of air or oxidising agents like KNO_3 , KCIO₃ etc.

 $2MnO_2 + 4KOH + O_2 \xrightarrow{fuse} 2K_2MnO_4 + 2H_2O$

 MnO_4^{2-} electrolytic oxidation $MnO_4^{-} + e^{-}$

- **69.** Y is NO_2 . Hence (X) may be $Mg(NO_3)_2$.
- **71.** R and S, P and Q are resonating structures while P and R are tautomers structures.

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73. Teflon is polymer of tetrafluoro ethylene and Natural rubber is polymer of isoprene.



are formed in the first step.













- 83. (X) has configurations
 (A) R Z R (B) S Z S (C) R Z S (D) R E R
- **84.** Cyclohexane in chair form is free from all strains. The boat form has maximum VDW strain between flagpoles hydrogen atom.



87. S₁: Pentaamminethiocyanato—N—chromium(III) tetrachlorozincate (II). or

Pentaammineisothiocyanatochromium(III) tetrachlorozincate (II).

- \mathbf{S}_2 : According to defination.
- $\boldsymbol{S_3}$: In it Cobalt is bonded by $\sigma\text{-bond}$ with 6 monodented ligands.
- \mathbf{S}_{4} : In it primary valency (ON) of iron is 0.

$$\rightarrow \alpha = (i - 1)$$

Now
$$K_a = \frac{C\alpha^2}{1-\alpha}$$
 \Rightarrow $K_a = \frac{(i-1)^2}{1-(i-1)}$

$$\Rightarrow K_{a} = \frac{(i-1)^{2}}{2-i}$$

93.
$$Z = 1 + \frac{B}{V}$$

÷.

comparing with $y = m \times + c$

$$m = B = b - \frac{a}{RT} = -0.1 L mol$$

b + 0.1 =
$$\frac{d}{RT}$$

a = (b + 0.1) RT
= $\left(b + \frac{1}{10}\right) \times 24.6 \text{ atm.L ml}^{-2}.$

94. $CuSO_4.5H_2O \rightleftharpoons CuSO_4.3H_2O + 2H_2O(g)$ $K_p = (7.8)^2 = 60.84$ $CuSO_4.3H_2O \rightleftharpoons CuSO_4.H_2O + 2H_2O(g)$ $K_p' = (P_{H_2O})^2 = (5.6)^2 = 31.36$

The ratio $\frac{K_p}{K_p} = \frac{60.84}{31.36} = 1.9$

95. Cathode : $NO_3^- + 3H_3O^+ + 2e^- \longrightarrow HNO_2 + 4H_2O$; $E^\circ = 0.94 V$ Anode : $2Hg^{2+} + 2e^- \longrightarrow Hg_2^{2+}$; $E^\circ = 0.92 V$ Overall balanced cell reaction :

 $NO_3^- + 3H_3O^+ + Hg_2^{2+} \longrightarrow 2Hg^{2+} + HNO_2 + 4H_2O$; E° = 0.02 V

$$E = E_{cell}^{o} - \frac{0.06}{2} \log \frac{[Hg^{2+}]^{2}[HNO_{2}]}{[NO_{3}^{-}][H_{3}O^{+}]^{3}[Hg_{2}^{2+}]}$$

$$E = E_{cell}^{o} - \frac{0.06}{2} \log \frac{1}{[H_{3}O^{+}]^{3}}$$

$$0 = 0.02 - 0.03 \log \frac{1}{[H_{3}O^{+}]^{3}}$$

$$0 = 0.02 - 0.03 \times 3 \text{ (pH)}$$

$$pH = \frac{0.02}{0.03 \times 3} = \left(\frac{2}{9}\right).$$

96.
$$0.62 = \frac{250 \times 10^{-3}}{M \times 100} \times 1000 \times 39.7 \times 1$$

M = 160 or 1.6 × 10² g/mol

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$$\frac{100 - 2x}{100 + x} = 0.1 \qquad \Rightarrow x = \frac{90}{2.1} = 42.85 \text{ mI}$$

0

105 & 106.

