Competency Focused Practice Questions

Chemistry (Volume 1) | Grade 12

Co-created by

CBSE Centre for Excellence in Assessment

and

Educational Initiatives

PREFACE

Assessments are an important tool that help gauge learning. They provide valuable feedback about the effectiveness of instructional methods; about what students have actually understood and also provide actionable insights. The National Education Policy, 2020 has outlined the importance of competency-based assessments in classrooms as a means to reform curriculum and pedagogical methodologies. The policy emphasizes on the development of higher order skills such as analysis, critical thinking and problem solving through classroom instructions and aligned assessments.

Central Board of Secondary Education (CBSE) has been collaborating with Educational Initiatives (Ei) in the area of assessment. Through resources like the Essential Concepts document and A-Question-A-Day (AQAD), high quality questions and concepts critical to learning have been shared with schools and teachers.

Continuing with the vision to ensure that every student is learning with understanding, Question Booklets have been created for subjects for Grade 10th and 12th. These booklets contain competency-based items, designed specifically to test conceptual understanding and application of concepts.

Process of creating competency-based items

All items in these booklets are aligned to the NCERT curriculum and have been created keeping in mind the learning outcomes that are important for students to understand and master. Items are a mix of Free Response Questions (FRQs) and Multiple-Choice Questions (MCQs). In case of MCQs, the options (correct answer and distractors) are specifically created to test for understanding and capturing specific errors/misconceptions that students may harbour. Each incorrect option can thereby inform teachers on specific gaps that may exist in student learning. In case of subjective questions, each question also has a detailed scoring rubric to guide evaluation of students' responses.

Each item has been reviewed by experts, to check for appropriateness of the item, validity of the item, conceptual correctness, language accuracy and other nuances.

How can these item booklets be used?

There are 245 questions in this booklet.

The purpose of these item booklets is to provide samples of high-quality competency-based items to teachers. The items can be used to–

- get an understanding of what good competency-based questions could look like
- give exposure to students to competency-based items
- assist in classroom teaching and learning
- get inspiration to create more such competency-based items

Students can also use this document to understand different kinds of questions and practice specific concepts and competencies. There will be further additions in the future to provide competency focused questions on all chapters.

Please write back to us to give your feedback.

Team CBSE

CONTENTS

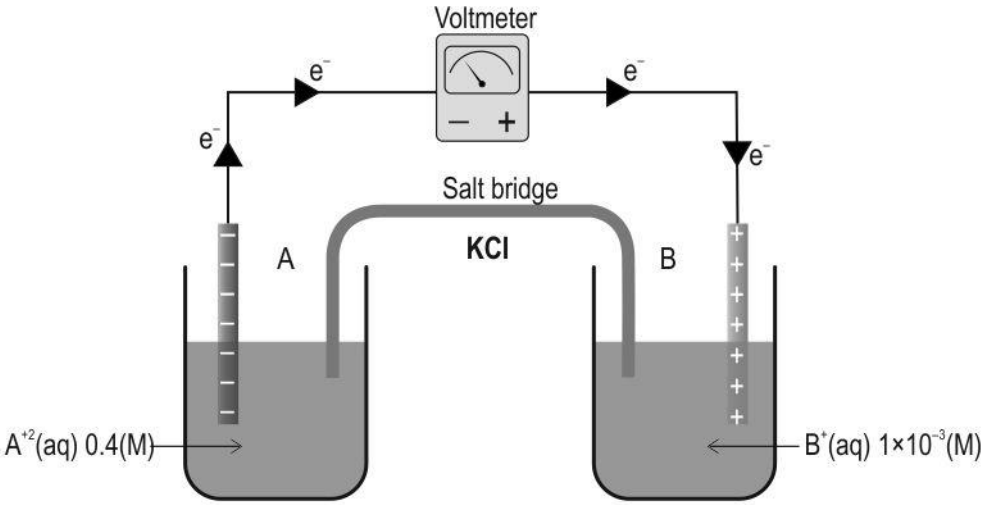
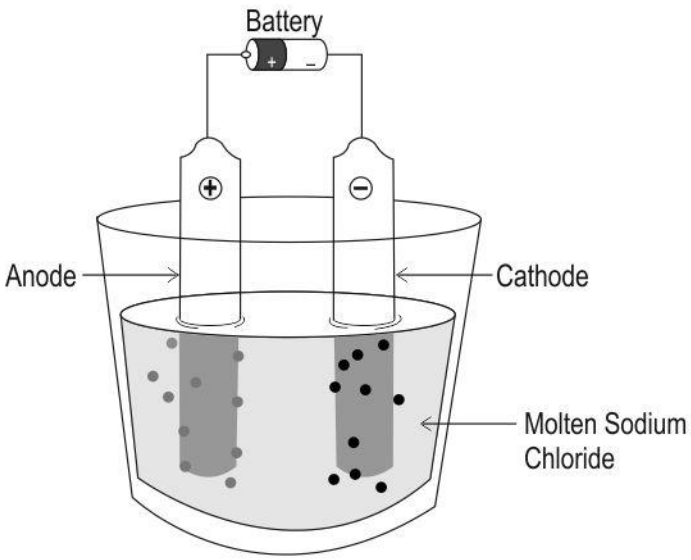
1. Chapter: Solutions

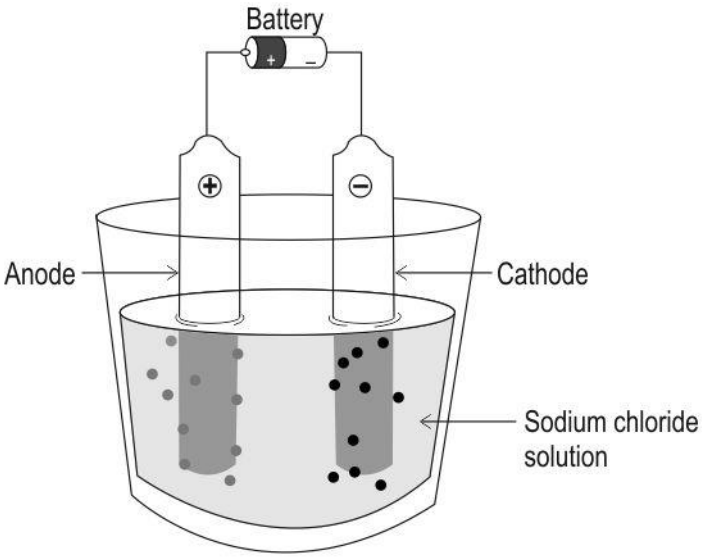
Q.No	Question	Marks
	Free Response Questions/Subjective Questions	
Q.1	The equivalent mass of $KMnO_4$ in acidic medium is less than that in neutral medium. Explain.	2

Answer Key & Marking Scheme

Q.No	Answers	Marks
Q.1	Molar mass of $KMnO_4$ = 158 $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O$ In acidic medium, No. of electrons gained = 5 Equivalent mass of $KMnO_4$ = Molecular mass/no. of electrons gained =158/5 = 31.6 In neutral medium, $2KMnO_4 + H_2O + 3e^- \rightarrow 2MnO_2 + 2KOH + 3[O]$ No. of electrons gained = 3 Equivalent mass of $KMnO_4$ = Molecular mass/no. of electrons gained = 158/3 = 52.67 Thus, the equivalent mass of $KMnO_4$ in acidic medium is less than that in neutral medium. *[Give 1 mark each for the calculation of equivalent weight in acidic and neutral medium.]*	2

2. Chapter: Electrochemistry

Q.No	Question	Marks
	Free Response Questions/Subjective Questions	
Q.2	Calculate the emf of the cell given below at STP:  $E°(B^+\|B) = 0.80$ V, $E°(A^{+2}\|A) = -2.37$ V	2
Q.3	Look at the diagram and answer the questions that follow:  : (i) Identify the ion(s) moving towards the cathode. Give a reason for your choice. (ii) What is the expected product at the anode? Write the reaction(s) occuring at the anode. (iii) Write the net reaction of the process seen in the above diagram. (iv) State the laws that govern the above process.	5

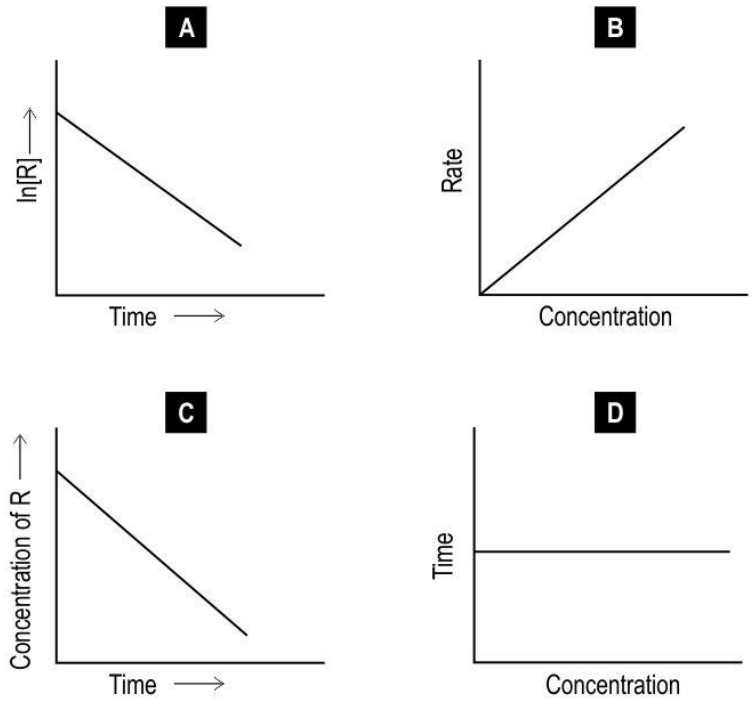
Q.4	Look at the diagram and answer the questions that follow:  The electrodes used in the cell are made up of platinum. (i) What are the product(s) formed at the cathode for the given setup? What factors did you consider to determine the products of electrolysis in the cell given above? (ii) What is the nature and function of the electrodes seen here? (iii) Write the electrode reactions if the electrolyte is changed to molten sodium chloride.	5

Answer Key: Electrochemistry

Q.No	Answers	Marks
Q.2	The reaction is: $A(s) + 2B^{+}(1\times10^{-3}M) \longrightarrow A^{+2}(0.4\ M) + 2B(s)$ Substituting the values in Nernst equation, $E = E° - (0.059/2)\log[A^{+2}/[B^{+}]^2]$ $= 0.80-(-2.37)-(0.059/2)\log(0.4/(10^{-3})^2)$ $= 3.17-0.1652$ $= 3.0047\ V$ *[Give 1 mark for the correct substitution and 1 mark for the correct answer]*	2
Q.3	(i) The ions moving towards the cathode are Na^{+}. The electrolyte is molten sodium chloride, so only one cation (Na^{+}) is present in the reaction medium. *[Give 0.5 marks for correctly identified ion and 0.5 marks for the reason.]* (ii) The product expected at the anode is chlorine. The anode reaction is : $Cl^{-} \rightarrow ½\ Cl_2\ (g) + e^-$ *[Give 0.5 mark for the correctly identified product formed at the anode and 0.5 marks for the anode reaction.]* (iii) The net reaction for the process is: $2NaCl \rightarrow 2Na + Cl_2\ (g)$ *[Give 1 mark for the correct reaction]* (iv) The above process is governed by the Faraday's law of electrolysis. They are as follows: 1. The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte. 2. The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights.	5

	[Give 1 mark for each correct law.]	
Q.4	(i) The product formed at the cathode for the above reaction is sodium hydroxide(NaOH) and hydrogen(H_2). (a) The products of electrolysis depend on the different oxidising and reducing species present in the electrolytic cell and their standard electrode potentials. (b) Nature of the electrode used. *[Give 0.5 marks for each correctly mentioned products.Give 1 mark for each correctly mentioned points. The students may write the answer in their own words]* (ii) The nature of the electrodes are inert. The electrodes do not participate in the chemical reaction but acts only as source or sink for electrons. *[Give 0.5 marks for identifying the nature of the electrode and 0.5 marks for writing the function of the electrode.]* (iii) The electrode reactions if the electrolyte is molten NaCl are: Cathode reaction: $Na^+ + e^- \rightarrow Na$ Anode reaction: $Cl^- \rightarrow ½Cl_2 + e^-$ *[Give 0.5 mark for each correct reaction.]*	5

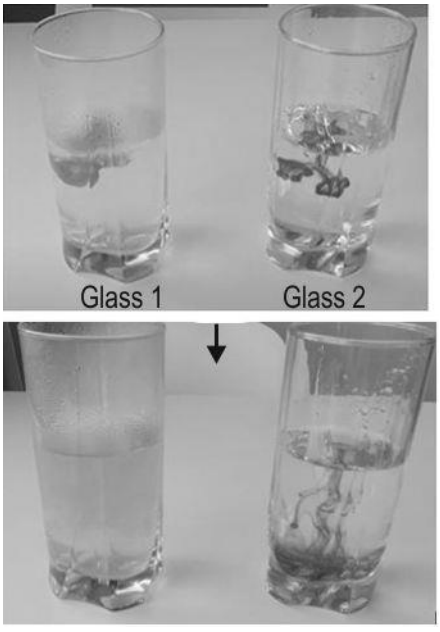
3. CHAPTER: CHEMICAL KINETICS

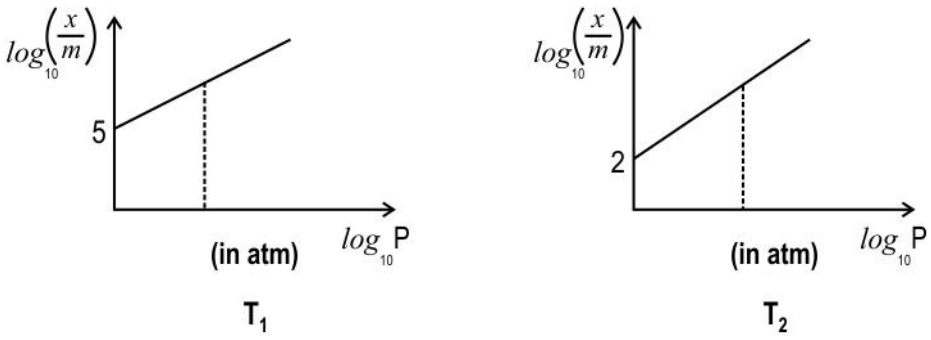
Q.No	Question	Marks
	Multiple Choice Question	
Q.5	Which of the following is the unit of the rate constant for a zero order reaction? A. s^{-1} B. mol L^{-1} C. mol L^{-1} s^{-1} D. L mol^{-1} s^{-1}	1
Q.6	Which of the following graphs represents a zero order rate of reaction?  A. A B. B C. C D. D	1

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.5	C. mol L^{-1} s^{-1}	1
Q.6	C. C	1

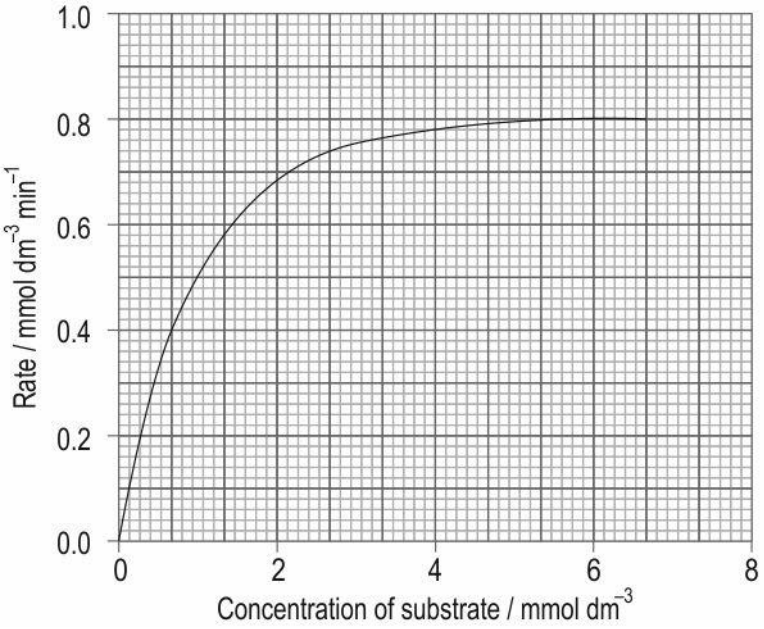
4. CHAPTER: SURFACE CHEMISTRY

Q.No	Question	Marks
	Multiple Choice Question	
Q.7	In the following question, two statements are given, one in Assertion (A) and the other Reason (R). Examine the statements carefully and mark the correct answer according to the instructions given below: **Assertion (A):** Cataphoresis of sewage water helps in sewage disposal. **Reason (R):** Al^{+3} ion is used to clean muddy water. A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) correct but (R) is not the correct explanation of (A) C. (A) is correct, (R) is wrong D. Both (A) and (R) are wrong	1
	Free Response Questions/Subjective Questions	
Q.8	Shweta was conducting an experiment in the chemistry lab. She took two similar glasses- one filled with cold water and one filled with hot water. In each of the glasses, she added the same amount of ink and noted her observations after 10-20 seconds. She observed the following results in these glasses:  (i) Which of the two glasses is filled with hot water? (ii) Why does the ink mix differently in the two cases?	2

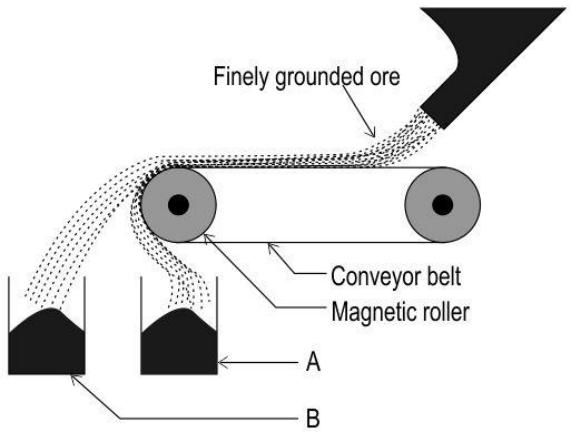
Q.9	The graph below shows the physical adsorption of nitrogen gas over the charcoal surfaces at two different temperatures T1 and T2. The quantity of the charcoal surface in both cases is 1 g.  (i) Which of the temperature is the higher? Give two reasons. (ii) What is the mass of nitrogen gas adsorbed at temperatures T1 and T2 on the surfaces of 1 g Charcoal for a pressure of 1 atm?	4
Q.10	In an enzyme-catalyzed reaction: (i) How will the rate of the reaction change by changing the concentration of substrate? Show graphically. (ii) Explain the reason behind the competitive inhibition during the enzyme-catalyzed reaction.	3
Q.11	Compare the effectiveness of the coagulation of $Al(OH)_3$ sol in the presence of K_3PO_4 and the coagulation of $Al(OH)_3$ sol in the presence of NaCl. Also, state the reason behind the difference between the two cases.	2

Answer Key and Marking Scheme

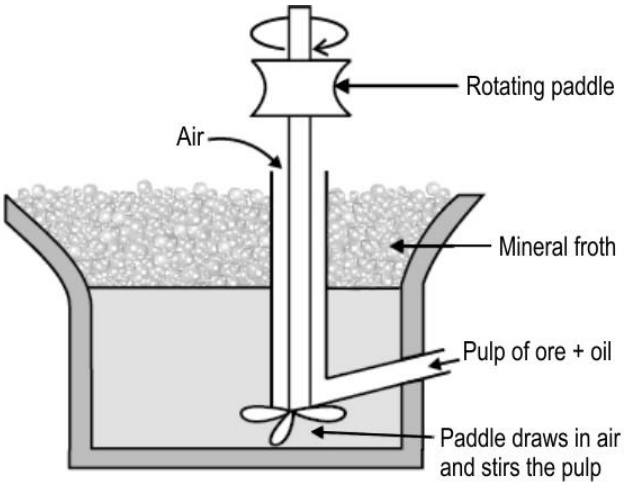
Q.No	Answers	Marks
Q.7	B. Both (A) and (R) correct but (R) is not the correct explanation of (A)	1
Q.8	(i) Glass 1 (ii) Since Glass 1 is filled with hot water, the speed of Brownian motion in hot water is higher than that in cold water which makes it difficult for ink particles to settle at the base and coagulate.	2
Q.9	(i) T2 is the highest [1] - because in physical adsorption higher the temperature lower will be the adsorption. [0.5] - Compare the adsorption, at P= 1 atm at T1 adsorption is higher (5 units) than T2 (2 units only) [0.5] - At T1, Mass of nitrogen gas: => log x/m = log K + (1/n) log p => log x/1 = 5 => x = 100000 units - At T2, Mass of nitrogen gas: => log x/m = log K + (1/n) log p => log x/1 = 2 => x = 100 units	4
Q.10	(i) Rate of reaction in enzyme-catalyzed reaction: - With the increase in the concentration of substrate, more enzymes can link with substrate molecules, and the rate increases [0.5] - Once all enzymes are used up, the rate can't increase further and becomes constant. [0.5] Graph: [1] *Give 1 mark if the basic pattern of the graph is the same even without values. But labelling of axes should be there*	3

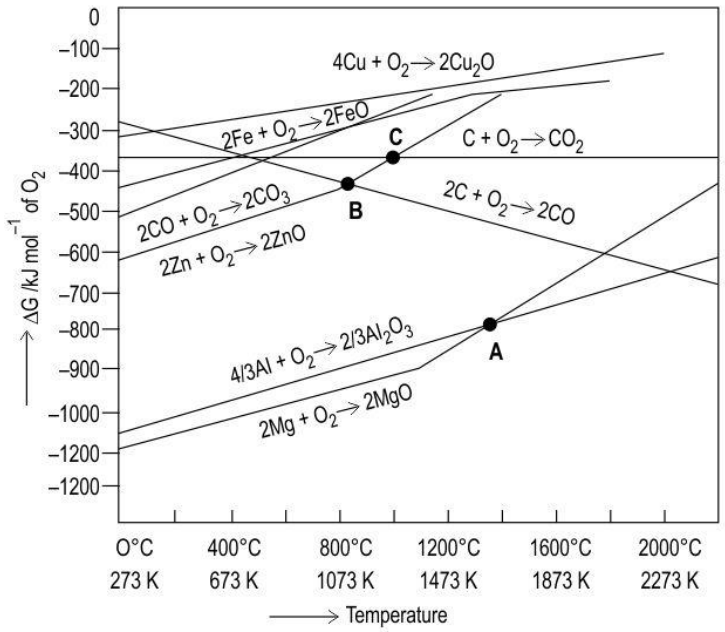
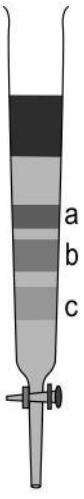
	 (ii) Reason for competitive inhibition: - When the inhibitor molecules are very similar to the substrate, the enzyme molecules can't distinguish among them and this leads to the competition [0.5] - This prevents the formation of enzyme-substrate complexes. Therefore, fewer substrate molecules can bind to the enzymes so the reaction rate is decreased. [0.5]	
Q.11	- Compared to NaCl, K_3PO_4 is more effective for the coagulation of $Al(OH)_3$ sol. Reason: - As per the Hardy-Schulze rule, for a positively charged sol ($Al(OH)_3$ sol) anion with the maximum charge would be the most effective for coagulation. Hence, K_3PO_4 (with 3 units of -ve charge) is more effective than NaCl (with 1 unit of -ve charge)	1

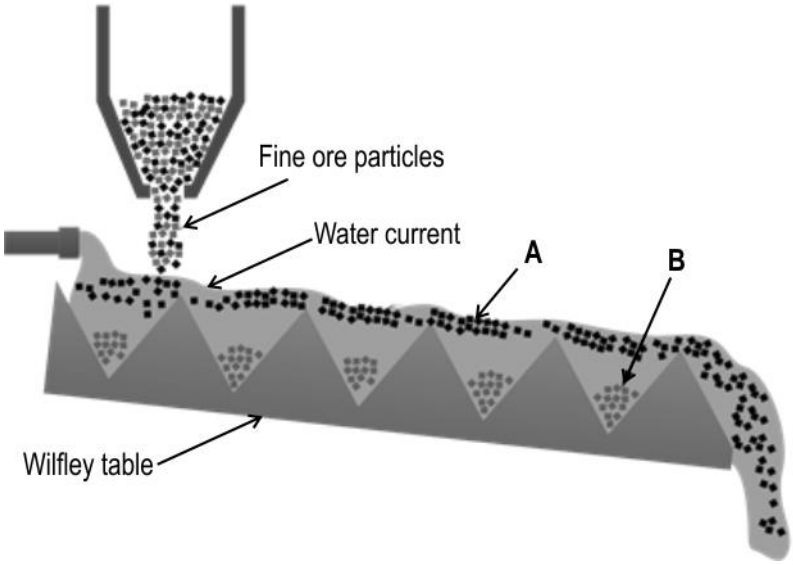
5. CHAPTER: GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS

