

CHEMISTRY

SESSION 2026-27

CHAPTERWISE QUESTION PAPERS

KENDRIYA VIDYALAYA SANGATHAN

AGRA REGION

तत् त्वं पूषन् अपावृणु
केन्द्रीय विद्यालय संगठन

OUR MENTORS

Smt Indira Mudgal
Deputy Commissioner
KVS Agra Region

Smt Rani Dange
Assistant Commissioner
KVS Agra Region

Sh Raj Kumar
Assistant Commissioner
KVS Agra Region

CO-ORDINATOR

Subhash Chandra Shrivastava
Principal
PM SHRI KV No 3, Jhansi

UNIT WISE MARKS DISTRIBUTION

COURSE STRUCTURE

CLASS XII

THEORY

Time: 3 Hours **Total Marks: 70**

S. No.	Title	Marks
1	Solutions	7
2	Electrochemistry	9
3	Chemical Kinetics	7
4	d -and f -Block Elements	7
5	Coordination Compounds	7
6	Haloalkanes and Haloarenes	6
7	Alcohols, Phenols and Ethers	6
8	Aldehydes, Ketones and Carboxylic Acids	8
9	Amines	6
10	Biomolecules	7
	Total	**70**

List of Teachers Allotted the Task of Preparing the Question Bank for Class XII

S.NO	NAME OF KV	NAME OF TEACHER	NAME OF CHAPTER
1	PM SHRI KV SEC-24 NOIDA (SH-I)	MS SHALINI VERMA	Solutions
2	PM SHRI KV MUZAFFARNAGAR (SH-I)	MRS. GEETA DEVI	Electrochemistry
3	PM SHRI KV ALIGARH	SMT.SHRADDHA SRIVASTAV	Chemical Kinetics
4	PM SHRI KV ETAH	MR VIJAY KUMAR	d- & f-block elements
5	PM SHRI KV NO 1 AFS AGRA	MR. MANOJ KUMAR	Coordination compounds
6	KV NTPC DADRI	MR VINAY KUMAR	Haloalkanes & Haloarens
7	PM SHRI KV NO. 2 AFS HINDAN	MS NEELAM SHARMA	Alcohols, Phenols & Ethers
8	PM SHRI KV NO 1 AFS AGRA	SANJEEV KUMAR SHARMA	Aldehydes, Ketones & Carboxylic acids
9	PM SHRI KV PUNJAB LINES MEERUT CANTT	MS. SHIVANI CHAUDHARY	Amines
10	PM SHRI KV ETAWAH	DR. SHASHI CHHABRA	Biomolecules

Moderation & Compilation of work:

1. **MR. AJAY SINGH,** PGT(CHEM)PM SHRI KV NO-3 JHANSI
2. **MRS.SHRADHHA SAXENA**, PGT (CHEM)PM SHRIKV NO-3 JHANSI
3. **MRS RANJANA UPADHAYAY,** PGT (CHEM)PM SHRIKV NO-1 JHANSI
4. **MR.A.K. SINGH,** PGT (CHEM) PM SHRI KV LALITPUR

KENDRIYA VIDYALAYA SANGATHAN

AGRA REGION

CLASS – XII

CHEMISTRY (043)

Max. Marks: 70 **Time: 3 Hours**

CHAPTER 1 : SOLUTIONS

Read the following Instructions carefully.

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION - A (16 × 1 = 16)

Questions No. 1 to 16 are Multiple Choice type questions carrying 1 markeach.

1. Colligative properties depend on:

(A)the nature of the solute

(B)the number of solute particles in solution

(C)the physical properties of solute

(D)the nature of the solvent

2 Increasing the temperature of an aqueous solution will cause:

(A)decrease in molality

(B)decrease in molarity

(C)decrease in mole fraction

(D)decrease in % (w/w)

3. A 5% solution of cane-sugar (molecular weight = 342) is isotonic with 1%solution of substance A. The molecular weight of X is

(A) 342

(B) 171.2

(C) 68.4

(D) 136.8

4 The Van't Hoff's factor for 0.1 M $Ba(NO_3)_2$solution is 2.74. The degree ofdissociation is

(A) 91.3%

(B) 87%

(C)100%

(D) 74%

5 If liquid A and B form ideal solution:

(A) The enthalpy of mixing is zero

(B) The entropy of mixing is zero

(C) The free energy of mixing is zero

(D) the free energy as well as entropy of mixing are zero

6 The number of moles of NaCl in 3 litres of 3M solution is:

(A)1

(B)3

(C)9

(D)7

7 Which has highest freezing point:

(A)1 M Glucose

(B)1 M NaCl

(C)1 M BaCl2

(D)1 M AlF3

8 Which of the following condition is not satisfied by an ideal solution?

(A)ΔHmixing = 0

(B)ΔVmixing = 0

(C)Raoult's Law is obeyed

(D)Formation of an azeotropic mixture

9 Considering the formation, breaking and strength of hydrogen bond, predict-which of the following mixtures will show a negative deviation from Raoult'slaw?

(A)Methanol and acetone.

(B)Chloroform and acetone.

(C)Phenol and aniline.

(D)Cyclohexane and ethanol

10.Which of the following pair will make an ideal solution?

(A) Chlorobenzene + Chloroethane

(B) Benzene + Toluene

(C) Acetone + Chloroform

(D) water + HCl

11.If 2 gm of NaOH is present in 200 ml of its solution, its molarity will be

(A) 0.25

(B) 0.5

(C) 5

(D)10

12.The atmospheric pollution is generally measured in the units of

(A)mass percentage

(B)volume percentage

(C)volume fraction

(D)ppm

Multiple choice Questions (Assertion/Reason)

For questions number 13 to 16, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below:

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

13.

Assertion (A): When NaCl is added to water a depression in freezing point is observed.

Reason (R): The lowering of vapour pressure of a solution causes depression in the freezing point.

14.

Assertion (A): Azeotropic mixtures are formed only by non-ideal solutions and they may have boiling points either greater than both the components or less than both the components.

Reason (R): The composition of the vapour phase is same as that of the liquid phase of an azeotropic mixture.

15.

Assertion (A): Molarity of a solution in liquid state changes with temperature.

Reason (R): The volume of a solution changes with change in temperature.

16.

Assertion: When methyl alcohol is added to water, boiling point of water increases.

Reason: When a volatile solute is added to a volatile solvent elevation in boiling point is observed.

SECTION -B

SHORT QUESTION ANSWER (2 MARKS)

17. a) Common salt and Calcium chloride are used to clear snow on the roads, both are of almost same cost but sodium chloride is preferred. Why?

b) How the freezing point changes when mercuric iodide is added to the aqueous solution of potassium iodide?

18.(a) How the osmotic pressure of 5 % aqueous solution of glucose ($\pi 1$) is related to that of 5 % aqueous solution of urea ($\pi 2$)?

b) Why do salt water fish die when they are suddenly transferred to a fresh water aquarium?

19.(a) Two 500 ml beakers were taken. One filled with 400ml water marked 'X' and another with 400ml of 2M NaCl solution marked 'Y'. At the same temperature both were placed in closed containers of same material and same capacity, in which container the vapour pressure is less.

b) Out of 1M sucrose and 1M urea solution which has more osmotic pressure?

20.(a) Arshi's father is suffering from high blood pressure but he is advised to consume less quantity of common salt. Why?

b) Two solutions A and B are separated by semi-permeable membrane. If the liquid flows from A to B then which solution is more concentrated?

OR

20.(a) Why the colligative property of an electrolyte solution is always greater than that of a non-electrolyte solution?

(b) Mohit wants to put an egg with outer shell removed in a bottle but he is unable to do so as mouth of bottle is slightly smaller. Suggest one method to help him putting the peeled egg in the bottle.

21.(a) Out of 1M and 2M sugar solutions which one has a lower boiling point?

b) While performing practical it is directed that the bottle of liquid ammonia is tobe cooled before opening the seal but Suman forgot to cool it before opening. What consequence she faced?

SECTION -C

SHORT QUESTION ANSWER (3 MARKS)

22.100 mg of a protein is dissolved in just enough water to make 10.0 mL of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25°C, what is the molar mass of the protein? (R = 0.0821 L atm mol^{-1} K^{-1} and 760 mm Hg = 1 atm.)

23. Account for the reason, marine life like fish prefers to stay at lower level and stayaway from the upper layer of water.

b) Why freezing/melting point of a substance used as a criterion for testing the purity of a substance?

c) Account for the reason for preservation of fruits against bacterial action by adding sugar.

24.A solution of glycerol ($C_3H_8O_3$; molar mass = 92 g mol^{-1}) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42 °C. What mass of glycerol was dissolved to make this solution? Kb for water = 0.512 K kg mol^{-1}.

OR

24. What mass of ethylene glycol (molar mass = 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from 0° C to -10.0° C? (K, for water = 1.86 K kg mol^{-1})?

25. a) What are hypotonic solutions?

b) Which cold drink you prefer one chilled or other one at room temperature and why?

c)At the same temperature hydrogen is more soluble in water than Helium. Which of them will have higher value of KH and why?

26.What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.5°C? The freezing point depression constant (K_f) for water is 1.86°C/m. Assume Van't Hoff factor for NaCl is 1.87. (Molar mass of NaCl = 58.5 g)

27.Some ethylene glycol, $HOCH_2CH_2OH$, is added to your car's cooling system along with 5 kg of water. If the freezing point of a water-glycol solution is -15.0°C, what is the boiling point of the solution?(K_b = 0.52 K kg mol^{-1} and K_f = 1.86 K kg mol^{-1} for water)

28.(a)Give an example of a solid solution in which solute is a liquid.

(b)X and Y liquids on mixing produce cold solution. What type of deviation is shown by them?

(c)Aquatic species are more comfortable in cold waters rather than in warm water. Give reason.

SECTION D

CASE BASED QUESTIONS (4 MARKS)

Read the passage given below and answer the following case-based questions:

29. Solution play a very important role in our daily life. Alloys, homogeneous mixture of metal are solution of solid in solid. 1 ppm (parts per million) of fluoride ions prevent tooth decay. All intravenous injections must be isotonic with our body fluids, i.e. should have same concentration as blood plasma. Diabetic patients are more likely to have heart attack and high blood pressure due to higher glucose level in blood. Common salt increase blood pressure because Na+ mixes up with blood. Aquatic species are more comfortable in cold water than warm water.

(a) 0.1 M glucose is not isotonic with 0.1 M KCl solutions. Why?

(b) What will happen if pressure applied on solution side is more than osmotic pressure, when solvent and solution are separated by semi-permeable membrane?

(c) What will happen if blood cells are placed in saline water (hypertonic solution)?

(d) Calculate the molality of ethanol solution in which mole fraction of water is 0.88.

30. Boiling point or freezing point of liquid solution would be affected by the dissolved solids in the liquid phase. A soluble solid in solution has the effect of raising its boiling point and depressing its freezing point. The addition of non-volatile substances to a solvent decreases the vapour pressure and the added solute particles affect the formation of pure solvent crystals According to many researches the decrease in freezing point directly correlated to the concentration of solutes dissolved in the solvent. This phenomenon is expressed as freezing point depression and it is useful for several applications such as freeze concentration of liquid food and to find the molar mass of an unknown solute in the solution. Freeze concentration is a high-quality liquid food concentration method where water is removed by forming ice crystals, this is done by cooling the liquid food below the freezing point of the solution. The freezing point depression is referred as a colligative property and it is proportional to the molar concentration of the solution (m), along with vapour pressure lowering boiling point elevation, and osmotic pressure. These are physical characteristics of solutions that depend only on the identity of the solvent and the concentration of the solute. The characters are not depending on the solute's identity.

a) Four samples $BaCl_2$, NaCl, $ZnCl_2$ and $AlCl_3$ of 0.5 M are being boiled Which of the among will show highest elevation in boiling point?

b)How does sprinkling of salt help in clearing the snow-covered roads in hilly areas?

c)The freezing point of nitrobenzene is 278.8 K. When 2.8 g of an unknown substance is dissolved in 100 g of nitrobenzene, the freezing point of solution is found 276.8 K. If the freezing point depression of nitrobenzene is 8.0 K kg mol^{-1},what is the molar mass of unknown substance? [K_f=8 KKgmol^{-1}for nitrobenzene]

OR

c)A solution prepared by dissolving 2g of oil of wintergreen (Methyl Salicylate) in100.0 g of benzene has a boiling point of 80. 31° C. Determine the molar mass of this compound. (B.P. of benzene - 80.10°C and Kb for benzene 2.520 C kg mol-1)

SECTION E

LONG QUESTION ANSWER(5MARKS)

31.a) Define the terms osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.

(b) Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.0 g of water. (K_b for water = 0.512 K kg mol^{-1}, Molar mass of NaCl = 58.44 g/mol)

OR

31.(a)State the following:

(i) Henry's law about partial pressure of a gas in a mixture.

(ii) Raoult's law in its general form in reference to solutions.

(b) A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming the gene fragment is a non-electrolyte, determine its molar mass.

32. (a) Define the following terms:

(i) Mole fraction (ii) Ideal solution

(b) 15.0 g of an unknown molecular material is dissolved in 450 g of water. The resulting solution freezes at – 0.34°C. What is the molar mass of the material?

(K_f for water = 1.86 K kg mol^{-1})

OR

32.a) Define the following terms:

(i) Molarity

(ii) Molal elevation constant (K_b)

(b) A solution containing 15 g Urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution.

33.(a) If the elevation in boiling point of a solution for which i = 1 in a solvent (K_f=x Kkg mol-1 and Kb=y K kg mol-1) is z K,then calculate the depression in freezing point of the same concentration.

b) Give two examples of materials used for making semi permeable membrane forcarrying out reverse osmosis.

(c) 3.9g of Benzoic Acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the Van't Hoff factor and predict the nature of solute (associated or dissociated).

(Given: Molar mass of benzoic acid = 122 g mol^{-1}, $K_f$for benzene = 4.9 K kg mol^{-1})

33. (a)Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.
(b) A 1.00 molal aqueous solution of Trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C. Determine the Van't Hoff factor for Trichloroacetic acid. (K_b for water = 0.512 K kg mol^{-1})
(c) An aqueous solution of sodium chloride freezes below 273 K. Explain the lowering in freezing points of water with the help of a suitable diagram.

PREPARED BY- SHALINI VERMA
PGT (CHEM)

KENDRIYA VIDYALAYA SANGATHAN

AGRA REGION

CLASS – XII

ELECTROCHEMISTRY

CHEMISTRY (043)

Max. Marks: 70 **Time: 3 Hours**

Read the following Instructions carefully.

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION-A

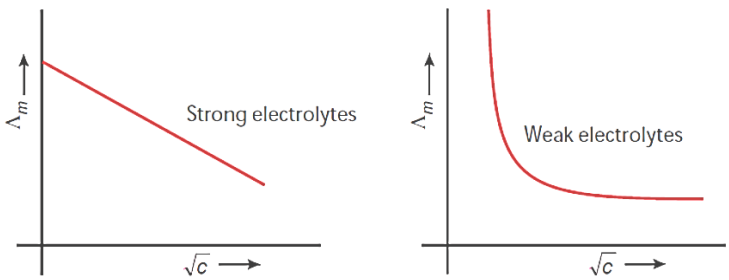
Question 1 to 16 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1		One Faraday of electricity liberates a X 10^{-1} gram atom of copper from copper sulphate. a is _____. a). 7 b). 5 c). 3 d). 1	[1]
2		For the cell reaction: $Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ the standard electrode potential is 1.10 V . At equimolar conc. and at 298 K, the cell potential will be (F = 96500 C mol^{-1}, R = 8.314 J mol^{-1} K^{-1}): a) 1.12 V b) 1.08 V c) 1.10 V d) 1.20 V	[1]
3		For a Daniell cell, the standard emf is 1.10 V. If $[Zn^{2+}]$ = 0.01 M and $[Cu^{2+}]$ = 1 M at 298 K, emf of the cell will be: (a) greater than 1.10 V (b) equal to 1.10 V (c) less than 1.10 V (d) zero	[1]

4	Which of the following claims about electrochemical cells is true? a) Cell potential is an extensive property b) Cell potential is an intensive property c) The Gibbs free energy of an electrochemical cell is an intensive property d) Gibbs free energy is undefined for an electrochemical cell	1]
5	The amount of electricity required to deposit 27 g of aluminium from a solution of $AlCl_3$ will be(a) 0.33 Faraday (b)1 Faraday(c) 3 Faraday (d)1.33 Faraday	[1]
6	Zinc is used to protect iron from corrosion because (a)E^0oxi of zinc is less than E^0oxi of iron. (b)E^0red. of zinc is less than E^0red.of iron. (c)Zinc is cheaper than iron. (d)Zinc is abundantly available.	[1]
7	How many Faraday charge is required to convert MnO_4^- to Mn^{2+}? (a) 1F (b) 3F (c) 5F (d) 6F	[1]
8	Which of the statements about solutions of electrolytes is not correct? (a) Conductivity of solution depends upon size of ions. (b) Conductivity depends upon viscosity of solution. (c) Conductivity does not depend upon solvation of ions present in solution. (d) Conductivity of solution increases with temperature.	[1]
9	Which of the following solutions of KCl will have the highest value of conductivity? (a) 0.5 M b) 0.01M c) 0.1M d) 1.0 M	[1]
10	.The highest electrical conductivity out of the following aqueous sol (a) 0.1 M acetic acid (b) 0.1 M chloro acetic acid (c) 0.1 M fluoroacetic acid (d) 0.1 M difluoro acetic acid	[1]
11	A galvanic cell can behave as an electrolytic cell when : (a) $E_{cell} = E_{ext}$ (b) $E_{cell} > E_{ext}$ (c) $E_{cell} = 0$ (d) $E_{ext} > E_{cell}$	[1]
12	Molar conductivity of 0.15 M solution of KCl at 298 K, if its conductivity is 0.0152 S cm^{-1} will be	[1]

	(a) 124 Ω^{-1} cm^2 mol^{-1} (b) 204 Ω^{-1} cm^2 mol^{-1} (c) 101 Ω^{-1} cm^2 mol^{-1} (d) 300 Ω^{-1} cm^2 mol^{-1}	
	Q. No. 13 – 16, two statements are given—one labelled Assertion (A) and the other labelled Reason (R). Select the correct option as given below: a. Both (A) and (R) are correct and (R) is correct explanation of (A). b. Both (A) and (R) are correct but (R) is not correct explanation of (A). c. (A) is correct, but (R) is incorrect statement. d. (A) is incorrect, but (R) is correct statement.	
13	Assertion: On increasing dilution, the specific conductance keeps on decreasing. Reason: On increasing dilution, degree of ionization of weak electrolyte increases and molality of ions also increases.	[1]
14	Assertion – Electrolysis of NaCI solution gives chlorine at Anode instead of oxygen. Reason- Formation of oxygen at anode require overvoltage.	[1]
15	Assertion (A) : In a cell Current stops flowing when $E_{Cell} = 0$. Reason (R) : Equilibrium of the cell reaction is attained.	[1]
16	Assertion: The cell potential of mercury cell is 1.35 v which remains constant . Reason : in mercury cell,the electrolyte is a paste of KOH and HgO.	[1]
	SECTION B **Question No. 17 to 21 are very short answer questions carrying 2 marks each**.	
17	Calculate the time to deposit 1.27 g of copper at cathode when a current of 2A was passed through the solution of $CuSO_4$. (Molar mass of Cu = 63.5 g mol^{-1},1 F = 96500 C mol^{-1})	[2]
18	The molar conductivity of 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1}. Calculate the conductivity of this solution.	[2]
19	Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution : $Ag^+(aq) + e^- \rightarrow Ag(s)$ $E° = +0.80$ V $H^+(aq) + e^- \rightarrow 1/2H_2(g)$ $E° = 0.00$ V On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why?	[2]

20	Write the reactions taking place at cathode and anode in lead storage battery when the battery is in use. What happens on charging the battery ? .	[2]
21	From the following cells and batteries: Lead storage battery, Mercury cell, Fuel cell and Dry cell Answer the following: (i) Which cell is used in hearing aids? (ii) Which cell was used in Apollo Space Programme? (iii) Which cell is used in automobiles and inverters? (iv) Which cell does not have long life?	[2]
	SECTION C **Question No. 22 to 28 are short answer questions, carrying 3 marks each.**	
22	The standard electrode potential of Zn^{2+}/Zn is –0.76 V and that of Cu^{2+}/Cu is +0.34 V at 298 K. (i) Calculate the standard Gibbs free energy change (ΔG°) for the reaction: $Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ (ii) Also calculate the equilibrium constant for the reaction.	[3]
23	Calculate the emf of the following cell at 25 0c $Al_{(S)}|Al^{3+}(0.001M)\ ||\ Ni^{2+}(0.1M)\ |Ni(s)$ Given $E^0\ Ni^{2+}/Ni$= -0.25V & $E^0\ Al^{3+}/Al$ =-1.66V Log 2= 0.3010, Log 3= 0.47	[3]
24	Calculate emf of the following cell at 25 °C: $Fe\ |\ Fe^{2+}\ (0.001\ M)\ ||\ H^+(0.01\ M)\ |\ H_2(g)\ (1\ bar)\ |\ Pt(s)$ $E°(Fe^{2+}\ |\ Fe) = –0.44\ V\ E°(H^+\ |\ H_2) = 0.00\ V$	[3]
25	a) How does molar conductivity vary with increase in concentration for strong electrolyte and weak electrolyte? b) b)How can you obtain limiting molar conductivity for weak electrolyte? X and Y are two electrolytes. On dilution molar conductivity of 'X' increases 2.5 times while that Y increases 25 times. Which of the two is a weak electrolyte? **OR** The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm2 mol^{-1}. Calculate the conductivity of this solution.	[3]

26	Resistance of a conductivity cell filled with 0.1 mol /L KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol /L KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol/L KCl solution. The conductivity of 0.1 mol /L KCl solution is 1.29 S/m.	[3]
27	Write correct cell notation if given cell notation is incorrect and calculate the emf and Gibb's energy of reaction for the following cell at 25°C : Ag(s) | Ag^{+} (10^{-3} M) || Cu^{2+} (10^{-1} M) | Cu(s) Given $E^{0}_{Ag+/Ag}$ = +0.80 V, $E^{0}_{Cu2+/Cu}$= +0.34 V [log 10^{n} = n log 10] Represent the cell in which the following reaction takes place Calculate its E(cell) if E^{o}(cell) = 3.17 V.	[3]
28	Calculate the emf of the following cell at 298 K : Al (s) | Al^{3+} (0.001 M) || Ni^{2+}(0.1 M) | Ni (s) Given: [$E^{o}_{Al^{3+}/Al}$ = – 1.66 V, $E^{o}_{Ni^{2+}/Ni}$ = - 0.25 V]	[3]
	SECTION D **Question No. 29 & 30 are case-based/data -based questions carrying 4 marks each.**	
29	The conductivity or specific conductivity of an electrolytic solution varies with the concentration of the solutions of different electrolytes. For comparing the conductance of the solutions of different electrolytes, it is essential that the solutions should have equal volumes and they must contain definite amount of the electrolytes which give ions carrying the same total charge. The conducting power of an electrolytic solution can be expressed in terms of equivalent conductance and molar conductance. The molar conductance of a solution does not vary linearly with concentration and it is related with specific conductance. The effect of molar conductance can be studied by plotting values against the square root of the concentration. Following two figures show the behaviour of strong and weak electrolytes with change of concentration. 	[4]

	Answer the following questions (a) What is meant by limiting molar conductivity? (b) Why on dilution the molar conductance of KCl increases drastically while that of CH_3COOH increases gradually? (c) The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1}. Calculate the conductivity of this solution. **OR** Calculate the degree of dissociation (α) of acetic acid if its molar conductivity (λ_m) is 39.05 S cm^2 mol^{-1}. Given λ^o_{H+} = 349.6 S cm^2mol^{-1} and $\lambda^o_{CH3COO^-}$ = 40.9 S cm^2mol^{-1}.	
30	Fuel cells and batteries are both electrochemical energy storage and conversion devices, but they differ fundamentally in their operation. Batteries store a fixed amount of chemical energy and convert it to electrical energy, while fuel cells generate electricity continuously as long as they are supplied with fuel like hydrogen, methane etc and an oxidant like oxygen. Batteries are also classified as primary batteries if they can be used only once or secondary batteries if they can be recharged by passing current through it in the opposite direction. Answer the following questions : (a) What are the fundamental differences between batteries and fuel cells? (b) The cell potential of Mercury cell is 1·35 V, and remains constant during its life. Give reason. (c) Write the reactions involved in the discharging of the lead storage battery. **OR** (c) Write the reactions involved in H_2-O_2 fuel cell.	[4]
	SECTION E **Question No. 31 to 33 are long answer type questions carrying 5 marks each.**	
31	a). Calculate emf of the cell in which following reaction takes place: $2Al(s) + 3\ Ni^{2+}(0.1M) \text{-----> } 2Al^{3+}(0.01M) + 3Ni(s)$ $[E^o cell = 1.41V]$ b). How does molar conductivity vary with increase in concentration for strong and weak electrolyte ? c). Why is alternating current used for measuring resistance of an electrolytic solution? **OR**	[5]

	a). State Kohlraush law for independent migration of ions ? b). Write two advantages of H_2-O_2 fuel cells aver ordinary cells. c). Calculate ΔG^o and log K_c for the following reaction: $Cd^{2+}(aq) + Zn(s) \text{ -----> } Zn^{2+}(aq) + Cd(s)$ [Given : $E^o(Cd^{2+}/Cd) = -0.403V$; $E^o(Zn^{2+}/Zn) = -0.763V$]	
32	a) Explain the variation of molar conductivity with concentration for strong electrolyte and weak electrolyte with help of diagram. b)The electrical resistance of a column of 0.25 mol/L HCOOH solution of diameter 1 cm and length 40 cm is 500 ohm. Calculate the conductivity, molar conductivity and degree of dissociation conductivity if $\lambda^0_{H^+} = 250 Scm^2mol^{-1}$ and $\lambda^0_{HCOO^-} = 175 Scm^2mol^{-1}$ **OR** a) State the law that is used for quantitative analysis of electrolysis. b) Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries? c) How much copper metal will be deposited when 2A current is passed through $CuSO_4$ solution for 10 minutes? (Atomic mass of Cu = 63.5 g/mol)	[5]
33	a)Λ^0m for NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 S cm^2 mol^{-1} respectively. Calculate Λm_0 for CH_3COOH. b) The electrical resistance of a column of 0.05 mol L^{-1} NaOH solutions of diameter 1 cm and length 50 cm is 5.55×10^3ohm. Calculate its resistivity, conductivity and molar conductivity. **OR** a)Write the Nernst equation and calculate emf of the following cells at 298 K: $Mg(s)\|Mg^{2+}(0.001M)\|\|Cu^{2+}(0.0001\ M)\|Cu(s)$ b)Consider the reaction: $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$ What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$	[5]

GEETA DEVI
PGT CHEMISTRY
PM SHRI KENDRIYA VIDYALAYA MUZAFFARNAGAR
SHIFT I

KENDRIYA VIDYALAYA SANGATHAN

AGRA REGION

CLASS – XII

CHEMISTRY (043)

Max. Marks: 70 **Time: 3 Hours**

CLASS: XII

CHAPTER : CHEMICAL KINETICS

GENERAL INSTRUCTIONS:

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

(log1.6=0.204, log 35=1.54, log54=1.73, log 63 =1.8, log 16=1.2,

log7 =0.84, log2= 0.30)

SECTION A

Questions No. 1 to 16 are Multiple Choice type questions carrying 1 markeach.