100 – 2x

$$\begin{array}{ll} Mg + \frac{1}{2} & O_2 & \longrightarrow MgO \\ 0.1 \ mol & 0.1 \ mol \\ Mg + H_2SO_4 & \longrightarrow MgSO_4 + H_2 \uparrow \\ 0.15 \ mol & 0.15 \ mol \\ MgO + H_2SO_4 & \longrightarrow MgSO_4 + H_2O \\ 0.1 \ mol \\ \left(WH_2SO_4\right)_1 = 100 \times 1.4 \times 0.3 = 42 \ gm \\ \left(WH_2SO_4\right)_1 = 42 - 0.25 \times 98 = 17.5 \ gm \\ (a) \ \% \ w/w \ of \ final \ H_2SO_4 \ solution = \frac{17.5}{100 \times 1.25} \times 100 = 14\% \\ (b) \ WO_2 \ used = \frac{0.1}{2} \times 32 = 1.6 \ gm \end{array}$$



110. For 5 \rightarrow 2 transition in H – atom sample

Max. spectral lines = $\frac{\Delta n(\Delta n + 1)}{2} = \frac{3 \times 4}{2} = 6$

 λ of photon corresponding to 3 \rightarrow 2 transition : $\frac{1}{\lambda} = R(1)^2$

$$\left[\frac{1}{2^2} - \frac{1}{3^2}\right] \therefore \ \lambda = \frac{36}{5R}$$

 \overline{v} of photon corresponding to 4 \rightarrow 3 transition : \overline{v} = R (1)²

$$\left[\frac{1}{3^2} - \frac{1}{4^2}\right] \therefore \overline{\nu} = \frac{7R}{144}$$

For single isolated atom, maximum spectral lines = 3 (5 \rightarrow 4, 4 \rightarrow 3, 3 \rightarrow 2)

(B) For 5 \rightarrow 1 transition in He⁺ ion sample,

Max. spectral lines = $\frac{n(n-1)}{2} = \frac{5 \times 4}{2} = 10$

 $\begin{array}{l} ({\rm H})_{3 \rightarrow 2} = ({\rm He}^{+})_{6 \rightarrow 4} \ ({\rm Not \ possible \ for \ given \ sample}) \\ ({\rm H})_{4 \rightarrow 3} = ({\rm He}^{+})_{8 \rightarrow 6} \ ({\rm Not \ possible \ for \ given \ sample}) \\ {\rm For \ single \ isolated \ ion, \ maximum \ spectral \ lines = 4} \ (5 \rightarrow 4, 4 \rightarrow 3, 3 \rightarrow 2, 2 \rightarrow 1) \\ ({\rm C}) \ {\rm For \ } 7 \rightarrow 3 \ transition \ in \ {\rm H \ atom \ sample}, \end{array}$

Max. spectral lines =
$$\frac{4(4+1)}{2}$$
 = 10

To emit photon of $\lambda = \frac{36}{5R}$, transition should be from 3 \rightarrow 2

(Not possibe)

To emit photon of $\overline{\nu} = \frac{7R}{144}$ transition should be from 4 \rightarrow 3

(possibe)

For single isolated atom, maximum spectral lines = 4 (7 \rightarrow 6, 6 \rightarrow 5, 5 \rightarrow 4, 4 \rightarrow 3)

(D) For 7 \rightarrow 4 transition in He⁺ ion sample,

Max. spectral lines =
$$\frac{3(3+1)}{2} = 6$$

$$(H)_{3 \rightarrow 2} = (He^{+})_{6 \rightarrow 4}$$
 (possible for given sample)

: photon of
$$\lambda = \frac{36}{5R}$$
, can be emitted

 $\begin{array}{l} (H)_{4 \ensuremath{\rightarrow} 3} = (He^{\star})_{8 \ensuremath{\rightarrow} 6} \mbox{ (Not possible for given sample)} \\ \mbox{For single isolated ion, maximum spectral lines = 3 (7 \ensuremath{\rightarrow} 6, 6 \\ \ensuremath{\rightarrow} 5, 5 \ensuremath{\rightarrow} 4) \end{array}$

Any photon whose energy is 1.55 to 3.1 ev, will be visible.