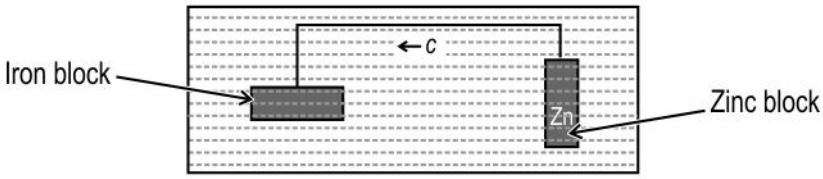
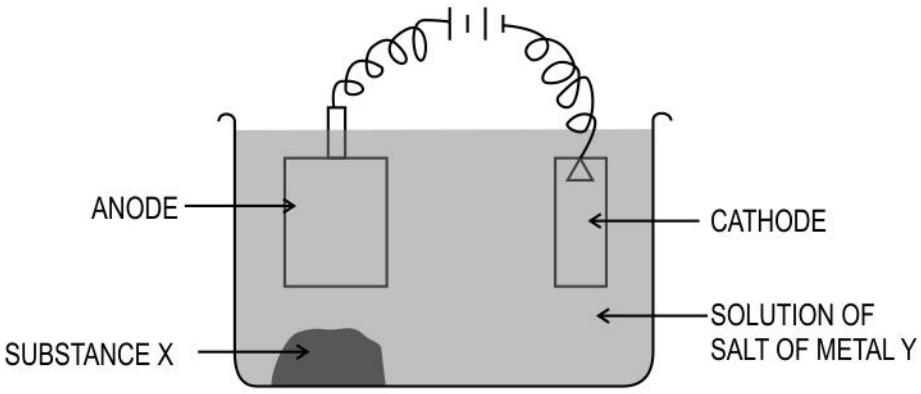
Q.No	Question	Marks
	Multiple Choice Question	
Q.12	Which of the arrangement of the following metals gives the correct increasing order of their electrode potentials? A. Zn< Ni< Al< Pb B. K< Li< Na< Ca C. Na< Al < Zn< Sn D. Al< Cr< Mg< Fe	1
Q.13	Supriti noted down some advantages of crushing of an ore, as follows: I) the speed of the metallurgical process is enhanced. II) lesser amount of chemicals is needed if the ores are crushed. III) the process occurs at a lower temperature. IV) with a small amount of crushed ore, the yield of products is higher. Which of the options are LIKELY to be the most appropriate reasons for crushing of an ore? A. Only I) and II) B. Only II) and III) C. Only I), III) and IV) D. Only I), II), and IV)	1
Q.14	A mixture of two ores of transition metals, A and B are passed over a conveyer belt. The following inferences were drawn from the given diagram.  	1

	(I) Metal A has unpaired electrons in its atomic state while metal B has paired electrons. (II) Metal B create an induced magnetic field in a direction opposite to the externally applied magnetic field. (III) Metal A create an induced magnetic field in a direction opposite to the externally applied magnetic field. (IV) Metal A is diamagnetic but metal B is paramagnetic in nature Which of the options given below identifies the correct inference(s)? A. Both (I) and (IV) are correct. B. Both (I) and (II) are correct. C. Both (II) and (III) are correct. D. Both (II) and (IV) are correct.	
Q.15	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A):** Arkel Method for Refining is a type of vapour phase refining. **Reason (R):** This method is useful for producing semiconductors and other metals of high purity. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1
Q.16	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A):** Negative value of ΔG is favoured by an increase in entropy change. **Reason (R):** Formation of products in a chemical reaction, results in a positive value of ΔG. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1

Free Response Questions/Subjective Questions		
Q.17	Answer the following questions with respect to Hall-Heroult's process where alumina is mixed with calcium fluoride. (a) Among the ions that migrate towards the cathode which has the lowest reduction potential? Is it discharged at the cathode? (b) 'In Hall-Heroult's process the anode has to be replaced from time to time.' Justify the above statement with supporting equation(s).	2
Q.18	Look at the image and answer the questions that follow:  (a) Which of the following ore(s) can be concentrated by the above method? Kaolinite, Siderite, Sphalerite, Copper glance (b) What is the function of pine oil in this method of concentration?	2
Q.19	The reduction of metals from their oxide is guided by the following graph.	2

	 (a) In the graph seen above the (Mg, MgO) line is a straight line with a bent. What is the reason for this bent in the straight line? (b) What inference can be drawn from points B and C on the graph?	
Q.20	A certain form of iron is used for casting railway sleepers. This form of iron is a little hard and brittle. (a) Which form of iron are we discussing and how is it produced? (b) Name the forms of iron that can be made using the form of iron mentioned in (a)?	3
Q.21	A sample of a dye of a flower consists of three components a,b,and c. The sample is dissolved in a suitable solvent and the solution is then poured into the apparatus shown below that contains a solid stationary phase.  Arrange the three components of the dye in the increasing order of their affinity for the stationary phase. Give a reason for your answer.	2

Q.22	(a) In the electro-refining of copper, the electrolyte is an acidified solution of copper sulphate. What will be the observation in the electrolyte's colour with the reaction's progress? (b) Four strips of pure copper, after the purification process, are placed in four different colourless salt solutions of $NaNO_3$, $ZnSO_4$, AgCl, and $HgCl_2$. Which of the solution(s) will not show any observable change?	3
Q.23	(a) Identify the process of concentration shown in the image given below:  (b) What is the principle of this process? (c) Identify A and B.	3
Q.24	Rishaan subjected oxides of two metals M and N to a reduction in the presence of coke. Metal M was obtained after the process but he could not get metal N by heating in the presence of coke. (a) In the Gibbs energy (ΔG-) vs T plots which element occupies the highest position among M, N, and coke? (b) Which of the metals, M and N is MOST LIKELY to be Cu and the Mg? (c) In a solution containing metals M and N which is expected to get deposited?	3
Q.25	Mithai wanted to create a cathode ray tube. She required an extremely pure sample of gold. (a) Suggest the most suitable way of benefaction that can be followed to get a cleaner sample of the metal from the gold block that she had. (b) Identify/name the solution and state the reaction condition that may be used to dress the ore. (c) Represent the above reaction with the help of a chemical equation.	4

Q.26	An iron block and a zinc block are connected with a wire. The whole setup is submerged in water. Study the diagram given below and answer the questions that follow:  (a) Which metal block will undergo corrosion in the given setup? (b) Which metal block acts as the cathode?	2
Q.27	A metal Y is used to manufacture electrical wires. Hence, metal Y of high-purity metal is needed as a small amount of impurities may change the conductivity of the wire. So, metal Y is refined using the method shown below:  (a) What is the anode and cathode made up of? (b) What can be the most suitable electrolyte for the process? (c) What is substance X? Describe it. (d) How can we utilize substance 'X' to make this process cost-effective? (e) Name an alloy formed only by this metal, with another metal that can be refined by this process	5

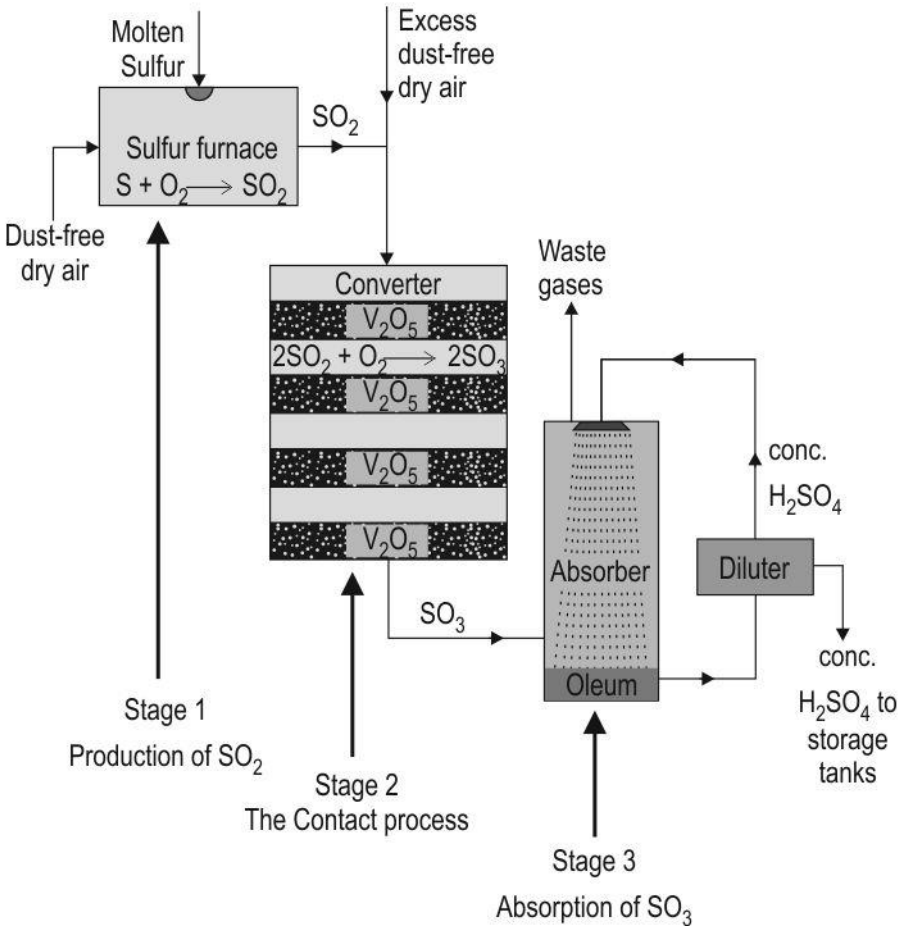
Answer Key and Marking Scheme

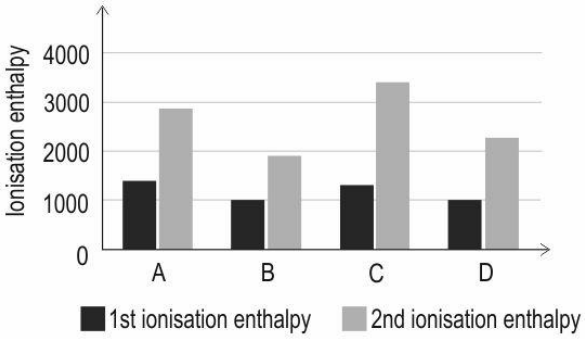
Q.No	Answers	Marks
Q.12	C. Na< Al < Zn< Sn	1
Q.13	D. Only I), II), and IV)	1
Q.14	B. Both (I) and (II) are correct.	1
Q.15	C. (A) is true but (R) is false	1
Q.16	C. (A) is true but (R) is false	1
Q.17	(i) Ca^{+2} ion has the lowest reduction potential. No, it is not discharged at the cathode. *[Give 0.5 marks for each correct answer]* (ii) The above statement is justified by the following reactions: $C(s) + O^{2-}(melt) \rightarrow CO(g) + 2e^{-}$ $C(s) + 2O^{2-}(melt) \rightarrow CO_2(g) + 4e^{-}$ *[Give 0.5 marks for each correct equation.]*	2
Q.18	(a) The ore(s) that can be concentrated by the above method are copper glance and Sphalerite. *[Give 1 mark for the correct answer.]* (b) The mineral particles are preferentially wetted by pine oil rather than in water while the gangue particles are wetted by water. This helps in the concentration of the mineral ore. *[Give 1 mark for the correct answer.]*	2
Q.19	(a) (Mg, MgO) plot is a straight line except when some phase change occurs. The temperature at which such change occurs is indicated by an increase in the slope on the positive side. *[Give 1 mark for each correct answer.]* (b) From points B and C, we can infer that ZnO can be reduced to Zn by carbon monoxide and carbon dioxide. *[Give 1 mark for each correct answer.]*	2

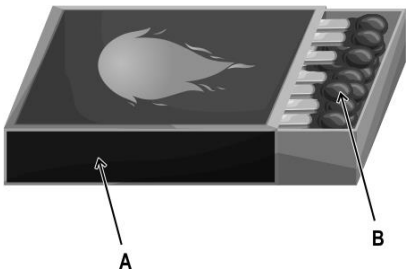
Q.20	(a) Cast iron is used to cast railway sleepers. It is made by melting pig iron with scrap iron and coke using hot air blast. *[Give 1 mark for each correct answer]* (b) The other two forms of iron that can be made from cast iron is wrought iron and alloy steel. *[Give 1 mark for each correct answer]*	3
Q.21	The components in the increasing order of their affinity for the stationary phase Component c< Component b< Component a This is because a component which has a greater affinity for the stationary phase takes a longer time to travel through it than a component that has less affinity for the stationary phase. *[Give 1 mark for the correct order and 1 mark for the reason.]*	2
Q.22	(a) In the electrolytic refining of copper anodes are of impure copper and pure copper strips are taken as cathode. The colour of the electrolyte is blue due to the presence of Cu^{+2}ions. The colour of the electrolyte in this process remains blue due to there is a continuous flow of Cu+2 from anode after impure copper ions in the solution. *[Give 2 marks for the correct explanation]* (b) Two solutions will not show any observable change. They are AgCl and $HgCl_2$.	3
Q.23	(a) This is an image of hydraulic washing. *[Give 1 mark the correct answer.]* (b) The principle of this process of concentration is gravity separation. *[Give 1 mark the correct answer.]* (c) A is gangue particles and B is the concentrated ore particles. *[Give 1 mark the correct answer.]*	3
Q.24	(a) Metal M occupies the highest position in the Gibbs energy (ΔG-) vs T plots among these three elements. *[Give 1 mark for the correct answer.]* (b) Metal M is most likely to be Cu and metal N is most likely to be Mg. *[Give 1 mark for the correct answer.]*	3

	(c) In a solution containing metals M and N, metal M is expected to be deposited. *[Give 1 mark for the correct answer.]*	
Q.25	(a) The most suitable method of benefaction that can be followed is Leaching. [*Give 1 mark for identifying the correct process.*] (b) The solution needed to carry out the process is either sodium cyanide or potassium cyanide in the presence of excess of air or oxygen. *[Give 1 mark for any of the two solutions and 1 mark for the reaction conditions.]* (c) $4Au + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \rightarrow 4[Au(CN)_2]^-(aq) + 4OH^-$ *[Give 1 mark for the correctly balanced equation.]*	4
Q.26	(a) Zinc block (b) Iron block	2
Q.27	(a)Give 0.5 marks each for the correct answer. No marks if copper is not mentioned. - The cathode is made up of pure copper. - The anode with an impure block of copper. (b)The most suitable solvent is acidified copper sulphate solution. [Give 1 mark for the correct answer. No marks if 'acidified' is missing.] (c) - Substance X is anode mud. [0.5 marks] - Some impurities from the impure block of copper get dissolved in the acid while some remain insoluble. The insoluble impurities get collected at the bottom of the anode as anode mud. [0.5 marks] (d) Recovery of the impurities like antimony, selenium, tellurium, silver, gold and platinum helps in meeting the cost of refining. (e) The alloy is brass.	5

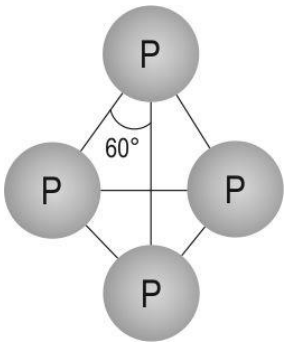
6. CHAPTER: THE P-BLOCK ELEMENTS

Q.No	Question	Marks
	Multiple Choice Question	
Q.28	Which one of the following effects does V_2O_5 have on the equilibrium of the following reaction? $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + heat$ A. It speeds up the forward reaction. B. It slows down the reverse reaction. C. It increases the value of K_p. D. It increases the concentration of the product at equilibrium.	1
Q.29	The image shows the flow diagram for the formation of sulfuric acid through contact process.  Which of the following explains the use of heat exchangers in the converter in stage 2?	1

	(i) To warm the incoming gas (ii) To avoid overheating the catalyst (iii) To supply more SO_3 at equilibrium (iv) To speed up the reaction A. Only ii B. Only i and ii C. Only iii and iv D. All of them	
Q.30	Which of the following rows correctly shows the effect of plunging a similar red-iron hot rod into different hydrogen halides? **Rows / HI / HBr / HCl** A: unaffected / decomposes completely / decomposes completely B: decomposes completely / slightly decomposes / unaffected C: decomposes completely / unaffected / unaffected D: unaffected / decomposes completely / slightly decomposes A. A B. B C. C D. D	1
Q.31	The graph below shows the first two ionization enthalpies of four elements A, B, C, and D (the letters are not their chemical symbols). These elements are the first two elements of groups 15 and 16. Which element is Oxygen? 	1

	A. A B. B C. C D. D	
Q.32	Which of the following statement(s) is/are true about halogens? (P) I_2 is less reactive than ICl. (Q) Both ClI_3 and ClBr can be prepared by direct combination of halogens. (R) The angle between two adjacent Br-F bonds (bond angle) in BrF_3 is 90^0. A. P and Q only B. P and R only C. Q and R only D. P only	1
Q.33	The burning of a match stick is based on the chemistry and the reaction involved with phosphorous.  Which of the following correctly maps out the parts of the matchbox with the type of phosphorus used? A. A- Red phosphorous; B- Red phosphorous B. A- Some other chemical; B- Red phosphorous C. A- White phosphorous; B- Red phosphorous D. A- Red phosphorous; B- some other chemical	1
Q.34	The standard enthalpy changes of formation of HCl and HI are -92 and +26 $kJmol^{-1}$. Which of the following statements is the most important in explaining this difference? A. The activation energy for the decomposition of HI is smaller than that for HCl. B. The bond energy of H-I is smaller than that of H-Cl. C. The bond energy of I-I is smaller than that of Cl-Cl. D. The acidic nature of HI is greater than that of HCl.	1
Q.35	Which of the following halide ions can be oxidised by F_2?	1

	Cl^-, Br^-, I^- A. only Cl^- B. only I^- C. only Br^- and I^- D. all- Cl^-, Br^-, I^-	
Q.36	Which of the following reactions of halide with another halide ion from a salt solution is/are possible? (i) bromine + iodide ions (ii) iodine + chloride ions (iii) chlorine + iodide ions A. i only B. iii only C. i and iii only D. all- i, ii, and iii	1
	The table below shows a reactant and a product from different redox reactions involving halogens and their compounds. **Reactant** / **Product** A: $2Cl^-$ → Cl_2 B: Cl^- → ClO^- C: ClO_3^- → Cl_2 D: ClO^- → ClO_3^-	
Q.37	Which conversion of reactant to product involves the greatest change in oxidation state? A. A B. B C. C D. D	1
Q.38	How many of the changes in the table are examples of oxidation? A. 1 B. 2 C. 3	1

	D. 4	
Q.39	Which of the following is the BEST way to identify the presence of iodine in an aqueous solution? A. Adding hexane to form a purple layer. B. Adding hexane to form an orange layer C. Adding acidified silver nitrate solution to form a yellow precipitate which is soluble in concentrated ammonia D. Adding acidified silver nitrate solution to form a yellow precipitate which is insoluble in concentrated ammonia	1
	Free Response Questions/Subjective Questions	
Q.40	White phosphorous consists of discrete tetrahedral P_4 molecules as shown below.  When phosphorous is heated in an inert atmosphere, a polymeric chain of tetrahedral P_4 is formed as red phosphorous. (i) How does each phosphorous atom in a polymeric chain of tetrahedral maintain the same bond order as that in a discrete white phosphorous? (ii) What could be the reason behind the lower reactivity of red phosphorous than white phosphorous?	2
Q.41	(i) Explain with the help of chemical reactions why Phosphine is important for producing signals in sea? (ii) The presence of phosphine on Venus is a controversial topic with scientific communities on both sides. However, if phosphine exists on Venus, then explain why Phosphine can accumulate on Venus but not on Earth.	4
Q.42	Heating halogen halides to same temperature has the following effects. -HI decomposes. -HBr shows some evidence of decomposition. -HCl is unaffected. What do you think the effect of heating would be on HF? Explain your answer.	2

<table>
<tr><td>Q.43</td><td>The table below shows the gas(es) produced when solid halides of an element A reacts with H_2S0_4 and H_3PO_4.

<table><tr><th>Reagent added</th><th>Fluoride</th><th>Chloride</th><th>Bromide</th><th>Iodide</th></tr><tr><td>Conc. H_2SO_4</td><td>HF(g) produced</td><td>HCl(g) produced</td><td>HBr(g) + a little red-brown Br_2(g) produced</td><td>a little HI(g) + purple brown I_2(g) produced</td></tr><tr><td>Conc. H_3PO_4</td><td>HF(g) produced</td><td>HCl(g) produced</td><td>HBr(g) produced</td><td>HI(g) produced</td></tr></table>
(i) Why does conc. H_2S0_4 produce Br_2 gas on reacting with solid halide while conc. H_3PO_4 does not?

(ii) Why does conc. H_2S0_4 not produce any chlorine gas (Cl_2) or fluorine (F_2) when it reacts with solid chloride or solid fluoride respectively?</td><td>3</td></tr>
<tr><td>Q.44</td><td>The table below shows the equation and description of reactions of hydrogen and the halogens.