1. In the presence of a catalyst, the heat evolved or absorbed during the reaction

(a) increases

(b) decreases

(c) remains unchanged

(d) may increase or decrease

2. Activation energy of a chemical reaction can be determined by

(a) determining the rate constant at standard temperature

(b) determining the rate constant at two temperatures

(c) determining probability of collision

(d) using catalyst

3. Consider the Arrhenius equation given below and mark the correct option.

$$K=A\, e^{-Ea/RT}$$

(a) Rate constant increases exponentially with increasing activation energy and decreasing temperature

(b) Rate constant decreases exponentially with increasing activation energy and decreasing temperature

(c) Rate constant increases exponentially with decreasing activation energy and decreasing temperature

(d) Rate constant increases exponentially with decreasing activation energy and increasing temperature

4. Which of the following statements is not correct about order of a reaction?

(a) The order of a reaction can be a fractional number

(b) Order of a reaction is experimentally determined quantity

(c) The order of a reaction is always equal to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction

(d) The order of a reaction is the sum of the powers of molar concentration of the reactants in the rate law expression

5.On which of the following magnitude of conductivity does not depends?

(a) Nature of material (b) Temperature (c) Pressure (d) Mass of the material

6. Rate law for the reaction A+2B--> C is found to be

Rate =K[A][B]

Concentration of reactant ' B ' is doubled, keeping the concentration of 'A ' constant, the value of rate constant will be…

(a) the same

(b) doubled

(c) quadrupled

(d) halved

7. Which of the following statement is not correct for the catalyst?

(a) It catalyses the forward and backward reactions to the same extent

(b) It alters of the reaction

(c) It is a substance that does not change the equilibrium constant of a reaction

(d) It provides an alternate mechanism by reducing activation energy between reactants and products

8. When 9650 coulombs of electricity is passed through a solution of copper sulphate, the amount of copper deposited is (given at. wt. of Cu = 63.6)

(a) 0318g (b) 3.18 g (c) 31.8g (d) 63.6g

9. Half-life of a substance following first order kinetics is 100 min. Starting with 20g of A, amount left after 300 min is

(a) 2.5 g

(b) 1.25 g

(c) 10 g

(d) 5 g

10. The slope of the plot of In [R] vs time for a first order reaction gives

(a) + k

(b) + $\frac{K}{2.303}$

(c) -k

(d) - $\frac{K}{2.303}$

11.For the reaction, A+2B → AB_2, the order w.r.t. reactant A is 2 and w.r.t. reactant Bis zero. What will be change in rate of reaction if the concentration of A is doubled and B is halved?

(a) increases four times

(b) decreases four times

(c) increases two times

(d) no change

12. The unit of rate constant for the reaction : 2A+2B → A_2B_2 which has rate = $k[A]^2[B]$ is :

(a) mol L's^{-1}

(b) s-1

(c) mol L^1

(d) mol^{2}L's^{-1}

Question number 13-16 are of assertion–reason type questions. Select the most appropriate answer from the options given below:

(a) Both A and R are true and R is the correct explanation of A

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

(c) Ais true but R is false.

(d) A is false but R is true

13. Assertion (A) The order of a reaction can have fractional value

Reason (R) The order of a reaction cannot be written from balanced equation of a reaction.

14. Assertion (A) Rate of reaction is a measure of change in concentration of reactant with respect to time.

Reason (R) Rate of reaction is a measure of change in concentration of product with respect to time.

15. Assertion (A) Molecularity has no meaning for a complex reaction.

Reason (R) The overall molecularity of a complex reaction is equal to the molecularity of the slowest

16.. Assertion (A): Rate of reaction increases with increase in temperature.

Reason (R): Number of effective collisions increase with increase in temperature.

SECTION B

17. The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate E_a.

18. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is 4 x 10^{-3} M s^{-1}.How long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M?

19. In a reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, the concentration of N_2O_5 decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the average rate of this reaction and rate of production of NO_2 during this period.

20. a) Write two conditions for collisions to be effective collisions.

b) How do order of reaction and molecularity differ towards a complex reaction?

21.A first order reaction takes 40 minutes for 20% completion. Calculate its Half life period .

SECTION C

22. The activation energy for the reaction

$2HI(g)\ H_2(g) + I_2(g)$

is 209.5 kJ mol^{-1} at 581 K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy.

23. Two reactions of the same order have equal pre-exponential factors but their activation energies differ by 24.9 kJ mol-1. Calculate the ratio between the rate constants of these reactions at 27°C

(Gas constant, R = 8.3 JK-1 mol-1).

24. For a first order reaction, time taken for half of the reaction to complete is t_1 and 3/4 of the reaction to complete is t_2. How are t_1 and t_2 related ?

25. Areaction is first order in reactant A and second order in reactant B.

(i) Write differential rate equation.

(ii) How is the rate affected when concentration of B alone is increased to three times?

(iii) How is the rate affected when concentration of both A and B are doubled ?

26. a. What is the effect of adding a catalyst on

(i) Activation energy

(ii) Gibbs free energy of a reaction?

b. Can activation energy for reactions be zero ?

27. The time required for 10% completion of a first order reaction at 298 K is equal to that required for its 25% completion at 308 K. If the value of A is $4 \times 10^{10} s^{-1}$ calculate k at 318 K and E_a.

28. The rate of reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (2+1+1) marks each. Read the passage carefully and answer the questions that follow

29. Rate of reaction depends upon the experimental condition such as concentration of reactants, temperature and catalyst. Mathematical representation of rate of reaction is given by rate law

Rate = k[A][B]

A balanced equation never gives a true picture of how a reaction takes place since rarely does a reaction get completed in one step. The reaction taking place in one step are called elementary reactions. When a sequence of elementary reactions give us products, the reactions are called complex reactions. Order and molecularity of elementary reactions are same.

Answer the following questions:

(a) A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E) for the reaction. [R = 8.314 J K^1 mol^1

[Given: log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021]

(b) How are molecularity and order are different for complex reaction?

OR

What are units of third order reaction?

(c) What is order and molecularity of following reaction:

$H_2(g) + Cl_2(g)$ Sun $\rightarrow$ 2HCl(g) light

30. Most of chemical reactions are accelerated by increase in temperature. For example, in decomposition of N_2O, the time taken for 11/2 = 12 min at 50° C, 5 hours at 25°C and 10 days at 0°C, acidified KMnO, reacts very slowly with oxalic acid at room temperature but faster at 60-70° C. The rate of reaction becomes almost double for every 10° rise in temperature. Catalyst increases the rate of reaction without itself undergoing any permanent chemical change.

Answer the following questions:

(a) The rate of reaction becomes double when temperature is increased from 300 K to 310 K. Calculate activation energy. (Given: 2.303 R = 19.15, log 2 = 0.30)

(b) Name the catalyst used in the following reaction.

$2KClO_3 \rightarrow 2KCl + 3O_2$

OR

Why does rate of reaction increase by using catalyst?

(c) Write the equation which represents temperature dependence of rate of reaction accurately.

SECTION E

31 (a) The activation energy of a reaction is 100 kJ/mol. In the presence of catalyst the activation energy is decreased by 75%. What is the effect on rate constant of the reaction at 20°C?

(b). The rate constant of a first order reaction becomes 6 times when the temperature is increased from 350 K to 410 K. Calculate the energy of activation for the reaction. (Gas constant R = 8.314JK^{-1}mol^{-1}).

OR

(a)What is the effect of adding catalyst on the free energy of a reaction?

(b). What happens to the activation energy E, and rate constant as the temperature of a chemical action is increased? Justify.

32(a) The rate of reaction, 2NO + Cl2→2 NOCI is double when concentration of Cl_2 is doubled and it becomes eight times when concentration of both NO and Cl_2 are doubled. Deduce the order of the reaction.

(b). Write the rate equation for 2 A+ B → C if the order of the reaction is zero.

OR

For a first order reaction, calculate the ratio between the time taken to complete 3/4 of the reaction and the time taken to complete half of the reaction

(a) Show that the time required for completion of the of 3 /4th

reaction of first order is twice that of half-life of the reaction.

33. Pressure of the gaseous reactant on the surface of a solid at different intervals of times is given below. Show that the decomposition of the gas is a zero order reaction. Calculate *k*and $t_{1/2}$ also.

Time (in sec.)	Pressure (in Pa)
0	5.0×10^3
100	4.2×10^3
200	3.4×10^3
300	2.6×10^3

33b)Why reactions of higher order are less in number?

OR

33a)The rate constant for the first order decomposition of $H_2O$is given by the following equation:

log k = 14.34 – 1.25 x 10^4K/t

Calculate E_a for this reaction. At what temperature will its half-period be 256 minutes?

33b)Why is Carbon 14 radioactive while Carbon 12 is not?

KENDRIYA VIDALAYA SANGATHAN AGRA REGION

SUB-CHEMISTRY (CODE - 043)

d and f block elements

CLASS XII (2026-27)

Time: 3 hours **Max. Marks: 70**

GENERAL INSTRUCTIONS:

Read the following instructions carefully.

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

Q1 The number of unpaired electrons in gaseous species of Mn3+, Cr3+ and V3+ respectively are:

A) 4, 4 and 2 B) 3, 3 and 2

C) 4, 3 and 2 D)3, 3 and 3

Q2. Gun metal is an alloy of:

A) Cu and Al B) Cu and Sn

C) Cu, Zn and Sn D) Cu, Zn and Ni

Q3. Which one of the following elements shows the maximum number of different oxidation states in its compounds?

A) Eu B)La

C) Cd D)Am

Q4. Which of the following characteristics of transition elements is associated with their catalytic activities?

A) Paramagnetic nature

B) Colour of hydrated ion

C) High enthalpy of atomisation

D) Variable oxidation state

Q5. Zinc and mercury do not show variable valency like d-block elements because

A) They are soft

B) Their d-shells are completed.

C) They have only two electrons in the outermost subshell.

D) Their d-shell is not completed.

Q6. $KMnO_4$ acts as an oxidising agent in alkaline medium. When alkaline $KMnO_4$ is treated with KI , iodide ions are oxidised to

A) I_2 B) IO^-

C) IO^{3-} B) IO^{4-}

Q7. The pair that has similar atomic radii is

A) Mn and Re B)Ti and Hf

C) Sc and Ni D)Mo and W

Q8. The most common oxidation state of lanthanoid is

A)+3 B)+2

C)+4 D)+6

Q9. Lanthanoid contraction is due to increase in

A) atomic number B) effective nuclear charge

C) atomic radius D) valence electrons

Q10. Generally transition elements form coloured salts due to the presence of unpaired electrons. Which of the following compounds are coloured in solid state.

A) Ag_2SO_4 B) CuF_2

C) ZnF_2 D) Cu_2Cl_2

Q11. The oxidation state of Cr in final product formed by reaction of KI and acidified dichromate solution is-

(A) +4 (B) +6 (C) +2 (D) +3

Q12. Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids?

(A) Ce (B) Eu (C) Tb (D) Ho

ASSERTION REASON TYPE QUESTIONS (1MARK EACH)

In the Following questions a statement of Assertion(A) is followed by a statement of Reason(R). Select the most appropriate answer from the options given below:

A) Both A and R are true and R is the correct explanation of A

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

C) A is true but R is false.

D) A is false but R is true.

Q13. Assertion: Cr (VI) in the form of dichromate in acidic medium is a strong oxidizing agent.

Reason: Cr (III) is more stable in aqueous medium.

Q14. Assertion: Ce (IV) is stable.

Reason: All the Lanthanoides cannot exhibit +4 oxidation states.

Q15. Assertion: Zn, Cd, Hg and Cn are not regarded as transition metals.

Reason: These elements do not belong to the d-block of the periodic table.

Q16. Assertion: In the series Sc to Zn the enthalpy of atomisation of Zinc is the lowest.

Reason: Zinc has all paired electrons, so metal-metal bond is weaker.

SECTION B (2 MARKS EACH)

Q17. In the series Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomization of zinc is the lowest, i.e., 126 kJ/mol. Why?

OR

What is meant by 'disproportionation' of an oxidation state? Give an example.

Q18. Why is Cr2+ reducing and Mn3+ oxidising when both have d4 configuration?

Q19. (i) Explain why Cu+ ion is not stable in aqueous solutions?

(ii) How would you account for the increasing oxidising power in the series?

VO2+< Cr2O72–< MnO4–

Q20. Why is the E^o value for the Mn3+/Mn2+ couple much more positive than that for Cr3+/Cr2+ or Fe3+/Fe2+? Explain.

Q21. Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.

SECTION C (3 MARKS EACH)

Q22. (i) Name a member of the lanthanoids series which is well known to exhibit +4 oxidation state.
(ii) Actinoids contraction is greater from element to element than lanthanoids contraction. Why?

(iii) Which out of Lu (OH)3 and La(OH)3 is more basic and why?

Q23. (i) Name a member of the lanthanoids series which is well known to exhibit +2 oxidation state.

(ii) Actinoids show more variability in oxidation states than lanthanoids. Why?

(iii) Which out of Ce(OH)3 and Yb(OH)3 is more basic and why?

Q24. (a) Indicate the steps in the preparation of K2Cr2O7 from chromite ore.

(b) What is the effect of increasing pH on a solution of potassium dichromate?

(c) Describe the oxidising action of potassium dichromate and write the ionic equations for its reaction with: (i) Iodide (ii) iron(II) solution and (iii) H2S

Write the ionic equations for the reactions.

Q25 Account for the following:
(a) Mn_2O_7 is acidic whereas MnO is basic.
(b) Though copper has completely filled d-orbital (d^{10}) yet it is considered as a transition metal.
(c) Actinoids show a wide range of oxidation states.
Q26. Explain giving a suitable reason for each of the following:-
a. Metallic bonding is more frequent for the 4d & 5d series of transition metals than 3d series.
b. Cu+ salts are colourless while Cu2+ salts are Coloured.
c. Mn2+ exhibits maximum paramagnetism.
Q27. Account for the following
(a) Metal –metal bonding is more frequent for the 4d & 5d series of transition metals than that for the 3d series.
(b) d1 configuration is very unstable in ions.
(c) Although Zr belongs to 4d and Hf belongs to 5d transition series but it is quite difficult to separate them.
Q28. Assign reasons for the following:

(a) Scandium is a transition element but Zinc is not.
(b) Silver atom has completely filled d orbital (4d10) in its ground state, yet it is transition element.
(c) The higher oxidation states are usually exhibited by the members in the middle
of a series of transition elements ?

SECTION D (4 MARKS EACH)

Q29 CASE BASED QUESTIONS

The Following questions are case based questions that carry 4 (1+1+2) marks. Read the given passage carefully and answer the questions that follow:

Transition elements are elements that have partially filled d-orbitals. The configuration of these elements corresponds to (n - 1) d1-10 ns1-2. It is important to note that the elements mercury, cadmium and zinc (are not considered transition elements because of their electronic configurations, which corresponds to (n - 1) d1-10 ns2.

Some general properties of transition elements are :

These elements can form colored compounds and ions due to d-d transition;

These elements exhibit many oxidation states. A large variety of legends can bind themselves to these elements, due to this, a wide variety of stable complexes formed by these ions. The boiling and melting point of these elements are high. These elements have a large ratio of charge to the radius.

a. Give reason Zn is soft whereas Cr is hard.

b. Explain why transition metals show higher oxidation state with oxygen as compare to fluorine.

c. Why Zn, Cd and Hg have low melting and boiling point?

OR

c. The enthalpies of atomization of transition elements are high. Give reason

Q30 CASE BASED QUESTIONS

The Following questions are case based questions that carry 4 (1+1+2) marks. Read the given passage carefully and answer the questions that follow:

Iron and steel are the most important construction materials. Their production is based on the reduction of iron oxides, the removal of impurities and the addition of carbon and alloying metals such as Cr, Mn and Ni. Some compounds are manufactured for special purposes such as TiO for the pigment industry and MnO_2 for use in dry battery cells. The battery industry also requires Zn and Ni/Cd. The elements of 11 group are still worthy of being called the coinage metals, although Ag and Au are restricted to collection items and the contemporary UK ‘copper’ coins are copper-coated steel. The ‘silver’ UK coins are a Cu/Ni alloy. Many of the metals and/or their compounds are essential catalysts in the chemical industry. V_2O_5 catalyses the oxidation of SO_2 in the manufacture of sulphuric acid.

a. what do you mean by interstitial compounds.

b. Transition metals are well known to form alloys. Why?

c. coinage metals are treated as transition elements although they are having (n-1) d^{10} fully filled configuration.

OR

Transition metals and their many compounds act as good catalyst.

SECTION E(5 MARKS EACH)

Q31. Explain giving reasons:

(i) Which of the following ions will have a magnetic moment value of 1.73 BM.

Sc3+, Ti3+, Ti2+, Cu2+, Zn2+

(ii) In order to protect iron from corrosion, which one will you prefer as a sacrificial electrode, Ni or Zn? Why? (Given standard electrode potentials of Ni, Fe and Zn are -0.25 V, -0.44 V and -0.76 V respectively.)

(iii) The second ionization enthalpies of chromium and manganese are 1592 and 1509 kJ/mol respectively. Explain the lower value of Mn.

(iv) Give two similarities in the properties of Sc and Zn.

(v) What is actinoid contraction? What causes actinoid contraction? OR

Explain giving reasons:

(i) Write the ionic equation for reaction of KI with acidified KMnO4.

(ii) The enthalpies of atomization of the Mn is low.

(iii) Ag+ and Zn^{2}+ compounds are colourless.

(iv) Pt and Ni act as good catalysts.

(v) Scandium (Z = 21) does not exhibit variable oxidation states.

Q32. Give Reasons for the following

i) Ce4+ in aqueous solution is a good oxidising agent.

ii) Actinoids contraction is greater from element to element than lanthanoid contraction.

iii) There is in general increase in density of element from titanium to copper.

iv) La^{3+} and Lu^{3+}do not show any colour in solutions.

v) Chemistry of all the lanthanoids are quite similar.

OR

(A)Complete and balance the following reactions

a) $Cr_2O_7^{2-} + Fe^{2+} + H^+ \rightarrow$

b) $MnO_4^- + H^+ + C_2O_4^{2-} \rightarrow$

c) $Cr_2O_7^{2-} + OH^- \rightarrow$

d) $MnO_4^- + H_2O + I^- \rightarrow$

(B) Name the oxo metal anion of one of the transition metals in which the metal exhibits the oxidation state equal to the group number.

Q33 i) What is the general configuration of d-block elements?

ii) How do the d-block elements differ from f-block elements?

iii) Why are 4f series called lanthanides?

iv) What are the characteristics of d-block elements?

v) What are the catalytic properties of transition elements?

OR

Describe the oxidising action of potassium dichromate and write the ionic equations for its reaction with:

(i) iodide ions (ii) iron(II) solution and (iii) H_2S

(iv) Tin (II) ions (v) SO_3^{2-} ions

KENDRIYA VIDALAYA SANGATHAN AGRA REGION
SUB-CHEMISTRY (CODE - 043)
COORDINATION COMPOUNDS
CLASS XII (2026-27)

Time: 3 hours **Max. Marks: 70**

GENERAL INSTRUCTIONS:

Read the following instructions carefully.

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

Section A: (1 mark each)

Multiple Choice Questions (Q1 to Q12): (1 × 16 = 16 Marks)

1.Which of the following ligands are bidentate?

I. CN^- II. en III. SCN^- IV. $C_2O_4^{2-}$

A. I & II B. I &III C. II & IV D. None of the above

2. The oxidation state of iron in $[Fe(CN)_6]^{3-}$ is:

A. +3 B. +2 C. +1 D. 0

3.Which of the following is an example of a homoleptic complex?

I. $[Co(NH_3)_6]\ Cl_3$ II. $[Fe(CN)_5Br]^{3-}$

III. $[Pt(NH_3)_2Cl_2]$ IV. $[Ni(CO)_4]$

A. I & II B. I& IV C. II & III D. III & IV

4.The coordination number and oxidation state of central metal atom in the Complex $[Co(en)_2Cl_2]Cl$ are:

A. 4, +3 B. 6, +2 C.6, +3 D. 4, +2

5 Which of the following exhibits geometrical isomerism?

A. $[Ni(CN)_4]^{2-}$ B. $[Pt(NH_3)_2Cl_2]$ C. $[Fe(H_2O)_6]^{3+}$ D. $[Co(NH_3)_6]^{3+}$

6.Which of the following is not a chelating ligand?

A. en B. CN^- C. $C_2O_4^{2-}$ D. EDTA

7.In the complex $[Ni(CO)_4]$, the hybridisation of Ni is:

A. sp^3 B. dsp^2 C. d^2sp^3 D. sp^2

8.Which one of the following complexes will exhibit optical isomerism?

A. $[Co(en)_3]^{3+}$ B. $[Cr(NH_3)_6]^{3+}$ C. $[Pt(NH_3)_2Cl_2]$ D. $[Ni(CN)_4]^{2-}$

9.Which of the following will not ionise in aqueous solution?

A. $[Ni(H_2O)_6]Cl_2$ B. $[Co(NH_3)_6]Cl_3$

C. $[Pt(NH_3)_2Cl_2]$ D. $Na_4\ [Fe(CN)_6]$

10.The IUPAC name of $[Cr(NH_3)_4Cl_2]Cl$ is:

A. Tetraamminechloridochromium (III) chloride

B. Tetraamminedichloridochromium (III) chloride

C. Dichlorotetraamminechromium (III) chloride

D. Chromium(III) tetraammine dichloride chloride

11.The colour of a coordination complex is due to:

A. s-s transition B. d-d transition C. f-f transition D. p-p transition

12.Which of the following is a correct statement about ligand field theory?

A. It treats ligands as point charges

B. It considers only covalent bonding

C. It ignores metal-ligand interactions

D. It applies only to alkali metals

Assertion and Reasoning (Q13 to Q16):

Direction: For each of the following questions, two statements are given: Assertion (A) and Reason (R). Choose the correct option:

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, but R is not the correct explanation of A.

(C) A is true, but R is false.

(D) A is false, but R is true. Assertion

13. Assertion(A): Coordination compounds are useful in medicine for treating diseases.

Reason (R): Some coordination compounds, like cisplatin, are used as anticancer agents due to their ability to interact with DNA.

14 Assertion (A): $[Fe(CN)_6]^{3-}$ is low spin.

Reason (R): CN^- causes minimum splitting of d-orbitals in crystal field.

15 Assertion (A): Coordination number depends on the size of the central atom.

Reason (R): Larger atoms can accommodate more ligands around them.

16 Assertion (A): Cis$[M(AA)_2X_2]$ isomer is optically active but trans-$[M(AA)_2X_2]$ isomer is optically inactive

Reason (R): trans - isomer has plane of symmetry.

Section B: (2 marks each) (5 × 2 = 10 Marks)

17.Define coordination number and write the coordination number of Fe in$[Fe(C_2O_4)_3]^{3-}$.

18. (A) Using crystal field theory write electronic configuration of d^5 species, if $\Delta_0 > P$.

(B) Arrange the following complex ions in increasing order of crystal field splitting

energy (Δo): $[CrCl_6]^{3-}$, $[Cr(CN)_6]^{3-}$, $[Cr(NH_3)_6]^{3+}$.