112. (A)
$$\underset{(sp^2)}{\overset{+4}{\longrightarrow}}$$
 $H_2O \xrightarrow{\text{Redox}}$ $H_{NO_3}^{+5} + H_{NO_2}^{+3}$ $\underset{(sp^2)}{(sp^2)}$ $\underset{(sp^2)}{\overset{(sp^2)}{\longrightarrow}}$

Hybridisation reamin same.

(B) $SOF_2 + 2H_2O \longrightarrow 2HF + H_2SO_3$

Non-redox reaction, hybridisation reamin same (sp³) HF can react with SiO_2 (glass)

 $SiO_2 + 6HF \longrightarrow H_2SiF_6 + 2H_2O$

(C) $XeF_4 + H_2O \longrightarrow Xe + O_2 + XeO_3 + HF$

Redox reaction and HF can react with SiO₂

(D) $ICl_5 + 3H_2O \longrightarrow HIO_3 + 5HCI$

Non-redox reaction. HF reacts with glass.



$$\label{eq:basic} \begin{split} \beta &= 180^\circ \text{ all bond angles are not identical.} \\ \alpha &= 90^\circ \\ \text{ all bond lengths are identical.} \end{split}$$



all bond angles identical (109° 28')

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इसका अर्थ है
$$\frac{[Au(CN_2)]}{[Au^+] + [Au(CN_2)]}$$
100[Au(CN)₂]⁻ = 99[Au⁺] + 99[A
[Au⁺] =
$$\frac{[Au(CN_2)]^-}{99} - (I)$$

$$K_f = \frac{[Au(CN_2)]^-}{[Au^+] [CN^-]^2}$$
Putting the [Au⁺] from (I) in K_f
4 × 10²⁸ =
$$\frac{99}{[CN^-]^2}$$

$$\Rightarrow [CN^-] = 5 × 10^{-14} M$$

It means $\frac{[Au(CN_2)]^-}{[Au^+] + [Au(CN_2)]^-} = \frac{99}{100}$ 99 $\frac{1}{2}]^{-} = \frac{33}{100}$ u(CN)₂]-

Au⁺ + 2CN⁻ = [Au(CN)₂]⁻ 99 mol% [Au(CN)₂]⁻

119.

 $\Rightarrow \overline{K_{b}} = \overline{0.6} = K_{c} = \overline{2} = \overline{[A]}$ 2 C = 2A $K_{c}' = \frac{1}{\kappa^2} = 4.$

118. A
$$\underbrace{K_{f}}_{K_{b}}$$
 C
 $\xrightarrow{K_{f}}$ $\underbrace{K_{f}}_{K_{b}} = \underbrace{0.3}_{K_{b}} = \underbrace{K_{b}}_{K_{b}} = \underbrace{1}_{K_{b}} = \underbrace{[C]}_{K_{b}}$

 $(P_g - P) \times \left(45 + \frac{225}{13}\right) = (P_g - P + 10) \times \left(45 - \frac{225}{13}\right) = nRT$ $\therefore P_a - P = 8 \text{ cm}$

$$= P) \times \left(\frac{45 + \frac{225}{13}}{45 - \frac{225}{13}} \right) = (P - P + 10) \times \left(\frac{45}{13} + \frac{225}{13} \right)$$

$$\begin{bmatrix} 0 \\ -1 \\ -1 \\ -1 \end{bmatrix} 45 - \frac{225}{13}$$

$$\begin{array}{c|c} (1) & \begin{array}{c} \mathbf{n} \\ \mathbf{n} \\ \mathbf{n} \end{array} & \begin{array}{c} 45 + \frac{225}{13} \\ 10 \end{array} \end{array}$$

$$1)\begin{bmatrix} a \\ I \\ a \end{bmatrix} = 45 + \frac{225}{13}$$

$$-1$$

$$P_{g}(1) \qquad P_{g}$$

$$45 \longrightarrow -10 \longrightarrow 45 \longrightarrow 45$$

$$[CI^-] = \frac{0.2}{2} = 0.1 \text{ M}$$

CuCl(s), is at equilibrium after precipitation stopes so [Cu⁺][Cl⁻] = 10⁻⁶

$$\Rightarrow \quad [Cu^+] = \frac{10^{-6}}{0.1} = 10^{-5} = 1 \times 10^{-5} \Rightarrow x + y = 6$$