<table><tr><th>Equation for reaction</th><th>Description of reaction</th></tr><tr><td>$H_2(g) + F_2(g) \longrightarrow 2HF(g)$</td><td>reacts explosively even in cool, dark conditions</td></tr><tr><td>$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$</td><td>reacts explosively in sunlight</td></tr><tr><td>$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$</td><td>reacts slowly on heating</td></tr><tr><td>$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$</td><td>forms an equilibrium mixture on heating</td></tr></table>
Astatine (At) lies below iodine at the bottom of group 17. Based on the above table, write down:

(i) the equation for its reaction with hydrogen

(ii) thermal stability of its hydride. Also give reasons behind your answer.</td><td>3</td></tr>
<tr><td>Q.45</td><td>Alika found an unknown solid compound in a chemistry lab. She made a hypothesis that the compound is potassium bromide. How should she test her hypothesis and get a positive result if her hypothesis is correct?</td><td>2</td></tr>
<tr><td>Q.46</td><td>Sulphur is a group VI element whose highest oxidation number is +6. Which halogen, X can be used to form SX_6 and why?</td><td>0.5</td></tr>
<tr><td>Q.47</td><td>The below table shows the nine most plentiful components of the atmosphere by mass. Over 98% is nitrogen and oxygen, but the noble gas argon comes third, making up over half the residue.</td><td>2</td></tr>
</table>

	<table><tr><th>Component</th><th>Mass/t</th><th>Molar mass/g mol^{-1}</th></tr><tr><td>N_2</td><td>3.87×10^{15}</td><td>28</td></tr><tr><td>O_2</td><td>1.19×10^{15}</td><td>32</td></tr><tr><td>Ar</td><td>6.59×10^{13}</td><td>40</td></tr><tr><td>H_2O</td><td>1.70×10^{13}</td><td>18</td></tr><tr><td>CO_2</td><td>2.46×10^{12}</td><td>44</td></tr><tr><td>Ne</td><td>6.48×10^{10}</td><td>20</td></tr><tr><td>Kr</td><td>1.69×10^{10}</td><td>84</td></tr><tr><td>He</td><td>3.71×10^{9}</td><td>4</td></tr><tr><td>Xe</td><td>2.02×10^{9}</td><td>131</td></tr><tr><td>Total</td><td>5.14×10^{15}</td><td>—</td></tr></table> *Source: The molecular world, by Charlie Harding, Rob Janes and David Johnson* The discovery of the noble gases was initiated when, in 1892, Lord Rayleigh noted that atmospheric nitrogen obtained by the removal of oxygen, CO_2 and water vapour from air was slightly denser (1.2572 g/litre) than chemically prepared nitrogen (1.2505 g/litre). Which undiscovered element do you think was mainly responsible for this discrepancy? Why?	
Q.48	Answer the following: (i) Noble gases have very high ionisation energy yet it decreases down the group. Why? (ii) Why do melting point and boiling point increase down the group for noble gases?	2
Q.49	The table below shows standard enthalpies of formation of some noble gas compounds at room temperature. <table><tr><th>Substance</th><th>State</th><th>$\Delta H_f^\ominus$ / kJ mol^{-1}</th></tr><tr><td>XeF_2</td><td>s</td><td>−163</td></tr><tr><td>XeF_2</td><td>g</td><td>−107</td></tr><tr><td>XeF_4</td><td>s</td><td>−267</td></tr><tr><td>XeF_4</td><td>g</td><td>−206</td></tr><tr><td>XeF_6</td><td>s</td><td>−338</td></tr><tr><td>XeF_6</td><td>g</td><td>−279</td></tr><tr><td>XeO_3</td><td>s</td><td>400</td></tr><tr><td>XeO_4</td><td>s</td><td>643</td></tr><tr><td>KrF_2</td><td>s</td><td>20</td></tr><tr><td>KrF_2</td><td>g</td><td>60</td></tr></table>	4

<table>
<tr><td></td><td>(i) Out of XeF_4 and XeO_4, which one is thermodynamically unstable at room temperature and why?
(ii) Can KrF_2 be made by the combination of krypton and F_2 gases at room temperature? Why?
(iii) Observe the below reaction at room temperature:
$XeF_6(s) + 3H_2O(l) = XeO_3(aq) + 6HF(aq)$
Is Xenon fluoride an oxidising agent or a reducing agent? Support your answer.</td><td></td></tr>
<tr><td>Q.50</td><td>(i) Sodium chloride and sodium iodide are both compounds which contain halide ions. Silver nitrate solution may be used to differentiate between solutions of sodium chloride and sodium iodide. Write the observations that would be expected in both cases.
(ii) Chlorine produces a range of oxoacids, including chloric(I) acid, HOCl, and chloric (VII) acid, $HClO_4$. Which amongst them is the strongest acid?</td><td>3</td></tr>
<tr><td>Q.51</td><td>The table below shows the boiling point of some of the compounds:
<table><tr><th>Compound</th><th>Boiling temperature / K</th></tr><tr><td>HF</td><td>293</td></tr><tr><td>HCl</td><td>188</td></tr><tr><td>HBr</td><td>206</td></tr><tr><td>HI</td><td>238</td></tr><tr><td>H_2O</td><td>373</td></tr></table>(i) Explain why the boiling point of HI is higher than that of HBr.
(ii) Why H_2O has a higher boiling temperature than HF?</td><td>2</td></tr>
<tr><td>Q.52</td><td>Once NO_2 is present in the atmosphere, it is photochemically decomposed which leads to the formation of ozone molecule and a chain reaction. Write down all the reactions in this chain.</td><td>2</td></tr>
<tr><td>Q.53</td><td>(i) Explain why traces of sulfur dioxide are emitted from oil burning furnaces?
(ii) Write an equation to show how one of the following substances could be used to reduce the sulfur dioxide in part a: $CaCl_2$, $CaSO_4$, $Ca(OH)_2$.</td><td>2</td></tr>
<tr><td>Q.54</td><td>When chlorine gas reacts with cold and dilute sodium hydroxide, they form A, B, and water as products. But, when the chlorine gas reacts with hot and conc. sodium hydroxide, they form A, C, and water as products.
(a) Identify A, B, and C.
(b) Which among A, B, and C has the highest positive oxidation number of the central atom.</td><td>2</td></tr>
</table>

Q.55	There are three important variables that are required to catch fire: oxygen, fuel, and heat. The working of a matchbox depends upon a very basic reaction involved with phosphorous. Explain how a match stick catches fire using the three variables mentioned above.	2
Q.56	(i) Complete the following reactions: $N_2O_3 + H_2O$ ----->$N_2O_5 + H_2O$ ------> (ii) With reference to the above reactions, explain which of the oxides is more acidic.	2
Q.57	(i) In order to obtain metallic silver from its nitrate, why can we not use orthophosphoric acid(H_3PO_4)? (ii) It is found that platinum spokes used in bikes or cycles do not corrode in the presence of air or moisture. Justify.	2
Q.58	Why do the precipitates of AgCl and AgBr dissolve in ammonia? Explain with the help of reactions.	2
Q.59	David has a solution that contains bromide ions. He goes inside a lab and carries out these steps: Step 1: bubbles chlorine gas through a sample of the solution. The mixture changes colour. Step 2: adds cyclohexane to the mixture and then shakes the mixture and allows the layers to seperate. (i) Write the ionic reaction for step 1. (ii) What will be the final color of cyclohexane layer in step 2?	2
Q.60	Chlorine is toxic to humans. This toxicity does not prevent the large scale use of chlorine in water plants. (i) Give one reason why water is treated with chlorine. (ii) Explain why the toxicity of chlorine does not prevent this use. (iii) Write an equation for the reaction of chlorine with cold water.	3

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.28	A. It speeds up the forward reaction.	1
Q.29	B. Only i and ii	1
Q.30	B. B	1
Q.31	C. C	1
Q.32	D. P only	1
Q.33	D. A- Red phosphorous; B- Some other chemical	1
Q.34	B. The bond energy of H-I is smaller than that of H-Cl.	1
Q.35	D. all- Cl^-, Br^-, I^-	1
Q.36	C. i and iii only	1
Q.37	C. C	1
Q.38	C. 3	1
Q.39	A. Adding hexane to form a purple layer.	1
Q.40	(i) When the white phosphorus is heated, one of the bonds between two atoms in a discrete tetrahedral is broken. This enables the phosphorous to form a chain of tetrahedral, maintaining the same bond order for each atom (ii) Red phosphorus has a polymeric structure which makes it extra stable [0.5] - Unlike white phosphorous, its bond angle is higher than that of white phosphorous which causes less strain and makes it more stable [0.5]	2
Q.41	(i) Signals are produced as a part of two stage reaction. In stage 1, calcium phosphide reacts with water to give Phosphine. Also, calcium carbide reacts with water to give acetylene gas. - $Ca_3P_2+6H_2O \rightarrow 2PH_3+3Ca(OH)_2$ [1] - $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$ [1] - In stage 2, due to impurities of P_2H_4 present in phosphine, it reacts with oxygen in a combustion reaction and burns up. [0.5] - The heat obtained in this process also burns acetylene, due to which it seems like the ocean is on fire. [0.5]	4

	(ii) Phosphine reacts quickly with oxygen to give an acid. [0.5] - $PH_3 + O_2$ ----> H_3PO_4 - On Venus, oxygen is absent so Phosphine can be accumulated. [0.5]	
Q.42	- HF is also unaffected [1] - HF has the strongest bond in the group. Since, HCl is unaffected, HF will definitely be unaffected as it requires more energy to break HF bond [1]	2
Q.43	(i) When H_2S0_4 reacts with solid bromide, it produces HBr(g). However, as H_2S0_4 is a powerful oxidising agent it oxidises HBr to Br_2. [1] -Conc. H_3PO_4 on the other hand is not a strong oxidising agent and hence does not oxidise HBr(g) to Br_2. [1] (ii) Concentrated sulfuric acid is not a strong enough oxidizing agent to oxidize fluoride or chloride. In terms of the halide ions, unlike bromides and iodides, fluorides and chlorides are not strong enough reducing agents to reduce the sulfuric acid.	3
Q.44	(i) $H_2(g) + At_2(g)$ gives as 2HAt(g) *(In i give marks if equilibrium sign is shown in reaction)* (ii) Hydrogen astatine will be the least thermally stable in group 17. [1] - This is because the astatine atom is the largest atom, so the overlap of its outer shell with a hydrogen atom gives a much longer bond length than with the other smaller halogen atoms. The longer the bond, the weaker it is, and the less energy required to break it. [1]	3
Q.45	- In a beaker add some amount of the unknown solid compound. - Add a few drops of conc. sulfuric acid to it. - If a reddish-brown gas is seen, it means Br_2 is being released. If this does not happen then her hypothesis is wrong [1] - She can infer that conc. sulfuric acid gives hydrogen bromide in the first stage of the reaction. Since HBr decomposes easily with strong oxidising agent, HBr changes to Br_2 quickly. [1] *Note give full marks if students uses $AgNO_3$ in place of conc. sulfuric acid and writes formation of pale yellow solid.*	2
Q.46	- Fluorine [1] - Fluorine is small in size, has high electronegativity and hence it can oxidise the metal to its highest oxidation state. [1]	2

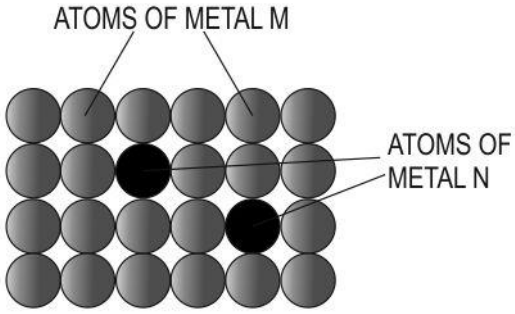
Q.47	Argon Reason: - Of the noble gases, argon is the most abundant. Its molar mass (40) is also higher than that of N_2 (28), so the presence of argon in nitrogen tends to raise the density. [1]	2
Q.48	(i) As we go down the group, the distance between electrons and nucleus increases which increases polarizability down the group. Hence the electron cloud is loosely bond [1] (ii) The induced dipole-induced dipole interactions that hold the atoms together, increase with polarizability. Thus, the melting and boiling temperatures increase down the group as the ionization energy decreases. [1]	2
Q.49	(i) XeO_4; because ΔH_f^- is positive for XeO_4. It will decompose even at room temperature (ii) No; The positive value of ΔH_f^- suggests not; formation from the standard states Kr(g) and F_2(g) is thermodynamically unfavourable at room temperature (iii) Oxidising agent [1] - The XeO_3 further decomposes at room temperature to give Xenon atom. Thereby, XeF_6 finally changes to Xe (change in oxidation number from positive to zero) [1]	4
Q.50	- With sodium chloride, it will give white precipitate - With sodium iodide it will give yellow precipitate (ii) chloric(VII) acid [1] - because it (almost) completely dissociates to release H^+ ions. [1]	3
Q.51	(i) (Iodine/HI) has more number of electron shells. So, more energy is needed to separate molecules with a stronger London force. (ii) Water forms (up to) two hydrogen bonds (per molecule) but HF forms only one.	2
Q.52	(i) NO_2 ---> NO + O [0.5] (ii) O + O_2 ----> O_3 [0.5] (iii) NO + O_3 ----> NO_2 +O_2 [0.5] (iv) NO_2 ---> NO + O (and the steps continue to form photochemical smog) [0.5]	2

Q.53	(i) Oil is an example of fossil fuels. Most fossil fuels contain sulfur as impurities. When sulfur reacts with oxygen, it forms sulfur dioxide. [1] (ii) Lime water can be used. $Ca(OH)_2 + SO_2$ ----> $CaSO_3 + H_2O$ $CaSO_3 + H_2O + SO_2$ (excess) ----> $Ca(HSO_3)_2$ [1]	2
Q.54	(a) A- NaCl; B - NaOCl ; C- $NaClO_3$ (b) $NaClO_3$ has the highest positive oxidation number on Cl as +5	2
Q.55	Working on a matchstick fire: - Generation of heat: When a matchstick is rubbed on the side part of a matchbox coated with red phosphorus, the friction breaks the polymeric nature of red phosphorus and makes it unstable, causing it to react with oxygen and generating heat. [1] - Fuel- The tip of the match stick is highly inflammable in nature when exposed to heat and it acts as a fuel. [0.5] - When the heat generated due to the friction, and fuel meet in the presence of oxygen, we get fire [0.5]	2
Q.56	(i) $N_2O_3 + H_2O$ -----> $2HNO_2$ $N_2O_5 + H_2O$ ------> $2HNO_3$ (ii) N_2O_5 is more acidic as it gives a strong nitric acid when reacted with water	2
Q.57	(i) Orthophosphoric acid (H_3PO_4) is a strong oxidizing agent and it can't reduce $AgNO_3$. (ii) Platinum has very high ionization energy and is one of the inert metals, hence it does not react with moisture or air.	2
Q.58	- The precipitates of AgCl and AgBr dissolve in ammonia because they react with it to form soluble complex salt containing $Ag(NH_3)_2^+$ (aq.) [1] => $AgCl(s) + 2NH_3(aq.)$ ----> $Ag(NH_3)_2^+$ (aq.) + Cl^- (aq.) [0.5] => $AgBr(s) + 2NH_3(aq.)$ ----> $Ag(NH_3)_2^+$ (aq.) + Br^- (aq.) [0.5]	2
Q.59	(i) Cl_2 (aq.) + $2Br^-$ (aq.) ----> $2Cl^-$ (aq.) + Br_2 (aq.) (ii) Cyclohexane forms a layer on the top of water. Cyclohexane layer will be brown in colour due to bromine molecules.	2

Q.60	(i) Any one from: - to sterilise / disinfect water - to destroy / kill microorganisms / bacteria / microbes / pathogens Don't give marks if they write - to purify water - to clean water from germs (ii) The (health) benefit outweighs the risk. Once it has done its job, little of it remains - used in (very) dilute concentrations / small amounts / low doses (iii) Any one: $Cl_2 + H_2O \rightarrow HClO + HCl$ **Or** $Cl_2 + H_2O \rightarrow 2H+ + ClO^- + Cl^-$ **Or** $2Cl_2 + 2H_2O \rightarrow 4HCl + O_2$	3

7. CHAPTER: THE D-AND F-BLOCK ELEMENTS

Q.No	Question	Marks
	Multiple Choice Question	
Q.61	Two elements X and Y have electronic configurations as follows: X= $3d^5\ 4s^1$; Y= $5d^{10}\ 6s^2$ Which of the following statements is correct about X and Y? A. They both have a high enthalpy of atomization. B. X is a misch metal but Y is not. C. Both are transition elements. D. X is a hard metal but Y is not.	1
Q.62	Pt is used as a catalyst in the preparation of SO_3 by direct combination of SO_2 and O_2 at 450°C. In the reaction Pt is used as catalyst which_____ A. Increases the yield of SO_3 B. Absorbs the SO_2 and O_2 molecules C. Decreases the activation energy D. Adsorbs the SO_2 molecule selectively	1
Q.63	In which of the following oxometal anions does the metal NOT exhibit an oxidation state equal to its group number? A. CrO_4^{2-} B. MnO_4^- C. $Cr_2O_7^{2-}$ D. MnO_4^{2-}	1
Q.64	Manav poured some potassium chromate in a test tube for qualitative analysis. The yellow solution of potassium chromate soon turned orange in colour. Manav realised that this happened because the test tube was not clean and contained a few drops of some liquid. Which of the following were the liquid drops most likely to be? A. Drops of hydrochloric acid B. Drops of methyl orange C. Drops of naoh solution D. Drops of water.	1

Q.65	A transition element 'X' is placed in the first series of transition elements. It has the following characteristics: i) It is a coinage metal. ii) It has a positive reduction potential. ii) It does not react with HCl but reacts with Nitric acid. Which of the following is element X likely to be? A. Zinc B. Iron C. Copper D. Chromium	1
Q.66	Which of the following characteristics make transition elements good catalysts? P) their tendency to form reaction intermediates with the reactants, thereby reducing the activation energy Q) their ability to have multiple oxidation states R) their ability to form complex compounds A. only P B. only Q C. only Q and R D. all - P, Q and R	1
Q.67	Given below is an image showing a specific property of transition metals.  Which property of transition metals is shown in the image? A. Catalytic action B. Formation of alloy C. Coloured complex formation D. Interstitial compound formation	1

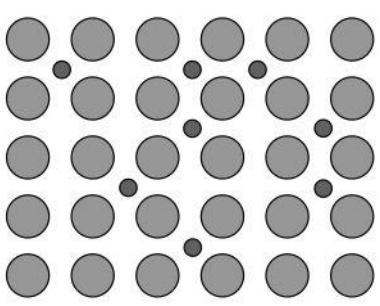
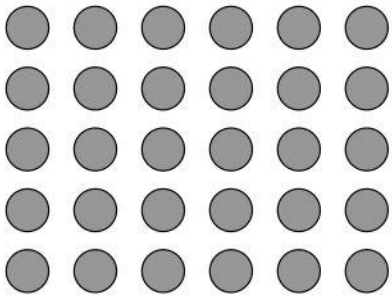
Q.68	Priya listed 4 uses of $KMnO_4$ as follows: P) It is used in volumetric analysis. Q) It is used in the Chromyl Chloride test to detect Cl^- ion. R) It is used as a germicide. S) It is used in Baeyer's test, the test for unsaturated hydrocarbon. Which of the uses are CORRECTLY listed by Priya? A. Only P. R, and S B. Only Q, R, and S C. Only S and R D. Only P and Q	1
Q.69	Two important compounds of transition element Chromium are $K_2Cr_2O_7$ and K_2CrO_4. Compound $K_2Cr_2O_7$ is orange in colour and K_2CrO_4 is yellow in colour. The colour observed is because Chromium ion in these compounds; A. Contain completely filled d-orbitals. B. Contain empty d-orbitals C. Undergo d-d transition of electrons. D. Undergo charge transfer between oxide ion and itself.	1
Q.70	The bond angle between the atoms of a chromate ion is A. 109.5° B. 108° C. 110° D. 94°	1
Q.71	The following reactions occur in an acidic medium. Which of the following options gives the correct pOH value? Reaction 1: MnO^-_4 ---> MnO_2 Reaction 2: MnO^-_4 ----> Mn^{+2}	1

	Reaction 1	**Reaction 2**
L	High	High
M	Low	High
N	Low	Low
O	High	Low

	A. L B. M C. N D. O	
Q.72	Which of the given options gives the correct magnetic properties of the given ions? [At no. of: La = 57 Ce = 58 Yb = 70 Lu = 71] A. Both La and La^{+3} is paramagnetic in nature. B. Both La^{+3} and Lu^{+3} are repelled by the applied magnetic field. C. Ce^{+2} is diamagnetic in nature. D. Yb^{+2} has a magnetic moment of 2.76 BM.	1
Q.73	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): Ce^{4+} ion is a good analytical reagent. Reason (R): Ce^{4+} has a stable electronic configuration. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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.	1
Q.74	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): The atomic density of copper is less than that of chromium. Reason (R): The atomic mass of copper is more than that of chromium. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct and (R) is not the correct explanation of (A) C. (A) is true but (R) is false	1

	D. (A) is false but (R) is true.	
Free Response Questions/Subjective Questions		
Q.75	The standard electrode potential E^0 (M^{2+}/M) for three metals X, Y, and Z are as follows: **X**: -1.18 V; **Y**: -0.91V; **Z**: -0.44V Which metal out of X, Y, and Z will be the most stable in the M^{2+} state? Give reason.	2
Q.76	The preparation of potassium dichromate is a stepwise process, as shown below. Step I - $4FeCr_2O_4 + 16NaOH + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8H_2O$ Step II - $2Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$ Step III - $Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2NaCl$ (a) What process should be used to remove impurities from sodium chromate solution, after step I? (b) What makes the reaction in step III possible?	2
Q.77	Why is mercury liquid at room temperature even though it is a metal? Give reasons.	2
Q.78	A bottle contains compound 'A', which is the ammonical solution of nitrate salt of a transition element. A chemical compound 'B', containing carbonyl functional group is taken in a test tube. When compound 'A' is added in test tube containing compound ' 'B' in basic medium. the wall of test tube B developes a shiny coating on it. Based on this information, answer the following questions; i) Write the formula and name of the compound present in bottle A. ii) Which carbonyl compound in test tube B gives a silver mirror formation on heating with compound A. iii) Write a general chemical reaction taking place between chemical A and B.	3
Q.79	The melting points of three elements J, K, and L were recorded. These three elements are from 1st, 2nd, and 3rd transition series (not necessarily in the order). All of them have half-filled d orbital. The melting point of J is more than K and melting point of K is more than L. Which element is expected to have valence electrons in 5f orbitals and why?	2
Q.80	a) Complete the table given below. [Note: X (At. No.: 48) and Y(At. No.: 40)]	5

<table>
<tr><td></td><td>
<table>
<tr><th>Element</th><th>Electronic configuration of only the valence shell in the atomic state</th><th>Tensile strength (High/Low)</th><th>Shows colour in aqueous solution(yes/No)</th></tr>
<tr><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Y</td><td></td><td></td><td></td></tr>
</table>
b) Give a reason for your choice of tensile strength and colour in aq. solution.
</td><td></td></tr>
<tr><td>Q.81</td><td>Complete the table given below:
<table>
<tr><th>Properties</th><th>Actinoids</th><th>Lanthanoids</th></tr>
<tr><td>Magnetic properties (Higher/Lower)</td><td></td><td></td></tr>
<tr><td>The action of boiling water</td><td></td><td></td></tr>
</table>
</td><td>2</td></tr>
<tr><td>Q.82</td><td>The ionic radii of certain elements of the 3rd transition series are tabulated below:
<table>
<tr><th>Element</th><th>Ionic radii</th></tr>
<tr><td>X^{+3}</td><td>87 pm</td></tr>
<tr><td>Y^{+3}</td><td>106 pm</td></tr>
<tr><td>Z^{+3}</td><td>95 pm</td></tr>
</table>
a) Arrange the elements in the decreasing order of atomic number.

b) Define the phenomenon seen in this table.
</td><td>2</td></tr>
<tr><td>Q.83</td><td>The structure of two different samples of the same metal is shown below:

Sample I

Sample II
Complete the table with respect to the samples given above with the given information:
</td><td>2</td></tr>
</table>

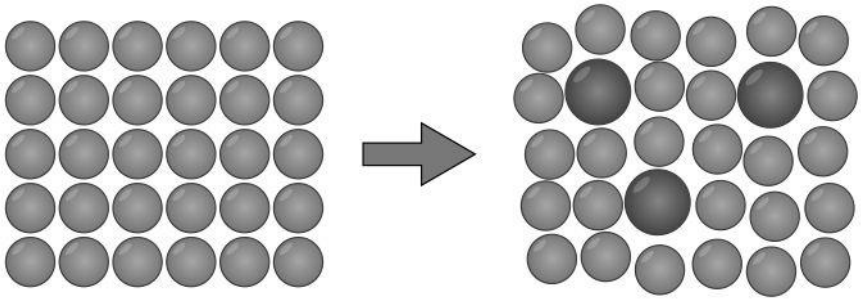
<table>
<tr><td></td><td>[1668°C, 3160°C, chemically reactive, chemically inert]

<table><tr><th></th><th>Sample I</th><th>Sample II</th></tr><tr><td>Melting point</td><td></td><td></td></tr><tr><td>Chemical reactivity</td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>Q.84</td><td>Substance D is used for the bleaching of wool, cotton, silk and other textile fibres and for the decolourisation of oils. It is dark purple in colour and is almost insoluble in water. The shape of the molecule is tetrahedral.

a) Calculate the magnetic moment of this substance.

b) What is the magnetic nature of the compound D?

c) What is the bond angle of the central metal atom with the other atoms?</td><td>2</td></tr>
<tr><td>Q.85</td><td>Look at the image given below and answer the questions that follow:

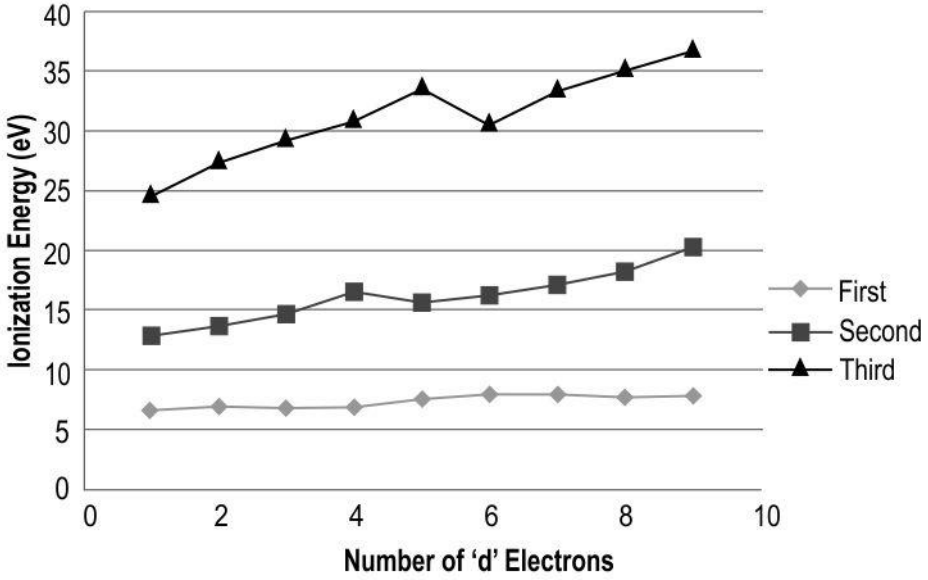
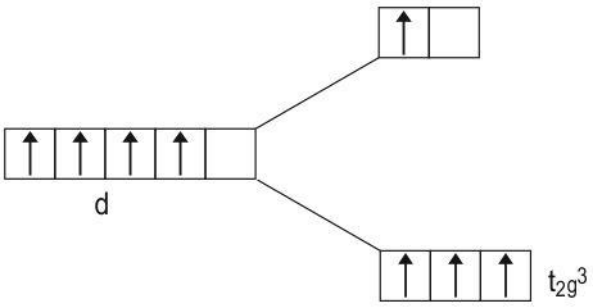
a) Define the process seen here.