19.What is the difference between a double salt and a complex salt? Give one example of each.

20.Write the formula and draw the structure of a complex formed by Co^{3+} and $EDTA^{4-}$.

21 Explain the spliting of d orbital in octahedral field .

Section C: (3 marks each)

(7 × 3 = 21 Marks)

22. Identify the types of isomerism exhibited by the following complexes:

(a) $[Co(NH_3)_5Br]SO_4$

(b) $[Co(en)_2Cl_2]$

(c) $[Pt(NH_3)_2Cl_2]$

23. A complex compound has the formula $[Co(NH_3)_5SO_4]Br$. Write:

(a) The IUPAC name

(b) The primary valency

(c) The secondary valency

24. Using Crystal Field Theory, explain why $[Fe(CN)_6]^{3-}$ is low spin while $[FeF_6]^{3-}$ is high spin.

25. Write the Oxidation state of metal ,hybridisation, magnetic behaviour, and geometry of the following complex: $[Fe(CO)_5]$.

26. Define the following terms with one example each:
(a) Ambidentate ligand
(b) Chelate effect
(c) Linkage isomerism

27.Calculate the magnetic moment of $[Cr(H_2O)_6]^{3+}$ and state whether it is paramagnetic or diamagnetic.

28.State a reason for each of the following situations:
(i) Co^{2+} is easily oxidized to Co^{3+} in presence of a strong ligand.
(ii) CO is a stronger complexing reagent than NH_3.
(iii) Chelate complexes are more stable than their monodentate counterparts.

Section D: Case-Based Questions

(2 Questions × 4 = 8 Marks)

29. Case Study – Geometry and Hybridisation

Read the passage and answer the following questions:

The geometry of a coordination complex depends on the hybridisation of the central atom. For example, in $[Ni(CO)_4]$, nickel undergoes sp^3 hybridisation forming a tetrahedral complex. In contrast, $[Ni(CN)_4]^{2-}$ has dsp^2 hybridisation, giving a square planar geometry.

Questions:

a) What is the oxidation state of Ni in $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$?
b) Explain the difference in magnetic properties between the two complexes.
c) Identify the type of ligand CO and CN^- are (weak field or strong field).
d) Which of the two complexes will be more stable and why?

30. Read the given passages and answer the questions that follow.

Complex compounds play an important role in our daily life. Werner's theory of complex compounds says every metal atom or ion has primary valency (oxidation state) which is satisfied by negatively charged ions, ionizable where secondary valency (coordination number) is non-ionizable, satisfied by ligands (+ve, –ve, neutral) but having lone pair. Primary valency is non-directional, secondary valency is directional. Complex compounds are name according to IUPAC system. Valence bond theory helps in determining shapes of complexes based on hybridization, magnetic properties, outer or inner orbital complex. Complex show ionization, linkage, solvate and coordination isomerism also called structural isomrism. Some of them also show stereoisomerism i.e., geometrical and optical isomerism.
Ambidentate ligand are essential to show linkage isomerism.
Polydentate ligands form more stable complexes then unidentate ligands. There are called chelating agents. EDTA is used to treat lead poisoning, cis-platin as anticancer agents. Vitamin B12 is complex of cobalt. Hemoglobin, oxygen carrier is complex of Fe^{2+} and chlorophyll essential for photosynthesis is complex of Mg^{2+}.
(i) Write the Name of metal present in vitamin B-12.
(ii)Out Cis $[Pt(en)_2Cl_2]^{2+}$ and trans $[Pt(en)_2\ Cl_2]^{2+}$ which one shows optical isomerism?
(iii)One mole of CrCl3. 6H2O reacts with excess of AgNO3 to yield 1 moles of AgCl. Write formula of complex. Write IUPAC name also.

OR

Name the hexadentate ligand used for treatment of lead poisoning. Write IUPAC name also.

Section E: Long Answer Questions

(3 Questions × 5 = 15 Marks)

31. A coordination compound has the empirical formula $CoCl_3 \cdot 6NH_3$. When it is dissolved in water, it gives a white precipitate with $AgNO_3$. However, another compound with the same empirical formula does not give a precipitate with $AgNO_3$. A third compound with the same empirical formula gives a partial white precipitate.

Based on this information:

a) Write the structural formulas of the three possible isomers.
b) Identify the types of isomerism shown by these compounds.
c) Explain the test with $AgNO_3$ in terms of ionisation.
d) Give the IUPAC names of the three isomers.

32. Coordination compounds play a vital role in biological systems and industrial processes. Consider the following two coordination compounds:

- **$[Fe(CN)_6]^{4-}$**
- **$[Fe(H_2O)_6]^{2+}$**

a) Compare the magnetic properties of both complexes using Crystal Field Theory.
b) Determine the oxidation state and electronic configuration of Fe in each complex.

c) Predict which complex is more stable and explain why.
d) How does the nature of ligands influence the colour of the complex?

33. a) i) What is meant by crystal field splitting energy?
ii) On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t^2g and eg in an octahedral field when (a) $\Delta o > P$ (b) $\Delta o < P$

b) Write the hybridisation and number of unpaired electrons in the complex $[CoF6]^{3-}$ (Atomic Number of Co =27)

OR

(I) Give IUPAC name of the ionization isomer of $[Ni(NH_3)_3NO_2]Cl$.

(ii) Which of the following is more stable complex and why?

$[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$

(III) Why are low spin tetrahedral complexes not formed?

(iv) Describe the shape and magnetic behaviour of following complex:

$[Ni(CN)_4]^{2-}$ (At. No. , Ni = 28)

KENDRIYA VIDYALAYA SANGATHAN, AGRA REGION

PRACTICE PAPER(2026-27)

CLASS-XII

TIME: 3:00 Hrs. **SUBJECT -CHEMISTRY** **M.M: 70**

HALOALKANES & HALOARENES

SECTION-A

Sr. No.	MCQs	Marks
1.	Recimisation of configuration is observed in (a) S_N1 (b) S_N2 (c) Neither S_N1 nor S_N2 (d) S_N1 as well as S_N2	1
2.	Which alkyl halide will undergo S_N1 faster (a) $(CH_3)_3C$-Br (b) $(CH_3)_2CH$-Br (c) CH_3-CH_2-Br (d) $(CH_3)_3CH_2$-Br	1
3.	The conversion of an alkyl halide into an alkene by alcoholic KOH is classified as	1

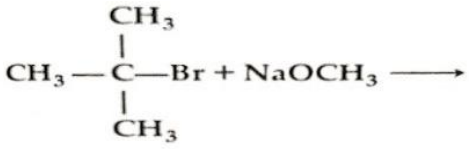
(a) a substitution reaction (b) an addition reaction

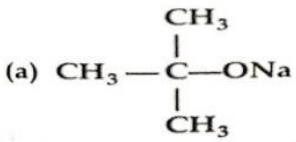
(c) a dehydrohalogenation reaction (d) a dehydration reaction

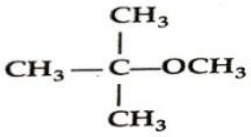
4. Which of the following has highest boiling point 1

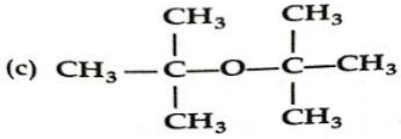
(a) C_2H_5- F (b) C_2H_5- Cl (c) C_2H_5- Br (d) C_2H_5- I

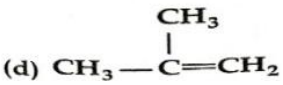
5. Major product formed in the following reaction 1



(a) 

(b) 

(c) 

(d) 

6. Which of the following isomer has the highest melting point? 1

(a) 1,2-dichlorobenzene (b) 1,3-dichlorobenzene

(c) 1,4-dichlorobenzene (d) All isomers have same melting points

7. The organic compound used in refrigerators and air conditioner is- 1

(a) DDT (b) freon (c) Carbon tetrachloride (d) BHC

8. The catalyst used in the preparation of an alkyl chloride by the action of dry HCl on an alcohol is- 1

(a) $FeCl_3$ (b) Cu (c) anhydrous $AlCl_3$ (d) anhydrous $ZnCl_2$

9. Chronic chloroform exposure may cause damage to liver and kidneys due to formation of- 1

(a) methylene chloride (b) phosgene gas (c) methyl chloride (d) carbon tetrachloride

10. What should be the correct IUPAC name for diethylbromomethane is- 1

(a) 1-bromo-1,1-diethylmethane (b) 3-bromopentane

(c) 1-bromo-1-ethylpropane (d) 1-bromopentane

11. Toluene reacts with a halogen in the presence of iron(III) chloride giving ortho and para halo compound. This reaction is called 1

(a) Electrophilic elimination reaction (b) Electrophilic substitution reaction

(c) Free radical addition reaction (d) Nucleophilic substitution reaction

12. Match the following 1

Column–I	Column–II
(*i*) S_N1 reaction	A. *vic*-dibromides
(*ii*) Chemical in fire extinguisher	B. *gem*-dihalides
(*iii*) Bromination of alkenes	C. Racemisation
(*iv*) Alkylidene halides	D. Saytzeff rule
(*v*) Elimination of HX from alkylhalide	E. Chlorobromocarbons

(*a*) (*i*) — C, (*ii*) — E, (*iii*) — A, (*iv*) — B, (*v*) — D
(*b*) (*i*) — A, (*ii*) — B, (*iii*) — C, (*iv*) — D, (*v*) — E
(*c*) (*i*) — B, (*ii*) — C, (*iii*) — E, (*iv*) — D, (*v*) — A
(*d*) (*i*) — A, (*ii*) — C, (*iii*) — E, (*iv*) — D, (*v*) — B

Question no. 13 to 16 consist of two statements- Assertion (A) and Reason (B). Answer these questions by selecting the appropriate option given below:

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

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

(c) A is true but R is false.

(d) A is false but R is true.

13. Assertion (A): Alkyl halides are insoluble in water. 1

Reason (R): Alkyl halides have halogen attached to sp3 hybridised carbon.

14. Assertion (A): Aryl halides undergo nucleophilic substitution reaction with ease. 1

Reason (R): The carbon halogen bond in aryl halides having partial double bond character.

15. Assertion (A): Aryl iodide can be prepared by reaction of arenes with iodine in presence of an oxidising agent. 1

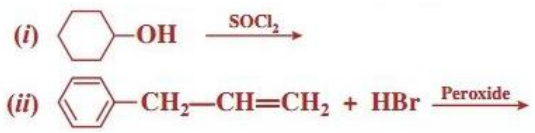
Reason (R): Oxidising agent oxidises I_2 into HI.

16. Assertion (A): *tert*- butyl bromide undergo Wurtz reaction to give 2,2,3,3tetramethylbutane. 1

Reason (R):In Wurtz reaction, alkyl halides reacts with sodium in dry ether to give hydrocarbon containing double the number of carbon atoms present in alkyl halide.

SECTION-B

17. Draw the structure of major monohalo product in each of the following reactions: 2



18. Give reasons: 2

(i) C-Cl bond length in chlorobenzene is shorter than C-Cl bond length in CH_3-Cl.

(ii) S_N1 reactions are accompanied by racemisation in optically active alkyl halides.

19. How will you distinguish between the following pairs of compounds: 2

(i) Chloroform and carbon tetrachloride.

(ii) Benzyl chloride and chlorobenzene.

20. Write equations for the following: 2

(i) Oxidation of chloroform by air and light

(ii) Reaction of chlorobenzene with CH_3Cl/anhyd. $AlCl_3$

21. Predict the order of reactivity of the following compounds in S_N1 and S_N2 reactions: 2

$C_6H_5CH_2Br$, $C_6H_5CH(C_6H_5)Br$, $C_6H_5CH(CH_3)Br$, $C_6H_5C(CH_3)(C_6H_5)Br$

SECTION- C

22. How do you convert the following: 3

(i) Prop-1-ene to 1-fluoropropane (ii) Chlorobenzene to 2-chlorotoluene

(iii) Ethanol to propanenitrile

23. Compound 'A' with molecular formula C_4H_9Br is treated with aq. KOH solution. The rate of this reaction depends upon the concentration of the compound 'A' only. When another optically active isomer 'B' of this compound was treated with aq. KOH solution, the rate of reaction was found to be dependent on concentration of compound and KOH both. 3

(i) Write down the structural formula of both compounds 'A' and 'B'.

(ii) Out of these two compounds, which one will be converted to the product with inverted configuration?

24. Give reasons for the following observations: 3

(i) p-dichlorobenzene has higher melting point than those of o- and m-isomers.

(ii) Haloarenes are less reactive than haloalkanes towards nucleophilic substitution reaction.

(iii) The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohol but in the presence of alcoholic KOH, alkene is the major product.

25. Give reasons: (i) n-Butyl bromide has higher boiling point than t-butyl bromide. 3

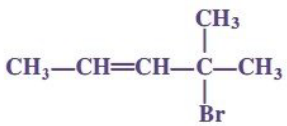
(ii) Racemic mixture is optically inactive.

(iii) The presence of nitro group (NO_2) at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reactions.

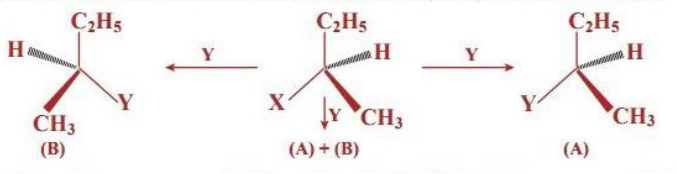
26. (a) Write equation for preparation of 1-iodobutane from 1-chlorobutane. 3

(b) Out of 2-bromopentane, 2-bromo-2-methylbutane and 1-bromopentane, which compound is most reactive towards elimination reaction and why?

(c) Give IUPAC name of



27. Consider the three types of replacement of group X by group Y as shown here. 3



This can result in giving compound (A) or (B) or both. What is the process called if

(i) (A) is the only compound obtained?

(ii) (B) is the only compound obtained?

(iii) (A) and (B) are formed in equal proportions?

28. Give reasons for the following: 3

(i) p-nitrochlorobenzene undergoes nucleophilic substitution faster than chlorobenzene. Explain giving the resonating structures as well.

(ii) Iodoform is obtained by reaction of acetone with hypoiodite ion ion but not iodide ion.

SECTION-D

29. Read the passage below and answer the following questions: 4

Alkyl halides are prepared by the free radical halogenation of alkanes, addition of halogen acids to alkenes, replacement of -OH group of alcohols with halogens using phosphorus halides, thionyl chloride, or halogen acids. Aryl halides are prepared by electrophilic substitution to arene. Fluorine and iodides are best prepared by the halogen exchange method. These compounds find wide applications in industry as well as in day-to-day life. These compounds are generally used as solvents and as starting materials for the synthesis of a large number of organic compounds.

(i) What is the best method for the conversion of an alcohol into an alkyl chloride ?

(ii) The catalyst used in the preparation of an alkyl chloride by the action of dry HCl on alcohol is-

(iii) An alkyl halide reacts with metallic sodium in dry ether. The reaction is known as:

(iv) Fluorobenzene (C6H5F) can be synthesized in the laboratory

30. Read the passage below and answer the following questions: 4

Nucleophilic substitution reactions are of two types; substitution nucleophilic bimolecular (SN2) and substitution nucleophilic unimolecular (SN1) depending on molecules taking part in determining the rate of reaction. The reactivity of alkyl halide towards SN1 and SN2 reactions depends on various factors such as steric hindrance, stability of intermediate or transition state, and polarity of the solvent. SN2 reaction mechanism is favoured mostly by primary alkyl halide or transition state and polarity of the solvent, SN2 reaction mechanism is favoured mostly by primary alkyl halide then secondary and then tertiary. This order is reversed in the case of SN1 reactions.

(i) Which of the following is most reactive towards nucleophilic substitution reaction?

(a) C_6H_5Cl (b) $CH_2 = CHCl$ (c) $ClCH_2CH = CH_2$ (d) $CH_3CH = CHCl$

(ii) Isopropyl chloride undergoes hydrolysis by

(a) SN^1 mechanism (b) SN^2 mechanism (c) SN^1 and SN^2 mechanism

(d) Neither SN^1 nor SN^2 mechanism

(iii) Tertiary alkyl halides are practically inert to substitution by SN2 mechanism because of

(a) Insolubility (b) Instability (c) Inductive effect (d) Steric Hindrance

(iv) Which of the following is the correct order of decreasing SN2 reactivity?

(a) $RCH_2X > R_2CHX > R_3CX$ (b) $R_3CX > R_2CHX > RCH_2X$

(c) $R_2CHX > R_3CX > RCH_2X$ (d) $RCH_2X > R_3CX > R_2CHX$

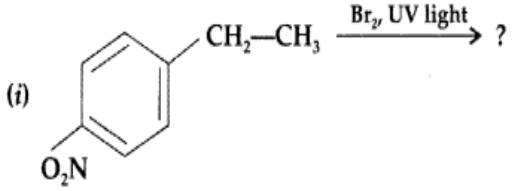
SECTION E

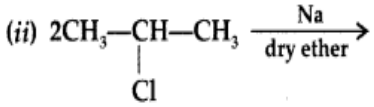
31. How can the following conversions be carried out : 5

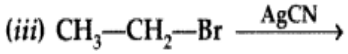
(i) Aniline to bromobenzene (ii) Chlorobenzene to 2-chloroacetophenone

(iii) Chloroethane to butane

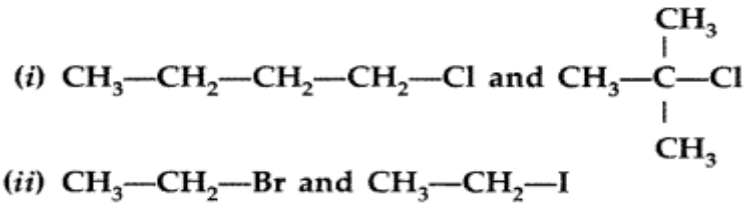
32. (a) Write the major product(s) in the following: 5







(b) In the following pairs of the halogen compounds which compound undergoes faster S_N^1 reaction.



33. A compound with molecular formula C_3H_7Cl reacts with alcoholic KOH form a compound 'A' which gives compound 'B' of molecular formula C3H7Br on treatment with HBr in presence of Peroxide. Compound 'B' reacts with NaI and Dry ether give compound 'C', on reaction with Mg with dry ether it gives a very much important compound 'D' which gives propane when exposed to moisture. Identify compounds A,B,C and D and write complete reaction. 5

VINAY KUMAR

PGT- CHEMISTRY

KV NTPC DADRI

CHEMISTRY (CODE - 043)

SAMPLE QUESTION PAPER

CLASS XII (2026-27)

ALCOHOLS PHENOLS AND ETHERS

Time: 3 hours

Max. Marks: 70

GENERAL INSTRUCTIONS: Read the following instructions carefully.

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

Section-A

Question 1 to 16 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1 The correct order of boiling point of primary (1°), secondary (2°) and tertiary (3°) alcohols is
(a) 1° > 2° > 3° (b) 3° > 2° > 1° (c) 2° > 1° > 3° (d) 2° > 3° > 1°

2 Which compound is predominantly formed ,when phenol is allowed to react with bromine in aqueous medium? (a) Picric acid (b) o-Bromophenol (c) 2, 4, 6-Tribromophenol (d) p-Bromophenol

3 Phenols are more acidic than alcohols because
(a) Phenoxide ion is stabilized by resonance (b) Phenols are more soluble in polar solvents
(c) Phenoxide ion does not exhibit resonance (d) Alcohols do not lose H atoms at all

4 Which of the following reagents cannot be used to distinguish between phenol and benzyl alcohol?
(a) $FeCl_3$ (b) Litmus solution (c) Br_2/CCl_4 (d) All of these

5 CH_3CH_2OH can be converted into CH_3CHO by _____.
a) catalytic hydrogenation c) treatment with $LiAlH_4$
b) treatment with pyridiniumchlorochromated) treatment with $KMnO_4$

6 Phenol is less acidic than a) Ethanol b) o-nitrophenol c) o-methylphenol d) o-methoxyphenol

7 Which of the following reagents can be used to oxidise primary alcohols to aldehydes?
(i) CrO_3 in anhydrous medium. (iii) Pyridiniumchlorochromate
(ii) KMnO4in acidic medium(iv) Heat in the presence of Cu at 573K.
a) (i), (ii) b) (i), (iii), (iv) c) (ii), (iii), (iv) d) (iii), (iv)

8 Arrange the following compounds in increasing order of boiling point.

Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol

a) Propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol

b) Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol

c) Pentan-1-ol, butan-2-ol, butan-1-ol, propan-1-ol

d) Pentan-1-ol, butan-1-ol,butan-2-ol, propan-1-ol

9 Phenol reacts with bromine in CS2 at low temperature to give

a). m-bromophenol b) o-and p-bromophenol

c). p-bromophenol d). 2,4,6-tribromophenol

10 Benzene diazonium chloride on reaction with phenol in weakly basic medium gives

a. diphenyl ether b). p-hydroxyazobenzene

c). Chlorobenzene d). Benzene

11 Give IUPAC name of the compound CH_3-CH(Cl)-CH_2-CH_2-CH(OH)-CH_3

a) 2-Chloro-5-hydroxyhexane c) 5-Chlorohexan-2-ol

b) 2-Hydroxy-5-chlorohexane d) 2-Chlorohexan-5-ol

12 Arrange the following compounds in increasing order of their acid strength:

Propan-1-ol, 2, 4, 6-trinitrophenol, 3-nitrophenol, 3, 5-dinitrophenol, phenol, 4-methylphenol.

ASSERTION (A) & REASON (R) BASED QUESTIONS:

(A): Assertion and Reason both are correct statements. And reason is the correct explanation for assertion.

(B): Assertion and reason both are correct statements but reason is not the correct explanation for assertion.

(C): Assertion is correct but reason is wrong statement.

(D): Assertion is wrong but reason is correct statement.

13 Assertion: Phenols are more acidic than aliphatic alcohols.

Reason: The phenoxide ion is more resonance stabilized than alkoxide ion.

14 Assertion: Tertiary alcohols get converted into an alkene instead of a carbonyl Compounds in the presence of heated metallic copper.

Reason: Tertiary alcohols prefer to undergo dehydrogenation instead of dehydration in the presence of heated copper

15 Assertion: Ethers are non-polar when they are symmetrical.

Reason: Ethers have a bent structure

16 Assertion: n-Butanol has higher boiling point than 2-methyl propan-2-ol.

Reason: Branching increases the strength of Vander Waals forces

17 a). Alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses. Explain this fact.

b). Which of the following isomers is more volatile: o-nitrophenol or p-nitrophenol?

OR

Write the mechanism of hydration of ethene to yield ethanol.

18 a). Write IUPAC name of $CH_2(OH)$-$CH(OH)$-$CH_2(OH)$. b). Write the IUPAC name of Aspirin ?

19 a). Arrange the given compounds in the increasing order of acidity: Phenol, o-nitrophenol and o-Cresol.

b). Alcohols react with active metals like Na, K.to give corresponding alkoxide. Write down thedecreasing order of reactivity of sodium metal towards primary, secondary and tertiary alcohols ?

20 Why primary alcohols are more acidic than secondary alcohol?

21 Give one chemical test each to distinguish between the following pairs of compounds:

(i) Phenol and Benzoic acid (ii) Propan-1-ol and Propan-2-ol

SECTION C

22 a)Write the mechanism of acid catalyzed hydration of propene.

23 How are following conversions carried out ?

(i) Propane to Propan-2-ol (ii) Phenol to acetophenone (iii) Propene to propan-1-ol

24 Write the equations involved in the following reactions:

a) Reimer - Tiemann reaction b)Kolbe's reaction

25 Give structures of the products you would expect when each of the following alcohol reacts with (a) HCl –$ZnCl_2$ (b) HBr and (c) $SOCl_2$.

26 Give reasons for the following: -

(i) 3^0 halides are not used to prepare ether by williamson's ether synthesis.

(ii) o-nitrophenol is less soluble in water than the m & p -isomers

(iii) Phenols give o & p nitrophenol on nitration with conc HNO_3 and sulphuric acid mixture.

27 Give one chemical test each to distinguish between the following pairs of compounds:

(i) Phenol and Benzoic acid (ii) Propan-1-ol and Propan-2-ol (iii) Methanol and ethanol.

28 Give the structures and IUPAC names of the products expected from the following reactions:

(a) Catalytic reduction of butanal.

(b) Hydration of propene in the presence of dilute sulphuric acid.

(c) Reaction of propanone with methylmagnesium bromide followed by hydrolysis.

SECTION D

Question no 29&30 are case based questions

29 An organic compound (A) having molecular formula C_6H_6O gives a characteristic colour withaqueous $FeCl_3$ solution. (A) on treatment with NaOH gives (B), which on treatment with CO_2 andfurther acidification gives a compound (C). Identify A,B and C and Write the Chemical reactions involved

OR

An organic compound A (C_6H_6O) gives a characteristic colour with aq.$FeCl_3$ solution.

(A) On reacting with CO_2 and NaOH at 400 K under pressure gives (B) which on acidification gives a compound (C). The compound (C) reacts with acetyl chloride to give (D) which is a popular pain killer. Deduce the structure of A, B, C& D.