mass of water present in the salt =
$$\frac{18x}{120+18x} \times 32$$
 g

Molality of the solution =
$$\frac{32}{120 + 18x} \times \left[\frac{1000}{84 + \frac{18 \times 32x}{120 + 18x}} \right]$$

$$= \frac{4000}{1260 + 261 \text{ x}}$$

$$\Delta T_{\rm f} = 4.836 = 2 \times 1.86 \times \frac{4000}{1260 + 261 \text{ x}}$$

$$x = 6.9 \approx 7$$

122. M_{CaCl2} = 111 g

$$n_{CaCl_2} = \frac{222}{111} = 2 \text{ mole} \qquad n_{H_2O} = \frac{324}{18} = 18 \text{ mole}$$

Relative lowering in vapour pressure

R.L.V.P. =
$$\frac{P_0 - P_S}{P_0} = \frac{n_1 i}{n_1 i + n_2} = \frac{100 - 80}{100} = \frac{i \times 2}{i \times 2 + 18}$$

or 0.2 = $\frac{2i}{2i + 18}$ or 0.4i + 3.6 = 2i
i = 2.25.
So i = 2.25
For CaCl₂ \longrightarrow i = 1 + (n - 1) α
2.25 = 1 + (3 - 1) α

$$\alpha = \frac{1.25}{2} = 0.625.$$

 $6.4 \times 0.625 = 4.$

so, mole fraction of KOH in its aqueous solution = 1 - (1 - X) = XThus, both aqueous NaOH solution and aqueous KOH solution

have same mole fraction of solute.

Now, molality =
$$\frac{X_{solute \times 1000}}{(1 - X_{solute}) \times Mol.Mass_{solvent}}$$

Since both solutions have same solvent (H₂O) and same mole fraction of solute, so they will have same molality

- : Molality of aq. KOH solution = m

 $\therefore Y = m / m = 1$

117. Case – 1

Case – 2

115. Let mole fraction of NaOH in its aqueous solution be X. \therefore Mole fraction of H₂O in an aqueous solution of KOH = 1 – X CHEMISTRY 10-10

$$[CI^{-}] = \frac{0.2}{2} = 0.1 \text{ M}$$

$$\Rightarrow \quad [Cu^{+}] = \frac{10^{-6}}{0.1} = 10^{-5} = 1 \times 10^{-5} \Rightarrow x + y = 6$$

121. molar mass of salt = 120 + 18x

mass of water present in the salt =
$$\frac{18x}{120+18x} \times 32 \text{ g}$$

blality of the solution =
$$\frac{32}{120 + 18x} \times \left[\frac{1000}{84 + \frac{18 \times 32x}{120 + 18x}} \right]$$

123.
$$X_B = 0.5$$
 $X_T = 0.5$
 $P_{total} = P_B^o X_B + P_T^o \cdot X_T$
 $80 = 0.5 P_B^o + 0.5 P_T^o$
 $160 = P_B^o + P_T^o$ (1)
 $y_B = \frac{P_B^o \cdot X_B}{P_{total}} = \frac{P_{T}^o \cdot 0.5}{80} = \frac{P_B^o}{160}$
 $y_T = \frac{P_T^o \cdot X_T}{P_{total}} = \frac{P_T^o \cdot 0.5}{80} = \frac{P_T^o}{160}$
 $p'_{total} = 100 = P_B^o \cdot y_B + P_T^o \cdot y_T$
 $= 100 = P_B^o \cdot \frac{P_B^o}{160} + P_T^o \cdot \frac{P_T^o}{160}$
 $P_B^{o^2} + P_T^{o^2} = 100 \times 160$
From (1) Eq.
 $(P_B^o + P_T^o)^2 = 160^2 = P_B^{o^2} + P_T^{o^2} + 2P_B^o \times P_T^o$
 $= P_B^{o^2} + P_T^{o^2} + 2P_B^o P_T^o$
 $= 100 \times 160 + 2P_B^o P_T^o$
 $2P_B^o P_T^o = 160^2 - 160 \times 100 = 160 \times 60$
 $P_B^o P_T^o = 160 \times 30; P_B^o + P_T^o = 160$
 $P_B^o = 120 = x ; P_T^o = 40 = y$
 $\therefore \frac{x + 2y}{50} = 4$
124. $\Delta T_F = K_F \times m = K_F \times \left[\frac{W_{acid} \times 1000}{M_{acid} \times H_2O} \right]$
Also $N_1V_1 = N_2V_2$
 $\frac{0.45}{(M_{acid})_{thor}} = \frac{1}{5} \times 15 \times \frac{1}{1000}$,
 $(M_{acid})_{thor} = \frac{0.45 \times 5 \times 1000}{15} = 150$
 $i = \left(\frac{M_{thor}}{M_{exp}} \right) = \frac{150}{120} = 1.25$
 $\therefore a = (i - 1) = 1.25 - 1 = 0.25$.