b) If the melting point of substance P is 1023°C, the melting point of Q should be more or less than 1023°C?</td><td>2</td></tr>
<tr><td>Q.86</td><td>Oxide of a metal D in the lanthanoid series is used as phosphors in television screens and similar fluorescing surfaces.

a) State the valency of element D and the formula of its oxide in terms of ‘D’.

b) What will the pH range of its aqueous solution be?

c) What role does it play in the petroleum industry?</td><td>4</td></tr>
<tr><td>Q.87</td><td>The graph below shows the first, second and third ionisation energies of a set of elements.</td><td>2</td></tr>
</table>

	 In the graph, we can see a deviation in the fifth element in the trend for second ionisation energy and a deviation in the sixth element in the trend for third ionisation energy. Identify the elements and explain why the deviation occurs.	
Q.88	Read the information given below on a transition metal M and answer the question that follows. P) The M^{2+} state has d^4 configuration, where n = 4. Q) The crystal field splitting for M ion is given below  (a) Is M^{2+} ion reducing or oxidising in nature? Explain. (b) Identify the metal ion.	3
Q.89	Shown below is a step-wise process for the formation of an orange-coloured crystalline compound C. Identify the compound C and write the chemical reactions to show the formation of compounds A, B, and C. Chromate ore fused with NaOH in presence of air forms a yellow coloured compound A → Yellow coloured compound A on acidification with dil. Sulphuric acid gives compound B → Compound B on reaction with KCl forms an orange coloured crystalline compound C	4

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.61	D. X is a hard metal but Y is not.	1
Q.62	C. Decreases the activation energy	1
Q.63	D. MnO_4^{2-}	1
Q.64	A. Drops of hydrochloric acid	1
Q.65	D. Chromium	1
Q.66	D. All - P, Q and R	1
Q.67	B. formation of alloy	1
Q.68	A. Only P. R, and S	1
Q.69	D. Undergo charge transfer between oxide ion and itself.	1
Q.70	A. 109.5°	1
Q.71	B. M	1
Q.72	B. Both La^{+3} and Lu^{+3} are repelled by the applied magnetic field.	1
Q.73	B. Both (A) and (R) are correct and (R) is not the correct explanation of (A)	1
Q.74	D. (A) is false but (R) is true.	1
Q.75	- Metal X will be most stable in M^{2+}state. [1] - The given electrode potential of metal X is $M^{2+}/M = -1.18$ V which is the least reduction potential among the three metals. It suggests metal X will undergo the reduction process very slowly hence it will show more stability at X^{2+}state or M^{2+}state. [1]	2
Q.76	(a) Filtration (b) Sodium dichromate is more soluble than potassium dichromate	2
Q.77	• The hardness of metals depends upon the strength of metallic bonds in it which in turn depends upon the number of unpaired electrons, which overlap to form covalent bonds.	2

<table>
<tr><td></td><td>

- The greater the number of unpaired d-electrons, the greater the number of covalent bonds, and hence greater the strength of bonds.
- Mercury is in group 12, period 6. Its electronic configuration is [Xe]$4f^{14}5d^{10}6s^2$. Due to the absence of unpaired electrons and covalent bonds, mercury is very soft and is a liquid.
-
- *[Give 0.5 marks for the first two points. Give 0.5 marks each for the correct position of mercury in the periodic table and its correct electronic configuration respectively. Students may write the answer in their own words.]*

</td><td></td></tr>
<tr><td>Q.78</td><td>

i)

formula of compound present in bottle A is $[Ag(NH_3)_2]\ NO_3$

Name of the compound is diammine silvernitrate or Tollen's reagent

ii) Compound present in test tube B containing Aldehyde functional group gives silver mirror formation.

iii) $RCHO + [Ag(NH_3)_2]\ NO_3 + NaOH$

$\text{---}^{heat}\text{---}\ RCOO^- + Ag_{(s)} + NH_3 + H_2O$

</td><td>3</td></tr>
<tr><td>Q.79</td><td>

Element J is expected to valence electrons in the 5f orbitals. The melting point of the element J is the highest among the three. So, it is expected to belong to the 3rd transition series with the valence electrons in 5f orbitals.

[1 marks for correctly identifying the element + 1 mark for the correct reason]

</td><td>2</td></tr>
<tr><td>Q.80</td><td>

a)

Element	Electronic configuration of only the valence shell in the atomic state	Tensile strength (High/Low)	Shows colour in aqueous solution(yes/No)
X	$5s^2,4d^{10}$	Low	No
Y	$5s^2,4d^2$	High	Yes

[Give 0.5 marks for each correctly filled blank]

b) The presence of unpaired electrons leads to strong metallic bonds in the transition elements. Element U has no unpaired electron in it so it has low tensile strength.Element V can form metallic bonds due to the presence of unpaired electrons.

</td><td>5</td></tr>
</table>

<table>
<tr><td></td><td>The elements with completely filled or completely empty d-orbitals are colourless. So, aqueous solutions of element U are expected to be colourless while that of element V is expected to show some colour.

[1+1 for each reason]</td><td></td></tr>
<tr><td>Q.81</td><td><table>
<tr><th>Properties</th><th>Actinoids</th><th>Lanthanoids</th></tr>
<tr><td>Magnetic properties (Higher/Lower)</td><td>Lower</td><td>Higher</td></tr>
<tr><td>The action of boiling water</td><td>gives a mixture of oxide and hydride</td><td>gives a mixture of hydroxides and hydrogen gas</td></tr>
</table>[0.5 marks for each correct answer]</td><td>2</td></tr>
<tr><td>Q.82</td><td>a) The elements in decreasing order of atomic number are:

X > Z > Y

b) The overall decrease in atomic and ionic radii from lanthanum to lutetium (the lanthanoid contraction) is a unique feature in the chemistry of the lanthanoids. This is called 'Lanthanoid contraction.'</td><td>2</td></tr>
<tr><td>Q.83</td><td><table>
<tr><th></th><th>Sample I</th><th>Sample II</th></tr>
<tr><td>Melting point</td><td>3160°C</td><td>1668°C</td></tr>
<tr><td>Chemical reactivity</td><td>chemically inert</td><td>chemically reactive</td></tr>
</table>[0.5 marks for each correct answer]</td><td>2</td></tr>
<tr><td>Q.84</td><td>a) The central atom in this compound is Mn^{+2} and the compound is D is $KMnO_4$.

The number of valence electrons in Mn in $KMnO_4$ is 0 as its electronic configuration is $[Ar]4s^0 3d^0$.

So, its magnetic moment is 0. [1]

b) The magnetic moment of D is diamagnetic in nature. [0.5]

c) The bond angle of the central metal atom with the other atoms is 109° [0.5]</td><td>2</td></tr>
<tr><td>Q.85</td><td>a) The process seen here is alloying. The process of formation of homogeneous solid solutions in which the atoms of one metal are distributed randomly among the atoms of the other is called alloying. [1]

b) The melting point of Q will be more than P. [1]</td><td>2</td></tr>
</table>

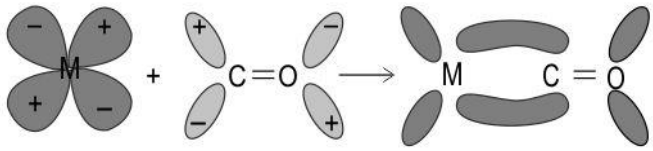
Q.86	a) - The valency of element D is 3. [1] - The formula of its oxide is D_2O_3. [1] b) The range of pH of the aqueous solution of this element D is from 7 to 14. c) The element is employed as a catalyst in petroleum cracking.	4
Q.87	The element that shows deviation in the trend for the second ionisation energy is Manganese. The element that shows deviation in the trend for the third ionisation energy is Iron. [0.5+0.5] The deviation occurs because Mn^{2+} ion and Fe^{3+} have $3d^5$ configuration which is more stable than the configuration of Cr^{2+} and Mn^{3+} ions. [1]	2
Q.88	(a) It is evident from the crystal field splitting that the configuration of M changes from d^4 to $t2g^3$ and eg^1. (1) Since the half-filled t_{2g}^3 level is more stable, the M^{2+} ion will furnish one electron and will act as a reducing agent. (1) (b) Metal ion M has n=4 and d^4 configuration. Its electronic configuration will be $[Ar]4s^03d^4$. As its oxidation state is +2, therefore metal ion is likely to be Cr^{2+}.	3
Q.89	The above given process is depicting the preparation of potassium dichromate. The unknown compound 'C' is Potassium dichromate ($K_2Cr_2O_7$) Stepwise chemical equations involved are as follows $4FeCr_2O_4 + 16NaOH + 7O_2$ ----> $8Na_2CrO_4 + 2Fe_2O_3 + 8H_2O$ Compound A is Na_2CrO_4 $2Na_2CrO_4 + H_2SO_4$ ----------> $Na_2Cr_2O_7 + Na_2SO_4 + H_2O$ Compound B is $Na_2Cr_2O_7$ $Na_2Cr_2O_7 + 2KCl$ ----------> $K_2Cr_2O_7 + 2NaCl$ Compound C is $K_2Cr_2O_7$	4

8. CHAPTER: COORDINATION COMPOUNDS

Q.No	Question	Marks
	Multiple Choice Question	
Q.90	A co-ordination compound Pentaaminechloridocobalt(III)sulfate is dissolved in water. When a few drops of chemical 'A' is added to the solution, it gives white precipitate. Identify chemical 'A'. A. AgCl B. $AgNO_3$ C. $BaSO_4$ D. $BaCl_2$	1
Q.91	How many ions will be produced by the complex compound $[Cr(en)_3]Cl_3$ when it is dissolved in water? A. 2 B. 4 C. 7 D. 10	1
Q.92	In the complex compound $Fe_4[Fe(CN)_6]_3$ oxidation states of counter ion Fe and central metal ion Fe respectively are; A. II, III B. III, II C. IV, III D. II, II	1
Q.93	When a co-ordination compound is dissolved in water it produces three moles of potassium ion as cation and one mole co-ordination entity as anion.The central metal ion Fe in entity is surrounded by three didentate anionic ligands. What is the oxidation state of Fe ion in the compound? A. II B. III C. 0 D. I	1

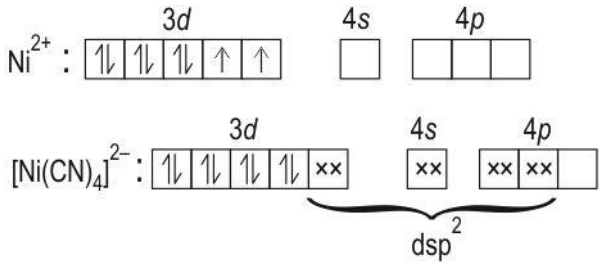
Q.94	In an octahedral coordination entity the metal ion is surrounded by 6 F^- ions. If crystal field splitting energy for this complex is Δ_0 and electron pairing energy is P then which of the following expression is correct about the complex? A. $\Delta_0 = P$ B. $\Delta_o < P$ C. $\Delta_0 > P$ D. $\Delta_0 \geq P$	1
Q.95	$[M(AA)X_2Y_2]$ is a type of a co-ordinate compound in which M= metal ion, AA= didentate ligand, X= monodentate ligand, and Y=monodentate ligand. Which of the following isomerisms does this compound exhibit? A. Co-ordination isomerism B. Linkage isomerism C. Geometrical isomerism D. Optical isomerism	1
Q.96	As per the Crystal field theory, which of the following is correct about the repulsion between ligands and d_{xy}, d_{yz}, d_{zx} orbitals in tetrahedral complexes? A. It is more than that in octahedral complexes B. It is less than that in octahedral complexes C. It is the same as in octahedral complexes D. It is zero	1
Q.97	Which of the following coordination compounds is diamagnetic, has 0 unpaired electrons and has an octahedral geometry? [Atomic number: Mn - 25, Ni - 28, Fe - 26, Cu - 29] A. $[MnCl_6]^{-3}$ B. $[Ni(CN)_4]^{-2}$ C. $[Fe(CN)_6]^{-4}$ D. $[CuCl_4]^{-2}$	1
Free Response Questions/Subjective Questions		
Q.98	In an experiment Test Tube 'A' contains $FeSO_4(NH_4)_2SO_4.6H_2O$ solution and test tube 'B' contains $K_3[Fe(C_2O_4)_3]$ solution. On adding few drops of KSCN in the two test tubes, solution of one of the test tubes turns into red. i) Identify which out of two solutions in the test tubes 'A' or 'B' turns into red? ii) Give reason why does one solution give red colour precipitate with KSCN but other solution does not show any change.	2

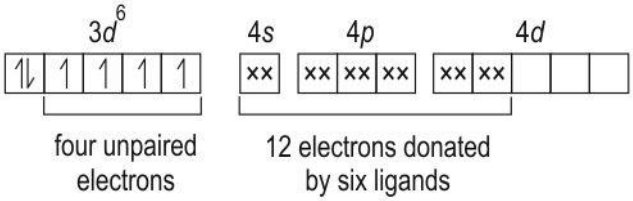
Q.99	$[Ni(CN)_4]^{2-}$, when kept in magnetic field, is weakly repelled where as $[Co(F)_6]^{3-}$is weakly attracted in the magnetic field. Justify with the help of orbital representation. *(Atomic number of Ni =28, Co = 27)*	4
Q.100	There are two samples solutions of complex compounds kept in two test tubes, A and B. Test tube 'A' contains the solution of $[Co(NH_3)_3Cl_3]$ complex, and test tube 'B' contains the solution of complex $[CoCl_2(en)_2]^+$. If plane polarised light is allowed to pass through these solutions, which sample out of A and B can rotate plane polarised light and why?	2
Q.101	Given below is a reaction of the formation of a complex ML_n. $[M(H_2O)_n] + nL$ ------> $ML_n + nH_2O$ Write overall stability constant β_n expression for it. If β_n for the above reaction is $2.1x10^{13}$, find out the over all dissociation constant of the complex.	2
Q.102	One mole of an isomer of complex $[Cr(H_2O)_6]Cl_3$ when treated with $AgNO_3$ produces 2 moles of a white precipitate of AgCl. Write the formula of this isomer of the complex and show how the metal-ligand bonding differs in the two isomers though both are octahedral.	3
Q.103	A complex $[Co(a)_4(b)_2]Br$ is octahedral in shape. The oxidation state of Co is +3. When this complex is treated with $AgNO_3$ it gives one mole yellow precipitate of AgBr. Based on the above information show, what is the denticity and charge on the ligands a and b. Give reason for it.	2
Q.104	A coordination complex compound of Cr^{+3} is homoleptic and optically active. Draw the structures of optical isomers of the compound if the general formula of the complex is $[M(AA)_3]^{3+}$where M= Cr and (AA) = didentate ligand.	3
Q.105	Heteroleptic complexes with co-ordination number 6 show geometrical isomerism. A complex $[MA_3B_3]$shows geometrical isomerism. If central metal ion M has +3 oxidation state. then 1. Predict the denticity and charge on ligands A & B in the given complex. 2. Draw the structure of two geometrical isomers of the complex and name them.	4
Q.106	Coordination compounds are of great importance in medicinal chemistry. Explain how EDTA complex of calcium is useful in saving lives from hazardous lead metal?	1
Q.107	$[Co(NH_3)_6]^{3+}$and $[Co(H_2O)_6]^{2+}$ are two octahedral complexes of Co.	3

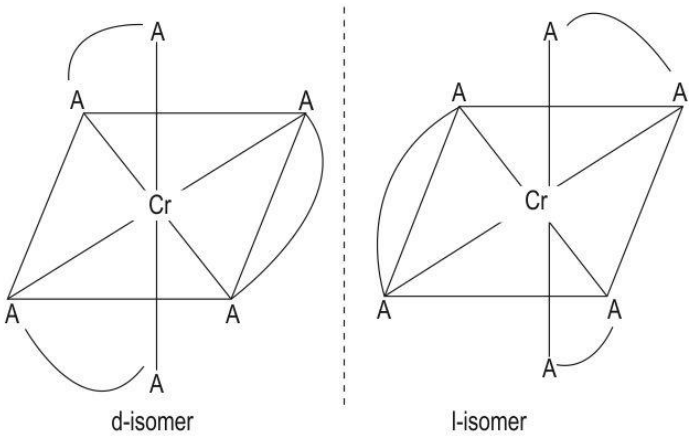
	(i) Which one of them will have LESS crystal field splitting energy? (ii) Which factor influences splitting of d orbitals in these two complexes?	
Q.108	Extraction of Silver from its ore Ag_2S involves several steps. In one of the steps, NaCN is added to the solution. i) Explain the reason why NaCN is added to the solution? ii)Why Zn metal is used to recover the Ag metal? Explain with the help of chemical reactions.	3
Q.109	The image given below shows bonding in a carbonyl compound.  Answer the following questions to describe the bonding in the metal carbonyl. i) What type of bond is formed by the donation of a lone pair of electrons of CO to central metal ion? ii) What type of interaction between metal and CO ligands creates a synergic effect? iii) How is Δ_0 value affected by the interaction of CO ligands and metal ion in metal carbonyl?	5
Q.110	(i) Give a reason why all salts of sodium and potassium are white in colour. (ii) What will be the formula of Cr^{+3} complex with H_2O and Cl^- as ligands if its molar conductivity is similar to salt with the formula AB_2. [A is the metal and B is the non-metal].	3
Q.111	(a) Mrs.Dey is a goldsmith. She got an order to make a silver bangle. Write down the equations of the reaction that is most likely to be carried out by her workers in her workshop to extract the required silver from its sulphide ore. (b) Write the distribution of the electrons in the central metal ion of the coodination complex formed after extraction of silver. Justify your answer.	4
Q.112	In an unknown complex $[M(X)_4]$, the oxidation state of central metal is zero i.e.M (0). If in an experiment metal M is found to be Ni then predict whether the ligand X in the formula is CO or CN to give a stable complex. Justify your answer and predict the shape of the molecule.	2
Q.113	When $AgNO_3$ solution is added into the solution of a co-ordination compound $PdCl_2.4NH_3$, it produces 2 moles of AgCl precipitate. On the basis of the information above, designate the following:	2

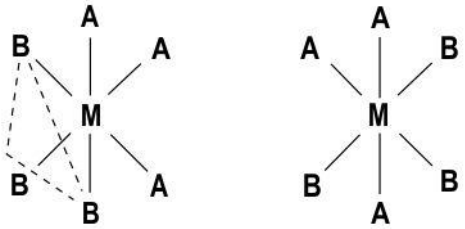
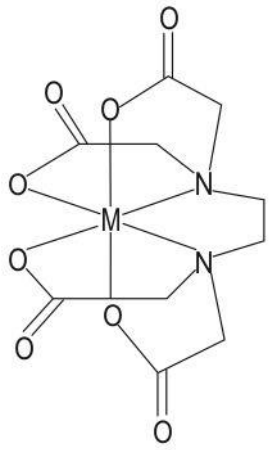
	- coordination entity - counter ions - coordination number of central metal ion - the oxidation number of Pd	
Q.114	(i) A co-ordination compound $[Co(x)_6]^{3-}$ shows d^2sp^3 hybridisation. Identify the nature of ligand x as weak or strong. (ii) Explain how does the presence of ligand *x* affect crystal field splitting energy Δ_0 and pairing energy P. *(atomic number of Cobalt is 27)*	3

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.90	D. $BaCl_2$	1
Q.91	B. 4	1
Q.92	B. III, II	1
Q.93	B. III	1
Q.94	B. $\Delta_0 < P$	1
Q.95	D. Optical isomerism	1
Q.96	A. It is more than that in octahedral complexes	1
Q.97	C. $[Fe(CN)_6]^{-4}$	1
Q.98	i) Solution of $FeSO_4(NH_4)_2SO_4.6H_2O$ in Test Tube 'A' will turn into red. [1] ii) $FeSO_4(NH_4)_2SO_4.6H_2O$ solution in Test Tube 'A' is a double salt and it ionises fully in aqueous solution.The Fe^{2+}ions in solution reacts with KSCN and give red colour due to formation of $FeSCN^{2+}$ complex. [0.5] - But $K_3[Fe(C_2O_4)_3]$ is a complex. It cannot ionise fully in aqueous solution.The Fe^{2+}ion remain intact in sphere. Therefore it does not react with KSCN to give red colour. [0.5]	2
Q.99	- In $[Ni(CN)_4]^{2-}$ oxidation state of Ni is +2 and its configuration is [Ar] $4s^0 3d^8$ - four CN ligands are strong ligands which allow pairing of electrons in 3d-orbitals and donate pair of electrons in next empty d s p^2 orbitals. [1] - since there is no unpaired electrons in it, it is diamagnetic and thus weakly repelled in the magnetic field. [1]  - At the same time in $[Co(F)_6]^{3-}$central atom Co is in +3 state. $_{27}Co^{3+}$ - $[Ar]4s^0 3d^6$	4

	- F is a weak ligand which does not allow pairing of electrons in 'd' orbitals of Co^{3+} [1]  - Presence of 4 unpaired e^- in 'd' orbital makes it para magnetic .Thus complex is weakly attracted towards magnetic field. [1] *(Note: Cut 1 marks each if images are not shown)*	
Q.100	- Sample solution $[CoCl_2(en)_2]$ in test tube B can rotate plane polarised light. (1) - The spatial arrangement of two didentate ligands ethylene diamine and two Cl monodentate ligands around the metal ion is such that it makes the molecule unsymmetrical. such molecules are optically active i.e.they can rotate plane polarised light. (1)	2
Q.101	β_n = $[ML_n] / [M(H_2O)_n] [L_n]$ over all dissociation constant (D.C.)is reciprocal of stability constant(β_n) Dissociation constant = $1/\beta_n$ D.C. = $1/2.1x10^{13}$ Thus D.C. = $4.7x10^{-14}$	2
Q.102	The formula of the isomer is $[Cr(H_2O)_5Cl]Cl_2$ since two mole AgCl is produced hence 2 chloro groups are present as primary valencies. In complex $[Cr(H_2O)_6]Cl_3$ six aqua ligands make direct bond with Cr metal ion thus complex is octahedral. (1) Whereas in complex $[Cr(H_2O)_5Cl]Cl_2.H_2O$ only 5 aqua and one Cl ligands make direct bond with metal. This complex is also octahedral. The remaining one aqua is present as water of crystallisation. (1)	3
Q.103	Any complex with 6 monodentate ligands is octahedral in shape.	2

	The complex [Co $(a)_4$ b_2] Br is octahedral in shape hence ligands a and b are monodentate. (1) In any complex the sum of charges on ligands and counter ions shows oxidation state of metal ion which is +3 in Co. $[Co(a)_4(b)_2]Br$ Br has -1 charge because 1 mole AgBr is formed. Since both a and b ligands are monodentate it is clear b has charge-1 and charge on a is 0 x+(0) + (-1x2) +-1= 0 x = +3 Thus we can say charge on ligand a = 0 and b = -1 (1)	
Q.104	- Since complex has 3 didentate ligands there must be 6 donor atoms present around the central metal M (1) Six donor atoms around the metal ion suggest complex is octahedral. (1) The optical isomers are:  d-isomer *l*-isomer (1)	3
Q.105	1. Since oxidation state of metal ion M is +3, therefore the charge on one of the ligands is 1 and the other will have charge =0 while writing the formula the neutral ligand is written before anionic ligand. Also coordination number is 6 so there are 6 monodentate ligands. Hence	4