30 **Read the passage given below and answer the following questions.**

Alcohols and ethers are related to each other as functional isomers but differ widely in characteristics. Whereas alcohols are completely miscible with water, ethers are nearly immiscible with it. Unlike alcohols which are extremely reactive, ethers are almost inert chemically. The low reactivity is due to the presence of C-O-C bond which has which has no active site as is present in case of alcohols(-O-H is polar). However, ethers participate in the formation of co-ordinate complexes by donating the lone electron pairs present on oxygen and also react with halogen acids under specific conditions involving the cleavage of C-O-C bond.

Answer the following questions:

1. Why is the bond angle in an ether molecule more than the normal tetrahedral bond angle ? 1M

2. What happens when tertiary butyl bromide is heated with sodium ethoxide ? 1M

3. Sodium metal can be used to dehydrate ethers but not alcohols. Why ?

OR

3. Explain Why alcohols and ethers of comparable molecular masses have different boiling points. ? 2M

OR

Read the passage given below and answer the following questions:

Treatment of sodium salt of phenol with carbon dioxide under pressure bring s about substitution of the carboxyl group, -COOH, for hydrogen of the ring. This provides a path of conversion of phenol into hydroxy carboxylic acids. The acids formed are industrially very important compounds and form many useful compounds such as aspirin,salol,methylsalicylate (constituent of oil of wintergreen),etc.

Answer the following:

1.A spirin is obtained by the acetylation of which of the following compounds?

(a)Salicylaldehyde (b)Salicylic acid (c) Acetylsalicylicacid (d)Phenol

2.The Williamson's synthesis of preparing dimethyl ether is an:

(a)SN^1reaction (b)Elimination reaction (c)SN^2reaction (d) Nucleophilic addition reaction

3.The alcohols with lower molecular mass are:

(a)Miscible in limited amount of water (b) miscible in excess of water
(c)miscible in water in all proportions (d) immiscible in water

4.The compound with the highest boiling point is

(a)CH_4 (b)CH_3OH (c) CH_3Cl (d)CH_3OCH_3

SECTION E

Question no 31 to 33 carrying 5 marks each

31 (1) Give reasons for the following: -

(a) Alcohols are more soluble in water than the hydrocarbon of comparable molecular masses.

(b) Lower alcohols are soluble in water higher alcohols are not.

(c) Ortho nitro phenol is more acidic than Ortho-methoxyphenol.

(d) 2,4,6-trinitrophenol gives sodium bicarbonate test.

(e) Alcohol reacts with sodium metal whereas ether do not

OR

(2) Account for the following: -

(a) Phenol doesn't react with $NaHCO_3$ whereas carboxylic acid reacts.

(b) Phenol is more easily nitrated than benzene.

(c) Sodium metal can be used for drying Di ethyl ether but not ethyl alcohol.

(d) Ether acts as Lewis base.

(e) Ortho nitro phenol is more volatile than para nitro phenol

32 Arrange each set of compounds in the decreasing order of property indicated
a) Methanol, ethanol, diethyl ether, ethylene glycol. (Boiling point)
b) Phenol, O- nitrophenol, p- methoxyphenol, p- nitrophenol. (Ka value)
c) Dimethyl ether, ethanol, phenol. (Solubility in water)
d) 2-methylpropan-1-ol, n-Butanol, 2-methylpropan-2-ol (acidic nature)
e) Ethanol, n-butane, water, propane. (Boiling point)

OR

a) Isobutane, n-butane, n- butanol, n-butyl chloride (boiling point)
b) Water, ethanol, phenol (acidity character)
c) Ethanol, isopropanol, tertiary butyl alcohol (reactivity towards Lucas reagent)
d) Methanol, ethyl alcohol, ethylene glycol, glycerol. (Solubility in water)
e) Phenol, o- nitrophenol, p-nitrophenol, m-nitrophenol (boiling point order)

33 Write the following name reaction:
a) Kolbe's reaction b) Reimer-Tiemann reaction c) Williamson synthesis d) Hydroboration
e) Esterification

OR

a) Write the mechanism of acid catalysed hydration of alkenes.
b) Write the structure of the following compound whose IUPAC name are as follows:
(a) 2-methylpropan- 2-ol molecule.
(b) Hex-l-en-3-ol
c) Orthonitrophenol has lower boiling point than p-nitrophenol. Why?

Class-XII

SUBJECT-CHEMISTRY (043)

ALDEHYDES KETONES AND CARBOXYLIC ACIDS

M.M: 70 **TIME: 3Hrs**

General Instructions:

Read the following instructions carefully and follow them:

(i) This question paper contains 33 questions. All questions are compulsory.

(ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.

(iii) Section A - question number 1 to 16 are multiple choice type questions. Each question carries 1 mark.

(iv) Section B - question number 17 to 21 are very short answer type questions. Each question carries 2 marks.

(v) Section C - question number 22 to 28 are short answer type questions. Each question carries 3 marks.

(vi) Section D - question number 29 and 30 are case-based questions. Each question carries 4 marks.

(vii) Section E- question number 31 to 33 are long answer type questions. Each question carries 5 marks.

(viii) There is no overall choice given in the question paper. However, an internal choice has been provided in

few questions in all the Sections, except Section -A.

(ix) Use of calculator is NOT allowed.

(SECTION A)

Q 1. Rosenmund's reaction can produce which of the following carbonyl compounds?

a) Methanal b) Benzaldehyde c) Butanone d) Acetone

Q 2. Reactions occur between aldehydes and ketones.

a) nucleophilic addition b) electrophilic substitution c) electrophilic addition d) nucleophilic substitution

Q 3. Cannizzaro reaction is not given by the compound:

a) HCHO b) $(CH_3)_3C$-CHO c) C_6H_5-CHO d) CH_3CHO

Q 4. The reaction which converts ..... into a ketone by hydrogenation.

a) tert- alcohol b) aldehyde c) sec-alcohol d) primary alcohol

Q 5. Which reagent is used to distinguish aldehydes from ketones?

(a) Fehling's solution (b) Schiff's reagent (c) Both (a) and (b) (d) Grignard reagent

Q 6. The IUPAC name of CH_3COCH_2CHO is:

(a) 3-Oxobutanal (b) 4-Oxobutanal (c) 2-Oxopropanal (d) Butane-1,2-dione

Q7. Acetophenone on reduction with Zn–Hg/conc. HCl gives:

(a) Toluene (b) Benzene (c) Ethylbenzene (d) Phenol

Q8. Which of the following is most acidic?

(a) Formic acid (b) Acetic acid (c) Benzoic acid (d) Trichloroacetic acid

Q9 Aldol condensation involves:

(a) α-hydrogen abstraction (b) Radical formation

(c) Electrophilic substitution (d) Nucleophilic substitution

Q10. The product of reaction of benzaldehyde with dilute NaOH is:

(a) Benzoic acid (b) Benzyl alcohol and sodium benzoate (c) Benzophenone (d) Benzene

Q 11. Acetone combines with ethylene glycol in dry HCl gas to generate _____

a) hemiacetals b) cyclic ketals c) cyclic acetals d) acetals

Q 12. Cannizzaro reaction is given by aldehydes:

(a) With α-hydrogen (b) Without α-hydrogen (c) Aromatic aldehydes only (d) Ketones only

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

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

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

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

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

Q 13. Assertion: Compounds containing –CHO group are easily oxidized to corresponding carboxylic acids.

Reason : Carboxylic acids can be reduced to alcohols by treatment with $LiAlH_4$.

Q 14 Assertion: Alcohol and carboxylic acids are distinguished by sodium bicarbonate test.

Reason : An aqueous solution of $NaHCO_3$ produces brisk effervescence due to the evolution of CO_2 with a carboxylic acid.

Q15. Assertion: Ketones are less reactive than aldehydes towards nucleophilic addition.

Reason: The carbonyl carbon in ketones is more hindered and less electrophilic.

Q16. Assertion: Carboxylic acids are stronger acids than alcohols.

Reason: Carboxylate ion is resonance-stabilized, whereas alkoxide ion is not.

(SECTION B)

Q17. Explain why methanal undergoes Cannizzaro reaction but ethanal does not.

Q 18 Give chemical test to distinguish between

(a) phenol and benzoic acid. (b)Benzaldehyde and Propanal

Q 19. Although phenoxide ion has more no. of resonating structures than carboxylate ion , even though carbxylic acid is a stronger acid why ?

Q 20. There are two-NH_2 group in semicarbazide . How ever only one is involved in formation of semicarbazones. Why?

Q 21. Why does solubility decreases with increasing molecular mass in carboxylic acid?

OR

Q 21 Why are aldehydes are more reactive than ketones when undergo nucleophillic addition reaction?

(SECTION C)

Q 22. An organic compound (A) {$C_8H_{16}O_2$} was hydrolysed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C)with chromic acid produced (B).(C) on dehyration gives but-1-ene .Identity A,B,C

Q 23 .Explain with suitable example- (a).Aldol condensation (b.) Clemmension reduction

OR

Distinguish between the following:-

(a)Phenol and alcohol (b)Benzaldehyde and Propanal (c)Acetic acid and formic acid

Q 24 Complete the following reactions-

a. $R\text{-}\overset{\overset{O}{\|}}{C}\text{-}H \xrightarrow{Zn/HCl,4[H]}$ -------

b. $CH_3\text{-}\overset{\overset{O}{\|}}{C}\text{-}NH_2 \xrightarrow{HNO_2}$ ------

Q 25 An organic compound ‘A’ has the molecular formula $C_5H_{10}O$ .It does not reduce Fehling’s solution but forms a bisulphite compound .It also gives positive Iodoform test. What are possible structure of ‘A’ ?Explain your reasoning.

Q 26 An organic compound A ($C_4H_2O_2$) reacts with sodium carbonate to produce brisk effervescence. A gives

ester B with ethanol in presence of conc. H_2SO_4. B has fruity odour.

(a) Identify A and B. (b) Write chemical reactions involved.

(c) Explain why A gives brisk effervescence with Na_2CO_3 but ethanol does not.

Q 27 (i) How will you convert Ethanol to Acetaldehyde?

(ii) Arrange the following in increasing order of acidic character :

$HCOOH$, $CH_2ClCOOH$, CF_3COOH , CCl_3COOH

(iii) Write the IUPAC name of the compound : $CH_3\text{-}CH(CH_3)\text{-}CO\text{-}CH(CH_3)_2$

Q 28.An organic compound (A) having molecular formula $C_9H_{10}O$ forms an orange red ppt (B) with 2,4 – DNP

reagent. Compound (A) gives a yellow ppt (C) when heated in the presence of Iodine and NaOH along

with a colourless compound (D). (A) does not reduce Tollen's reagent or Fehling's sol. Nor does it decolourise bromine water. On drastic oxidation of (A) with Chromic acid, a carboxylic acid (E) of molecular formula $C_7H_6O_2$ is formed. Deduce the structure of the organic compounds (A) to (E).

OR

Q 28. A compound (A) with molecular formula, $C_5H_{12}O$ on oxidation forms compound (B) with molecular formula, $C_5H_{10}O$. The compound B gives iodoform test but does not reduce ammonical silver nitrate. (B)

on reduction with amalgamated Zinc & HCl gives compound (C) with molecular formula C_5H_{12}. Identify A,

B & C. Write down the chemical reaction involved.

(SECTION D)

Q 29 2,4 dinitro phenylhydrazone undergo addition. The reaction begins with protonation of Carbonyl compound followed by attack of ammonia derivative and finally the product is formed by elimination of water molecule. In this case the control of PH is very important factor as the reaction is catalyzed by acids. In acidic medium oxygen of carbonyl group is protonated by acids and due to resonance positive charge increases on carbonyl carbon. Consequently a week nucleophile like Ammonia derivative attacks on carbonyl carbon. Here the pH control is very important in this addition reaction .It medium is too acidic the ammonia derivative being basic in nature themselves get protonated and form salt and ammonia derivatives are no longer nucleophile and reaction does not occur. If medium is slightly acidic the carbonyl group is not protonated, and will not increase electron deficiency on carbon atom of carbonyl group and weak nucleophile like ammonia derivatives will not be able to react and reaction does not occur. Hence to carry out reaction with ammonia derivative optimal value of pH is needed.

Based on a paragraph answer the following questions: (1+1+2 marks)

a) What products are formed when a carbonyl compound reacts with hydroxylamine?

b) Which reagent would you like to use to distinguish a carbonyl compound from a Non Carbonyl compound?

c) Give the chemical equation for products formed when propanone reacts with hydroxylamime. What product will form, if medium is highly acidic?

OR

Which - NH_2 group is involved in semicarbazone formation of ammonia derivative and why ?

Q 30.A student performed Tollens' test with two different compounds: Compound "A "gave silver mirror, while Compound "B' did not. Later, compound 'B' gave a positive iodoform test.

(A) Identify compounds A and B.

(B) Write chemical equation for Tollens' test.

(C) Why does B not respond to Tollens' test but gives iodoform test?

(D) Name another reagent (besides Tollens') used to distinguish A and B.

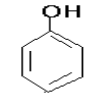
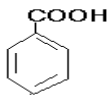
(SECTION E)

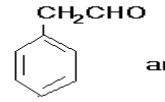
Q 31 (a) (i) Ketones are less reactive towards nucleophiles than aldehydes.

(ii) Benzoic acid is stronger acid than ethanoic acid.

(iii) Which acid is stronger- Phenol or Cresol? Explain.

(b) Write chemical tests to distinguish the following pair of compounds.

(i)  and 

(ii)  and CH_3COCH_3

OR

Q 31(A) How will you convert ethanal into the following compounds?

Butane-1,3-diol (ii) But-2-enal (iii) But-2-enoic acid

(B) Give a simple chemical test to distinguish between the following pairs:

(a)Propanone and Propanal (b) Benzoic acid and Phenol (c) Acetaldehyde and Acetone

Q 32. Which of the following compounds would undergo aldol condensation, which the Cannizzaro reaction

and which neither? Write the structures of the expected products of aldol condensation and Cannizzaro

reaction.

(i) Methanal (ii) 2-Methylpentanal (iii) Benzaldehyde (iv) Benzophenone (v) Cyclohexanone

OR

32 (A) Explain why: (a) Aldehydes are more reactive than ketones.

(b) Carboxylic acids have higher boiling point than alcohols.

(c) Formic acid is stronger than acetic acid.

(B) An organic compound with the molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation,it gives 1,2-benzenedicarboxylic acid. Identify the compound.

Q 33.A) Why PCC cannot oxidize methanol to methanoic acid and while $KMnO_4$ can?

B) During preparation of esters from a carboxylic acid and an alcohol in the presence of acid catalyst water or ester formed should be removed as soon as it is formed.

C) Why HCOOH does not give HVZ reaction while CH_3COOH does?

D) Explain why O-hydroxy benzaldehyde is a liquid at room temperature while p-hydroxy benzaldehyde is a high melting solid.

E) Why formic acid is stronger acid than acetic acid?

OR

Q33.(A) Complete the following reactions:

(a) $CH_3COOH + PCl_5 \rightarrow ?$

(b) $C_6H_5CHO + CH_3CHO$ (dil. NaOH) $\rightarrow ?$

(c) $CH_3–CO–CH_3 + HCN \rightarrow ?$

(B) Give simple chemical tests to distinguish between the following pairs of compounds.

(i) Propanal and Propanone (ii) Acetophenone and Benzopenone

PREPARED BY S K SHARMA

PM SHRI KV NO 1 AFS AGRA

KENDRIYA VIDYALAYA SANGATHAN, AGRA REGION

PRACTICE PAPER (2026-27) CLASS-XII AMINES

SECTION -A 1

Q1. Aniline when treated with bromine water gives: -----

(a) m-Bromoaniline (b) o-Bromoaniline (c) 2,4,6-Tribromoaniline (d) p-Bromoaniline

Q2. Which of the following is the strongest base in aqueous solution?

(a) $C_6H_5NH_2$ (b) $(CH_3)_2NH$ (c) CH_3NH_2 (d) NH_3

Q3. Which reaction is used to prepare amines by reduction of amides? 1

(a) Hoffmann bromamide reaction (b) Gabriel phthalimide synthesis

(c) Sandmeyer reaction (d) Diazotisation

Q4. Aliphatic amines are stronger bases than aromatic amines because:----- 1

(a) resonance effect in aromatic amines (b) +I effect of alkyl group

(c) solubility factor (d) steric hindrance

Q5. Which amine gives carbylamine test? 1

(a) 1° amine (b) 2° amine (c) 3° amine (d) aromatic amine only

Q6. Identify the product: $CH_3CONH_2 + (Br_2/KOH) \rightarrow$? 1

(a) CH_3NH_2 (b) $C_2H_5NH_2$ (c) CH_3CONH_2Br (d) Aniline

Q7. Which of the following does not undergo diazotisation? 1

(a) Aniline (b) p-Toluidine (c) m-Nitroaniline (d) N-Methylaniline

Q8. Hinsberg's reagent is: 1

(a) Benzene sulphonyl chloride (b) Chlorobenzene (c) C_6H_5Cl (d) SO_2Cl_2

Q9. The intermediate in Gabriel phthalimide synthesis is: 1

(a) Isocyanide (b) Phthalimide potassium salt (c) Amide ion (d) Nitro compound

Q10. Azo dyes are prepared by: 1

(a) Sandmeyer reaction (b) Coupling reaction of diazonium salts

(c) Gattermann reaction (d) Gabriel synthesis

Q11. Basicity order in aqueous solution is: 1

(a) $NH_3 > RNH_2 > R_2NH > R_3N$ (b) $R_2NH > RNH_2 > R_3N > NH_3$

(c) $R_3N > R_2NH > RNH_2 > NH_3$ (d) $RNH_2 > NH_3 > R_2NH > R_3N$

Q12 Which one of the following reactions will produce aniline? 1

(a) $C_6H_5Cl + NH_3 \rightarrow ?$ (b) $C_6H_5NO_2 \rightarrow (Sn/HCl) \rightarrow ?$

(c) $C_6H_5OH + NH_3 \rightarrow ?$ (d) $C_6H_5COOH \rightarrow ?$

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

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

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q13 Assertion (A): Diazonium salts are stable only in cold solution. 1

Reason (R): They decompose easily above 283 K releasing nitrogen gas.

Q14 Assertion (A): Aromatic amines cannot be prepared by Gabriel synthesis. 1

Reason (R): Gabriel synthesis involves nucleophilic substitution with alkyl halides.

Q15 Assertion (A): Acetanilide is less reactive than aniline towards electrophilic substitution. 1

Reason (R): $–NHCOCH_3$ group is electron withdrawing.

Q16 16. Assertion (A): Aniline is less basic than methylamine. 1

Reason (R): Lone pair of nitrogen in aniline is delocalised due to resonance.

SECTION -B

Q17 Do the following conversions:---------- 2

(a) Nitrobenzene → Aniline (b) Aniline → Acetanilide

Q18 Account for the following:---------- 2

(a) Aliphatic amines are stronger bases than aromatic amines.

(b) Primary amines form stable salts with mineral acids.

Q19 Give one chemical test to distinguish between:---------- 2

(a) Aniline and N-methylaniline (b) Primary and secondary amines

Q20 Explain why tertiary amines do not undergo acylation. 2

Q21 Discuss the basic strength of amines in the gaseous phase and in aqueous solution. 2

SECTION -C

Q22 Explain mechanism of Hoffmann bromamide reaction with example. 3

Q23 Write chemical equations for conversion of: 3

(a) Aniline → iodobenzene (b) Aniline → benzonitrile (c) Aniline → fluorobenzene

Q24 Explain why:-----(a) 3° amines do not undergo acylation. 3

(b) Gabriel synthesis gives only 1° amines.

(c) Aniline turns brown on standing in air.

Q25 Write IUPAC names of the following compounds: -------- 3

(a) $CH_3–NH–CH_3$ (b) $(C_2H_5)_2NH$ (c) $CH_3CH_2CH_2–NH_2$

Q26 An aromatic amine is used in the manufacture of dyes, drugs and as a starting material for pesticides. Identify this compound and write one important reaction and one use of it. 3

Q27 A student added nitrous acid to ethylamine and observed effervescence. 3

(a) Write the reaction involved. (b) Name the gas evolved.

(c) Give a chemical test to detect this gas.

Q28 The doctor prescribed a drug containing sulphanilamide to a patient. 3

(a) Which class of compounds does sulphanilamide belong to?

(b) Why are such compounds medically important? (c) Write the structure of sulphanilamide.

SECTION -D

Q29 Case1:-- Amines show strong intermolecular hydrogen bonding and hence have higher boiling points than hydrocarbons of comparable molecular mass. However, tertiary amines do not show such strong hydrogen bonding. 4

(a) Explain with the help of structures why tertiary amines have lower boiling points than primary amines.

(b) Arrange the following in increasing order of boiling point:

Diethylamine , n-Propylamine , Triethylamine

(c) Write one chemical test to distinguish between primary and secondary amines.

(d) Why are lower aliphatic amines soluble in water, whereas higher amines are not?

Q30 Case2:--Nitrobenzene is an important starting compound in organic synthesis. It can be reduced under different conditions to give different products. Under Sn/HCl, it gives aniline, while under Zn/NH_4Cl, it gives phenylhydroxylamine. 4

Answer the following:

(a) Write the reaction of nitrobenzene with Sn/HCl.

(b) Why is aniline considered an activated aromatic compound?

(c) Give one important dye which is prepared from aniline.

(d) What is the industrial importance of reducing nitrobenzene?

SECTION -E

Q31 Discuss the differences in the basic strength of aliphatic and aromatic amines in gaseous and aqueous phases with suitable examples and diagrams. 5

OR

Write equations for the following conversions:

(a) Nitrobenzene → aniline (b) Aniline → diazonium salt (c) Diazonium salt → iodobenzene

(d) Diazonium salt → phenol (e) Diazonium salt → chlorobenzene

Q32 Explain the classification of amines with suitable examples and structures. 5

OR

(a) Write the mechanism of Hoffmann bromamide reaction.

(b) State its significance.

Q33 Write the steps of preparation of methylamine by different methods with equations. 5

OR

(a) Discuss the differences in the basic strength of aliphatic and aromatic amines in gaseous and aqueous phase with examples.

(b) Classify amines as primary, secondary and tertiary with examples. Discuss the basic character of each type.

BIOMOLECULES

KENDRIYA VIDYALAYA SANGATHAN, AGRA REGION

STUDY MATERIAL 2026-27

CLASS – XII (BIOMOLECULES)

CHEMISTRY (043)

Max.Marks:70 **Time:3 Hours**

Read the following Instructions carefully.

(a) There are **33** questions in this question paper with internal choice.

(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.

(c) SECTION B consists of 5 short answer questions carrying 2 marks each.

(d) SECTION C consists of 7 short answer questions carrying 3 marks each.

(e) SECTION D consists of 2 case - based questions carrying 4 marks each.