125. (1) Silica gel adsorbs moisture

- (2) True
- (3) True. (Bonds weaken on the surface)
- (4) True
- (5) True (Chemisorption need activation energy.

True, physisorption is due to weak attractive forces, hence (6) it occurs little farther from surface atoms in comparison to chemisorption. Moreover the decrease in potential energy is more in chemisorption than in physisorption.

$$126. \ E = E^{\circ} - \frac{0.06}{2} \log \frac{[H^+]^2 [Cl^-]^2}{P_{H_2}}$$

$$\Rightarrow \quad 0.43 = 0.19 - \frac{0.06}{2} \log \frac{[H^+]^2 \times (10^{-3})^2}{10^{-2}}$$

$$\Rightarrow \quad 0.43 = 0.19 - \frac{0.06}{2} \log [H^+]^2 \times (10^{-2})^2$$

$$\Rightarrow \quad 0.43 = 0.19 - 0.06 \log (H^+) + 0.12$$

$$\Rightarrow \quad 0.12 = 0.06 \text{ pH}$$

$$\Rightarrow \quad \text{pH} = 2$$

~ ~

- 127. On truncating tetrahedron, triangle is generated at each corner and hexagon on each face. Hence 4 triangular and 4 hexagonal faces.
- 128. (i) Ionisation isomers $[\text{Co}(\text{NH}_3)_4\,(\text{NO}_2)_2]\text{C}\ell$ and $[\text{Co}(\text{NH}_3)_4\,(\text{NO}_2)\,(\text{C}\ell)]\,\text{NO}_2$ (ii) Linkage isomers $[\text{Co}(\text{NH}_3)_4\,(\text{NO}_2)_2]\text{C}\ell$ and $[\text{Co}(\text{NH}_3)_4\,(\text{ONO})_2\,]\,\text{C}\ell$ (iii) Geometrical isomers ; cis & trans





Hence the coordination number is 4.

(iv) Silicon \rightarrow Each Si is bonded to four silicon atoms.

(v) Coordination Number is 2

(vi)
$$O = \begin{bmatrix} S & O^{-} & C.N. \text{ is } 3. \\ O^{-} & H \\ H \\ O = \begin{bmatrix} O & - \\ O & -$$

$$(ix) H H H CN = 4$$

130. EAN = 26 - 3 + 6 × 2 = 35 3 + 5 = 8.

131. (a) Fe⁺² = d⁶, CN⁻ is SFL so all paired ($t_{2g}^{6} e_{g}^{0}$)

(b) $Co^{3+} = d^6$, $(t_{2g}^6 e_g^0)$

- (c) $Pt^{2+} = 5d^8$, CN = 4, all paired, square planar
- (d) $Fe^{2+} = d^6$, H_2O is WFL, so paramagnetic
- (e) $Zn^{2+} = d^{10}$, diamagnetic
- (f) $Mn^{+6} = d^1$, paramagnetic
- (g) Al³⁺ diamagnetic
- (h) $V^{2+} = d^3$, paramagnetic.
- **132.** $CaCO_3$, $Na_2S_2O_3$, CaC_2O_4 , KSCN, $Ca_3(PO_4)_2$, Na_2ZnO_2 ends with 'ate'.