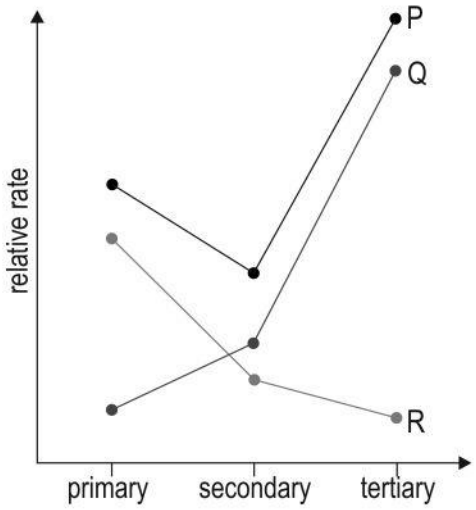
	<table><tr><th>Ligands</th><th>Denticity</th><th>Charge</th></tr><tr><td>A</td><td>monodentate</td><td>0</td></tr><tr><td>B</td><td>monodentate</td><td>-1</td></tr></table> 2. Two geometrical isomers are 1. facial isomer (fac) 2. Meridional isomer(mer) 	
Q.106	- EDTA makes Lead substituted complex with poisonous lead in the body which can be easily excreted by the body. (1)  fig: EDTA complex of lead (fig. is optional) Where (M= Pb, ligand= EDTA)	1
Q.107	(i) Complex $[Co(H_2O)_6]^{2+}$will have less crystal field splitting. (ii) The d orbital splitting here is more influenced by the charge on metal ion. For the similar metal ion complexes, the higher is the charge on metal ion more is the splitting energyΔ_0 . Similarly lower is the charge on metal ion less is crystal field splitting. (1)	3

	- In complex $[Co(NH_3)_6]^{3+}$oxidation state of Co is +3 but in complex $[Co(H_2O)_6]^{2+}$ the oxidation state of Co is +2. Therefore $[Co(H_2O)_6]$ will have less crystal field splitting. (1)	
Q.108	i) NaCN forms a complex with the ore Ag_2S of Ag. $Ag_2S + NaCN$ ----> $Na[Ag(CN)_2] + Na_2S$ (1) It is easier to obtain Ag from ionic complex $Na[Ag(CN)_2]$ than from simple covalent compounds. ii)To obtain metal Ag in precipitate form Zn metal is added into the solution which helps in the displacement of Ag from the complex. (1) $Na[Ag(CN)_2] + Zn$ ------> $Na_2[Zn(CN)_4] + Ag$ (ppt.) (1)	3
Q.109	i) The donation of a lone pair of electrons from ligand CO to metal ion forms σ bond. ii) In metal carbonyl the CO to Metal bond C → M is a sigma (σ) bond. There is also an overlapping of electrons from filled metal d orbitals into empty antibonding orbital of CO.This results into formation of a π bond and called back bonding. [1] - The M → C bond strengthens the bond between CO and the metal and this type of bonding creates a synergic effect. [1] (iii) Δ_0 value that is crystal field splitting energy increases in metal carbonyl. [1] - The ligand CO is capable of accepting an appreciable amount of electron density from the metal atom into its vacant π^*orbital. Due to this interaction Δ_0 increases. [1]	5
Q.110	(i) The colour of a salt arises due to two main factors: 1. Influence of ligands present in a salt. 2. Presence of incomplete d-subshells. - Both potassium and sodium lack incomplete d-orbitals. So, when light falls on such complexes no excitation of electrons occurs to higher energy levels to absorb or emit light of a certain wavelength. Hence, such salts are white in colour. *[Give 0.5 mark each for points 1 and 2, and 1 mark for the explanation]* (ii) A complex having molar conductivity similar to AB_2 should release 3 ions in the solution. Thus, the probable formula of the complex will be:	3

	$[Cr(H_2O)_5Cl]Cl_2 \rightleftharpoons [Cr(H_2O)Cl]^{+2} + 2Cl^-$ *[Give 1 mark for the correct formula]*	
Q.111	(a) The ore of silver is Silver sulphide(Ag_2S).The reactions that are most likely to be carried out in the workshop by Mrs. Dey are: $Ag_2S + 2NaCN \rightarrow 2Na[Ag(CN)_2] + Na_2S$ $2Na[Ag(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Ag$ *[Give 1 mark for each correct equation. No marks to be awarded if the equations are not balanced.]* (b) Zinc forms a tetrahedral complex in this case. As Zn^{+2} has 10 electrons in its d-shell so pairing of electrons occur and the distribution of the electrons is e^4t^6 . *[Give 1 for correct distribution of electrons and 1 mark for the correct reason.]*	4
Q.112	In the complex $[Ni(X)_4]$, unknown ligand X is CO. it is because- i) ligand CO is neutral which justifies zero oxidation state of Ni in the complex. (1) ii) Complex $[Ni(CO)_4]$is tetrahedral. It can be justified as Ni(0) - $[Ar]4s^2\ 3d^8$ since carbonyl is strong ligand therefore Ni(0) -$[Ar]4s^0\ 3d^{10}$ hence 4 CO ligands will occupy four sp^3 hybrid orbitals thus complex is tetrahedral. (1)	2
Q.113	- In any complex compound co-ordination entity is that part which contains ligands and metal ion together in a sphere. Thus - Coordination entity- $[Pd(NH_3)_4]^{2+}$ [0.5] - Counter ions are ionisable part which takes part in reaction hence counter ions are 2 Chloride ions or 2 Cl^- [0.5] - The number of attacking sites used by ligands around the metal ion represent coordination number Hence coordination number is = 4 [0.5] - Oxidation number of Pd = +2 [0.5]	2

Q.114	(i) - In complex d^2sp^3 , (n-1)d or inner d is involved in hybridisation therefore ligand *X* is a strong ligand. [1] (ii) - In any octahedral complex 'd' orbitals split as $t_2g < eg$ where t2g is lower in energy than eg. (0.5) - Central atom Co is in +3 state. The 6 electrons in d orbitals pair up due to strong ligand *x* (0.5) - Thus d- orbital configuration in complex is $t2g^6\ eg^0$ (0.5) - pairing of electrons in lower 'd' i.e. t2g shows pairing energy is lower than Δ_0 i.e. $\Delta_0 > P$. (0.5)	3

9. CHAPTER: HALOALKANES AND HALOARENES

<table>
<tr><th>Q.No</th><th>Question</th><th>Marks</th></tr>
<tr><td colspan="3">Multiple Choice Question</td></tr>
<tr><td>Q.115</td><td>Three graphs P, Q and R have been drawn to represent the relative rates of hydrolysis reactions for primary, secondary, and tertiary haloalkanes.
 

Which of the following correctly identifies the graphs that represent SN1 and SN2 reactions?
<table><tr><th>Option</th><th>SN_1 reaction</th><th>SN_2 reaction</th></tr><tr><td>W</td><td>graph P</td><td>graph Q</td></tr><tr><td>X</td><td>graph Q</td><td>graph P</td></tr><tr><td>Y</td><td>graph R</td><td>graph Q</td></tr><tr><td>Z</td><td>graph Q</td><td>graph R</td></tr></table>A. W
B. X
C. Y
D. Z</td><td>1</td></tr>
<tr><td>Q.116</td><td>Given below are four haloalkane compounds.
tert-bromobutane, tert-iodobutane, iodobutane, bromobutane
Which of them would be the most easily undergo S_N1 and S_N2 reactions?</td><td>1</td></tr>
</table>

Option	SN_1 reaction	SN_2 reaction
P	tert-iodobutane	iodobutane
Q	tert-bromobutane	bromobutane
R	iodobutane	tert-iodobutane
S	bromobutane	tert-bromobutane

A. P
B. Q
C. R
D. S

Q.117 The table below shows some of the features of S_N1 and S_N2 reaction mechanisms. 1

Rows	S_N1	S_N2
A	first order kinetics	2nd order kinetics
B	reaction favoured by any type of nucleophile	reaction favoured by a non-bulky nucleophile
C	reaction favoured by a good leaving group	reaction not favoured by a good leaving group
D	stereochemistry: racemization	stereochemistry: inversion

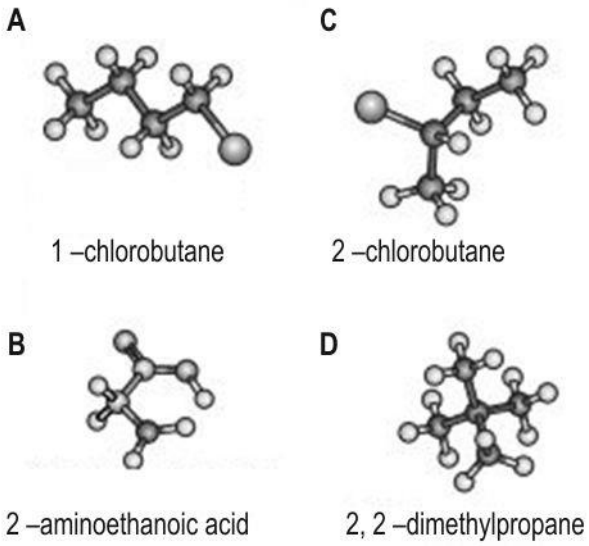
Which of the rows shows an INCORRECT feature for at least one of the mechanisms?

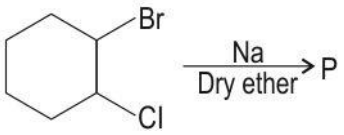
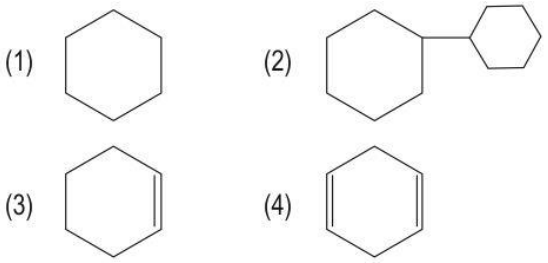
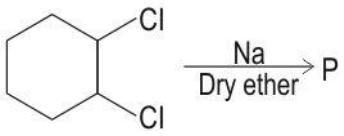
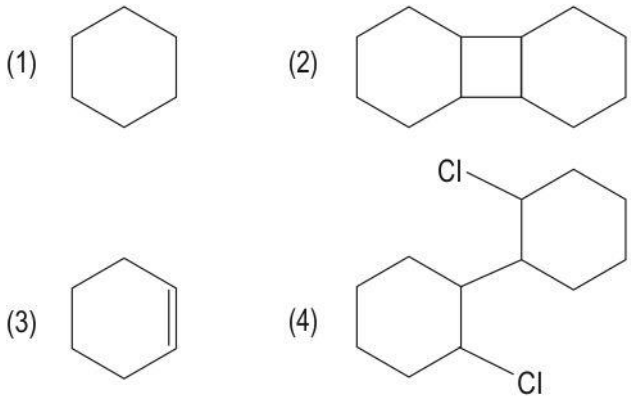
A. A
B. B
C. C
D. D

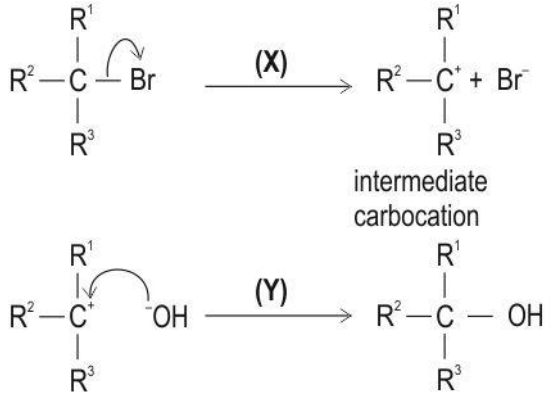
Q.118 Which of the following will be the major product formed in the reaction below? 1

$CH_3 - CH_2 - CH = CH_2 + HBr$ ----> ?

A. $CH_3 - CH_2 - CH_2 - CH_2Br$
B. $CH_3 - CH_2 - CHBr - CH_3$
C. $CH_3 - CHBr - CH = CH_2$
D. $CH_3 - CH = CH - CH_2Br$

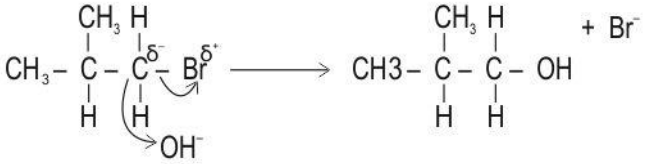
Q.119	Which of the following molecules exhibits optical isomerism? A. 3-iodopentane B. 2-iodo-2-methylpropane C. 1,3-diiodopropane D. 2-iodobutane	1
Q.120	The image below shows the ball and stick model of 4 different compounds.  How many of the above compounds is/are optically active? A. 1 B. 2 C. 3 D. 4	1
Q.121	Which of the following compounds will be hydrolysed most rapidly under similar reaction conditions? A. 1-chloropropane B. 1-chlorobutane C. 2-chloro-2-methylpropane D. 2-chlorobutane	1
	As per the Fittig reaction, when 2 moles of chlorobenzene reacts with metals such as sodium in the presence of dry ether, it gives diphenyl.	
Q.122	Observe the given reaction.	1

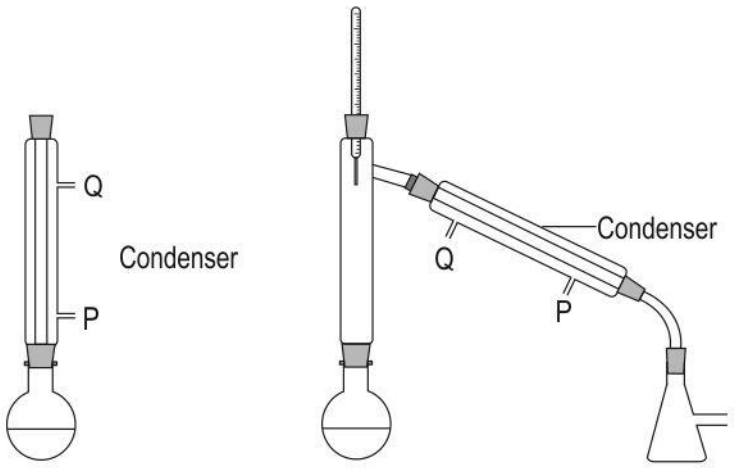
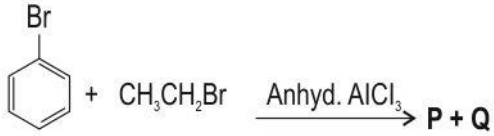
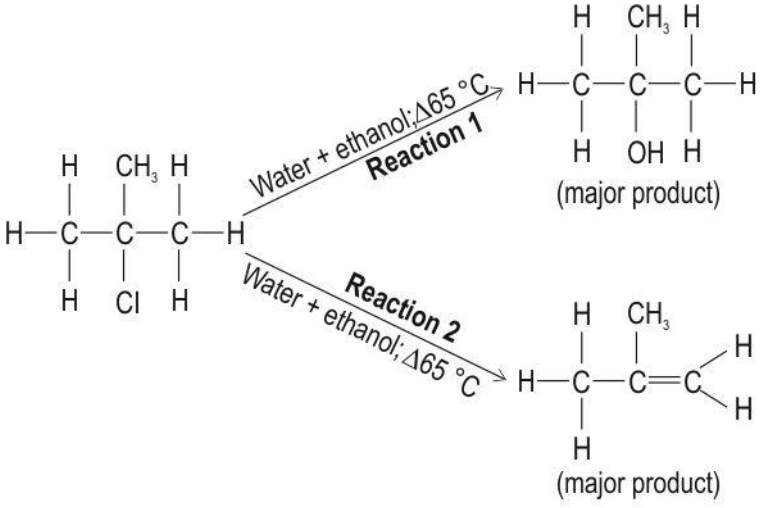
	 Which of the following products will be formed as P?  A. 1 B. 2 C. 3 D. 4	
Q.123	Observe the given reaction.  Which of the following products will be formed as P?  A. 1 B. 2 C. 3 D. 4	1
	Free Response Questions/Subjective Questions	
Q.124	The image below shows different stages for a S_N1 reaction.	2

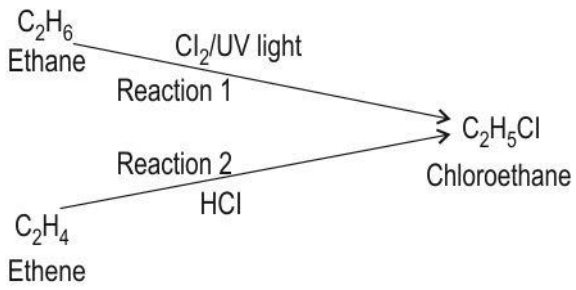
<table>
<tr><td></td><td> 

Which out of the two stages, X and Y, will be slower and why?</td><td></td></tr>
<tr><td>Q.125</td><td>(i) Consider the reaction between bromopropane and I^- ions.
$CH_3CH_2CH_2Br + I^- \text{----> } CH_3CH_2CH_2I + Br^-$
The reaction is carried out in a propanone solvent. The rate law for this reaction is found to be Rate = $k[CH_3CH_2CH_2Br]^x [I^-]^y$ Which mechanism does this reaction follow, S_N1 or S_N2? Justify your answer.

(ii) What will be the rate equation for the reaction $(CH_3)_3CBr$ with I^- ? Justify.</td><td>4</td></tr>
<tr><td>Q.126</td><td>The table below gives data about four different gaseous compounds.
<table><tr><th></th><th>Chemical Formula</th><th>Atmospheric lifetime (approx. years)</th><th>Boiling point (°C)</th></tr><tr><td>P</td><td>CCl_3F</td><td>45</td><td>24</td></tr><tr><td>Q</td><td>CCl_2F_2</td><td>114</td><td>-29.8</td></tr><tr><td>R</td><td>$CClF_2CClF_2$</td><td>300</td><td>3.5</td></tr><tr><td>S</td><td>CF_4</td><td>50,000</td><td>-46</td></tr></table>
(The atmospheric lifetime of a compound is an estimate of the average time it takes for that compound to leave the atmosphere.)
(i) State one problem caused by compound Q in the atmosphere.
(ii) Which two out of the four compounds are more suitable to be used as a refrigerant in refrigerators and why?</td><td>3</td></tr>
<tr><td>Q.127</td><td>For each of the following combinations of reagents and conditions, suggest whether substitution or elimination will predominate. Justify your answer.
(p) heating $CH_3CH_2CH_2Br$ with aqueous NaOH
(q) heating $(CH_3)_3CBr$ with NaOH in ethanol
(r) heating $(CH_3)_2CHBr$ with $(CH_3)_3CO^-K^+$</td><td>3</td></tr>
</table>

Q.128	Show the reaction mechanism for the reaction of tertiary butylbromide with ammonia.	2
Q.129	But-1-ene undergoes electrophilic addition reaction in the presence of HBr. (i) Write the name of all the products formed in the reaction. (ii) Which will be the major product formed and why?	4
Q.130	When 1-bromo-2methylpropane is heated with aqueous alkali, it gives 2-methylpropan-1-ol. Nanda suggested the following mechanism for this reaction.  Identify three mistakes in the mechanism shown by Nanda.	3
Q.131	Do any of the possible structures of $C_5H_{11}Cl$ show stereoisomerism? If no, then explain why. If yes, draw the 3D diagram of the enantiomers.	2
Q.132	1-bromobutane is prepared from 1-butanol as per the reaction below. $C_4H_9OH + NaBr + H_2SO_4$ ---> $C_4H_9Br + NaHSO_4 + H_2O$ Given below are the different stages in the preparation. (1) heating the reactants for around 50 minutes in the apparatus shown in figure 1 (2) distilling the reaction mixture to obtain the product 1-bromobutane in the apparatus shown in figure 2 (3) weighing the distillate obtained (a) Explain why the reactants are heated for 50 minutes in stage 1. (b) What is the function of condensor in stage 1 and in stage 2? How does it help the reaction?	3

	 Figure 1 P - water in Q - water out Figure 2	
Q.133	In the reaction below,  (i) Identify P and Q. (ii) Which of them is the major product and why?	3
Q.134	The image below shows two competing routes or reactions when a haloalkane reacts with water in the presence of alcohol. The major products under each of the routes are shown.  (i) Explain the mechanism for both these reactions. (ii) Which out of two reactions will predominate? Give reasons.	4
Q.135	Haloalkanes are important compound which are produced at scale for industrial purpose. To increase the efficiency and reduce the cost of production, scientists use different combinations of reactants and reaction conditions.	2

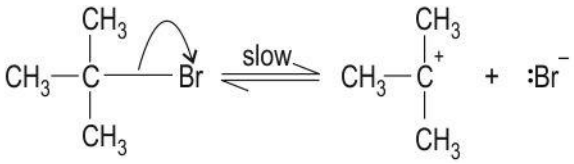
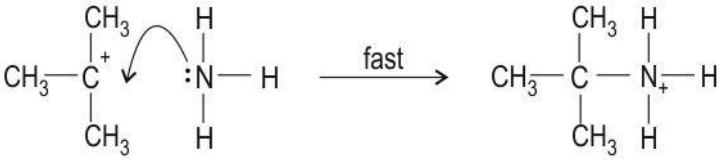
<table>
<tr><td></td><td>You are given two different compounds that can be used to make C_2H_5Cl as shown below.
 

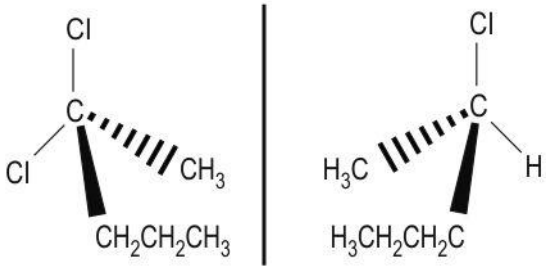
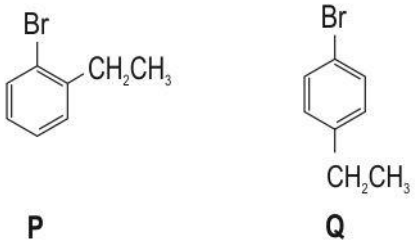
Which out of two reactants will you choose and why?</td><td></td></tr>
<tr><td>Q.136</td><td>Study the reaction below and answer the questions that follow:
$CH_3Cl + NaI \rightarrow CH_3I + NaCl$
(i) How can we increase the rate of the forward reaction?
(ii) If methyl fluoride is to be prepared by the above process, state the reactants?
(iii) Arrange methyl iodide, methyl fluoride and methyl chloride in the decreasing order of their dipole moment.</td><td>3</td></tr>
<tr><td>Q.137</td><td>An organic compound with the formula C_6H_5Br reacts with CuCN to form compound ‘P’ and CuBr in presence of pyridine at 475 K. Compound P on reaction with dil. HCl forms compound ‘Q’ which reacts with methyl alcohol produces a sweet smelling compound ‘R’.
Write the chemical reaction showing the above conversions.</td><td>3</td></tr>
<tr><td>Q.138</td><td>Give a reason why vinyl halides generally do not undergo nucleophilic substitution reactions.</td><td>1</td></tr>
<tr><td>Q.139</td><td>To prepare a Grignard reagent, Udita mixes magnesium metal in dry ether with the compound shown below.
CH_3 - CHOH - CH_2 - CH_2Br
Will she obtain the Grignard reagent? Justify your answer.</td><td>1</td></tr>
<tr><td>Q.140</td><td>The table below shows the effect of aqueous silver nitrate on bromine containing compounds at room temperature.
<table><tr><th>Sodium bromide</th><th>1 - bromobutane</th></tr><tr><td>pale yellow precipitate appears immediately</td><td>no reaction at first;faint precipitate appears after several minutes</td></tr></table></td><td>3</td></tr>
</table>

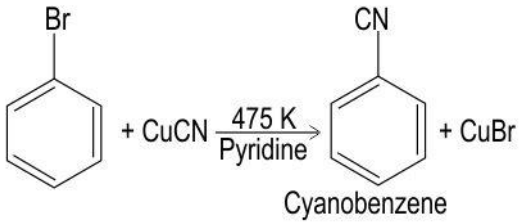
	(i) Why does silver nitrate produce no immediate precipitate with 1-bromobutane? (ii) Suggest a reason why a precipitate appears after several minutes.	