(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

SECTION-A

Question 1 to 16 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1	Which of the following bases is not present in DNA? (i) Adenine (ii) Thymine (iii) Cytosine (iv) Uracil	**[1]**
2	. Which of the following polymer is stored in the liver of animals? (i) Amylose (ii) Cellulose (iii) Amylopectin (iv) Glycogen	**[1]**
3	The vitamin which plays an important role in coagulation blood is: (A) Vitamin A (B) Vitamin E (C) Vitamin D (D) Vitamin K	**[1]**
4	Which of the following statements is not true about glucose? (i) It is an aldohexose. (ii) On heating with HI, it forms n-hexane. (iii) It is present in furanose form. (iv) It does not give 2,4-DNP test.	**[1]**
5	Which of the following B group vitamins can be stored in our body? (i) Vitamin B1 (ii) Vitamin B2 (iii) Vitamin B6 (iv) Vitamin B12	**[1]**
6	Glycogen is a branched-chain polymer of α-D-glucose units in which the chain is formed by C1—C4 glycosidic linkage, whereas branching occurs by the formation of C1-C6 glycosidic linkage. The structure of glycogen is similar to _____. (i) Amylose (ii) Amylopectin (iii) Cellulose (iv) Glucose	**[1]**
7	$\alpha - D(+)$glucose and $\beta - D(+)glucoseare$ Geometrical isomers (b) Enantiomers (c) Anomers (d) Optical isomers	**[1]**
8	Proteins are found to have two different types of secondary structures viz. α-helix and β-pleated sheet structure. α-helix structure of the protein is stabilized by : (i) Peptide bonds (ii) van der Waals forces (iii) Hydrogen bonds (iv) Dipole-dipole interactions	**[1]**

9	Night –Blindness is caused by the deficiency of Vitamin: (A) B (B) C (C) K (D) A	[1]
10	On hydrolysis, which of the following carbohydrates gives glucose and galactose? Sucrose (b) Lactose (c) Maltose (d)Cellulose	[1]
11	The deficiency of which of the vitamins causes 'Pernicious anaemia'? (a)Vitamin B_1 (b) Vitamin B_2 (c) Vitamin B_6 (d) Vitamin B_{12}	[1]
12	Which of the following carbohydrates does not satisfy the formula $C_x(H_2O)_y$? a) Fructose b) Glucose c) Deoxyribose d) Lactose	[1]
	IN QUES NO 13 TO 16 , Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true.	
13	Assertion : The two strands of DNA are complimentary to each other Reason : .Adinine forms H- bond with Guanine and Thyamine forms H- bond with Cytosine	[1]
14	Assertion: Aqueous solution of Sucrose is optically inactive. Reason: . Sucrose on hydrolysis forms equal number of Glucose and Fructose.	[1]
15	Assertion:Solubility of Protien is maximum at isoelectronic point Reason :At isoelectronic point protein stops behaving like zwitter ion.	[1]
16	Assertion: The coagulation of egg white occurs on boiling Reason: Denaturation of protein occurs when its native state is subjected to physical or chemical change .	[1]
	SECTION B Question No. 17 to 21 are very short answer questions carrying 2 marks each.	
17	Where does the water present in the egg go after boiling the egg?	[2]
18	Write the Products of hydrolysis of the following carbohydrates ? (a) Maltose (b) Sucrose (c) Lactose (d) Galactose	[2]
19	Write the reactions showing the presence of following in the open structure of glucose: (i) A carbonyl group (ii) Straight chain with six carbon atoms.	[2]
20	What is the basic structural differences between Starch and Cellulose?	[2]
21	(i) Name one water soluble vitamin which is a powerful antioxidant. Give its one natural source.	[2]
	SECTION C Question No.22 to 28 are short answer questions, carrying 3 marks each.	
22	Aminoacids behavelikesaltsratherthan simpleamines orcarboxylicacids. Explain	[3]
23	(a) Write the product when D-glucose reacts with conc. HNO_3. (b) Amino acids shows amphoteric behavior. Why? (c) Write one difference between alpha – Helix and beta- pleated structures of proteins.	[3]
24	(i) What type of linkage is present in nucleic acids? (ii) What are the different types of RNA present in our body? (iii) Why it is recommended to take vitamin D supliments (tablet / powder) with milk?	[3]
25	(i) Which polysaccharide component of carbohydrates is commonly present in bread? (ii) Write the two types of secondary structure of proteins. (iii) Give two examples of water soluble vitamins.	[3]
26	(i) Mention one important function of nucleic acids in our body (ii) Which component of starch is water soluble? (iii) Which component of starch is a branched polymer of a-glucose and insoluble in water?	[3]
27	Differentiate between DNA and RNA .	[3

	OR What is essentially the difference between α-form of glucose and β-form of glucose? Explain.	]
28	Aminoacids maybeacidic,alkaline orneutral,Howdoes this happen?	[3]
	SECTION D Question No. 29 & 30 are case-based based questions carrying 4 marks each.	
29	Read the passage carefully and answer the questions that follow. When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein The denaturation causes change in secondary and tertiary structures but primary structures remains intact. Examples of denaturation of protein are coagulation of egg white on boiling, curding of milk, formation of cheese when an acid is added to milk. **Choose the most appropriate answer:** **(i) Mark the wrong statement about denaturation of proteins.** (a) The primary structure of the protein does not change. (b) Globular proteins are converted into fibrous proteins. (c) Fibrous proteins are converted into globular proteins. (d) The biological activity of the protein is destroyed. **(ii) Which statement(s) of protein remain(s) intact during denaturation process?** (a) Both secondary and tertiary structures (b) primary structure only (c) secondary structure only (d) tertiary structure **(iii) α-helix and β-pleated structures of proteins are classified as** (a) primary structure (b) secondary structures (c) tertiary structure (d) quaternary structure **Or** **Cheese is a** (a) globular protein (b) conjugated protein (c) denatured protein (d) derived protein **(iv) Secondary structure of protein refers to v(a) mainly denatured of proteins and structures of prosthetic groups** (b) three-dimensional structure, especially the bond between amino acid residues that are distant from each other in the polypeptide chain (c) linear sequence of amino acid residues in the polypeptide chain (d) regular folding patterns of continuous portions of the polypeptide chain.	[4]
30	A young woman complained of weakness, bleeding gums, and delayed wound healing. Her blood test revealed low levels of vitamin C. The doctor also explained that vitamins are essential as coenzymes in several biochemical reactions. In another study, scientists analyzed her DNA sample and observed the ratio of purines to pyrimidines as 1:1, consistent with Chargaff's rule. **1.** Deficiency of vitamin C leads to a particular disease. Name the disease Why cannot vitamin C be stored in our body? (1) **2.** Differentiate between fat-soluble and water-soluble vitamins with one example of each. **3.** DNA and RNA differ in their sugar components. Name the sugars present in each and explain how this affects their stability.	[4]

	4. If a DNA molecule contains 20% guanine, calculate the percentage of adenine	
	SECTION E Question No. 31 to 33 are long answer type questions carrying 5 marks each.	
31	a).Write the structure of the product obtained when glucose is (i) Oxidised with Bromine water. (ii) Reacts with HI (b)Write such reactions and facts about glucose which cannot be explained by its open chain structure**.** **OR** **How do you explain** (i) The presence of all the six carbon atoms in glucose in a straight chain? (ii) Glucose contains 5 hydroxyl groups (iii) The carbonyl group present in Glucose is aldehydic. (iv) The formation of Gluconic acid in glucose (v) Sucrose is known as Invert Sugar.	**[5]**
32	(i) What are essential and non-essential amino acids in human food? Give one example of each type. (ii) How will you differentiate between following. (a) Globular and Fibrous Protiens (b) primary and secondary structure of protien	**[5]**
33	Define the following terms . (i) Peptide linkage (ii) primary structure(protein) (iii) Denaturation (iv) Nucleotide (v) Anomers **OR** Define the following terms . (i) Glycosydic Linkage (ii) Secondary structure (protein) (iii) Nucleoside (iv) Oligosaccarides(v) Non –Essential aminoacids	**[5]**

MARKING SCHEME

KENDRIYA VIDYALAYA SANGATHAN

CLASS - XII

CHEMISTRY (043)

MARKINGSCHEME

(SOLUTIONS)

	SECTION-A	
1	b	**[1]**
2	b	**[1]**
3	c	**[1]**
4	b	**[1]**
5	a	**[1]**
6	c	**[1]**
7	a	**[1]**
8	d	**[1]**
9	b	**[1]**
10	b	**[1]**
11	b	**[1]**
12	d	**[1]**
13	a	**[1]**
14	b	**[1]**
15	a	**[1]**
16	d	**[1]**
	SECTION B	

17	a) NaCl is needed in lesser quantity. b) Freezing point is raised as no. of particles decreases which results in decreasein colligative property.	**[2]**
18	a) $\pi 1 < \pi 2$ b) Water from aquarium enters in cell causing them to expand and get ruptured.	**[2]**
19	a) Y b) Both have osmotic pressure.	**[2]**
20	a) More salt use will increase ions in the body fluid which increases blood pressure b) B **OR** a) Due to dissociation of electrolyte the number of ions increases b) Peeled egg shrinks in saturated brine solution.	**[2]**
21	a)1M (higher the concentration of solute added higher is the colligative property. b) It is cooled to lower down the pressure of ammonia else the gas will bump outof the bottle.	**[2]**
	SECTION C	
22	W=100 mg = 0.100 = 0.1 g, V = 10.0 mL = 0.01 L π = 13.3 mm Hg = 13.3760 atm, T = 25°C = 25 + 273 = 298 K R = 0.0821 L atm mol^{-1} K^{-1}, M = ?	**[3]**

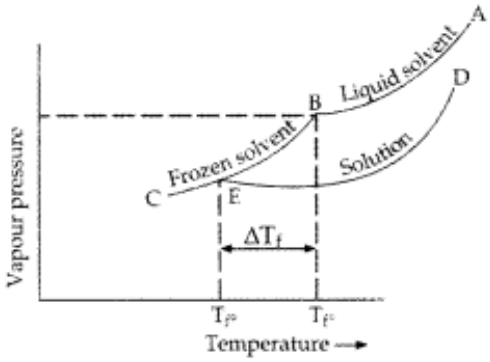
	Using formula : $M = \frac{wRT}{\pi V}$ $\Rightarrow \quad M = \frac{0.1 \times 0.0821 \times 298 \times 760}{13.3 \times 0.01}$ $\Rightarrow \quad M = \frac{1859.4008}{0.133} = 13980.4$ Molar mass, M = 13980.4 g mol^{-1}	
23	a) Temperature is higher in upper layer so solubility of oxygen is less b) M.P./F.P. changes due to impurities. c) Bacterium in canned fruit loses water through the process of osmosis, shrivel and dies.	**[3]**
24	Given : M_2 = 92 g mol^{-1} w_1 = 500g ΔT_b = 100.42°C – 100°C = 0.42°C K_b = 0.512 K kg mol^{-1} Substituting above values in the formula $\Delta T_b = \frac{1000 K_b w_2}{w_1 \times M_2}$ $\therefore \quad w_2 = \frac{w_1 M_2 \Delta T_b}{1000 K_b} = \frac{500 \times 92 \times 0.42}{1000 \times 0.512}$ $= \frac{19320}{512} = \mathbf{37.73\ g}$ **OR** According to the formula : $M_2 = \frac{1000 \times K_f \times w_2}{w_1 \times \Delta T_f}$ **where** [M_2 = 62, w_1 = 5.50, K_f = 1.86 Substituting the values in the *formula,* we get $62 = \frac{1000 \times 1.86 \times w_2}{1000 \times 5.50 \times 10}$ or $w_2 = \frac{62 \times 5.50 \times 10 \times 1000}{1.86 \times 1000} = \frac{3410}{1.86}$ $= 1833$ gm $= 1.833$ kg	**[3]**
25	A solution which has lower osmotic pressure than the other solution separated by asemipermeable membrane is called hypotonic solution b) Chilled as solubility of CO_2 is more at low temp. c) Helium as greater the K_H value lower the solubility	**[3]**

26	Given : M_2 = 58.5 g mol^{-1} w_1 = 65 g ΔT_f = 7.5 °C K, = 1.86 K_f kg mol^{-1} i = 1.87 Substituting these values in the formula $\Delta T_f = iK_f\, m \qquad \Delta T_f = iK_f \frac{w_2 \times 1000}{M_2 \times w_1}$ $\therefore \quad 7.5 = 1.87 \times 1.86 \times \frac{w_2 \times 1000}{58.5 \times 65}$ $\text{or} \quad w_2 = \frac{7.5 \times 58.5 \times 65}{1.87 \times 1.86 \times 1000}$ $\text{or} \quad w_2 = \frac{28518.75}{3478.2} = 8.199$ ∴ Mass of NaCl to be dissolved, w_2 = 8.199 g	**[3]**
27	Given :ΔT_f = 0 – (-15) = +15° C, w_1 = 5 kg = 5000 g K_f = 1.86 K kg mol^{-1} K_b = 0.52 K kg mol^{-1} Using *Formula:* $\Delta T_f = \frac{1000 \times K_f \times w_2}{w_1 \times M_2}$ $w_2 = \frac{\Delta T_f \times w_1 \times M_2}{1000 \times K_f} = \frac{+15 \times 5000 \times 62}{1000 \times 1.86}$ $\therefore \quad w_2 = 2500$ gm, $\therefore \quad \Delta T_b = 0.52 \times \frac{2500^{500} \times 1000}{62 \times 5000} = \mathbf{4.19°\ C}$	**[3]**
28	(a) Amalgam of mercury with sodium (b) Positive deviation (c)Solubility of gases increases with decrease in temperature as it is an exothermicprocess	**[3]**
	SECTION D	
29	(a)This is because, they do not have same osmotic pressure as number of particles aredifferent. (b) The process of reverse osmosis will take place. It is used for desalination of water. (c) These will shrink.	**[4]**

	(d)m = 7.57 mol/kg	
30	a) $AlCl_3$ b) By depression of freezing point (it lowers freezing point of water less than 0 c) ΔTf = ikfm 2=1x 8 x (2.8/Mb)x1000/100 =8x2.8x10/Mb Mb=8x28/2=8x14=112g/mol **OR** ΔTb = i kb m 0.21= 1x 2.52x2x1000/100xMb Mb= 2.52x2x10/0.21=240 g/mol	**[4]**
31	**Osmosis :** The net spontaneous flow of the solvent molecules from the solvent to the solution or from a less concentrated solution to a more concentrated solution through a semipermeable membrane is called osmosis. **Osmotic pressure :** The minimum excess pressure that has to be applied on the solution to prevent the entry of the solvent into the solution through the semipermeable membrane is called the osmotic pressure.The osmotic pressure method has the advantage that it uses molarity instead of molality and it can be measured at room temperature. (b) Since NaCl is an ionic compound so undergoes complete dissociation. OR **(a) (i) Henry's law :** "The solubility of a gas in a liquid at a particular temperature is directly proportional to the pressure of the gas in equilibrium with the liquid at that temperature."	**[5]**

	(**ii) Raoult's law :** For a solution of volatile liquids the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. $P = P°x$ Non-ideal solution shows positive and negative deviations from Raoult's law. (b)Given : $w_2 = 8.95\ mg = 8.95 \times 10^{-3}\ g$ $V = 35\ mL\pi = 0.335\ torr$ $T = 25°C = 298\ K\ M_2 = ?$ Substituting all the values in the given formula $\pi = CRT$ $\pi = \frac{w_2 RT}{M_2 V}$ or $M_2 = \frac{w_2 RT}{\pi V}$ $M_2 = \frac{8.95 \times 10^{-3} g \times 0.0821\ L\ atm\ mol^{-1}\ K^{-1} \times 298K \times 760 \times 1000}{0.335\ atm \times 35\ L}$ $= \frac{166416.3716}{11.725} = 14193.3\ g\ mol^{-1}$	
32	(a) **(i) Mole fraction :** Mole fraction is the ratio of number of moles of one component to the total number of moles in a mixture. (**ii) Ideal solution :** The solution which obeys Raoult's law under all conditions is known as an ideal solution. (b) $\Delta T_f = K_f m$ $T_f^\circ - T_f = 1.86 \times \frac{15}{M_2} \times \frac{1000}{450}$ $\Rightarrow 0 - (-0.34) = 1.86 \times \frac{15}{M_2} \times \frac{1000}{450}$ $\Rightarrow M_2 = \frac{1.86 \times 15 \times 1000}{0.34 \times 450} = \frac{62}{0.34}$ $= 182.35\ g/mol$ OR (a) (i) Molarity is the number of moles of solute dissolved in one litre of solution. (ii) Molal elevation constant may be defined as the elevation in boiling point when the	**[5]**

	molality of solution is unity i.e. 1 mole of solute is dissolved in 1 kg of the solvent. (b) For urea, concentration = 15/60 moles/lt. For glucose, concentration = w/180 moles/lt. ∵ Solutions are isotonic ∴ w/180=15/60 w = 15×180/60 = 45 g	
33	a) z x/y (b)Cellulose acetate, potassium ferrocyanide c) $\Delta T_f = iK_f \times m$ $\Delta T_f = iK_f \times \frac{w_b \times 1000}{m_b \times w_a}$ $1.62 = i \times 4.9 \times \frac{3.9}{122} \times \frac{1000}{49}$ $i = \frac{1.62 \times 122 \times 49}{4.9 \times 3.9 \times 1000}$ $i = \frac{9684.36}{19110} = 0.506$ As i < 1, therefore solute gets associated OR **Non-ideal solutions exhibit Negative deviation from Raoult's law :** For any composition of the non-ideal solution, the partial vapour pressure of each component and total vapour pressure of the solution is less than expected from Raoult's law. Such solutions show negative deviation. Example : Mixture of $CHCl_3$ and acetone. Non-ideal solutions show positive deviations from Raoult's law on mixing of two volatile components of the solution. Example : Mixture of acetone and benzene solutions show positive deviation, (b) Answer: As $\Delta T_b = iK_bm$ (100.18 – 100) °C = i × 0.512 K kg mol^{-1} × 1 m 0.18 K = i × 0.512 K kg mol^{-1} × 1 m ∴i = 0.3	**[5]**

	(c) An aqueous solution of sodium chloride freezes below 273 K because vapour pressure g of the solution is g less than that of the pure solvent.  	

KENDRIYA VIDYALAYA SANGATHAN

CLASS - XII

CHEMISTRY (043)

ELECTROCHEMISTRY

MARKING SCHEME

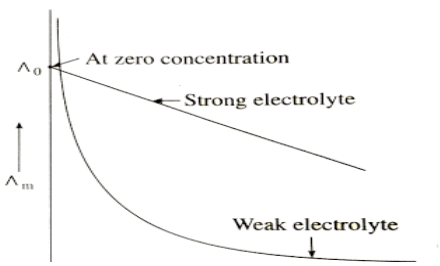
SECTION-A		
1	b	**[1]**
2	c	**[1]**
3	a	**[1]**
4	b	**[1]**
5	c	**[1]**
6	b	**[1]**
7	c	**[1]**
8	a	**[1]**
9	d	**[1]**
10	d	**[1]**
11	d	**[1]**
12	c	**[1]**
13	b	**[1]**
14	a	**[1]**
15	a	**[1]**
16	c	**[1]**
	SECTION B	
17	$CuSO_4 \rightarrow Cu+ + SO_4^{2-}$ $Cu^{2+} + 2e^- \rightarrow Cu$	**[2]**

	63.5 gram of copper is deposited = 2 × 96500 C 1.27 gram of Cu is deposited = 2×9650063.5 × 1.27 = I × t (Q = I × t) t = $2\times96500\times1.2763.5\times2$ = 1930 seconds	
18	$\Lambda_m = \frac{1000\,\kappa}{M}$ $\Rightarrow \quad 138.9\ \text{S cm}^2\ \text{mol}^{-1} = \frac{1000\times\kappa}{1.5}$ $\therefore \qquad \kappa = \frac{138.9\times1.5}{1000} = \frac{208.35}{1000} = 2.0835\times10^{-1}\ \text{S cm}^{-1}.$	**[2]**
19	At the cathode Ag^+ (aq) + e^- → Ag(s) reaction is feasible, because Ag+ ion has higher reduction potential i.e. higher E° value.	**[2]**
20	At Anode: Pb + SO_4^{-2} → $PbSO_4$ + 2e at Cathode : PbO_2 + SO_4^{-2} + $4H^+$ + 2e → $PbSO_4$ + $2H_2O$ On charging the battery, the reaction is reversed and $PbSO_4$ on anode and cathode is converted into Pb and PbO_2 respectively	**[2]**
21	(i) Mercury cell is used in hearing aids. (ii) Fuel cell was used in the Apollo Space Programme. (iii) Lead storage cell is used in automobiles and inverters. (iv) Dry cell does not have a long life.	**[2]**
	SECTION C	
22	i.the standard Gibbs free energy change (ΔG°) for the reaction: $E^\circ_{Zn2+/Zn}$ = -0.76 V , $E^\circ_{Cu2+/Cu}$ = +0.34 V Cell reaction- . $Zn_{(s)}$ + $Cu^{2+}_{(aq)}$ → $Zn^{2+}_{(aq)}$ + $Cu_{(s)}$ $E^0_{Cell} = E_R - E_L$ $E^0_{Cell} = E^\circ_{Cu2+/Cu} - E^\circ_{Zn2+/Zn}$ E^0_{Cell} = +0.34 V – (-0.76 V) = 1.10 V No. of electrons n= 2 $\Delta G^\circ = -nFE_{cell}$	**[3]**

	$\Delta G° = -2.123 \times 10^5$ J mol^{-1} (ii) the equilibrium constant for the reaction. $\Delta G° = -2.303RT \log K$ $2.123 \times 10^5 = -2.303RT \log K$ $\log K = nFE_0 / RT$ $\ln K = 2 \times 96500 \times 1.10 / 8.314 \times 298$ $\ln K = 85.69$ $K = e^{85.69}$ $= 1.6 \times 10^{37}$ (Very large K reaction essentially goesto completion under standard conditions.)	
23	Anode (oxidation): $Al \rightarrow Al^{3+} + 3e^-$ ($E°(Al^{3+}/Al) = -1.66$ V) Cathode (reduction): $Ni^{2+} + 2e^- \rightarrow Ni$ ($E°(Ni^{2+}/Ni) = -0.25$ V) Standard EMF $E°cell = E°cathode - E°anode = (-0.25) - (-1.66) = +1.41$ V Nernst correction at 25 °C Overall reaction (balanced electrons): $2\ Al(s) + 3\ Ni^{2+} \rightleftharpoons 2\ Al^{3+} + 3\ Ni(s)$, so n = 6. Reaction quotient: $Q = [Al^{3+}]^2 / [Ni^{2+}]^3$ $= (10^{-3})^2 / (10^{-1})^3 = 10^{-6} / 10^{-3} = 10^{-3}$. $E = E° - (0.0591/n) \cdot \log_{10} Q$ $= 1.41 - (0.0591/6) \cdot (-3)$ $= 1.41 + (0.00985) \cdot 3$ $= 1.41 + 0.02955$ $= 1.43955$ V ≈ 1.44 V	**[3]**

24	$$Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$$ $$2H^+(aq) + 2e^- \longrightarrow H_2(g)$$ $$Fe(s) + 2H^+(aq) \longrightarrow Fe^{2+}(aq) + H_2(g)$$ Here, $n = 2$ $$E_{Cell} = E^\circ_{Cell} - \frac{0.0591}{2}\log\frac{[Fe^{2+}]}{[H^+]^2}$$ $$= (E^\circ_{H^+/H_2} - E^\circ_{Fe^{2+}/Fe}) - \frac{0.0591}{2}\log\frac{10^{-3}}{[10^{-2}]^2}$$ $$= [0 - (-0.44\ V)] - \frac{0.0591}{2}\log 10$$ $$= +0.44\ V - 0.0295 = 0.4105\ V.$$	**[3]**
25	For strong electrolytes, molar conductivity increases gradually with dilution due to a decrease in ion-ion interactions. For weak electrolytes, molar conductivity increases steeply as dilution increases the degree of dissociation, producing more ions to contribute to conductivity. OR C = 1.5 M, Λ_m = 138.9 S cm^2 mol^{-1} $\Lambda_m = K \times 1000c$ $\therefore K = \Lambda m \times C1000 = 138.9 \times 1.51000 = 0.20835$ S cm^{-1}	**[3]**
26	The cell constant is given by the equation: Cell constant = G* = conductivity × resistance = 1.29 S/m × 100 Ω = 129 m^{-1} = 1.29 cm^{-1} Conductivity of 0.02 mol L^{-1} KCl solution = cell constant / resistance = * G /R = 129 m/ 520 Ω = 0.248 S m^{-1} Concentration = 0.02 mol L^{-1} = 1000 × 0.02 mol m^{-3} = 20 mol m^{-3} Molar conductivity = Λ m = κ/c= 0.248 / 20 = 124 × 10^{-4} S $m^2 mol^{-1}$	**[3]**
27	$E_{cell} = E_{oCell} - 0.0591/n \log [Cu^{2+}]/[Ag^+]^2$ $E_{oCell} = E_{o\ Cathode} - E_{o\ anode}$ E_{oCell}= 0.80-0.34 = 0.46 V $E_{cell} = 0.46 - 0.0591/2 \log [10^{1-}]/[10^{3-}]^2$ E_{cell} = 0.46 – 0.1477 = 0.31 V $\Delta G = - nFE_{oCell} = - 2 \times 96500 \times 0.31 = -59830$ Joule/mole	**[3]**

28	$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{6} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$ $E_{cell} = [-0.25 + 1.66] - \frac{0.059}{6} \log \frac{[0.001]^2}{[0.1]^3}$ $= 1.41 - \frac{0.059}{6} \log 10^{-6+3}$ $= 1.41 + \frac{0.059}{6} \times 3$ $= 1.41 + 0.0295$ $= 1.4395\ V$	**[3]**
	SECTION D	
29	aThe molar conductivity of a solution at infinite dilution is called limiting molar conductivity. b In the case of CH3COOH, which is a weak electrolyte, the number of ions increase on dilution due to an increase in degree of dissociation. $CH_3COOH + H_2O$ □ $CH3COO^- + H_3O^+$ a $\Lambda_m = \frac{\kappa \times 1000}{M}$ $\kappa = \frac{\Lambda_m \times M}{1000}$ c. $\kappa = \frac{138.95\ S\ cm^2 mol^{-1} \times 1.5\ mol\ L^{-1}}{1000\ cm^3\ L^{-1}} = \mathbf{0.208455\ cm^{-1}}$ OR $\Lambda^{\circ}_{(CH_3COOH)} = \lambda^{\circ}_{(CH_3COO^-)} + \lambda^{\circ}_{(H^+)}$ $= (40.9 + 349.6)\ S\ cm^2\ mol^{-1}$ $= 390.5\ S\ cm^2\ mol^{-1}$ $\alpha = \frac{\Lambda^c_m}{\Lambda^{\circ}_m} = \frac{39.05\ S\ cm^2\ mol^{-1}}{390.5\ S\ cm^2\ mol^{-1}} = 0.1$ - $\alpha = \mathbf{10\%}$	**[4]**
30	(a) Batteries store a fixed amount of chemical energy and convert it to electrical energy, while fuel cells generate electricity continuously as long as they are supplied with fuel and an oxidant. (b) As the overall reaction does not involve any ion in solution whose concentration can change during its life time.	**[4]**

	Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$ Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$ i.e., overall cell reaction consisting of cathode and anode reactions is: $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$ Cathode: $O_2(g) + 2H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$ Anode: $2H_2(g) + 4OH^-(aq) \longrightarrow 4H_2O(l) + 4e^-$ Overall reaction being: $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$	
31	)Correct formula (1) orrect substitution (1) orrect answer Ecell = 1.42V(1) (ii) Molar conductivity decreases with increase in concentration for both strong and weak electrolytes. (1) i.Alternating current (AC) is used to measure the resistance of an electrolytic solution to prevent electrolysis, OR a. Correct statement (1) b. Any two advantages (1) c. Correct formula (1) Correct substitution (1) Correct answer Kc=1.49 X 10^{12} (1)	**[5]**
32	 a. (b) Conductivity = 0.101 S cm^{-1} Molar conductivity = κ × 1000/C =0.101 x 1000/0.25 = 404 S $cm^2 mol^{-1}$ (1)	**[5]**

	Degree of dissociation = Λm/Λm∞ = 404/425 = 0.95 **OR** a. Faraday's law b. Enthalpy of combustion is converted into electricity. Example - H_2-O_2 cell Advantages- Non-polluting c. $w = \frac{M.Q}{nF}$ $w = \frac{63.5x2x600}{2x96500}$ Deposition of Cu = 0.395 g		
33	(1)Λ_m^0(HCl) + Λ_m^0(CH_3COONa) - Λ_m^0(NaCl) 425.9 + 91.0 - 126.4 = 390.5 S $cm^2 mol^{-1}$ (2) A = πr^2 = 3.14 × 0.5 x0.5 cm^2 = 0.785 cm^2 = 0.785 × 10^{-4} m^2 l = 50 cm = 0.5 m R = ρ l/ A ρ (resistivity) = RA/l = [5.55 × 10^3 ohm x 0.785 cm^2] / 50 cm = 87.135 ohm cm Conductivity (κ) = 1/ ρ = [1 / 87.135] S cm^{-1} = 0.01148 S cm^{-1} Molar conductivity, Λ_m = [κ (S cm-1) x 1000 (cm^3/L)] / Molarity (mol/L) = [0.01148 ×1000]/ 0.05 = 229.6 S $cm^2 mol^{-1}$ **OR**		**[5]**

	(i)Cell reaction: $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$ (n=2) Nernst equation: $E_{cell} = E°_{cell} - 0.059/2 \log [Mg^{2+}]/[Cu^{2+}]$ $\therefore E_{cell} = 0.34 - (-2.37) - 0.059/2 \log 10^{-3}/10^{-4}$ $= 2.71 - 0.02955 = 2.68$ V (ii)$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$ From this equation, we can see that 6 moles of electrons are required to reduce 1 mole $Cr_2O_7^{2-}$ Quantity of electricity (Q) = Moles of electrons (n) × 96500C =6x96500 =579000C or 6F		

GEETA DEVI

PGT CHEMISTRY

PM SHRI KENDRIYA VIDYALAYA MUZAFFARNAGAR

KENDRIYA VIDYALAYA SANGATHAN

CLASS - XII

CHEMISTRY (043)

MARKINGSCHEME

(CHEMICAL KINETICS)

	SECTION-A	
1	c	**[1]**
2	b	**[1]**
3	d	**[1]**
4	c	**[1]**
5	d	**[1]**
6	a	**[1]**
7	b	**[1]**
8	b	**[1]**
9	a	**[1]**
10	c	**[1]**
11	a	**[1]**
12	d	**[1]**
13	a	**[1]**
14	b	**[1]**
15	c	**[1]**
16	a	**[1]**
	SECTION B	
17	Ea ≈ 52.9 kJ mol^{-1} Method: Using $k_2/k_1 = \exp[Ea/R\ (1/T1 - 1/T2)]$ with	**[2]**

	$k2/k1 = 2$ for 10 K rise.	
18	$t \approx 9$ s ≈ 0.15 min Method: Zero order: $t = ([A]0 - [A])/k$.	**[2]**
19	Average rate (disappearance of N_2O_5) = 0.010 mol L^{-1} min^{-1}; Rate of formation of NO_2 = 0.020 mol L^{-1} min^{-1}	**[2]**
20	(a) Proper orientation and energy ≥ Ea. (b) Order is experimental and may be fractional; molecularity is for elementary steps only and is an integer.	**[2]**
21	$t_1/_2$ ≈ 124.3 min Method: First order: $k = -(1/t) \ln(0.8)$; $t_1/_2 = \ln2/k$.	**[2]**
	SECTION C	
22	Fraction ≈ 1.460e-19 Method: Boltzmann factor $e^{\{-Ea/RT\}}$.	**[3]**
23	k(higher Ea)/k(lower Ea) ≈ 2.198×10^4 Method: Arrhenius with same pre-exponential factor.	**[3]**
24	$t_2 = 2\ t_1$ Method: Because $\ln4 = 2 \ln2$ for first order.	**[3]**
25	(i) $-d[A]/dt = k[A][B]^2$. (ii) Increasing [B] to 3× → rate × 9. (iii) Doubling both → rate × 8. Method: Apply rate law.	**[3]**
26	(a) (i) Ea decreases (ii) ΔG° unchanged. (b) Ea cannot be zero for ordinary reactions; otherwise rate would be diffusion-controlled; practically very small at best. Method: Catalyst changes pathway; thermodynamics unaffected.	**[3]**
27	Ea ≈ 76.7 kJ mol^{-1}; k(318 K) ≈ 1.026e-02 s^{-1} Method: Use equality of times and Arrhenius with given A.	**[3]**
28	Ea ≈ 52.9 kJ mol^{-1} Method: Arrhenius temperature dependence.	**[3]**
	SECTION D	
29	(a) Ea ≈ 43.8 kJ mol^{-1}; (b) Molecularity is for an elementary step (integer), order is experimental (may be fractional).	**[4]**

	OR Units of third order: $L^2\ mol^{-2}\ s^{-1}$; (c) For $H_2 + Cl_2 \rightarrow 2HCl$ (photochemical), order = molecularity = 2 for the elementary step.	
30	(a) Ea ≈ 53.6 kJ mol^{-1}; (b) Catalyst: MnO_2 for $KClO_3$ decomposition. **OR** A catalyst lowers Ea to increase rate. (c) k = A e^(−Ea/RT) (Arrhenius equation).	**[4]**
31	(a) Rate constant multiplies by ≈ 2.35x 10^{30} at 293 K. (b) Ea ≈ 35.6 kJ mol^{-1}. **OR** (a) Catalyst does not change ΔG of reaction. (b) Increasing T decreases effective Ea barrier per kT and increases k exponentially per Arrhenius. .	**[5]**
32	(a) Rate = $k[NO]^2[Cl_2]^1$; overall order = 3. (b) For zero-order overall: rate = k (independent of [A] and [B]). **OR** For first-order ratio t(3/4)/t(1/2) = 2.	**[5]**
33	a. Zero-order verified: pressure drops by 0.8×10^3 Pa every 100 s (linear). k ≈ 8.0 Pa s^{-1}; $t_1/_2$ ≈ 312 s ≈ 5.2 min. b .Low probability of simultanous collision **OR** 33a. For H_2O_2: Ea ≈ 239.3 kJ mol^{-1}; T for $t_1/_2$=256 min ≈ 669 K. b .Due to unstable imbalance of 6 protons and 8 neutrons.	**[5]**

Marking Scheme
Subject: Chemistry
d AND f BLOCK ELEMENTS

Max Marks: 70

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
C	C	D	D	B	C	D	A
Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
B	B	D	B	A	B	C	A

Q17.

Due to the absence of unpaired electrons, the inter-atomic electronic bonding is the weakest in Zn and as a result, it has the least enthalpy of atomization

OR

When a particular oxidation state becomes less stable relative to other oxidation states, one lower, one higher, it is said to undergo disproportionation.

For example, manganese (VI) becomes unstable relative to manganese (VII) and manganese (IV) in acidic solution.

$3\ MnO_4^{2-} + 4\ H^+ \text{-------} > 2\ Mn^{VII}O_4^- + MnO_2 + 2H_2O$

Q18. Cr^{2+} is reducing as its configuration changes from d4 to d3, the latter having a half-filled t2g level. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled (d5) configuration which has extra stability.

Q19. (i) because of less negative enthalpy of hydration than of Cu^{2+}.

(ii) This is due to the increasing stability of the lower species to which they are reduced.

Q20. A much larger third ionization energy of Mn (where the required change is d5 to d4) is mainly responsible for this.

Q21. With atomic number 25, the divalent ion in aqueous solution will have d5 configuration (five unpaired electrons). The magnetic moment, μ is $\mu = \sqrt{5(5 + 2)} = 5.92BM$

Q22. (i) Cerium (Z = 58)

(ii) This is because of poor shielding by 5f electrons in actinoids in comparison with shielding of 4f electrons in lanthanoids.

(iii) La (OH)3 is more basic than Lu (OH)3 due to lanthanoids contraction.

Q23. (i) Europium (Z = 63)

(ii) This is because of the very small energy gap between the 5f, 6d and 7s orbital of actinoids rather than the 4f, 5d and 6s orbitals of lanthanoids.

(iii) Yb (OH)3 is more basic than Ce (OH)3 due to lanthanoids contraction.

Q24. (a) Give preparation

(b) $Cr_2O_7^{2-} + 2OH^- \rightleftharpoons 2CrO_4^{2-} + H_2O$

(c) Give equations

Q25. (a) Mn has + 7 oxidation state in Mn2O7 and +2 in MnO. In the higher oxidation state of the metal, valence electrons are involved in bonding and are not available. Instead effective nuclear charge is high and hence it accepts electrons and behaves as a Lewis acid.

(b) Copper exhibits +2 oxidation state wherein it will have incompletely filled d-orbitals (3d9), hence transition metal.

(c) This is due to comparable energies of 5f, 6d and 7s-orbitals.

Q26. (a) 4d and 5d transition elements (2nd and 3rd series) are Larger in size than the

corresponding 3d elements. Hence the valence electrons are less tightly held and form M-M bond more frequently (b) Due to the absence of unpaired electrons in d-orbitals Cu+ salts are colourless while due to presence of unpaired electrons in d-orbitals Cu2+ salts are Coloured (c) Because Mn2+ contain 5 unpaired electrons in their 3d sub shells.

Q27. (a) 4d and 5d transition elements (2nd and 3rd series) are Larger in size than the

corresponding 3d elements. Hence the valence electrons are less tightly held and

form M-M bond more frequently

(b) The ions in d1 configuration tend to lose one more electron to get into stable d^o configuration i.e. inert gas configuration.

(c) because of lanthanoid contraction both Zr &Hf have similar radii and similar Properties

Q28. (a) Scandium is a transition element because it has incompletely filled d orbitals but Zinc has completely filled d orbitals i.e $3d^{10}$ configuration

(b) Silver (Z = 47) can exhibit +2 oxidation state wherein it will have incompletely filled d-orbitals (4d), hence a transition element.

c) It is due to greater number of unpaired electrons in (n-1)d and ns orbitals at

the middle of the series. The lesser number of oxidation states at the extreme

ends stems from either too few electrons to lose or share.

Q29. a. Cr (3d54s1) has five unpaired electrons in its d-orbitals whereas Zn (3d104s2) has no unpaired electrons in its d-orbitals. As a result of this weak metallic bonds exist in Zn whereas strong metallic

b. Ability to stabilize higher oxidation states by oxygen is due to form multiple bonds with metals.

c. All the electrons in the d-subshell are paired. Hence, the metallic bonds present in them are weak.

OR

c. Because of large number of unpaired electrons in their atoms, transition elements have stronger interatomic interaction and hence stronger bonding between atoms resulting in higher enthalpies of atomization

Q30. a. When small atoms like H, C or N are trapped inside the crystal lattices of metals then these are called interstitial compounds.

b.Because of similar radii and other characteristics of transition metals, alloys are readily formed by these metals

c.coinage metals are treated as transition elements because they are having partially filled (n-1) d orbital in simple oxidation state. $Cu^{2}+$, $Ag^{2}+$ and $Au^{3}+$ having $3d^{9}$, $4d^{9}$ and $5d^{8}$ configuration respectively.

OR

This is due to ability to adopt multiple oxidation states and to form complexes.

Q31 (i) Both Ti3+ and Cu2+ have 1 unpaired electron, so the magnetic moment for

both will be 1.73 BM

(ii) Zn, it has a more negative electrode potential so will corrode itself in place of iron.

(iii) Mn+ has 3d54s1 configuration and configuration of Cr+ is 3d5, therefore, ionisation enthalpy of Mn+ is lower than Cr+.

(iv) Sc and Zn both form colourless compound and are diamagnetic.

(v) The decrease in the atomic and ionic radii with increase in atomic number of actinoids due to poor shielding effect of 5f electron.

OR

(i) $10I^-(aq) + 2MnO_4^-(aq) + 16H^+(aq) \rightarrow 5I_2(s) + 2Mn^{2+}(aq) + 8H_2O(l)$

(ii) The enthalpies of atomization of the Mn is low due to stable $3d^5$ configuration.

(iii) Ag+ and Zn^2+ compounds are colourless because there are no unpaired d-electrons.

(iv) Pt and Ni act as good catalysts because of free valency on the surface.

(v) Scandium (Z = 21) does not exhibit variable oxidation states as $3d^1$ configuration is very unstable in ions.

Q32. (i) because it can readily change to the most stable +3 oxidation state by gaining one electron

(ii) due to poor shielding by 5f-electrons in actinoids than that by 4f-electrons in the lanthanoids

(iii) The decrease in metallic radius coupled with increase in atomic mass results in

a general increase in the density.

(iv) due to absence of unpaired electron in f orbital

(v) The change in the size of the lanthanoids due to lanthanoid contraction is very small]

OR

(a) $Cr_2O_7^{2-} + 14H^+ + 6e- \text{—-->} 2Cr^{3+} + 7H_2O$

(b) $2MnO^{4-} + 16\ H^+ + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

(c) $Cr_2O_72- + 2\ OH- \rightarrow 2CrO_42- + H_2O$

(d) $2\ MnO_4- + H_2O + I- \rightarrow 2MnO_2 + 2OH- + IO_3-$

B. In MnO_4- ion, the oxidation state of Mn is + 7. It is equal to its group number 7.

In CrO_42-ion, the oxidation state of Cr is + 6. It is equal to its group number 6.

Q33.i) The general configuration of d-block elements is (n-1)d1-10 ns2.

ii) In the d- blocks, the last electron enters into the d-orbital of the penultimate shell. In the f-block elements, the electron enters into the f-orbital of anti-penultimate shell.d-block elements show a variable oxidation state, while most f-blocks show +3 oxidation state. Almost all d-blocks are stable, while more f-blocks are radioactive.

iii) The name lanthanides comes from lanthanum (La, Z=57) because these elements are closely related to lanthanum. This series included 14 elements from cerium (Z=58) to lutetium (Z=71). Iv) correct answer

v) Transition elements show catalytic properties because of the presence of vacant d-orbitals, the tendency to exhibit variable oxidation states,

OR

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$.

Thus, acidified potassium dichromate will oxidise iodides to iodine, iron(II) salts to iron(III), sulphides to sulphur, tin(II) to tin(IV)

and sulphite to sulphate ions.

Marking Scheme
Subject: Chemistry
Coordination Compounds

Q.No	Correct Answer
1	C.
2	A. +3
3	B. I & IV
4	C. 6, +3
5	B. $[Pt(NH_3)_2Cl_2]$
6	B. CN^-
7	A. sp^3
8	A. $[Co(en)_3]^{3+}$
9	C. $[Pt(NH_3)_2Cl_2]$
10	B. Tetraamminedichloridochromium(III) chloride
11	B. d-d transition
12	A. It treats ligands as point charges

Max Marks: 70

Section A: 16 × 1 = 16 Marks Q1 to Q12 (MCQs)

Q13 to Q16 (Assertion-Reason)

Q.No	Correct Option	Reasoning
13	A	Both statements are true, and the reason correctly explains the assertion.
14	C	CN^- causes large splitting → low spin
15	A	Bigger central atoms can accommodate more ligands
16	A	cis isomer is optically active

Section B: 5 × 2 = 10 Marks

Q.No	Expected Answer	Marks
17.	Coordination number = no of coordinate bond in complex , Coordination number = 6 for $[Fe(C_2O_4)_3]^{3-}$. Each oxalate = bidentate → 3×2 = 6	2
18	(A) $t_2g^5\ eg^0$	1
	(B) $[Cr(Cl)_6]^{3-} < [Cr(NH_3)_6]^{3+} < [Cr(CN)_6]^{3-}$	1
19	Double salt dissociates into simple ions in solution e.g., $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$), coordination compound form complex ion e.g., $[Co(NH_3)_6]Cl_3$)	2
20	$[Co(EDTA)]^-$ Drawing should show all six coordination sites	2
21	Award marks for correct answer .	2
	Section C: 7 × 3 = 21 Marks	

Qus	Expected Answer	Marks
22	(a) Ionisation isomerism	1
	(b) Optical/geometrical	1
	(c) Geometrical isomerism	1
23	(a) Pentaamminesulphatocobalt(III) bromide	1
	(b) Primary valency = 3	1
	(c) Secondary valency = 6	1
24	CN^- causes pairing → low spin; F^- doesn't → high spin	3
25	For the complex [Fe(CO)5] Since, CO is a neutral ligand thus, Fe is in 0 oxidation state. Electronic configuration of Fe = $4s^2\ 3d^6$ The unpaired electrons will pair up as the CO ligands are strong field ligands and dsp3 hybridisation is formed. Since, there is no unpaired electron so the compound is diamagnetic and low spin.	3
26	(a) has two or more donar atom but only one forms bond at a time. Example NO_2^- (binds via N or O) (b) Multidentate ligands form stable chelates (c) Linkage isomerism occurs with *ambidentate* ligands that are capable of coordinating in more than one way. Ex $[Co(NO_2)(NH_3)_5]^{2+}$ and $[Co(ONO)(NH_3)_5]^{2+}$	3
27	$Cr^{3+} = d^3$ → 3 unpaired electrons $\mu = \sqrt{(n(n+2))} = \sqrt{15} = 3.87$ BM → paramagnetic	3
28	i) Strong ligands (like CN^-, en, CO) stabilize the higher oxidation state (+3) through strong ligand field stabilization and π-back bonding.	1
	(ii) CO can act as both a σ-donor (through the lone pair on carbon) and a π-acceptor (back bonding from metal d-orbitals to CO's empty π* orbitals). This synergic effect makes the metal–CO bond much stronger than the purely σ-donor bond of NH_3.	1
	(iii) because the ligand is attached to the metal ion from many points. Thus, there is a strong force of attraction between the metal and the ligand.	1

Section D: 2 × 4 = 8 Marks

Q29 – Hybridisation & Geometry

Sub-question	Marking Points
a) Ox. state of Ni in both = 0 in $[Ni(CO)_4]$, +2 in $[Ni(CN)_4]^{2-}$	1
b) $[Ni(CO)_4]$ → sp^3 → diamagnetic; $[Ni(CN)_4]^{2-}$ → dsp^2 → diamagnetic (pairing due to strong ligand)	1
c) CO, CN^- → strong field ligands	1
d) $[Ni(CO)_4]$ more stable → due to π accepter ligand and backbonding .	1

Q30 –

Sub-question	Marking Points
i) Cobalt	1
ii) cis-$[Pt(en)_2Cl_2]^{2+}$ shows optical isomerism due to the lack of a plane of symmetry and the presence of non-superimposable mirror images.	1
iii) [CrCl2(H2O)4]Cl·2H2O IUPAC Name: The IUPAC name for this complex is: Tetraaquadichlorochromium(III) chloride dihydrate OR The hexadentate ligand used for the treatment of lead poisoning is ethylenediaminetetraacetate, commonly known as EDTA. IUPAC Name: Ethylenediaminetetraacetic acid	2

Section E: 3 × 5 = 15 Marks

Q31 – Structural Isomers

a) 3 isomers:(i) $[Co(NH_3)_4Cl_2]Cl$ (ii)$[Co(NH_3)_5Cl]Cl_2$ (iii)$[Co(NH_3)_6]Cl_3$	1.5
b) Ionisation isomerism	1
c) Precipitate with $AgNO_3$ depends on number of free Cl^- ions	1
d) Names:(i) Tetraamminedichloridocobalt(III) chloride	1.5
(ii)Pentaamminechloridocobalt(III) chloride	
(iii)Hexaamminecobalt(III) chloride	

Q32 – CFT & Stability

Points	Marks
a) $[Fe(CN)_6]^{4-}$ = low spin; diamagnetic $[Fe(H_2O)_6]^{2+}$ = high spin paramagnetic ($H_2O < CN^-$ in CFSE)	1.5
b) $Fe^{2+} = d^6$ → config shown in both. Oxidation state of iron is +2 in both complex	1
c) $[Fe(CN)_6]^{4-}$ more stable due to higher CFSE	1
d) Ligand affects d-d transition energy → colour of complex	1.5

Q33

a) (i)The difference between energies of two sets of d-orbitals t2g and eg is called crystal field splitting energy (Δ0).	1
(ii) (a) If Δ0 > P, the configuration will be t2g4, eg0. Ligands will produce strong field and pairing takes place. (b) If Δ0 < P, the configuration will be t2g3, eg1. Ligands will produce weak field and no pairing takes place	1 1
b) Hybridisation – sp3d2, number of unpaired electron= 4.	1,1

OR	
(i)ionization isomer: [Ni(NH3)3Cl]NO2 IUPAC Name : triamminechloridonickel(II) nitrite	1
(ii) More stable: $[Co(en)_3]3+$ Why: Chelate effect—each en is bidentate; forming rings increases entropy and reduces dissociation vs six monodentate NH_3 ligands in	1
(iii) Low spin tetrahedral complexes are not formed because the crystal field splitting energy (CFSE) in a tetrahedral field is too small (Δt) to overcome the energy required to pair electrons	1
(iv) $[Ni(CN)_4]^{2-}$ (Ni^{2+}: d^8; CN^- strong field): Shape: square planar (dsp^2). diamagmnetic	1+1

KENDRIYA VIDYALAYA SANGATHAN, AGRA REGION

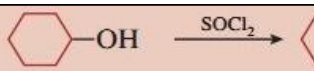
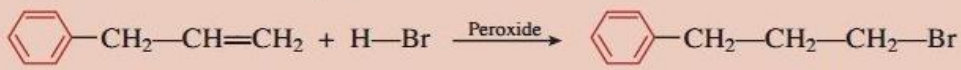
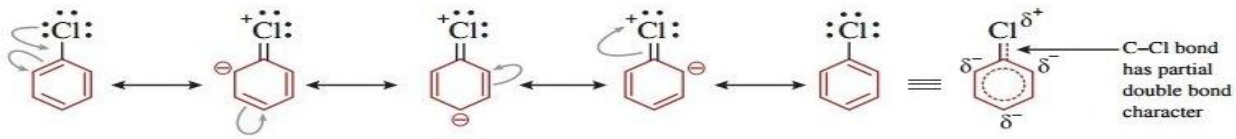
PRACTICE PAPER(2026-27)

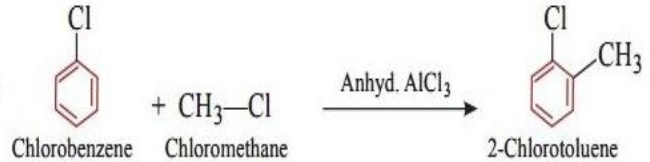
CLASS - XII

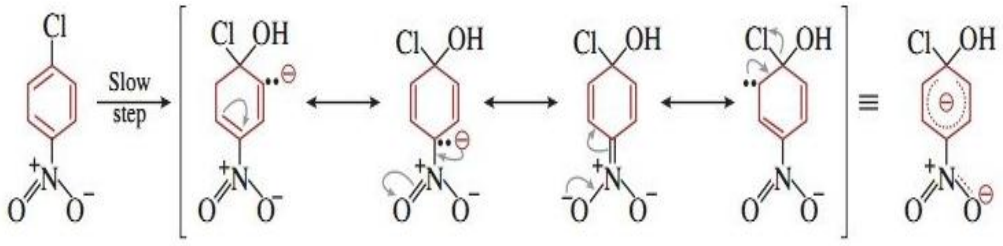
TIME: 3:00 Hrs. **SUBJECT - CHEMISTRY** **M.M: 70**