133.
$$\underline{\overset{+2}{Fe}S_2}$$
, $\underline{\overset{+3}{Fe}}_2$ O₃, Fe₃O₄ ($\underline{\overset{+2}{Fe}O} + Fe_2O_3$)
[$\underline{\overset{+1}{Fe}}$ (H₂O)₅(NO)]²⁺, Na₂[$\underline{\overset{+2}{Fe}}$ (CN)₅(NO)], $\underline{\overset{+3}{Fe}}$ [$\underline{\overset{+3}{Fe}}$ (CN)₆],
K₂ $\underline{\overset{+2}{Fe}}$ [$\underline{\overset{+2}{Fe}}$ (CN)₆], $\underline{\overset{+2}{Fe}}$ (C₅H₅)₂, $\underline{\overset{+2}{Fe}}$ WO₄

134. : for molecules upto N₂, $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2 p_x^2 =$

 $\pi 2 p_v^2 \sigma 2 p_z^2$ order is followed.

Hence in	(a) 10e⁻	(b) 9e⁻	(c) 7e⁻
	(d) 8e-	(e) 8e-	(f) 10e-
(g) 8e-	(h) 2e-	(i) 5e⁻	are present

135. Bond order of XeO_6^{4-} is 4/3 = n

It has 15 possible structures \therefore m = 15

Thus mn =
$$15 \times \frac{4}{3} = 20$$
 \therefore 0.2 mn = 0.2 \times 20 = 4







137. IO_6^{5-} , XeO_6^{4-} , N_3^{-} .

138. 4 structures each :



139. Most stable states :

	+1 state	TI
	+2 state	Cu
	+3 state	Al, Bi, Cr, Sc
ſ	+4 state	Si
	+5 state	Р

Most stable state of Mn is +2 in acidic medium and +4 in alkaline/ neutral media.

(CHEMISTRY)

$$\begin{array}{rcl} \mbox{140.} & (NH_4)_2SO_4 & \rightarrow & 2NH_3\uparrow + SO_3(g)\uparrow + H_2O\uparrow \\ & (NH_4)NO_2 & \rightarrow & N_2\uparrow + 2H_2O\uparrow \\ & (NH_4)NO_3 & \rightarrow & N_2O\uparrow + 2H_2O\uparrow \\ & Ba(N_3)_2 & \rightarrow & Ba + 3N_2\uparrow \\ & 2NH_4CIO_4 & \rightarrow & N_2\uparrow + CI_2 + 4H_2O + 2O_2 \\ & (NH_4)_2Cr_2O_7 & \rightarrow & N_2\uparrow + 4H_2O\uparrow + Cr_2O_3 \\ & Pb(NO_3)_2 & \rightarrow & PbO + 2NO_2 + \frac{1}{2}O_2 \\ & 2NaN_3 & \rightarrow & 2Na + 3N_2\uparrow \end{array}$$

141.
$$H_{2}(g) + I_{2}(g) \xrightarrow{} 2HI(g)$$

$$t = 0 \qquad 1 \qquad 3 \qquad 0$$

$$t = (t_{eq})_{1} \qquad 1 - \frac{x}{2} \qquad 3 - \frac{x}{2} \qquad x$$

$$t = (t_{eq})_{2} \qquad 3 - x \qquad 3 - x \qquad 2x$$

$$K_{C} = \frac{x^{2}}{(1 - \frac{x}{2})(3 - \frac{x}{2})} = \frac{4x^{2}}{(3 - x)^{2}}$$

हल करने पर = x = 1.5

142. (i)
$$4\text{Cl}^- + \text{Cr}_2\text{O}_7^{2^-} + 6\text{H}^+ \longrightarrow 2\text{CrO}_2\text{Cl}_2^{\uparrow} (\text{deep red}) + 3\text{H}_2\text{O}$$

(ii) $\text{NO}_2^- + \text{H}^+ \longrightarrow \text{HNO}_2$; $3\text{HNO}_2 \longrightarrow \text{HNO}_3 + \text{NO}^{\uparrow} + 2\text{H}_2\text{O}$