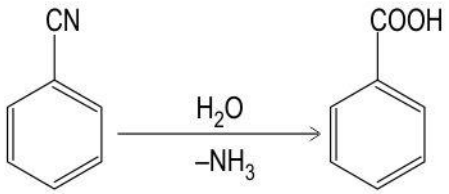
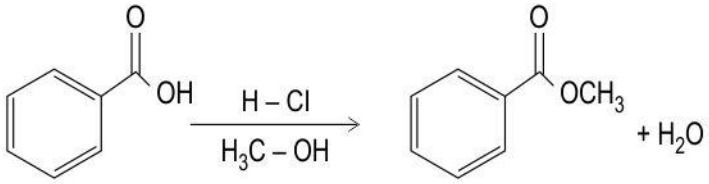
Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.115	D. Z	1
Q.116	A. P	1
Q.117	C. C	1
Q.118	B. CH_3 - CH_2 - CHBr - CH_3	1
Q.119	D. 2-iodobutane	1
Q.120	A. 1	1
Q.121	C. 2-chloro-2-methylpropane	1
Q.122	C. 3	1
Q.123	C. 3	1
Q.124	(i) X will be slower [1] - X involves breaking of C-Br bond to form a carbocation [0.5] - the carbocation is very unstable and reactive so the second step will be fast [0.5]	2
Q.125	(i) S_N2 [1] - because in S_N2 reaction the incoming nucleophile (I^-) interacts with the substrate (bromopropane) causing the C - Br bond to break and a new C - I bond to form. These two processes occur simultaneously in a single step without the formation of any intermediate. The rate of reaction is determined by the concentrations of both the reactants. [1] (ii) Rate = k[$(CH_3)_3CBr$] given by S_N1 [1] - because S_N1 is a two step mechanism in which there is an intermediate carbon cation formed. The rate of reaction is determined only by the concentration of bromopropane. [1]	4
Q.126	(i) CCl_2F_2 decomposes under UV light to give free radical chlorine which reacts with ozone and destroys the ozone layer. (ii) Compounds Q and S; [1]	3

	- It is very important that the refrigerant has a low boiling point, so that it turns into gas easily when it absorbs heat. [1]	
Q.127	(p) Substitution; In polar solvent, substitution predominates for primary haloalkanes with OH ions [1] (b) Elimination; In a less polar solvent like alcohol, elimination predominates for tertiary haloalkanes with OH ions [1] (c) Elimination; elimination predominates due to steric effect as the base used is bulky group [1]	3
Q.128	The mechanism involves an initial ionisation of the halogenoalkane to form a carbocation:  [1] - This is followed by a very rapid attack by ammonia on the carbocation formed:  [1]	2
Q.129	(i) 2-bromobutane and 1-bromobutane (ii)2-bromobutane [1] - During the reaction, intermediate primary and secondary carbocations are formed. [0.5] - Secondary carbocations are energetically more stable than primary carbocations due to positive inductive effect. [1] - The secondary carbocation will be formed in preference to the primary carbocation – hence, the major product will be 2-bromobutane not 1-bromobutane. [0.5] (give marks if they explain using equations instead of text to explain)	4
Q.130	1 mark each for the following: - C-Br dipole is reversed - OH^- to C arrow is reversed	3

	- lone pair of electrons is missing from OH^-	
Q.131	- Yes; structure of enantiomers:  	2
Q.132	(a) This substitution reaction is very slow in nature and hence takes a long time. (accept any other valid answer) (b) 1 mark each for the following: - In stage 1, it condenses vapours and returns liquid to the flask thus allowing the reaction mixture to be heated at the boiling point without any loss of the reactant. - In stage 2, it condenses vapours of the product that is distilling out.	3
Q.133	(i)  **P** **Q** (ii) Q is the major product [1] - Due to the steric effect of the bromine group, substitution at the ortho position is hindered and preferably occurs at the para position. (give marks if they mention less repulsion instead of steric)	3
Q.134	(i) - For reaction 1, water can behave as a nucleophile and donate a lone pair (from oxygen) and attack (positive) carbon (originally attached to Cl) carbocation [1] - For reaction 2, water behave as a base and accepts a hydrogen ion/proton. This leads to elimination of HCl from the reactant. [1]	4

	(ii) Reaction 2 [1] Reasons: - Tertiary carbocation formed during intermediate stage is stabilized by the electron density from three alkyl groups [0.5] - To avoid bulky group effect, elimination reaction dominates over substitution reaction [0.5]	
Q.135	- C_2H_4 - By reaction 2, a single product is obtained. - Whereas by reaction 1, a mixture of mono, di and tri-substituted products are formed. This reduces efficiency and increases cost of production. (Accept any other correct answer)	2
Q.136	(i) The rate of the reaction can be improved by precipitating NaCl in dry acetone. (ii) The reactants needed to prepare methyl fluoride is methyl chloride or methyl bromide and any metallic fluoride such as AgF, Hg_2F_2 , CoF_2 or SbF_3. (iii) The decreasing order of their dipole moment is: methyl fluoride> methyl chloride > methyl iodide. *[Give 1 mark for each correct answer. Marks should be granted if the answer is written correctly in own words.]*	3
Q.137	The chemical reactions showing the conversions are: Formation of P:  **P** Compound 'P' is cyanobenzene. Formation of Q:	3

	 **P** **Q** Compound 'Q' is benzoic acid. Formation of R:  **Q** **R** Compound 'R' is Acetophenone. *[Give 1 mark for each correct conversion]*	
Q.138	Vinyl halides generally do not undergo nuclepohilic substitution reactions. This is because the partial double bond character of the C-Cl bond makes it difficult to break.	1
Q.139	- She will not obtain the Grignard reagent. [0.5] - As the Grignard reagent is formed it will immediately be protonated by the alcoholic group in the compound X. [0.5]	1
Q.140	(i) The C-Br bond in 1-bromobutane is covalent in nature, therefore it does not produce Br ions immediately. (ii) Bromine is more electronegative than carbon, so the C-Br bond is polar [0.5] - The partial positive charge on carbon attracts nucleophiles with their lone pairs of electrons. [0.5] - Water molecules from silver nitrate attack the partial positive carbon, and a substitution reaction takes place, releasing bromine ions after some time. [1]	3

10. CHAPTER: ALCOHOLS, PHENOLS AND ETHERS

<table>
<tr><th>Q.No</th><th>Question</th><th>Marks</th></tr>
<tr><td colspan="3">Multiple Choice Question</td></tr>
<tr><td>Q.141</td><td>The pKa of phenol is lower than that of _____ which is a _____ acid than phenol.

A. ethanol, weaker
B. o-cresol, stronger
C. m-nitrophenol, weaker
D. p-nitrophenol, stronger</td><td>1</td></tr>
<tr><td>Q.142</td><td>Methoxy methane on treatment with excess hydrogen iodide yields

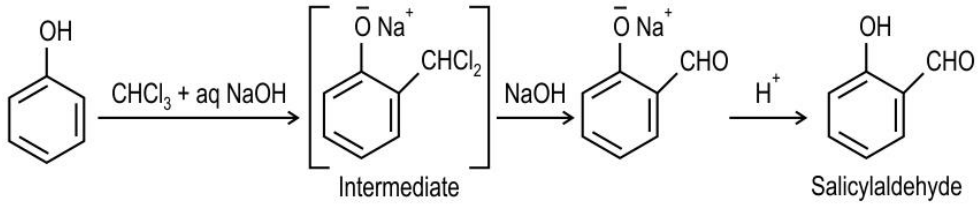
A. methanol as the only product.
B. an equimolar mixture of methyl iodide and methanol
C. methyl iodide as the only product
D. methanol as the major product with a little methyl iodide</td><td>1</td></tr>
<tr><td>Q.143</td><td>Anupam tabulated the time required for the reaction of different halogen halides with diethyl ether as follows:

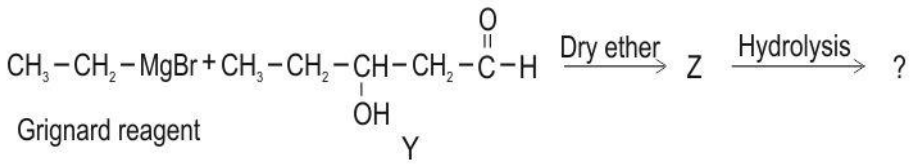
<table><tr><th>Halogen halide</th><th>HW</th><th>HX</th><th>HY</th></tr><tr><td>Time</td><td>1min</td><td>1min, 45sec</td><td>51 sec</td></tr></table>
Which of the following options correctly identifies the halide ions?

A. W = I^-, X = Br^-, Y = Cl^-
B. W = Cl^-, X = I^-, Y = Br^-
C. W = I^-, X = Cl^-, Y = Br^-
D. W = Br^-, X = Cl^-, Y = I^-</td><td>1</td></tr>
<tr><td>Q.144</td><td>The table below shows the number of hyperconjugation structures of three carbocations:

<table><tr><th>Carbocations</th><th>No. of hyperconjugation structures</th></tr><tr><td>P</td><td>3</td></tr><tr><td>Q</td><td>9</td></tr><tr><td>R</td><td>6</td></tr></table></td><td>1</td></tr>
</table>

	Which of the following gives the correct arrangement for the increasing order of acidity of the alcohols derived from the respective carbocations? A. R < Q < P B. Q< R< P C. Q < P < R D. P < R <Q	
Q.145	Which of the compounds is expected to have the lowest pH? S: $CH_3CH_2CH_2OCH_2CH_3$ T: $CH_3CH_2CH_2CH_2OH$ U: $CH_3CH_2CH=CH_2OH$ V: CH_3OCH_3 A. S B. T C. U D. V	1
Q.146	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): The carbon–oxygen bond length in phenol is slightly less than that in methanol. Reason (R): The hybridised state of carbon to which oxygen is attached sp^3 in phenol. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1
Q.147	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): The addition of diborane to alkene followed by treatment with alkaline H_2O_2 yields alcohols. Reason (R): Hydroboration is an addition reaction, where a C-C pi bond is broken, and two new single bonds to C are formed.	1

	Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct but (R) is not the correct explanation of (A) C. (A) is true but (R) is false D. (A) is false but (R) is true	
Q.148	On oxidation, an alcohol gave a product X which reduced Tollens' reagent. Which of the following could the alcohols be? P) $CH_3 - CH_2 - CH_2OH$ Q) $CH_3 - CH_2 - CHOH - CH_3$ R) $CH_3 - CH_2 - C(CH_3)_2 - OH$ A. only P B. only P or Q C. only Q or R D. any of P, Q or R	1
Q.149	Identify the electrophile in the following reaction.  A. $^-CCl_3$ B. $:CCl_2$ C. $^+CHCl_2$ D. ^+CHO	1
	Free Response Questions/Subjective Questions	
Q.150	2-Methyl-but-2-ene $[(CH_3)_2 - C = CH - CH_3]$ is reacted with water in the presence of an acid catalyst. (a) Predict and write the structures of the major and minor products formed in the reaction. (b) Give the reaction mechanism to explain the formation of the major product.	4
Q.151	Neha knows that aldehydes react with a Grignard reagent to give a secondary alcohol as the final product. She carried out the reaction sequence shown below to prepare 2,5-dihydroxyheptane.	3

<table>
<tr><td></td><td>


She was surprised to find that she did not obtain the final product she expected.
(a) Give the possible reason for the expected final product not being formed.
(b) Write the structures of the two final products Neha would have obtained.</td><td></td></tr>
<tr><td>Q.152</td><td>Phenol reacts with dil. HNO_3 at low temperature. The products are separated into two beakers. Zainab and Christine recorded the boiling of the compounds as given in the tables below:

Christine's readings:

<table>
<tr><th>Beaker</th><th>Boiling point</th></tr>
<tr><td>1</td><td>489 K</td></tr>
<tr><td>2</td><td>387 K</td></tr>
</table>

Zainab's readings:

<table>
<tr><th>Beaker</th><th>Boiling point</th></tr>
<tr><td>1</td><td>387 K</td></tr>
<tr><td>2</td><td>489 K</td></tr>
</table>

If beaker 1 contains p-nitrophenol and beaker 2 o-nitrophenol, identify the student whose data collection is correct. Give a reason for your answer.</td><td>3</td></tr>
<tr><td>Q.153</td><td>Anupam wanted to prepare alcohol using methyl magnesium bromide. He took three different compounds P, Q, and R.

-Compound P forms an alcohol with molecular formula C_2H_6O.

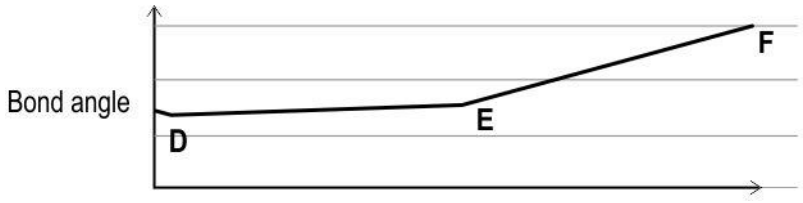
-Compounds Q and R are isomers with the molecular formula C_3H_6O.

-Compound Q does not form any silver mirror with Tollen's reagent.

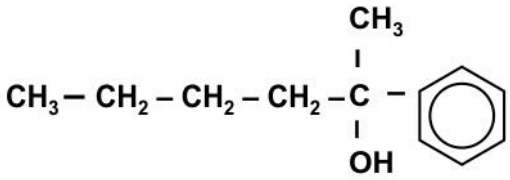
(a) Give the IUPAC name of compound P.

(b) Give the IUPAC names of the compounds formed from Q and R.

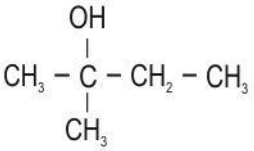
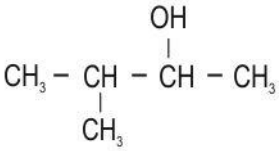
(c) Write the reaction showing the formation of the primary and tertiary alcohols.</td><td>5</td></tr>
</table>

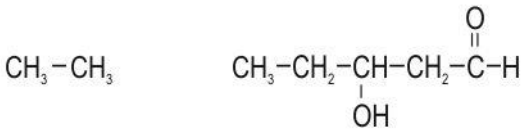
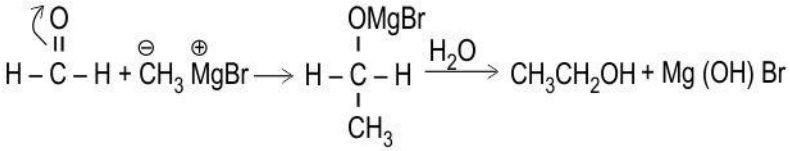
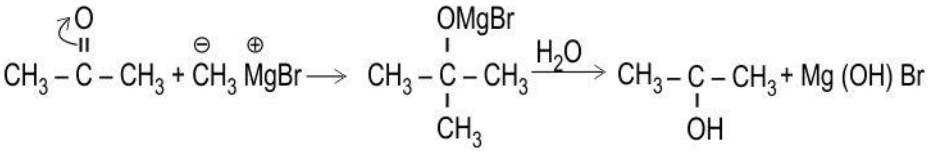
<table>
<tr><td></td><td>(d) Name the mechanism of the reaction of compound R with methyl magnesium bromide. Show the step for the formation of a secondary alcohol.</td><td></td></tr>
<tr><td>Q.154</td><td>Complete the table by comparing between Benzyl alcohol and Phenol:
<table><tr><th></th><th>Benzyl alcohol</th><th>Phenol</th></tr><tr><td>Hybridisation of the C-atom to which oxygen is attached to</td><td></td><td></td></tr><tr><td>C-O-H bond angle is 109^0 because</td><td></td><td></td></tr></table></td><td>2</td></tr>
<tr><td>Q.155</td><td>Susmita tabulated the graph given below showing the variation of bond angles of three compounds.
 

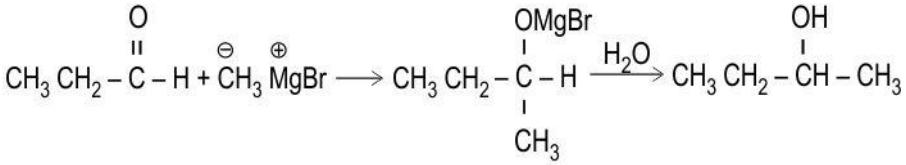
The compounds taken by Susmita are ethanol, phenol, and diethyl ether.
Look at the image and answer the questions that follow:
(a) Which compounds are most LIKELY to be D, E, F?
(b) Arrange the compounds in the decreasing order of C-O bond length.
(c) Complete the table:
<table><tr><th>Compound</th><th>D</th><th>E</th><th>F</th></tr><tr><td>percentage of s-character</td><td></td><td></td><td></td></tr></table></td><td>4</td></tr>
<tr><td>Q.156</td><td>Propene is subjected to two different reactions:
(i) reaction with water followed by acidic hydrolysis
(ii) reaction with diborane followed by oxidation with hydrogen peroxide in aqueous sodium hydroxide
State the following about the products formed in the two reactions:
(a) the molecular formulae
(b) the functional group present in the molecules
(c) the difference between the two products</td><td>4</td></tr>
</table>

Q.157	To prepare n-propyl ethyl ether, Kavita heats a mixture of n-propyl alcohol and ethyl alcohol in the presence of concentrated sulphuric acid. Is this a good method to prepare the product? Give reasons to your answer.	2
Q.158	Write the structure of all the products formed when n-propyl alcohol is heated with ethyl alcohol in the presence of concentrated sulphuric acid.	3
Q.159	2-phenyl-2-hexanol can be prepared by reacting a Grignard reagent and a ketone.  2 – phenyl - 2 – hexanol Write the structures of: (i) the two Grignard reagents that can be used (ii) the two ketones that can be used	4
Q.160	An alcohol has the formula $C_5H_{11}OH$. Draw the structural formulae of any one of its isomers that is: (i) a primary alcohol and has a IUPAC name based on propane (ii) a secondary alcohol and has a IUPAC name based on butane (iii) a tertiary alcohol	3

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.141	A. ethanol, weaker	1
Q.142	C. methyl iodide as the only product	1
Q.143	D. W = Br^-, X = Cl^-, Y = I^-	1
Q.144	B. Q< R< P	1
Q.145	C. U	1
Q.146	C. (A) is true but (R) is false	1
Q.147	A. Both (A) and (R) are correct and (R) is the correct explanation of (A)	1
Q.148	A. only P	1
Q.149	B. $:CCl_2$	1
Q.150	(a) 1 mark each for the correct structures as:  Major product  Minor product (b) 0.5 marks each for the following: - The reaction takes place in 3 steps. - In the 1st step, the C3 carbon atom is protonated in preference to C2 to form the more stable carbocation C2. - In the 2nd step, the carbocation undergoes nucleophilic attack by water. - In the third step, deprotonation occurs to give the alcohols shown in (a) as the major and minor products	4
Q.151	(a) The Grignard reagent reacts with the alcohol group on the molecule Y to form the hydrocarbon. (b) 1 mark each for the following:	3

	 1 2	
Q.152	p-nitrophenol is expected to have a higher boiling point than o-nitrophenol. So, Christine has recorded correct data. [1] - o-nitrophenol shows intramolecular hydrogen bonding thus it is expected to have a lower boiling point in comparison to p-nitrophenol. [1] - p-nitrophenol shows extensive intermolecular bonding and so it has a higher boiling point due to the association of the molecules. [1]	3
Q.153	(a) Methanal. *[Give 0.5 marks for the correct answer]* (b) The IUPAC name of the compound obtained from Q is 2-methylpropan-2-ol and from R is 2-Butanol. *[Give 0.5 marks for each correct answer]* (c) Primary alcohol  Tertiary alcohol  *[Give 1 mark for each correct equation]* (d) The first step of the reaction is the nucleophilic addition of Grignard reagent to the carbonyl group to form an adduct. Secondary alcohol formation	5



[Give 0.5 mark for naming the mechanism and 1 mark for the correct equation.]

Q.154

	Benzyl alcohol	Phenol
Hybridisation of the C-atom to which oxygen is attached to	sp^3	sp^2
C-O-H bond angle is 109^0 because	the compounds with sp3 hybridisation have a bond angle of 109°	of the partial double bond character on account of the unshared electron pair of oxygen with the benzene ring

[Give 0.5 marks for each correctly mentioned points]

2

Q.155

(a) D: ethanol

E: phenol

F: diethyl ether

[0.5 marks for each correct answer]

(b) The decreasing order of the C-O bond length is :

Diethyl ether ~ ethanol > phenol. *[1]*

(c)

Compound	D	E	F
percentage of s-character	25%	33%	25%

[0.5 marks for each correct answer]

4

Q.156

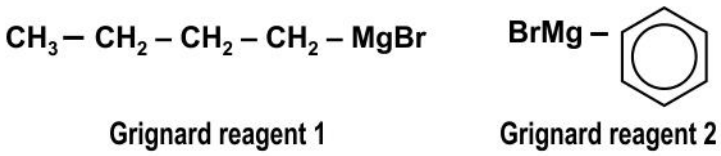
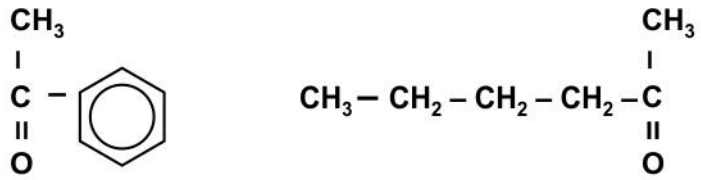
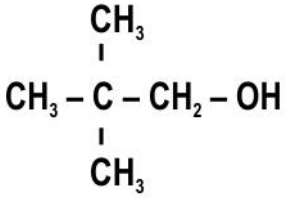
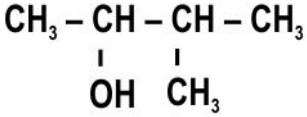
(a) The molecular formulae will be the same, C_3H_8O.

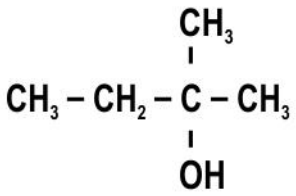
(b) Both the products contain the -OH or alcohol group.

(c) 1 mark each for the following:

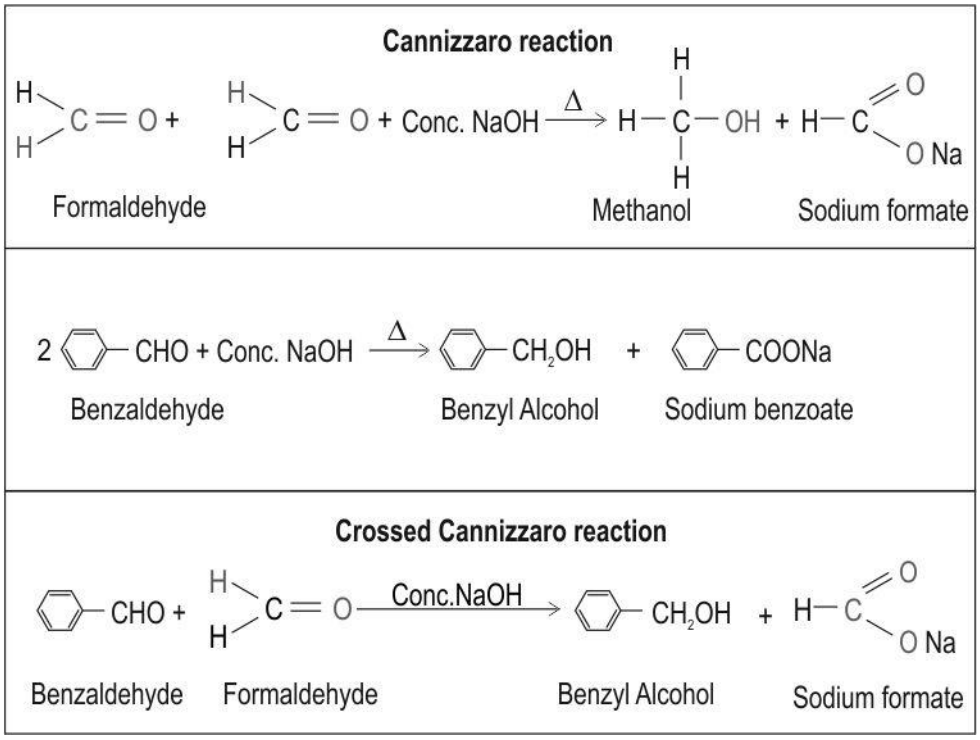
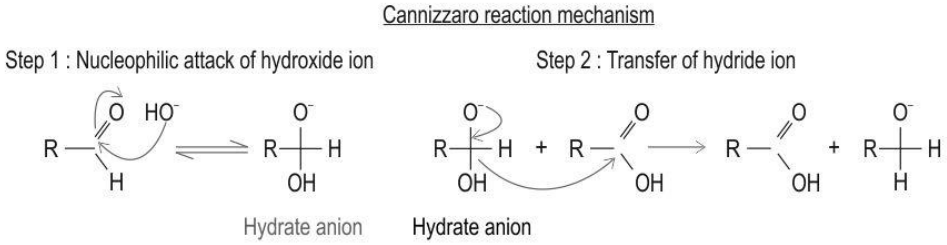
- Reaction with water will produce propan-2-ol.