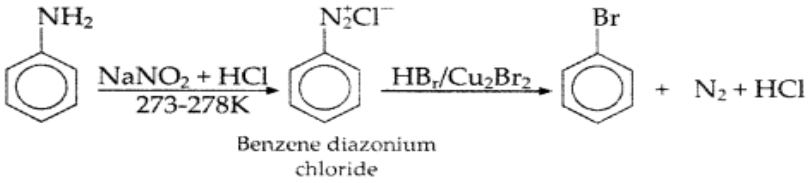
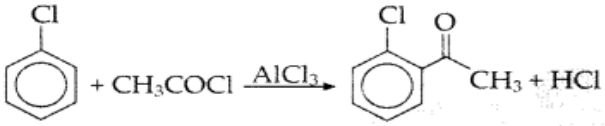
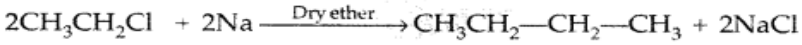
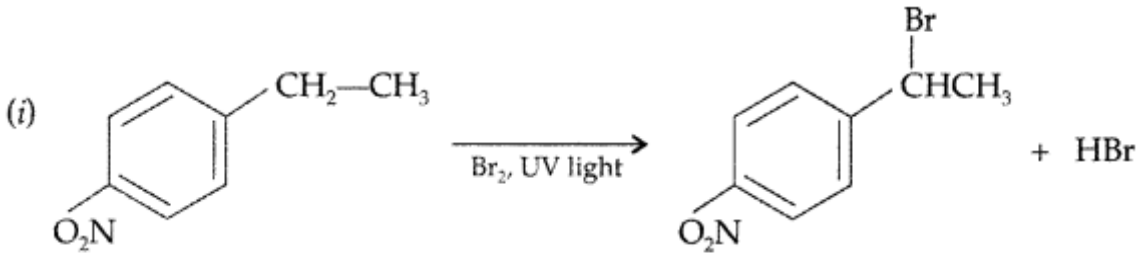
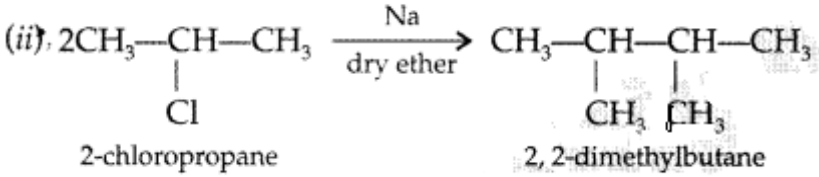
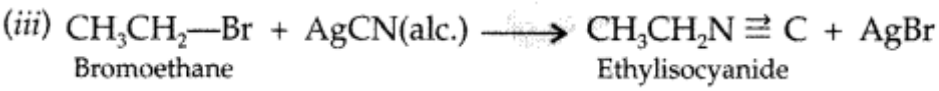
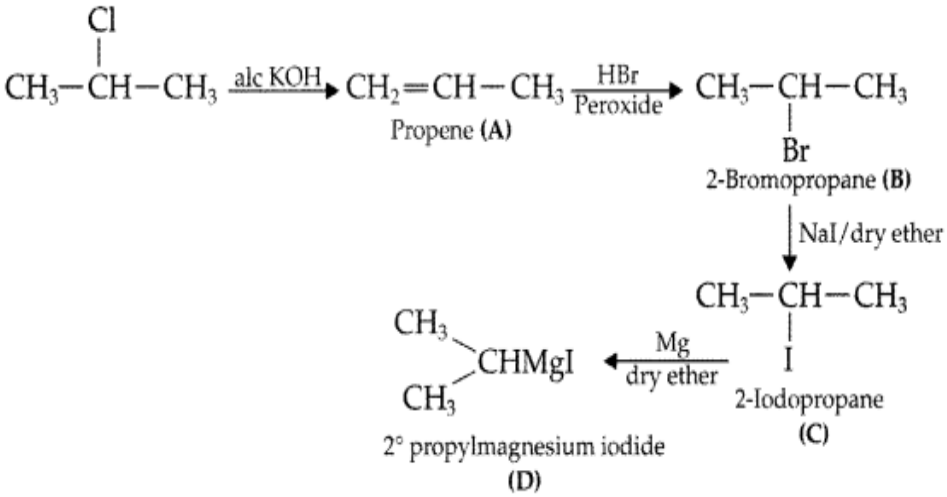
HALOALKANES & HALOARENES

ANSWER KEY

	SECTION-A	
Sr. No.	MCQs	Marks
1.	(a)	1
2.	(a)	1
3.	(c)	1
4.	(d)	1
5.	(d)	1
6.	(c)	1
7.	(b)	1
8.	(d)	1
9.	(b)	1
10.	(b)	1
11.	(b)	1
12.	(a)	1
13.	(b)	1
14.	(d)	1
15.	(c)	1
16.	(a)	1
	SECTION-B	
17.	(i)  (ii) 	1 1
18.	(i) In chlorobenzene, C-Cl bond acquires partial double bond character while in methyl chloride, C-Cl bond has pure single bond character. As a result C-Cl bond in chlorobenzene is shorter than methyl chloride.  (ii) Carbocations are intermediate in S_N1 reactions. Carbocations being sp^2 hybridised are planar	1 1

	species, therefore, attack of nucleophile on it can occur from both front and rear with almost equal ease giving a racemic mixture.	
19.	(i) On heating chloroform and carbon tetrachloride with aniline and ethanolic potassium hydroxide separately chloroform forms pungent smelling isocyanide but carbon tetrachloride does not form this compound. $C_6H_5NH_2 + CHCl_3 + 3KOH\,(\text{ethanolic}) \xrightarrow{\Delta} \underset{\text{Phenyl isocyanide}}{C_6H_5NC} + 3KCl + 3H_2O$ (ii) On adding sodium hydroxide and silver nitrate to both the compounds benzyl chloride forms white precipitate but chlorobenzene does not form white precipitate. $C_6H_5CH_2Cl + NaOH \longrightarrow C_6H_5CH_2OH + NaCl$ $NaCl + AgNO_3 \longrightarrow \underset{\text{White ppt.}}{AgCl(s)} + NaNO_3$	1 1
20.	(i) $\underset{\text{Chloroform}}{2CHCl_3} + O_2 \xrightarrow{\text{Light}} \underset{\text{Phosgene}}{2COCl_2} + 2HCl$ (ii)  	1 1
21.	$C_6H_5C(CH_3)(C_6H_5)Br > C_6H_5CH(C_6H_5)Br > C_6H_5CH(CH_3)Br > C_6H_5CH_2Br\ (S_N1).$ $C_6H_5C(CH_3)(C_6H_5)Br < C_6H_5CH(C_6H_5)Br < C_6H_5CH(CH_3)Br < C_6H_5CH_2Br\ (S_N2).$	1 1
	SECTION- C	
22.	(i) $\underset{\text{Prop-1-ene}}{CH_3-CH=CH_2} \xrightarrow[(C_6H_5COO)_2]{+HBr} CH_3-CH_2-CH_2-Br \xrightarrow[\Delta]{AgF} \underset{\text{1-Fluoropropane}}{CH_3-CH_2-CH_2-F}$ (ii)  (iii) $\underset{\text{Ethanol}}{CH_3-CH_2-OH} \xrightarrow{+PCl_5} CH_3-CH_2-Cl \xrightarrow{\text{Alk. KCN}} \underset{\text{Propanenitrile}}{CH_3-CH_2-C\equiv N}$	1 1 1
23.	(i) Compound A: $CH_3-\underset{\displaystyle Br}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$; Compound B: $CH_3-CH_2-\underset{\displaystyle Br}{\overset{|}{\underset{|}{CH}}}-CH_3$ (ii) Compound 'B'	1 1 1
24.	(i) It is due to the greater symmetry of para-isomer that fits in the crystal better as compared to	1

	ortho and meta-isomers. (ii) As C-X bond in aryl halide acquires a partial double bond character due to resonance while the C-X bond in alkyl halide is a pure single bond. (iii) Alkoxide ion present in alcoholic KOH, is not only a strong nucleophile but also a strong base so preferentially eliminate a molecule of HCl from alkyl halide to form alkenes.	1 1
25.	(i) n-Butyl bromide being a straight chain alkyl halide has larger surface area than tert.butyl bromide. Larger the surface area, larger the magnitude of the vander Waal's forces and hence higher is the boiling point. (ii) A racemic mixture contains the two enantiomers d and I in equal proportions. As the rotation due to one enantiomer is cancelled by equal and opposite rotation of another enantiomer, therefore, it is optically inactive. (iii) The presence of NO, group at o/p position in haloarenes helps in the stabilisation of resulting carbanion by -R and -I effects and hence increases the reactivity of haloarenes towards nucleophilic substitution reactions.	1 1 1
26.	(a) $CH_3CH_2CH_2CH_2Cl + NaI \xrightarrow{\text{Dry acetone}} CH_3CH_2CH_2CH_2—I + NaCl$ (b) 2-Bromo-2-methylbutane is more reactive as it gives more substituted alkene on elimination. (c) 4-Bromo-4-methylpent-2-ene	1 1 1
27.	(i) Retention (ii) Inversion (iii) Racemisation	3X1
28.	(i) In p-nitrochlorobenzene a carbanion intermediate is formed. This is stabilised by resonance as shown below.  The -I effect of nitro group further stabilises the intermediate. Hence, p-nitrochlorobenzene reacts faster than chlorobenzene. (ii) Hypoiodite ion can act as an oxidising agent while iodide ion does not.	2 1
	SECTION-D	
29.	(i)) The best method to convert an alcohol into an alkyl chloride is by reacting the alcohol with thionyl chloride ($SOCl_2$) in the presence of pyridine. This method is preferred because the gaseous by-products, sulfur dioxide (SO_2) and hydrogen chloride (HCl), readily escape the reaction mixture, leading to a high yield of pure alkyl chloride. (ii) anhydrous $ZnCl_2$ (iii) Wurtz reaction	1x4=4

	(Iv) From aniline by diazotization followed by heating the diazonium salt with HBF4	
30.	(i) c (ii) a (iii) d (iv) a	1x4
	SECTION E	
31.	(i) Aniline to bromobenzene  Benzene diazonium chloride **(ii) Chlorobenzene to 2-chloroacetophenone**  **(iii) Chloroethane to butane** 	2+2+1
32.	(a)   2-chloropropane 2, 2-dimethylbutane  Bromoethane Ethylisocyanide (b) 	3+2=5
33.	(a)  Propene (A) 2-Bromopropane (B) 2-Iodopropane (C) 2° propylmagnesium iodide (D)	1x5=5

VINAY KUMAR

PGT- CHEMISTRY

KV NTPC DADRI

	Marking scheme Class –XII SUB -CHEMISTRY	
1	A	
2	C	
3	A	
4	C	
5	B	
6	B	
7	B	
8	A	
9	B	
10	B	
11	B	
12	Propane-1-ol<4-methylphenol<phenol<3-nitrophenol<3,5dinitrophenol<2,4,6 trinitrophenol	
13	A	
14	C	
15	D	
16	C	
17	a). Alcohols can form H-bonds with water and break the H-bonds already existing between watermolecules. Therefore, they are in general, soluble in water. On the other hand, hydrocarbons cannot fromH-bonds with water and hence are insoluble in water. b). o-nitrophenol is more volatile due to intramolecular H-bonding.	
18	a). Propane-1,2,3-triol	

	b). 2-Acetoxybenzoic acid	
19	a). o-Cresol < Phenol < o-Nitrophenol b). Primary >Secondary > Tertiary	
20	As we move from primary to secondary alcohol, the number of alkyl groups attached to the carbonhaving the –OH group increases. Due to +I effect of alkyl group, the electron density on oxygen will be more in case of 2^{o}alcohols than in case of 1oalcohol. Hence the shared pair of electron of the O-H bond will be more displaced towards the O atom in case of 1oalcohol than in case of 2^{o}alcohol. Thus the release of proton (H+) is easier in case of 1oalcohols than in case of 2^{o}alcohol. Therefore, 1^{o} alcohol is more acidic than 2^{o}alcohol.	
21	PROPER TEST	
22	PROPER MECHANISM	
23	PROPER ANY METHOD OF CONVERTION	
24	Reimer - Tiemann reaction -When phenol is treated with chloroform in the presence of sodium hydroxide,a –CHO group is introduced at the orthoposition of the benzene ring. This reaction is known as the Reimer-Tiemann reaction. The intermediate is hydrolyzed in presence of alkalis to produce salicylaldehyde. KOLBES- Sodium phenoxide is generated by treating phenol with sodium hydroxide. It is treated with carbon dioxide to form ortho-hydroxy benzoic acid (salicylic acid).	
25	CORRECT STRUCTURES (a) HCl –ZnCl2, it is a Lucas reagent. (i) Turbidity appears upon heating (ii) white turbidity formed (b) With HBr to give alkyl halides. (c) Both alcohols react to give alkyl chlorides.	
26	a)The strong base and the steric hindrance around the tertiary carbon favour eliminationreaction. b)Because it forms intramolecular hydrogen bonds. c)OH group is an o-p directing and activating group increasing electron density	
27	Answer: -(i) Add NaHCO3to each. Phenol will not react, whereas benzoic acid will give brisk effervescence due to CO2. (ii) Add I2 and NaOH to each one. Propan-2-ol will give yellow ppt. of iodoform (iodoform test), whereas propan-1-ol will not give yellow ppt. (iii) Add I2 and NaOH to each one. Ethanol will give yellow ppt. of iodoform (iodoform test), whereas methanol will not give yellow ppt	

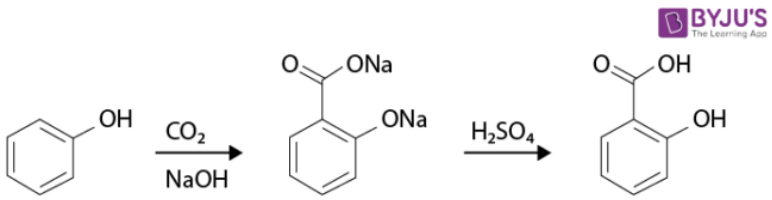
28	Ans. (a) Butan-1-ol (b) Propan-2-ol (c)2-methyl Propan-2-ol	
29	1. Phenol 2. 9($C_9H_8O_4$) 3. Kolbe reaction **OR** 6 $C_6H_5OH + FeCl_3 \dashrightarrow [Fe(O\ C_6H_5)_6]^{-3} + 3H^+ + 3HCl$	
30	Correct Explanation **OR** 1 2 3 4 b c c b	
31	-(a)Alcohols have hydrogen bonding whereas hydrocarbons have weak van der Waal's force of attraction. (b) Due to steric hindrance higher alcohols are incapable of forming hydrogen bonding with water and so are insoluble in water. (c) Ortho nitrophenol is more acidic due to electron withdrawing effect of nitro group which facilitates release of proton (d) 2,4,6-trinitrophenol is stronger acid due to presence of three nitro group showing electron withdrawing effect. (e) Alcohol reacts with sodium metal due to presence of active hydrogen in it. OR -(a) Phenol is less acidic than carbonic acid whereas carboxylic acid is more acidic than carbonic acid. (b) Phenol has activating group -OH which shows +R effect and so increases electron density at ortho and para position. so, phenol gets easily nitrated (c) Sodium metal does not react with ether whereas it reacts with alcohol. (d) Ether has two lone pair of electrons on oxygen and also two alkyl groups showing +I effect which helps in donation of electrons. (e) Ortho nitro phenol has intramolecular hydrogen bonding and so molecules are less associated with each other whereas para nitro phenol has intermolecular hydrogen BONDING	
32	a) Ethylene glycol > diethyl ether > ethanol > Methanol. b) O- nitrophenol>, p- nitrophenol> Phenol > p- methoxyphenol. c) Ethanol > phenol > Dimethyl ether. d) n-Butanol> 2-methylpropan-1-ol > 2-methylpropan-2-ol. e) Water > Ethanol > n-butane > propane. f) n- butanol> n-butyl chloride > n-butane >Isobutane. g) phenol> Water > ethanol.	

h) tertiary butyl alcohol > isopropanol > Ethanol.

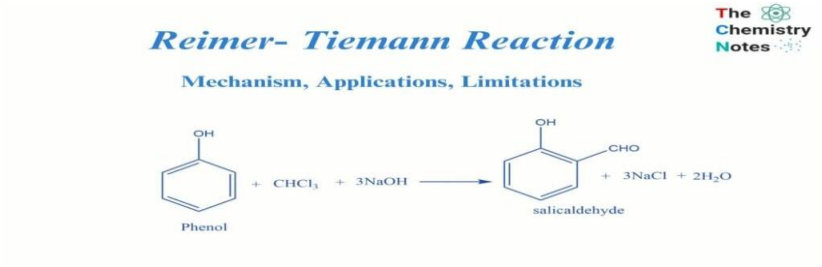
i) glycerol> ethylene glycol > methanol > ethyl alcohol.

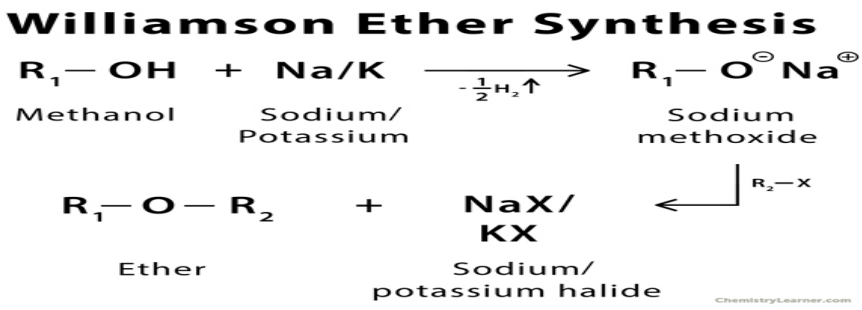
j) p-nitrophenol> o- nitrophenol> phenol

33 kolbes

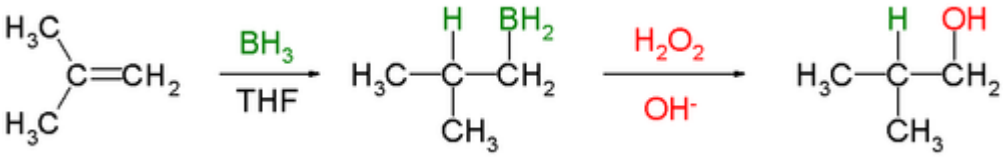


V

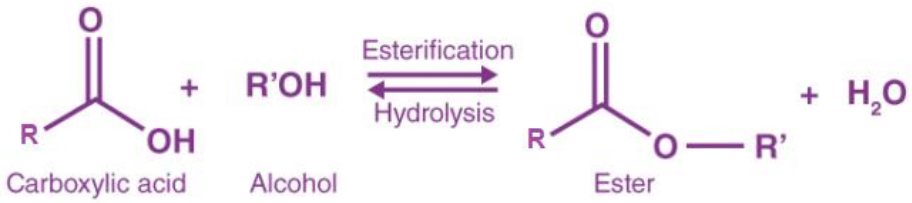




hydroboration







CLASS XII

MARKING SCHEME

ALDEHYES KETONES AND CARBOXYLIC ACIDS

ANSWERS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B	A	D	A	C	A	A	D	A	B	B	D	B	A	A	A

17 Methanal → no α-H → Cannizzaro

Ethanal → has α-H → Aldol not Cannizzaro

18 a) Test($NaHCO_3$ Test) Phenol Benzoic Acid

: No Reaction. With effervescence CO_2 is evolved.

Add a few drops of aq. sol. (saturated) of $NaHCO_3$

. $C_6H_5COOH + NaHCO_3 \rightarrow C_6H_5COONa + H_2O + CO_2$

(b) Benzaldehyde Propanal

It gives tollen's It also give tollen's reagent test

It doesn't give fehling solution test It gives fehling solution test

19 Ans:- The phenoxide ion has non equivalent resonance structures in which –ve charge is at less electronegative C atom and +ve charge as at more electronegative O-atom.

In carboxylate ion –Ve charge is delocalized on two electronegative O-atoms hence resonance is more effective and a stronger acid.

20 Ans.



NH_2- C – NH – NH_2

Due to resonance one NH_2 group undergoes or involved in resonance and hence can't participate in the formation of semicarhazone.

N^+H_2 = C – NH – NH_2

O-

Lone pair of -NH_2 group is not involved in resonance and is available for nucleophillic attack.

21 Ans. Because of increase in alkyl chain length which is hydrophobic in nature.
Hence solubility decreases.

OR

Ans (a) + I effect:- The alkyl group in Ketones due to their e-releasing character decrease the +Ve charge on C-atom and thus reduce its reactivity.

(b) Steric hindrance:- Due to steric hindrance in ketones they are less reactive.



22 Ans-: $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$ + H_2O

(A) Butyl Butanoate $CH_3CH_2CH_2COOH$ (B) + $CH_3CH_2CH_2$ CH_2OH

(C)

$CH_3CH_2CH_2$ CH_2OH $\xrightarrow{K_2Cr_2O_7}$ $CH_3CH_2CH_2COOH$

(C) (B)

$CH_3CH_2CH_2$ CH_2OH $\xrightarrow{Conc.}$ $CH_3CH_2CH = CH_2$

(bute – 1-ene)

23 a. Two molecules of acetaldehyde when heated in presence of dilNaOH,condense to form aldol.

$$CH_3\text{-}CHO + \text{Dil NaOH} \longrightarrow CH_3\text{-}CH(OH)\text{-}CH_2\text{-}CHO \xrightarrow{\text{heat}} CH_3\text{-}CH{=}CH\text{-}CHO$$

3-hydroxy butanal But-2-enal

b. $CH_3CH=O + 4[H]$ $\xrightarrow{Zn\text{-}Hg/HCl}$ $CH_3\text{-}CH_3 + H_2O$

OR

(a) Phenol Alcohol

It gives $FeCl_3$ test It doesn't give this test

(voiletcolour)

(b) Benzaldehyde Propanal

It gives tollen's reagent test It also give tollen's

It doesn't give fehling solution test It gives fehling solution test

(c) Acetic acid Formic acid

It doesn't gives tollen's reagent It gives tollen's test

It doesn't give fehling's test It gives fehling test

24Ans-

a. . $R\text{-}\overset{\overset{O}{\|}}{C}\text{-}H$ $\xrightarrow{Zn/HCl,4[H]}$ $R\text{-}CH_3 + H_2O$

b. . $CH_3\text{-}\overset{\overset{O}{\|}}{C}\text{-}NH_2$ $\xrightarrow{HNO_2}$ $CH_3COOH + N_2 + H_2O$

25 Ans-:It does not reduce Fehling's solution but forms bisulphite compound so it is a ketone therefore it gives positive Iodoform test therefore it is methyl ketone .

The possible structure are-: $CH_3 – CO – CH_2 – CH_2CH_3$ and $CH_3 – CO – CH(CH_3)_2$

26 $CH_3COOH + Na_2CO_3 \rightarrow CO_2 + CH_3COONa + H_2O$

$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

(c) Reason: Acid reacts with Na_2CO_3, alcohol does not

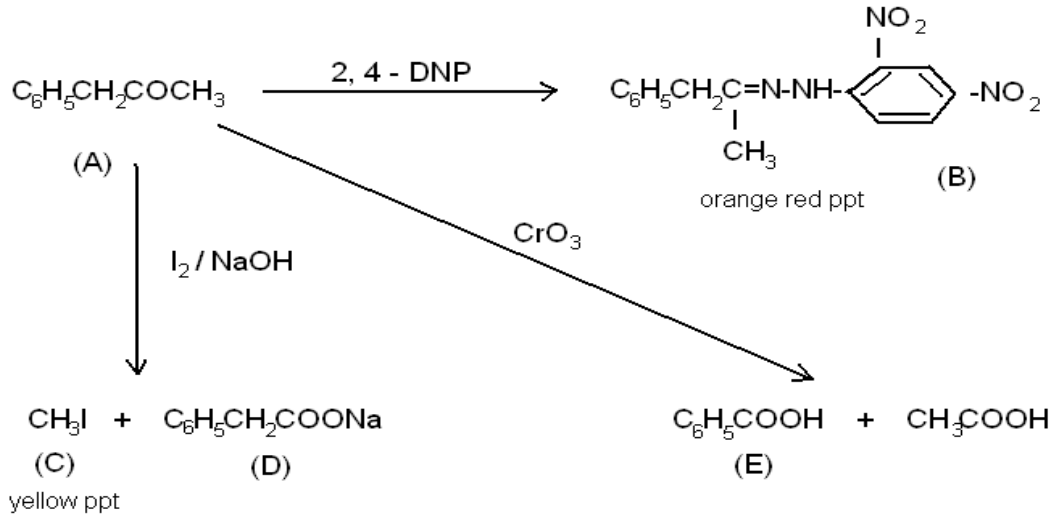
27 (i) CH_3CH_2OH ------pcc---→ $CH_3\text{-}CHO + H_2$

Ethanol Acetaldehyde

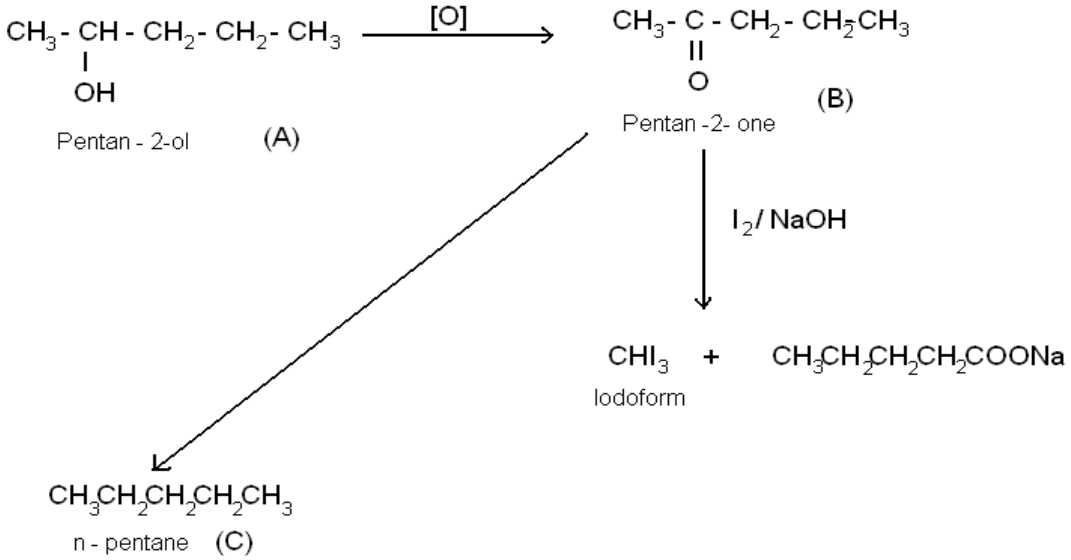
(ii) $HCOOH < CH_2ClCOOH < CCl_3COOH < CF_3COOH$

(iii) 2,4 – Dimethylpentan-3-one

28



28 **OR**



29 Ans a .Anoxime will form.

b. 2,4-Dinitrophenylhydrazinegives yellow/orange/red ppt with carbonyl compound.

c. $(CH_3)_2C=O + NH_2\text{-}OH \; H^+ \; (CH_3)_2C=N\text{-}OH$

No product will form in highly acidic medium as ammonia derivative is protonated and no more

nucleophile..