- $2NO \uparrow + O_2 \uparrow \longrightarrow NO_2 \uparrow (brown)$
- (iii) $3I^- + 2H_2SO_4 \longrightarrow I_3^- \uparrow (violet) + SO_4^{2-} + 2H_2O + SO_2$
- (iv) $K_2S + H_2SO_4 \longrightarrow H_2S \uparrow (colourless) + K_2SO_4$
- (v) $CI^- + H_2SO_4 \longrightarrow HCI^+ (colourless) + HSO_4^-$
- (vi) $2KBr + MnO_2 + 2H_2SO_4 \longrightarrow$ Br_2^{\uparrow} (reddish-brown) + $2K^+ + Mn^{2+} + 2SO_4^{2-} + 2H_2O_4^{2-}$
- (vii) $\text{KNO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{KHSO}_4 + \text{HNO}_3$;

 $4HNO_3 \longrightarrow + 2H_2O + O_2 + 4NO_2^{\uparrow}$ (brown)

(viii) $2\text{KCI} + \text{MnO}_2 + 3\text{H}_2\text{SO}_4 \longrightarrow$ $2\text{KHSO}_4 + \text{MnSO}_4 + \text{Cl}_2 \uparrow \text{(yellowish green)} + 2\text{H}_2\text{O}$

(ix) $SO_3^{2-} + 2H^+ \longrightarrow SO_2^{\uparrow}$ (colourless) + H₂O

144. $d_x^2 - y^2$ orbital involved in dsp² & sp³d²/d²sp³ hybridisation

$$\begin{array}{c} OH & O\\ I & II\\ 145. CH_2 = C - CH_2 - C - CH_2 - CH_3 \end{array}$$

$$\begin{array}{c} O & OH \\ \parallel & \parallel \\ CH_3-C-CH=CH-CH_2-CH_3 \\ cis \& trans \end{array}$$

$$\begin{array}{ccc} O & OH \\ \parallel & \parallel \\ CH_3-C-CH_2-CH=CH-CH_3, \\ cis \& trans \end{array}$$







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CHEMISTRY





151. 5 (i, ii, iv, v, vii)

- **153.** (A) has no C–OH group, α to the CH=O group. So it forms only phenylhydrazone with 1 mole of PhNHNH₂. (B) has (C–OH) group α to the CH=O group, so it forms only ozazone by reaction with 3 mole of PhNHNH₂.
- **154.** Neutral amino acid & acidic amino acid are negatively charged at pH = 7.0

Alanine, Cysteine, Glumatic acid, Glycine, Leucine, Aspartic acid



are more reactive than benzene towards nitration.





159. Only one product (Single stereoisomers)



















162. (iii), (iv), (vi), (vii), (viii)

163. CH₃-CH₂-CH=NH, CH₃-CH=CH-NH₂, CH₃-CH=N-CH₃



166. The smallest optically active alkenoic acid which can also show geometrical isomerism can be written as

$$H_3C \longrightarrow H$$

 $H_3C \longrightarrow H$
 $CH = CH - CH_3$

_ _ _ .

Hence its molecular formula is $C_6H_{10}O_2$.

167. Let mole fraction of O_2 is x

$$40 = 32 \times x + 80 (1 - x)$$
 or $x = 5 / 6$

$$a + b = x : (1 - x) = \frac{5}{6} : \frac{1}{6}$$

When ratio is changed

$$M_{mixture} = 32 \times \frac{1}{6} + 80 \times \frac{5}{6} = 72$$

169. KI +
$$O_3 \longrightarrow I_2 + H_2O + O_2$$
.
v.f = 2 v.f = 2
moles
= x.
 $I_2 + Na_2S_2O_3 \longrightarrow I^- + Na_2S_4O_6$
v.f = 2 M = 2
V = 1L
v.f = 1
eq of O_3 = eq of I_2 = eq of hypo
 $\Rightarrow 2 \times x = 2$
x = 1 mole
 \Rightarrow weight % of $O_2 = \frac{1 \times 48}{1 \times 10^{-10}} \times 10^{-10}$

$$\Rightarrow \text{ weight \% of } O_3 = \frac{1 \times 40}{1 \times 48 + 1 \times 32} \times 100$$

$$=\frac{3}{5} \times 100 = 60\%$$
 Ans. 60.