4

	- Reaction with diborane will produce propan-1-ol	
Q.157	This is not a good method for the preparation of n-propyl ethyl ether. The reaction will produce a mixture of three different ethers which would be difficult to separate.	2
Q.158	CH_3- CH_2 - O - CH_2 - CH_3 CH_3- CH_2 - O - CH_2 - CH_2 - CH_3 CH_3- CH_2 - CH_2 - O - CH_2 - CH_2 - CH_3	3
Q.159	(i) 1 mark each for the following:  Grignard reagent 1 Grignard reagent 2 (ii) 1 mark each for the following:  Ketone 1 Ketone 2	4
Q.160	(i)  (ii)  	3

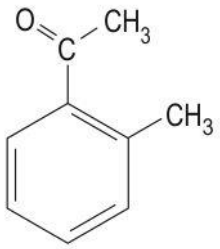
	(iii) 	

11. CHAPTER: ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

Q.No	Question	Marks
	Free Response Questions/Subjective Questions	
Q.161	The image I below shows the Cannizzaro reaction using: (i) formaldehyde (ii) benzaldehyde (iii) a mixture of benzaldehyde and formaldehyde.  Image II shows the reaction mechanism of the reaction.  (a) Give a possible explanation why sodium benzoate and methanol are not formed in the crossed Cannizzaro reaction.	4

	(b) Can 2,2-dimethylpropanal $(CH_3)_3$ - C - CHO undergo Cannizzaro reaction? Give a reason for your answer.	
Q.162	An organic compound with the molecular formula $C_9H_{10}O$: (i) forms the 2,4-DNP derivative. (ii) does not reduce Tollens' reagent. (iii) forms iodoform when reacted with sodium hypoiodite. (iv) gives 1,2-benzenedicarboxylic acid on oxidation. Determine the compound's structure and illustrate how you utilized provided information to identify it.	5

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.161	(a) 1 mark each for the following: - In benzaldehyde the carbocation is less electrophilic than in formaldehyde due to resonance with the ring electrons. - The initial nucleophilic addition of hydroxide anion is therefore faster on formaldehyde than on benzaldehyde. - The aldehyde that undergoes nucleophilic attack by OH^- is converted to the sodium salt of the acid and the other aldehyde to the alcohol. (b) - Yes [0.5] - It does not have an alpha hydrogen atom. [0.5] (No marks to be awarded if reason is not given.)	4
Q.162	 Since it forms a 2,4-DNP derivative, it contains a carbonyl group and must be an aldehyde or a ketone. Since it does not reduce Tollens' reagent, it cannot be an aldehyde and is therefore a ketone. Since it gives the iodoform reaction, it must have a methyl group linked to the carbonyl carbon atom and is, therefore, a methyl ketone. 0.5 marks each for the following: - Since it gives 1,2-benzenedicarboxylic acid on oxidation, it is a 1,2-substituted benzene derivative. - using the molecular formula together with the points above, we arrive at the structure of the compound	5

12. CHAPTER: AMINES

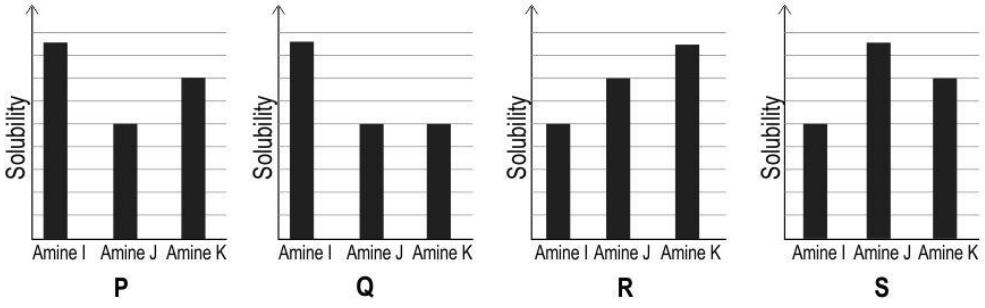
Q.No	Question	Marks
	Multiple Choice Question	
Q.163	The reaction of an arene diazonium chloride with aniline in an acidic medium gives a coloured compound. Which of the following occurs during the reaction? A. Benzene ring is replaced. B. Nitrogen is displaced. C. Diazo group is retained. D. Amino group is displaced.	1
Q.164	Which of the following is TRUE about the solubility of Ethylamine and Aniline? A. Aniline is soluble in HCl. B. Both are insoluble in HCl. C. Both are soluble in water. D. Ethylamine is insoluble in water.	1
Q.165	During an activity session, the teacher kept some pieces of papers in a box in which the names of chemicals were written. The teacher then asked 4 groups of students to select the appropriate pieces of paper with names of chemicals used to prepare para nitro aniline. The 4 groups have selected pieces of paper as follows; Group-1 Conc. H_2SO_4, Conc.HNO_3 , Acetic anhydride, Aniline. Group-2 Aniline, Conc.H_2SO_4 and Con. HNO_3 . Group-3 Conc.HNO_3 with Pyridine, Aniline Group-4 Conc. HNO_3, Conc. H_2SO_4, Aniline, Acetyl Chloride. Which group or groups of students have selected it appropriately. A. Group1 and 4 B. Group 3 and 4 C. Group3 D. Group 1	1

Q.166	The same volume of three isomeric amines are boiled and the time taken for vapourisation of the entire volume is noted in the table given below: **Amine** | **Time taken to vapourise(in secs)** Amine F | 30 Amine G | 49 Amine H | 100 Which of the following statements is most likely to be TRUE about these three amines? A. The expected molar mass of amine G and H are different B. Amine F is most likely to be a primary amine C. Amine G is most likely to be a secondary amine D. The expected molar mass of amine F is greater than that of amine H	1
Q.167	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): Aniline cannot be prepared by the Gabriel phthalimide synthesis. Reason (R): Aryl halides do not undergo nucleophilic substitution. Which of the following is correct? A. Both A and R are true, and R is a 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.	1
Q.168	Aniline on heating with chloroform and alcoholic KOH gives a foul-smelling product. Making which of the following changes in the reaction would still produce a foul-smelling product? P) replacing aniline with ethylamine Q) replacing chloroform with carbon tetrachloride R) replacing alcoholic KOH with alcoholic NaOH A. only P B. only R C. only Q and R D. only P and R	1

Q.169	Benzylamine is formed when _____ is treated with sodium amalgam in the presence of ethanol. A. benzonitrile B. aniline C. nitrobenzene D. benzylcyanide	1
Q.170	Which of the options correctly identifies the amount of ammonia and alkyl halide used in the reaction and the type of amine obtained?	1

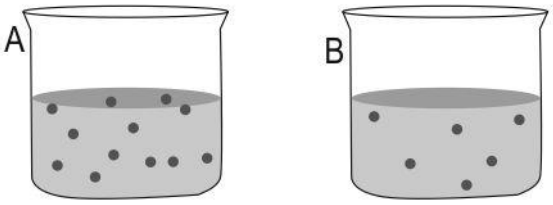
	Amount of ammonia used	Amine formed
L	Equimolar ratio of ammonia and alkyl halide	Secondary amine is the minor and tertiary amine is the major product
M	Large excess of ammonia	Quaternary ammonium salt as the only product
N	Large excess of ammonia	Primary amine as the major product
O	Equimolar ratio of ammonia and alkyl halide	Combination of all three types of amines in equimolar concentration

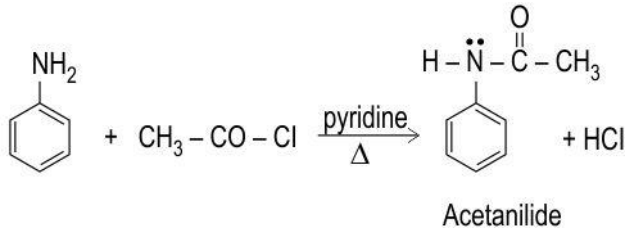
A. L
B. M
C. N
D. O

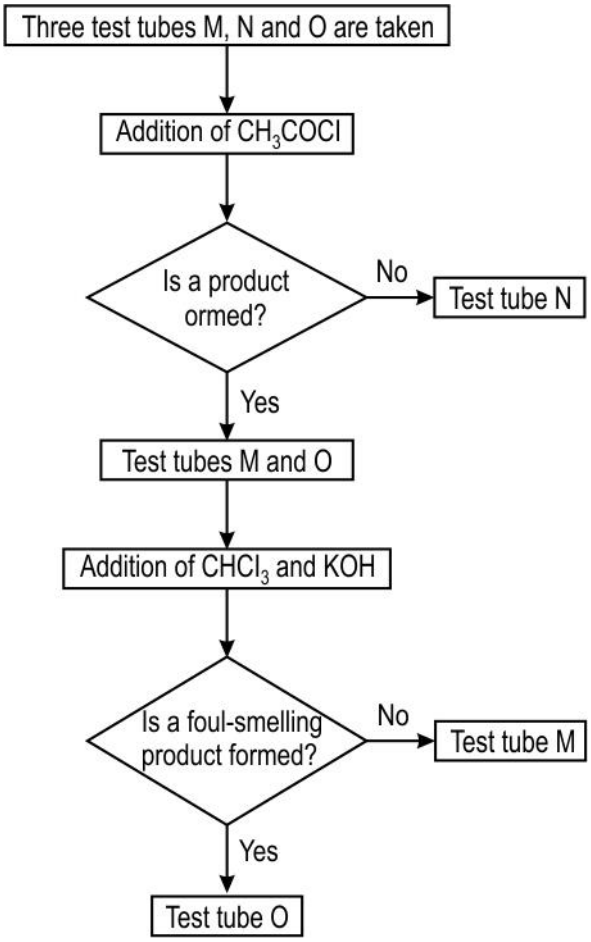
Q.171	The graphs below show the solubility of a primary, a secondary and a tertiary aliphatic amine I, J, and K in water, at the same temperature. The number of carbon atoms in each of the compounds is three. Amine I is the tertiary amine, amine J is the primary amine, and amine K is the secondary amine.  Which of the graphs identifies the three amines correctly? A. P B. Q C. R	1

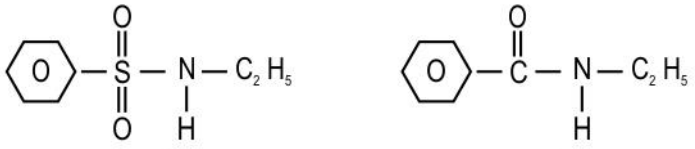
	D. S	
Q.172	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A)**: Besides ortho and para nitroaniline, nitration of aniline in an acidic medium also gives the meta derivative. **Reason (R):** In acidic medium aniline gets protonated forming anilinium ion. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1
Q.173	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A):** Cyanobenzene cannot be prepared from chlorobenzene by nucleophilic substitution. **Reason (R):** The cyano group can directly be introduced in a benzene ring by substitution. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1
Q.174	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A):** Propyl amine on reaction with nitrous acid forms aliphatic diazonium salts. **Reason (R):** Aliphatic diazonium salts are stable at 273-278 K. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1

Q.175	Which of the following sets have all the compounds with a pKb value more than ammonia? A. N, N-dimethylaniline, methylamine, ethanamine. B. aniline, N, N-dimethylaniline, N-methylaniline C. N,N-Dimethylmethanamine, Ethanamine, N, N-Diethylethanamine D. N-Diethylethanamine, ethanamine, Methanamine	1
Q.176	Two isomers, n- $C_4H_9NH_2$ and $(C_2H_5)_2NH$ have molar mass of 73 each. Which of the following is correct about their boiling points? A. The boiling point of n- $C_4H_9NH_2$ is higher than that of $(C_2H_5)_2NH$. B. The boiling point of $(C_2H_5)_2NH$ is higher than that of n- $C_4H_9NH_2$. C. Both the amines will have the same boiling point. D. The boiling point of both the amines will be lower than that of water.	1
Q.177	Aryl diazonium salts undergo reductive removal of the diazonium group in presence of weak acids. Which of the following products will be formed during this process? A. Chlorobenzene B. Phenol C. Benzene cyanide D. Benzene	1
Q.178	Benzene sulphonyl chloride is a chemical which can be used to identify the class of an Amine. When an amine 'A' reacts with benzene sulphonyl chloride it gives precipitate of sulphonamides which is soluble in alkali. The amine A is; A. N-Ethylethanamine B. N,N-Diethylethanamine C. Ethanamine D. N-Methylbenzenamine	1
Q.179	2-Methyl butanamide on reacting with Br_2 in alkaline medium gives an amine. Which of the following is a correct characteristic of that amine? A. It is optically active. B. It is a secondary amine. C. It can form a stable diazonium salt. D. It has one carbon atom more than the amide.	1
Free Response Questions/Subjective Questions		
Q.180	Consider two unknown primary amine compounds A and B, one of which is aromatic and the other is aliphatic amine. Compound A reacts with $NaNO_2$ in	4

	HCl to give a useful diazonium compound. But amine B on reaction with $NaNO_2$ and HCl produces ethanol. (a) Which of the two amines is aromatic and why? (b) Give evidence to identify the amine B.	
Q.181	You are given three compounds of nitrogen having the general formula NH_2-X. If X= C_6H_6, CH_3 or H, which of the three compounds will be protonated MOST easily in water? Justify your answer.	2
Q.182	Which out of H-NH_2 and CH_3-NH_2 has higher pKb value? Illustrate the ionisation of these compounds in aqueous medium and write their K_b expression to justify your answer.	3
Q.183	Two beakers 'A' and 'B' contain aqueous solutions of methyl amine. It is observed that beaker A contains more OH^- than beaker 'B'  Prove which of the two solutions will have higher pK_b value and why?	4
Q.184	There are 5 reagent bottles containing $NaNO_2$, HCl, Phenol, Aniline and NaOH separately in them. The teacher asked Amit to make an orange dye using suitable chemicals out of the five reagents given. (a)Write the chemical equations and the conditions for the steps involved in the preparation of the orange dye. (b) Name the type of reaction of the step in which phenol reacts.	3
Q.185	(a) Why are quarternary ammonium salts used in detergents? Explain it by giving one example. (b) Write the chemical reaction involved in the Ammonolysis process of preparation of quarternary ammonium salt.	3
Q.186	During an activity period, the teacher asked the students to write the chemical reactions involved in the conversion of compound Cl-$(CH_2)_4$-Cl into hexane-1,6 diamine. She also suggested students to use chemicals such as reducing agents, alcohol, cyano compounds etc as per the requirements. She then asked them to report their findings by answering the following: i) Write the chemical reaction taking place in first step of the conversion. ii) Identify the type of reaction. Justify. iii) Show the chemical reaction for the formation of the final product.	3

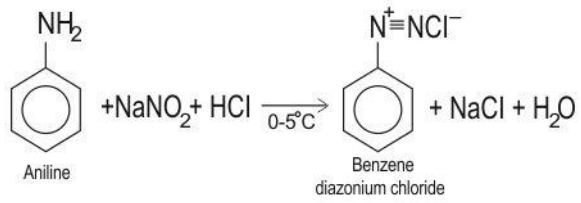
<table>
<tr><td>Q.187</td><td>p-chlorobenzene diazonium chloride and p-methyl benzenediazonium chloride are taken in separate beakers. Now phenol and a few drops of NaOH is added to both the beakers.
Which of the two para-substituted diazonium compounds will couple preferentially with phenol to give a coloured dye? Explain why.</td><td>2</td></tr>
<tr><td>Q.188</td><td>Primary and secondary amines undergo acylation reaction in the presence of a stronger base than the amine.
 
Acetanilide
(a) What would happen if a stronger base is not used for the acylation reaction?
(b) Can we use anhydrous $AlCl_3$ in place of a strong base? Justify your answer by writing the reaction.</td><td>3</td></tr>
<tr><td>Q.189</td><td>(a) When benzene diazonium chloride is treated with fluoroboric acid it gives a compound 'X'.
Identify compound X.
(b) When compound 'X' is heated alone or with $NaNO_2$ in the presence of Cu it releases N_2 gas.
What are the other two products produced when compound 'X' is:
i) heated alone?
ii) heated with $NaNO_2$?
Write the chemical equations involved in each of the reactions.</td><td>5</td></tr>
<tr><td>Q.190</td><td>Anusrita was measuring the pK_b of of two compounds A and B. She recorded her observations in the following table:
<table><tr><th>A</th><th>B</th></tr><tr><td>$pK_b = 4.70$</td><td>$pK_b = 9.38$</td></tr></table>
Which test tube is expected to contain benzylamine and which is expected to contain aniline? Give a reason for your choice.</td><td>3</td></tr>
<tr><td>Q.191</td><td>One of the ways of producing ethylamine from chloroethane is by adding ammonia to it. It is a nucleophilic reaction.
(a) What reaction mechanism does this reaction follow?
(b) Why is this not a very common method to prepare amines?</td><td>4</td></tr>
</table>

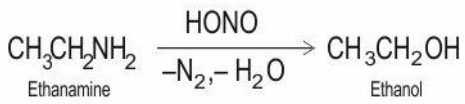
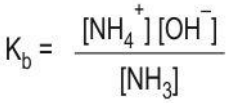
	(c) Between tertiary and quaternary amines, which will have a greater bond angle ? Justify your answer.	
Q.192	(a) Arrange the following in the increasing order of pK_b. Aniline, 2-methylaniline, 3-methylaniline, 4-methylaniline. (b) Give a reason for your arrangement.	3
Q.193	(a) Identify the type of amines M,N, and O in the flowchart below:  (b) Give one example of each type of amine.	3
Q.194	For a school project work Mrs. Roy asked her students to dye a white hanky. Ritama and Baivavi took the help of their chemistry teacher for the project. Ritama dyed her white hanky yellow in colour, and Baibavi dyed it orange. The yellow colour was formed by preparing a compound X and immediately adding aniline to it. The orange colour was formed by preparing compound X and immediately adding phenol to it. The students saw compound X was readily soluble in cold water.	5

	(a) Can an aqueous solution of compound X conduct electricity? Give a reason for your answer. (b) Write the equation showing the formation of compound X. (c) Why is aniline or phenol added immediately to compound X as soon as it is prepared? (id Write balanced equations showing the formation of the yellow and orange dyes.	
Q.195	Of the two compounds P and Q given below, which one is more likely to be acidic in nature? Justify your answer.  (P) (Q)	2
Q.196	While studying about diazotisation of amines and their reactions, students carried out the following two processes P and Q in the laboratory to prepare orange-coloured dye. P) aniline + dilute HCl + $NaNO_2$ + ice $\xrightarrow{30\ minutes}$ X $\xrightarrow{+\ phenol}$ Q) aniline + dilute HCl + $NaNO_2$ $\xrightarrow{30\ minutes}$ X $\xrightarrow{+\ phenol}$ Which of the two processes is likely to produce the orange-coloured dye in higher yield? Justify your answer.	2
Q.197	Krishna took three amines U, V, and W. The three amines were added to Hinsberg's reagent. The products were added to aq. NaOH and the observations were tabulated as follows: **Amines** | **Observations after the addition of the products formed to aq.NaOH solutions** U | The product is soluble in aq.NaOH. V | The product is insoluble in aq.NaOH W | The product is insoluble in aq.NaOH (a) What is Hinsberg's reagent? Name another reagent that can replace this one. (b) Which of the amine(s) have the structural formula of R-NH-R? (c) What does the solubility of the products formed in aq. alkali imply? (d) Which of the following amines may be prepared by the Gabriel phthalimide process? Give a reason.	5

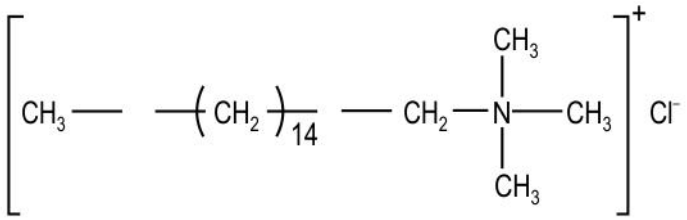
Q.198	Propanamide reacts with bromine in an aqueous solution of sodium hydroxide to form a compound G. a) What is the geometry of compound G and the hybridisation of the N-atom in compound G? b) What is the IUPAC name of the compound G?	2
Q.199	An amine M reacts with sulphuric acid at 473 K to form compound N. Amine M cannot be prepared by the Gabriel phthalimide synthesis. It is the simplest amine of its type. a) Identify M and write its IUPAC name. b) If electricity is passed through an aqueous solution of compound N and a bulb is connected to this circuit what will be your observation and why?	3
Q.200	Prapti takes some aniline in a container. She adds to it, a mixture of sodium nitrite and hydrochloric acid at 40°C. She leaves the mixture beside an open window on a hot and sunny day. What will be the change in the composition of the reaction mixture? Why?	2
Q.201	Aradhya prepares chlorobenzene from benzene diazonium chloride by two methods. With the same input of the reactant the output in method I is 25cc of chlorobenzene and in method II 30cc of chlorobenzene is produced. a) State the reactants used in method I and II. b) What is the reason for the observation?	2
Q.202	Which of these $(R)_4N^+Cl^-$ or $(R)_3N$ is more basic? Give reason.	2

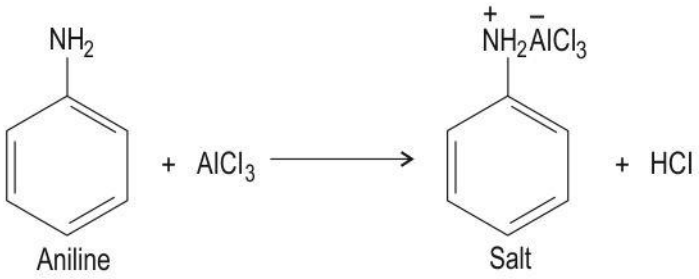
Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.163	C. Diazo group is retained.	1
Q.164	A. Aniline is soluble in HCl.	1
Q.165	A. Group1 and 4	1
Q.166	C. Amine G is most likely to be a secondary amine	1
Q.167	C. A is true, but R is false.	1
Q.168	D. only P and R	1
Q.169	A. benzonitrile	1
Q.170	C. N	1
Q.171	D. S	1
Q.172	A. Both (A) and (R) are correct and (R) is the correct explanation of (A)	1
Q.173	C. (A) is true but (R) is false	1
Q.174	C. (A) is true but (R) is false	1
Q.175	B. aniline, N, N-dimethylaniline, N-methylaniline	1
Q.176	A. The boiling point of n- $C_4H_9NH_2$ is higher than that of $(C_2H_5)_2NH$.	1
Q.177	D. Benzene	1
Q.178	C. Ethanamine	1
Q.179	A. It is optically active.	1
Q.180	(a)Compound A is an aromatic compound as it reacts with $NaNO_2$ and HCl to give Diazonium salt. 	4

	(b) Aliphatic amines give unstable diazonium compound on diazotization i.e. on reaction with $NaNO_2$ and HCl. The unstable Diazonium compound decomposes to give corresponding alcohol (with the release of $N_{2(g)}$.) Since alcohol is ethanol so the amine is Ethanamine ($C_2H_5NH_2$)  	
Q.181	- In C_6H_5-NH_2, the unshared pair of electrons on nitrogen is conjugated with the benzene ring making it less available for protonation than in ammonia. [1] The CH_3 group is an electron releasing group. This makes the unshared pair of electrons on N more available and a stronger proton acceptor than ammonia. [1]  Hence CH_3NH_2 gets protonated most easily. (The equation is only for reference.)	2
Q.182	The two Amines are H-NH_2 and CH_3-NH_2. pK_b value of H-NH_2 is higher. We know - $pK_b = -\log K_b$ H-NH_2 will ionise as follows; H-NH_2 + H_2O ——> NH_4^+ + OH^-  Since the lone pair of electrons on N in Ammonia accepts proton slowly in aqueous medium hence less OH^- ion will be available so less K_b therefore more pK_b In the same way Methanamine ionises CH_3-NH_2 + H_2O ———>$CH_3NH_3^+$+ OH^-	3