OR

-NH_2 group away from CO group will take part in formation of semicarbazone because the lone

pair of NH_2 group next to CO group is engage in resonance acquire +ve charge and lose nucleophillic character.

30 Ans A = Aldehyde (acetaldehyde), B = Ketone (acetone)

Tollens' eqn: $R–CHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow RCOO^- + 2Ag + 4NH_3 + 2H_2O$

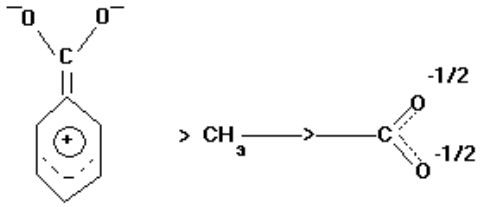
B does not oxidize but gives iodoform

Another reagent: Fehling's/Schiff

31 Ans.(a)

(i) The Alkyl group in Ketones decreases the positive charge on the Carboxyl carbon due to + I effect, makes > C= O less polar than Aldehyde and decreasing the attacking tendency of the nucleophile.

(ii) (ii) Phenyl group in Benzoic acid has weak +R effect and thus destablises the Carboxylate anion, makes it a stronger base. +I effect of Methyl group in Acetic acid is still greater than +R effect of Phenyl group. This further destabalises the Acetate ion comparatively, makes it a stronger base than Benzoic acid. So, acetic acid is weaker than Benzoic acid.



+R effect of Phenyl group in Bebzoic acid

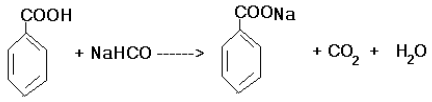
+I effect of $-CH_3$ group in acetic acid

Cresol is a weaker acid than Phenol because +I effect of –R group at the ortho and para position increases electron density on the Benzene nucleus, decreasing stability of ArO^- ion making it a stronger base as O-H bond becomes less polar. Hence, substituted Phenol is less acidic than Phenol.

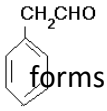
Ans.(b)

Test	Benzoic Acid	Phenol
(i) Sodium Bicarbonate test	CO_2 gas with	no reaction

Effervescence



(ii) Test CH_3COCH_3

Warming with Tollen's reagent  forms silver mirror no reaction

OR

Ans

(i)CH_3CHO–dilNaOH—>$CH_3CH(OH)CH_2CHO$ _H_2/Pd→$CH_3CH(OH)CH_2CH_2OH$

(ii) CH_3CHO–dilNaOH→$CH_3CH(OH)CH_2CHO$—heat—>$CH_3CH=CHCHO$

(iii)CH_3CHO–dilNaOH→$CH_3CH(OH)CH_2CHO$—heat—>$CH_3CH=CHCHO$–Tollen's reagent

—>$CH_3CH=CHCOOH$

B Ans a) Propanone vsPropanal → Fehling's/Schiff

(b) Benzoic acid vs Phenol → $NaHCO_3$ test

(c) Acetaldehyde vs Acetone → Iodoform test

32 (i)Cannizzaro (ii) aldol condensation (iii)Cannizzaro

(iv)neither Cannizzaro nor aldol condensation (v)aldol condensation

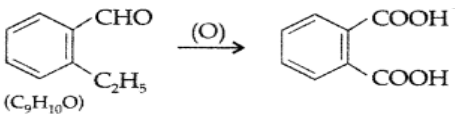
OR

Ans(**A)** (a) Aldehydes more reactive (less steric + less +I effect)

(b) Carboxylic acids > alcohols (H-bond dimerization)

(c) Formic acid stronger (no +I group)

(B) Compound $C_9H_{10}O$ forms 2, 4-DNP derivative, so it contains a carbonyl group. Also it reduces Tollens' reagent therefore carbonyl group is an aldehyde group. Since it undergoes Cannizzaro's reaction, aldehyde has no a hydrogen atom, so compound is C_8H_9-CHO. On vigorous oxidation, compound gives l, 2-benzene di-carboxylic acid hence the compound is 2 ethyl benzaldehyde



33A) This is because PCC is a mild oxidising agent and can oxide methanol to methanalonly.While $KMnO_4$ being strong oxidising agent oxidises it to methanoic acid.

B) The formation of esters from a carboxylic acid and an alcohol in the presence of acid catalyst is a reversible reaction.

$$R - COOH + R'OH \underset{}{\overset{H_2SO_4}{\rightleftharpoons}} R - COOR^{/} + H_2O$$

To shift the equilibrium in forward direction, the water or ester formed should be removed as fast as it is formed.

C) CH_3COOH contains α-hydrogens and hence give HVZ reaction but HCOOH does not contain α-hydrogen and hence does not give HVZ reaction.

D) Due to intramolecular H-bonding in O-hydroxybenzaldehyde exists as discrete molecule whereas due to intermolecular H-bonding p-hydroxybenzaldehyde exist as associated molecules.To break this intermolecular H-bonds a large amount of energy is needed. Consequently p-isomer has a much higher m.p. and b.p. than that of o-isomer.As a result o-hydroxybenzaldehyde is liquid.

E) Ans Due to +I effect, CH_3- group in acetic acid increases e- density on carbon atom which makes it Weak acid.While in formic acid no such pushing group is present, hence is more stronger acid than acetic acid.

OR

Ans (A) (a) $CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$ (1)

(b) $C_6H_5CHO + CH_3CHO$ (NaOH) → Cannizzaro products (1)

(c) $CH_3COCH_3 + HCN \rightarrow CH_3–C(OH)–CH_2CN$ (1)

(B) (i) Propanal and Propanone

By Schiff's reagent test as only propanal will give pink colour with Schiff's reagent in cold.

(ii) Acetophenone and Benzophenone

By Iodoform test as only Acetophenone will produce yellow precipitate on heating with iodine and sodium hydroxide solution.

ANSWER KEY OF AMINES PAPER

Q1	(c) 2,4,6-Tribromoaniline	1
Q2	(b) $(CH_3)_2NH$	1
Q3	(a) Hoffmann bromamide reaction	1
Q4	(a) Resonance effect in aromatic amines	1
Q5	(a) 1° amine	1

Q6	(a) CH_3NH_2	1
Q7	(d) N-Methylaniline	1
Q8	(a) Benzene sulphonyl chloride	1
Q9	(b) Phthalimide potassium salt	1
Q10	(b) Coupling reaction of diazonium salts	1
Q11	(b) $R_2NH > RNH_2 > R_3N > NH_3$	1
Q12	(b) $C_6H_5NO_2 \rightarrow (Sn/HCl) \rightarrow C_6H_5NH_2$	1
Q13	(A)	1
Q14	(B)	1
Q15	(A)	1
Q16	(A)	1
Q17	(a) Nitrobenzene → (Sn/HCl, reduction) → Aniline (b) Aniline + Acetic anhydride → Acetanilide	2
Q18	(a) Aliphatic > Aromatic due to resonance in aromatic amines reducing availability of lone pair. (b) Primary amines form stable salts due to strong H-bonding and ionic character.	2
Q19	(a) Aniline gives diazotisation, N-methylaniline does not. (b) Hinsberg test – 1° forms soluble sulphonamide (alkaline hydrolysis), 2° gives insoluble sulphonamide.	2
Q20	Tertiary amines lack H on N, so cannot form amides → no acylation.	2
Q21	In gaseous phase: basicity ∝ +I effect, order: 3°> 2°> 1°> NH_3. In aqueous phase: solvation effect important, order: 2° > 1° > 3° > NH_3.	2
Q22	Hoffmann bromamide mechanism: Amide + Br_2/KOH → R–NH_2 (1C less) Steps: 1. Formation of N-bromoamide 2. Base-induced deprotonation 3. Rearrangement (migration of R) 4. Hydrolysis → amine	3
Q23	(a) Steps: Aniline → diazonium salt → iodobenzene (Sandmeyer with KI). Equations: 1. $C_6H_5NH_2 + HNO_2 + HCl \rightarrow C_6H_5N_2^+ Cl^- + 2H_2O$ (formation of diazonium salt; use $NaNO_2$ + HCl at 0–5°C). 2. $C_6H_5N_2^+ Cl^- + KI \rightarrow C_6H_5I + N_2\uparrow + KCl$. (b) Aniline → benzonitrile One route: Diazotise and convert diazonium to nitrile (Sandmeyer type with CuCN): 1. $C_6H_5NH_2 \rightarrow C_6H_5N_2^+ X^-$ ($NaNO_2$/HCl, 0–5°C).	3

	2. $C_6H_5N_2^+ X^-$ + CuCN → C_6H_5CN + N_2↑ + CuX. Alternatively via dehydration of benzamide (but Sandmeyer/Schmidt routes are common). (c) Aniline → fluorobenzene Via diazonium and replacement by F using HBF_4 followed by thermal decomposition (Gattermann–Diazotisation variant called the Balz-Schiemann reaction): 1. $C_6H_5NH_2$ + HBF_4 + $NaNO_2$ → $C_6H_5N_2^+ BF_4^-$ (diazoniumtetrafluoroborate) (0–5°C). 2. Heat $C_6H_5N_2^+ BF_4^-$ → C_6H_5F + N_2↑ + BF_3 (gives fluorobenzene).	
Q24	(a) In aniline the lone pair on nitrogen is delocalized into the aromatic ring (resonance), reducing its availability for protonation. Methylamine's lone pair is localized and electron density is increased by methyl group's +I effect, so it is more basic. (b) Aniline oxidizes slowly in air (oxygen) to form various oxidized products (e.g., azobenzene, quinone imines, polyaniline-like species) and polymeric tars; these oxidation products are colored (brown) leading to browning on standing. Impurities and formation of nitroso/azo/p-quinone imines contribute.	3
Q25	(a) N-methylmethanamine (b) Diethylamine (N-ethylethanamine) (c) Propan-1-amine.	3
Q26	The compound is Aniline ($C_6H_5NH_2$) — widely used as chemical intermediate. Important reaction: Diazotisation to form diazonium salt: $C_6H_5NH_2$ + HNO_2 + HCl → $C_6H_5N_2^+Cl^-$ + $2H_2O$ (used to prepare dyes by azo coupling). One use: Manufacture of azo dyes (e.g., direct red, aniline yellow) and rubber chemicals, pharmaceuticals (paracetamol precursor), and pesticides.	3
Q27	(a) RNH_2 + HNO_2 → R–OH + N_2 + H_2O. So ethylamine + HNO_2 → ethanol + N_2 + H_2O (with intermediates). (b) Nitrogen gas (N_2). (c) The gas is insoluble, colorless and when bubbled through lime water no change. For exam: the gas evolved is N_2	3
Q28	(a) Sulfonamides (sulfa drugs). (b) Sulfonamides are antibacterial agents — they inhibit diaminopimelic acid / folic acid pathway in bacteria by acting as competitive inhibitors of para-aminobenzoic acid (PABA) in folic acid synthesis, thus preventing bacterial growth (bacteriostatic) (c) $C_6H_8N_2O_2S$	3
Q29	(a) Primary amines (RNH_2) can form two hydrogen bonds, they possess N–H groups that can both donate H-bond and the lone pair can accept H-bond, enabling strong intermolecular H-bonding (dimers/polymeric aggregates). Tertiary amines (R3N) lack	4

	N–H bonds so they cannot donate hydrogen bonds — only accept; so they form weaker dipole-dipole interactions but not strong H-bonding between molecules. Therefore tertiary amines have lower boiling points than primary amines of similar molar mass. (b) Triethylamine<Diethylamine< n-Propylamine. (c) Carbylamine test: Primary aliphatic amines give isocyanides (foul smell) with chloroform and alcoholic KOH. Secondary amines do not. OR Hinsberg test also distinguishes: primary gives soluble product that on acidification yields amine; secondary gives insoluble sulfonamide.) (d) Lower aliphatic amines are small and can hydrogen-bond with water via the lone pair and (when protonated) form ammonium ions that are highly solvated — so they are miscible/soluble. As hydrocarbon chain length increases, hydrophobic (nonpolar) alkyl portion dominates reducing solubility and steric hindrance reduces solvation thus higher amines are insoluble	
Q30	(a) $C_6H_5NO_2 + 3Sn + 6HCl \rightarrow C_6H_5NH_2 + 3SnCl_2 + 2H_2O$. (b) The –NH2 group donates electron density into the benzene ring by resonance (through lone pair on N), increasing electron density especially at ortho and para positions, making the ring more reactive toward electrophilic aromatic substitution compared to benzene. (c) Methylene blue (or azo dyes made via diazotisation of aniline and coupling). (d) Reduction of nitrobenzene yields aniline, an important industrial intermediate used to manufacture dyes (azo dyes, indigo), pharmaceuticals (paracetamol precursor), rubber chemicals (antioxidants), herbicides, pigments, and dyes.	4
Q31	(a) Amines are common in biomolecules; the –NH or protonatable N allows drugs to interact (ionic or H-bond) with biological targets (receptors, enzymes). (b) Basicity (pKa) determines the degree of protonation at physiological pH (~7.4). Protonated amines can form ionic interactions with acidic residues in receptor active sites (e.g., Asp, Glu), strengthening binding. (c) **1. Formation of potassium phthalimide**:---------- Phthalimide + KOH → potassium phthalimide. $C_6H_4(CO)_2NH + KOH \rightarrow C_6H_4(CO)_2N^- K^+ + H_2O$. **2. Alkylation:----** Potassium phthalimide + C_2H_5Br → N-ethylphthalimide (via SN^2). $C_6H_4(CO)_2N^- K^+ + C_2H_5Br \rightarrow C_6H_4(CO)_2N–C_2H_5 + KBr$.	5

	3. Hydrolysis (or hydrazinolysis):---- Hydrolysis of N-ethylphthalimide by hydrazine or by acid/base to give ethylamine: $C_6H_4(CO)_2N–C_2H_5 + 2H_2O + H^+ \rightarrow C_2H_5NH_2$ + phthalic acid (or using hydrazine gives phthalhydrazide). OR (a) Nitrobenzene → Aniline: $C_6H_5NO_2 + 6[H] \rightarrow C_6H_5NH_2 + 2H_2O$ (Sn/HCl or Fe/HCl or H_2/Pd). (b) Aniline → Diazonium salt: $C_6H_5NH_2 + NaNO_2 + 2HCl \rightarrow C_6H_5N_2^+ Cl^- + 2H_2O$ (0–5°C). (c) Diazonium → Iodobenzene: $C_6H_5N_2^+ Cl^- + KI \rightarrow C_6H_5I + N_2 + KCl$. (d) Diazonium → Phenol: $C_6H_5N_2^+ Cl^- + H_2O$ (warm / with Cu_2O/H_2O) $\rightarrow C_6H_5OH + N_2 + H^+$ (Sandmeyer or hydrolysis). (e) Diazonium → Chlorobenzene: $C_6H_5N_2^+ Cl^- + CuCl \rightarrow C_6H_5Cl + N_2 + Cu^+$.	5
Q32	Classification of amines: Based on structure and substitution on nitrogen: 1. On basis of carbon skeleton: Aliphatic amines — contain alkyl groups: methylamine (CH_3NH_2), ethylamine ($C_2H_5NH_2$), diethylamine ($(C_2H_5)_2NH$). Aromatic (aryl) amines — nitrogen attached to aromatic ring: aniline ($C_6H_5NH_2$), p-toluidine. 2. On basis of substitution at N (degree): Primary amine (1°): $R–NH_2$ (one alkyl/aryl group). Example: methylamine. Secondary amine (2°): R_2NH (two groups). Example: diethylamine. Tertiary amine (3°): R_3N (three groups). Example: triethylamine. Quaternary ammonium salts (4°): $R_4N^+ X^-$ (no N–H), e.g., tetraethylammonium bromide. 3. On basis of nature of substituents: Simple amines: only C and H with N. Heterocyclic amines: N in ring (pyridine, pyrrole). Aromatic amines: aniline derivatives (–NH2 on benzene ring) OR (a) $C_6H_5NH_2 < NH_3 < C_2H_5NH_2 < (C_2H_5)_3N$ (b) Aryl diazonium salts ($Ar–N_2^+ X^–$) are stabilized at low temperatures because thermal	5

	decomposition (loss of N_2) is exothermic and kinetically accessible at higher temperatures; at 0–5°C decomposition is slow and salt remains stable.	
Q33	1. From ammonolysis of methyl chloride 2. From ammonolysis of methanol-derived derivatives. 3.From reduction of nitromethane. other routes. OR (a) n-propylamine (1-aminopropane, $CH_3CH_2CH_2NH_2$). (b) No. Because hydrogenation of ethyl cyanide (ethyl cyanide = propionitrile (c) Catalytic hydrogenation (hydrogenation over Raney Ni/Pt/Pd) or catalytic hydrogenation of nitrile to primary amine	5

KENDRIYA VIDYALAYA SANGATHAN, AGRA REGION

MARKING SCHEME 2026-27

CLASS – XII (BIOMOLECULES)

CHEMISTRY(043)

1	(iv) Uracil	**[1]**
2	(iv) Glycogen	**[1]**
3	Vitamin K	**[1]**
4	It is present in furanose form.	**[1]**
5	Vitamin B12	**[1]**
6	Amylopectin	**[1]**
7	Anomers	**[1]**
8	Hydrogen bonds	**[1]**
9	VIT A	**[1]**
10	(b) Lactose	**[1]**
11	(d) Vitamin B_{12}	**[1]**
12	c) Deoxyribose	**[1]**
13	c. A is true but R is false.	**[1]**
14	d. A is false but R is true.	**[1]**
15	d. A is false but R is true.	**[1]**
16	a. Both A and R are true and R is the correct explanation of A	**[1]**
	SECTION B	
17	After boiling, the water in an egg doesn't disappear; it gets absorbed and adsorbed by the denatured and coagulated proteins. The proteins, which were originally soluble, transform into an insoluble, fibrous mass, and the water molecules become trapped within this structure through hydrogen bonds	**[2]**
18	(a) Maltose hydrolyzes to two glucose molecules. (b) Sucrose hydrolyzes to glucose and fructose. (c) Lactose hydrolyzes to glucose and galactose. (d) Galactose is a monosaccharide and does not undergo hydrolysis	**0.5*4=[2]**
19	(i) Glucose reacts with bromine water (Br2/H2O) to form gluconic acid, indicating the presence of an aldehyde group. (ii) Glucose reacts with HI to form n - hexane indicating that the six carbons are linked in straight chain	**1*2=[2]**
20	Starch is composed of α-D-glucose units with both linear (amylose) and branched (amylopectin) chains connected by α-glycosidic bonds. In contrast, cellulose is a linear polymer of β-D-glucose units connected by β-glycosidicbonds, giving it a rigid, fibrous structure	**[2]**
21	Vitamin C (Ascorbic Acid) A natural source is oranges or other citrus fruits	**1*2=[2]**
	SECTION C	

22	because they have both a basic amino group ($-NH_2$) and an acidic carboxyl group (-COOH) within the same molecule, leading to an internal acid-base reaction that forms a zwitterion In a zwitterion, the carboxyl group loses a proton, becoming negatively charged ($-COO^-$), while the amino group accepts that proton, becoming positively charged ($-NH_3^+$). This internal charge separation creates a dipolar ion, giving the amino acid properties similar to those of an ionic salt, such as being a high melting point solid and being soluble in water.	**[3]**
23	(d) he product is glucaric acid, also known as saccharic acid (e) because their molecules contain both a basic amino group ($-NH_2$) and an acidic carboxyl group (-COOH). In (f) an α-helix features intra-chain hydrogen bonds within a single polypeptide chain, causing it to coil into a spiral shape, whereas a β-pleated sheet involves inter-strand (between different polypeptide strands) or inter-chain (between different parts of the same chain) hydrogen bonds, resulting in a more extended, folded sheet structure.	**1*3=[3]**
24	(i) phosphodiester bond (ii) m-RNA, t- RNA, r- RNA (iii) vit D is fat soluble	**1+2=[3]**
25	(i) Starch (ii) alpha-helix (α-helix) and the beta-pleated sheet (β-pleated sheet (iii) Vitamin C (also known as ascorbic acid) and the B-complex vitamins	**1*3=[3]**
26	(iv) storing and transmitting genetic information (v) amylose (vi) Amylopectin	**[3]**
27	Correct differences (any three) with fig	**[3]**
28	Amino acids are classified as acidic, neutral, or basic (alkaline) based on the relative number of carboxyl (-COOH) and amino (-NH2) groups within their structure. **Neutral amino acids**: have one amino group and one carboxyl group. **Acidic amino acids**: have more carboxyl groups than amino groups, such as Aspartic Acid and Glutamic Acid. **Basic amino acids**: have more amino groups than carboxyl groups, such as Lysine and Arginine.	**[3]**
	SECTION D	
29	**Choose the most appropriate answer:** **(i)** (c) Fibrous proteins are converted into globular proteins. **(ii)**(b) primary structure only **(iii)** (b) secondary structures Or (c) denatured protein **(iv)** (d) regular folding patterns of continuous portions of the polypeptide chain.	**[4]**
30	**1.** disease : Scurvy vitamin C is water soluble and is excreted out and hencecan notbe stored in our body **2.** fat-soluble vitamin A,D.E.K and water-soluble vitamins B and C **3.** DNA : deoxyribose RNA : ribose **4.**We know, G = C and A = T. If **G = 20% → C = 20%**. Total G + C = 40%. Remaining (A + T) = 60%.	**[4]**

	Hence, **A = 30%** and **T = 30%**. **Answer: Adenine = 30%.**	
	SECTION E	
31	(a) (i) Gluconic acid (ii) n-hexane ($CH_3CH_2CH_2CH_2CH_2CH_3$) (b) (i) failure to give Schiff's test, (ii) 2,4-DNP test, (iii) form a bisulfite addition product, along with the lack of reaction between glucose pentaacetate and hydroxylamine**OR** (i) by heating glucose with hydroiodic acid (HI) and red phosphorus, which reduces the glucose molecule to n-hexane ($CH_3CH_2CH_2CH_2CH_2CH_3$) (ii) Glucose on reaction with acetic anhydride produces glucose pentaacetate. (iii) glucose undergoes mild oxidation with bromine water to form gluconic acid, a carboxylic acid, indicating the carbonyl group at the end of the carbon chain is an aldehyde group (-CHO). (iii) hrough an oxidation reaction where the aldehyde group (-CHO) of glucose is converted into a carboxylic acid group (-COOH) (iv) during its hydrolysis (the process of breaking it down with water), the optical rotation of the resulting mixture of glucose and fructose changes from positive (dextrorotatory, right-rotating) to negative (laevorotatory, left-rotating)	**[5]**
32	An example of an essential amino acid is lysine, found in foods like meat, fish, and eggs, and aa non-essential amino acid is glycine, which the body can produce on its own. (ii) (a)Globular proteins are compact, spherical proteins that are generally soluble in water and perform dynamic biological functions, while fibrous proteins are long, insoluble, thread-like structures that provide structural support and strength to tissues (b) Primary structure defines the order of amino acids, and secondary structure defines the shape of that sequence due to hydrogen bonding within the backbone	**2+3=[5]**
33	(i) the chemical bond that connects two amino acids, formed by a condensation reaction where the carboxyl group of one amino acid reacts with the amino group of another, releasing a water molecule (ii) the primary structure of a protein is defined as the sequence of amino acids linked together to form a polypeptide chain (iii) (iii) the process where a protein loses its three-dimensional native structure and biological function due to the disruption of weak chemical bonds by external factors like heat, extreme pH, chemicals, or mechanical stress (iv) (iv) A nucleotide refers to a molecule composed of three parts: a five-carbon sugar (either ribose or deoxyribose), a phosphate group, and a nitrogenous base (like adenine, guanine, cytosine, thymine, or uracil) (v) Anomers are a specific type of stereoisomer found in cyclic monosaccharides (sugars). They differ in configuration at the anomeric carbon, which is the carbon atom that was the carbonyl carbon (C=O) in the open-chain form of the sugar **OR** (i) The two monosaccharides units are joined together through an oxide	**1*5=[5]**

	linkage formed by loss of a molecule of H_2O . such a linkage between two monosaccharides units through oxygen atom is called glycosidic linkage (ii) Protein secondary structure refers to the local spatial arrangements of the polypeptide backbone.These structures are stabilized by hydrogen bonds between the carbonyl oxygen of one peptide bond and the amino hydrogen of another. (iii) A nucleoside is an organic molecule made of a five-carbon sugar (ribose or deoxyribose) and a nitrogenous base (iv) Carbohydrates composed of 3 to 10 or more simple sugar units (monosaccharides) linked together (v) Nonessential means that our bodies can produce the amino acid, even if we do not get it from the food we eat	