170.
$$PCI_5 \longrightarrow PCI_3 + CI_2$$

 $t = 0 \quad P \qquad 0 \qquad 0 \qquad (at 27^{\circ}C)$
 $t = 0 \quad \frac{480 \, P}{300} \quad 0 \qquad 0 \qquad (at 207^{\circ}C)$
 $t = eq. \quad \frac{480 \, P}{300} -P' \quad P' \qquad P' \qquad (at 207^{\circ}C)$

: Total pressure at eq. at 207°C = $\frac{480 \text{ P}}{300}$ -P'+2P' = 2P

(given)

$$\therefore \frac{8P}{5} + P' = 2P$$

$$\therefore P' = \frac{2P}{5}$$

∴ % dissociation of PCl₅ at 207°C =
$$\frac{P'}{\left(\frac{480P}{300}\right)} \times 100$$

_ .

$$= \frac{2 P/5}{8 P/5} \times 100 = 25\%$$

171. MX
$$\longrightarrow$$
 M⁺ + X⁻
x x + 10⁻⁶
[Na⁺] = 10⁻⁶ M
K_{Sol} = K_{M⁺} + K_{X⁻} + K_{Na⁺}
29 × 10⁻⁶ = 10³[6 × 10⁻³x + (4 × 10⁻³ (x + 10⁻⁶) + (5 × 10⁻³ × 10⁻⁶)]
x = 2 × 10⁻⁶
K_{SP} = 6 × 10⁻¹²

172. 3S
$$\implies$$
 S₃
1 $= \alpha$ $\frac{\alpha}{3} \Rightarrow i = 1 - \frac{2\alpha}{3}$
Now 0.1 $\left(1 - \frac{2\alpha}{3}\right) = 0.08 \Rightarrow \alpha = 0.3 \Rightarrow 30\%$ trimerization.

- **174.** Next nearest neighbour of Zn^{+2} would be = no of nearest surrounded Zn^{2+} ions next nearest neighbour of S^{2-} would be = no of nearest S^{2-} ions = 12 (due to FCC) and their number of neighbour ratio is 1 : 1 and that make Zn^{2+} neighbour are 12.
- 175. $_{24}Cr^{2+}$ = [Ar] 3d⁴ (as H₂O is WFE Ligand). Therefore $_{24}Cr^{2+}$ is $t_{2\alpha}^{1,1,1}$, $e_{\alpha}^{1,0}$

or CFSE =
$$(-3 \times 0.4 + 1 \times 0.6)\Delta_0$$

= $-0.6 \Delta_0$.

176. CO_3^{2-} and NO_3^{-}	: 1 or 2 donor oxygen atoms.	
edta	: 5 or 6 donor atoms (N and O).	
C ₂ O ₄ ²⁻	: 2 donor oxygen atoms.	
SO42-	: 1 or 2 donor oxygen atoms.	
CH3COCHCOCH3	 2 donor oxygen atoms. 	
$CH_3C \equiv N$: 1 donor nitrogen atom.	
SCN	: Either one nitrogen atom or one sulphur atom	
dmg	: 2 donor nitrogen atoms.	
[N(CH ₂ -COO) ₃] ³⁻	$[N(CH_2-COO)_3]^{3-}$ (or nta) : quadridentate ligand, 3 donor O	
	atoms and 1 N atom.	
gly :1	donor N atom and 1 donor O atom.	
dipy : 2	donor N atoms	



178. Incorrect are :

(v) N_2H_4 : NN bond length same as expected since the two lone pairs on N-atoms are at anti position wrt each other so LP-LP replusion is not effective.

179. $R-C-O^-$ produces red coloration with neutral $FeCl_3$

(tested in Inorganic Qual. analysis as well) while phenolic ^{-}OH group produces violet coloration with neutral FeCl₃.















[Total product 6]



186. X has 3 stereocentres with similar ends. Hence, 6 stereoisomers. $Y=CH_{3}CH-CHO$ has one sterteocentre, hence 2 stereoisomers. Z= $CH_3CH-CH=NOH$ has 2

stereocentres, hence 4 stereoisomers.











POS





05 all optically inactive.



















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