	$K_b = \frac{[OH^-][CH_3NH_3^+]}{[CH_3NH_2]}$ The methyl group is an electron releasing group. So the higher electron density on nitrogen makes it a stronger proton acceptor. Thus it furnishes more OH^- ion and shows comparatively higher K_b. Therefore its pK_b value is less.	
Q.183	Presence of more OH^- ions shows solution 'A' is more basic. we know that higher the concentration of OH^- higher is the K_b i.e.dissociation constant. [1] The reaction can be represented as; $CH_3\text{-}NH_2 + H_2O \longrightarrow CH_3NH_3^+ + OH^-$ [1 mark] $K_c = \frac{[CH_3NH_3^+][OH^-]}{[CH_3NH_2]}$ (Here $K_c = K_b$ i.e dissociation constant of base in aqueous solution.) But pK_b and K_b are related as $pK_b = -\log K_b$ [1] Thus we can say pK_b value of solution 'B' is higher because it has less concentration of OH^-. [1]	4
Q.184	(a) (i) 0.5 marks each for writing the formula of aniline and benzenediazonium chloride and 0.5 marks for mentioning the temperature: $C_6H_5NH_2 + NaNO_2 + HCl \xrightarrow{0\ ^\circ C} C_6H_5N_2^+Cl^-$ aniline benzenediazonium chloride (ii)0.5 marks each for writing the formula of phenol and p-hdroxyazobenzene $C_6H_5N_2^+Cl^- + C_6H_5OH + NaOH \longrightarrow C_6H_5 - N = N - C_6H_5OH$ benzenediazonium chloride phenol p - hydroxyazobenzene (b) electrophilic substitution	3
Q.185	Quarternary ammonium salts, which have one of the R= long hydrocarbon chain, are used in detergents because they can serve as surfactants.	3

	The molecules of these salts have a polar and a non-polar end. The non-polar end is soluble in oil(dirt) and the polar end is soluble in water. Thus it helps in the cleaning process.  n-hexadecyltrimethyl ammonium chloride or (cetyltrimethyl ammonium chloride) ex . (1 mark each for the explanation and the example) Preparation : $R\text{-}X + NH_3 \longrightarrow RNH_2$ (A) Compound A is Alkanamine.(RNH_2) $RNH_2 + 3R\text{-}X \longrightarrow R_4N^+X$ (detergent) (1)	
Q.186	Conversion given is; $Cl\text{-}(CH_2)_4\text{-}Cl \longrightarrow H_2N\text{-}CH_2(CH_2)_4\text{-}CH_2NH_2$ i) At first chloro compound will be converted into cyano compound.So first step is- $Cl\text{-}(CH_2)\text{-}Cl + KCN_{(alc.)} \longrightarrow NC\text{-}(CH_2)_4\text{-}CN$ (1) ii) This reaction is called Nucleophilic substitution reaction because nucleophile CN^- replaces Cl ion. (1) iii) Final product hexane-1,6-diamine is obtained by reduction of dicyano compound obtained in first step using reducing agent Ni or Pt or $LiAlH_4$ $NC\text{-}(CH_2)\text{-}CN + H_{2(g)} \xrightarrow{Pt}$ $H_2N\text{-}CH_2\text{-}(CH_2)_4\text{-}CH_2\text{-}NH_2$ (1)	3
Q.187	- The formation of the coloured dye is an Electrophilic substitution reaction in which, the diazonium compound is the electrophile and phenol is the substrate. [1] Since the chloro group is an electron withdrawing group, it increases the positivity on N_2^+ ion hence *p*-chlorobenzene diazonium cation is a stronger	2

	electrophile than the *p*-methyl benzenediazonium cation as the methyl group is an electron releasing group. So, *p*- chlorobenzene diazonium chloride couples preferentially with phenol to form a coloured dye. [1]	
Q.188	(a) - In the reaction, the corresponding amide is formed with the release of acid HCl. This acid is neutralised by the stronger base present in the reaction thus equilibrium will shift in forward direction [1] - If a stronger base is not used then the HCl formed in the reaction will be neutralised by aniline itself and this will make the reaction to stop after a point. [1] (b) No, we cannot use anhydrous $AlCl_3$ in place of a base because $AlCl_3$ is a Lewis acid and amines are Lewis bases. They both will react to give the corresponding salt and not amide.  	3
Q.189	(a) Compound X is benzenediazonium fluoro (b) (i) When compound *X* is heated alone it gives fluorobenzene and boron trifluoride with the release of N_2 gas. $C_6H_5N_2^+BF_4^- \xrightarrow{heat} C_6H_5F + N_2 + BF_3$ [Give 0.5 marks each for mentioning the two products and 1 mark for the correct equation] ii) When compound *X* is heated with $NaNO_2$ in presence of Cu metal it gives Nitrobenzene and sodium fluoroborate with the release of N_2 gas. (b) (ii) $C_6H_5N_2^+BF_4^- \xrightarrow[Cu]{NaNO_2} C_6H_5NO_2 + N_2 + NaBF_4$ [Give 0.5 marks each for mentioning the two products and 1 mark for the correct equation]	5

Q.190	-Test tube A contains benzylamine. [1] -The lone pair of electrons on N-atom of aniline is conjugated with and is delocalised over the benzene ring and hence is less available for protonation. [1 mark] - in aralkylamines, the lone pair of electrons on the N-atom is not conjugated with the benzene ring and therefore is not delocalized. Hence, the lone pair of electrons on the N-atom in aralkylamines is more readily available for protonation than that on the N-atom of aniline. [1] (No marks to be awarded if a reason is not given.)	3
Q.191	(a) The reaction mechanism followed is S_N2. [1] (b) Ammonolysis has the disadvantage of yielding a mixture of primary, secondary and tertiary amines and also a quaternary ammonium salt. [1] (c) Quaternary amines have greater bond angle than tertiary amines. Quaternary amines are sp^3 hybridized, have a tetrahedral shape, and have a bond angle of 109.5^o. Due to the presence of unshared pair of electrons, the bond angle is less than 109.5° in the case of triethylamine. [*1 mark for the correct bond angle and 1 mark for the reason.*]	4
Q.192	(a) 4-methylaniline < 3-methylaninline < aniline < 2-methylaniline. [1] (b) The methyl group is an electron-releasing group. Its effect is more at the p-position than at the meta position. So, 4-methylaniline is more basic than 3-methylaniline. The basic nature of 2-methyl aniline is expected to be more than aniline because of the +I-effect of the -CH3 group. But it is less than aniline due to the steric effect of the $-CH_3$ and the $-NH_2$ group in close proximity. The basic nature of 3-methyl aniline will be more than aniline because of the +I-effect of the $-CH_3$ group. The more basic the nature, the lower the pK_b value. [2 marks for correct reason]	3
Q.193	(i) Test tube M = Secondary amine Test tube N= Tertiary amine Test tube O = Primary amine [0.5 marks for each correct answers] (ii) Any correct example for each type of amine. [0.5 marks for each correct answers]	3

Q.194	(a) Aq. solution of compound X can conduct electricity due to the presence of ions in it. [1] (b) $C_6H_5NH_2 + NaNO_2 + 2HCl$ -------> $C_6H_5N_2^+Cl^-$ (compound X)+ $NaCl + 2H_2O$ [1] (c) Due to its instability, the benzene diazonium chloride salt is not generally stored and is used immediately after its preparation. [1] (d) $C_6H_5N_2^+Cl^- + C_6H_5NH_2$ -------> $C_6H_5N{=}NC_6H_5{-}NH_2$ (yellow dye)+ $Cl^- + H_2O$ [1] $C_6H_5N_2^+Cl^- + C_6H_5OH$ -----> $C_6H_5N{=}NC_6H_5{-}OH$ (orange dye)+ $Cl^- + H_2O$ [1]	5
Q.195	The sulphonyl group is a stronger electron-withdrawing group compared to the carbonyl group which makes the H atom attached to the N atom more acidic in nature. Hence P is more likely to be acidic in nature than Q.	2
Q.196	The orange-coloured dye will be produced in larger amounts by process P. [1] The diazonium salt X is unstable at higher temperatures and hence should should be prepared at low temperature or used immediately. [1]	2
Q.197	(a) Benzene sulphonyl chloride ($C_6H_5SO_2Cl$), which is also known as Hinsberg's reagent. Benzene sulphonyl chloride is replaced by p-toluene sulphonyl chloride. *[0.5+0.5]* (b) Amine V and W have the structural formula of R-NH-R. *[0.5+0.5]* (c) The hydrogen attached to nitrogen in the product formed after the amine U reacts with Heisenberg's reagent is strongly acidic due to the presence of a strong electron-withdrawing sulphonyl group. Hence, it is soluble in aq.NaOH. Amine V and W do not contain any hydrogen atom attached to the nitrogen atom in the product formed are not acidic and hence insoluble in aq.NaOH. Amine U may be prepared by the Gabriel phthalimide process. *[2]* (d) Amine U is soluble in aq. NaOH. So, it is a primary amine. Gabriel synthesis is used for the preparation of primary amines. *[0.5+0.5]*	5
Q.198	a) 0.5 marks each for the following:	2

<table>
<tr><td></td><td>- The geometry is pyramidal.

- the hybridisation of the N-atom in compound G is sp^3 .

b) The IUPAC name of compound G is Ethanamine.</td><td></td></tr>
<tr><td>Q.199</td><td>a) Amine M is aniline and its IUPAC name is phenylamine. [0.5+0.5]

b) If electricity is passed through an aqueous solution of compound N and a bulb is connected to this circuit then the bulb will not glow. This is because compound N forms a zwitter ion in the reaction medium. Zwitter ions do not conduct electricity as it is a neutral ion with both positive and negative charges in the same molecule. [1+1]</td><td>3</td></tr>
<tr><td>Q.200</td><td>When a mixture of sodium nitrite with hydrochloric acid at 40°C is added to aniline, benzene diazonium chloride is formed. This compound decomposes at high temperatures. [1]

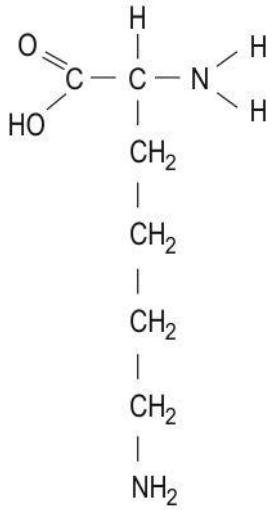
Since Prapti leaves this reaction mixture beside an open window on a hot and sunny day the temperature will be above 10°C and the diazonium compound decomposes to phenol. [1]</td><td>2</td></tr>
<tr><td>Q.201</td><td>a) The reactants are:

<table><tr><th></th><th>Method I</th><th>Method II</th></tr><tr><td>Reactant</td><td>benzene diazonium chloride + Cu in HCl.</td><td>benzene diazonium chloride+ cuprous chloride in HCl</td></tr></table>
[0.5+0.5]

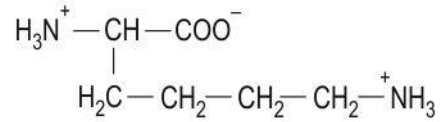
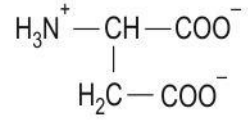
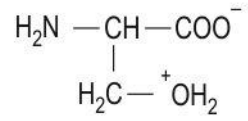
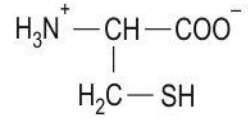
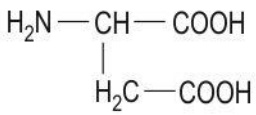
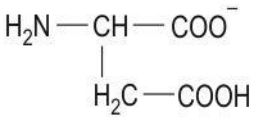
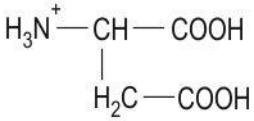
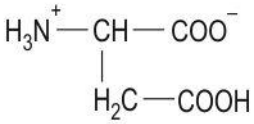
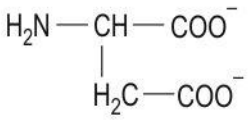
b) The copper in method II is in +1 state with complete $3d^{10}$ electronic configuration. This favours the forward reaction and hence the yield is more. [1]</td><td>2</td></tr>
<tr><td>Q.202</td><td>$(R)_3N$ is more basic as in this N has a lone pair of electron which it can donate.Thus it can acts as Lewis base. [1mark]

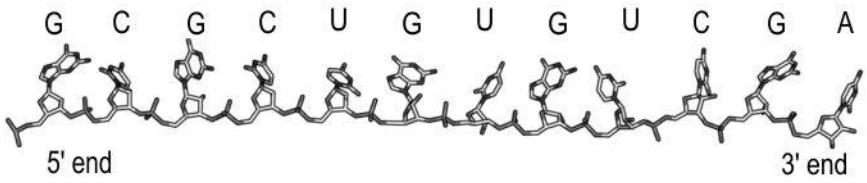
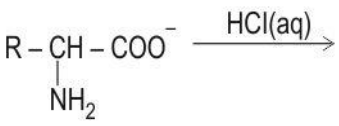
On the other hand in $(R)_4N^+Cl^-$ the lone pair of N is already protonated. Hence it is less basic. [1]</td><td>2</td></tr>
</table>

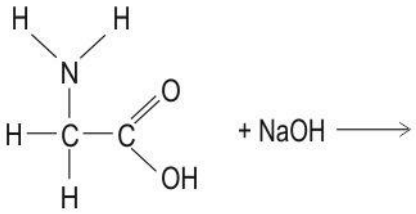
13. CHAPTER: BIOMOLECULES

Q.No	Question	Marks
	Multiple Choice Question	
Q.203	Shown below is the chain structure of an unknown compound A.  Which of the following statements is true for compound A? A. Compound A is neutral. B. Compound A is basic in nature. C. Compound A is acidic in nature. D. Compound A is ammonium salt.	1
Q.204	Assertion (A): Vitamins A and K reduce excess body fat in humans. Reason (R): Vitamins A and K are fat soluble. Which of the following is correct? A. Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A). B. Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A). C. Assertion (A) is true and Reason (R) is false. D. Assertion (A) is false and Reason (R) is true.	1
Q.205	Assertion (A): Sucrose and Fructose can not give positive Tollen's test Reason (R): Sucrose and Fructose do not contain an aldehyde group.	1

	Which of the following is correct? A. Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A). B. Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A). C. Assertion (A) is false and Reason (R) is true. D. Assertion (A) is true and Reason (R) is false.	
Q.206	Which of the following statements is/are correct? (i) Amongst Lysine, Histidine and Serine, Lysine is the most basic in nature. (ii) All non-essential amino acids are basic in nature. (iii) Adding acids such as lemon juice into meat protein does not denature the primary structure yet tenderize meat. A. i only B. iii only C. i and iii only D. all- i, ii, and iii	1
Q.207	Given below are two statements labeled as Assertion (A) and Reason (R). Assertion (A): All amino acids are solid at 20°C. Reason (R): Amino acids can form zwitter ions. The ionic nature of the zwitter ions gives amino acids relatively strong intermolecular forces of attraction. 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.	1
Q.208	Which is the structure of a zwitter ion of an amino acid?	1

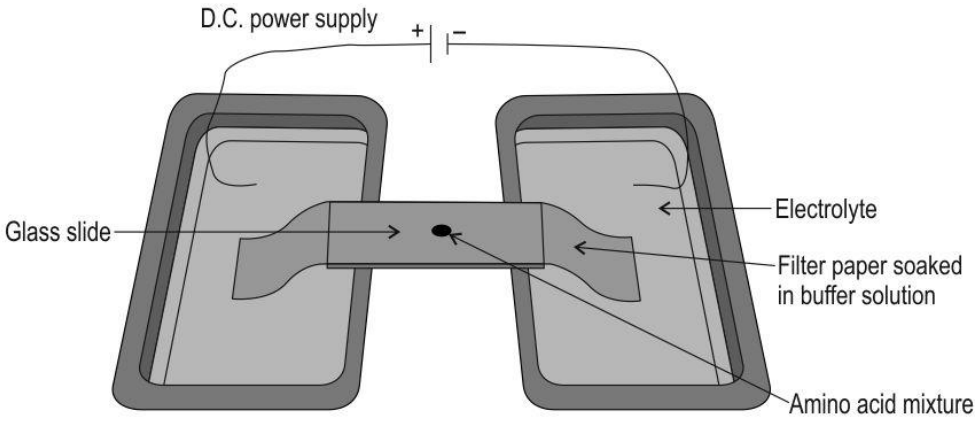
	A  **B**  **C**  **D**  A. A B. B C. C D. D	
Q.209	The structure of aspartic acid is shown in the image below.  Which of the following structures is the form of aspartic acid in solution at pH 12? **A**  **B**  **C**  **D**  A. A B. B	1

	C. C D. D	
Q.210	Which of the following statements is/are correct proteins or enzymes when they are subjected to physical changes as specified? (i) The sequence of amino acids in the peptide changes in a protein when the pH of its environment is changed. (ii) Most enzymes stop working above about 50°C. (iii) Albumen, a globular protein found in egg whites, sets into an insoluble white solid when the egg white is heated. A. iii only B. i and ii only C. ii and iii only D. all- i, ii, iii	1
Q.211	The following image shows the structure of DNA, with the letters indicating the bases present.  Which structure of DNA is represented above? A. Primary B. Secondary C. Tertiary D. Quarternary	1
Free Response Questions/Subjective Questions		
Q.212	Complete the following reactions. (i)  (ii)	2

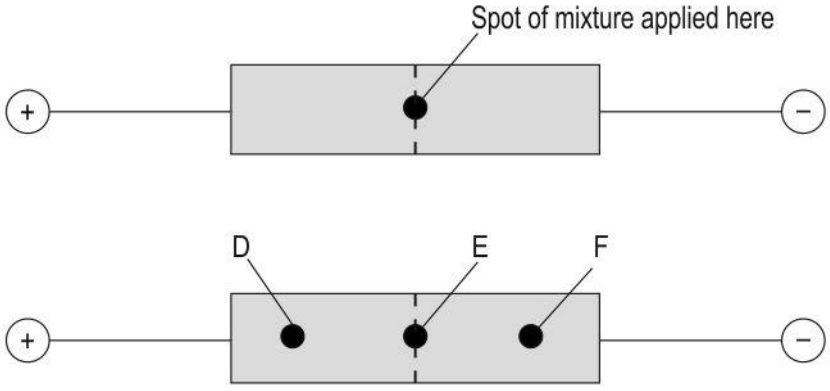


Q.213 Electrophoresis is used for DNA fingerprinting in forensic science. 3

The diagram below shows an electrophoresis apparatus used to separate different amino acids.



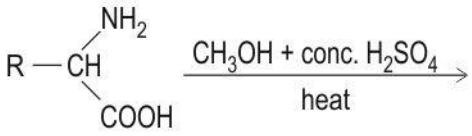
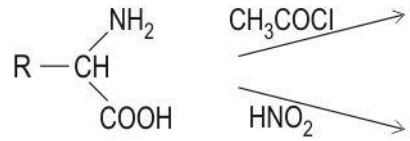
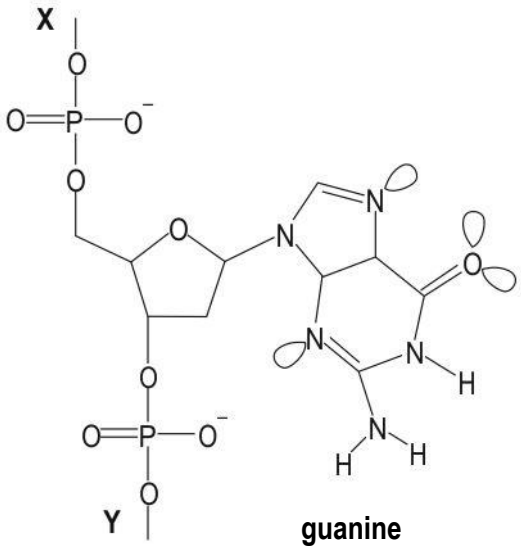
The mixture of the amino acids* consisted of glycine, lysine and glutamic acid at pH 7 (at which the amino acids are neither acidic nor alkaline). When an electric field is applied to this mixture and left for a certain period of time, the mixture separates as shown below.

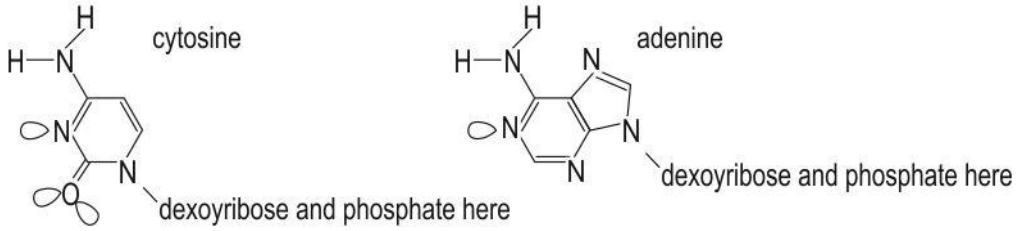
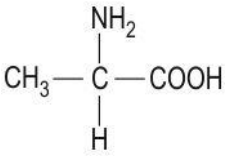
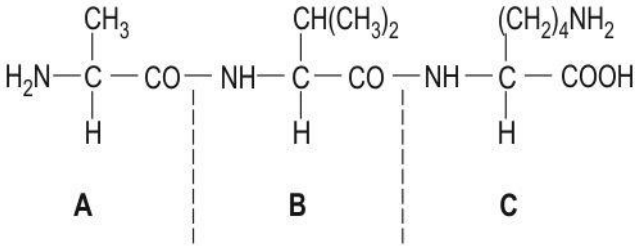
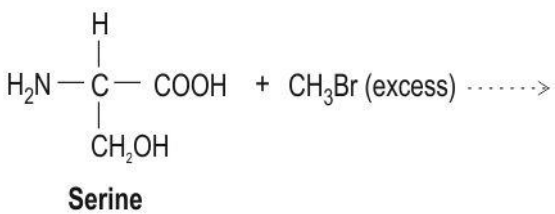


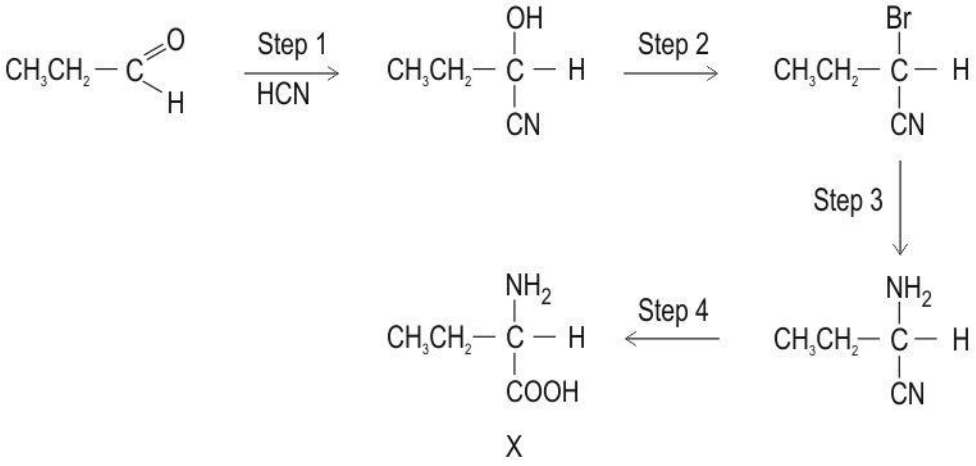
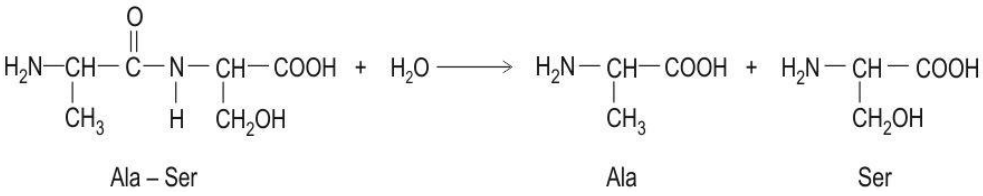
Identify the amino acids that would be found in spots labelled D, E and F. Give a reason to support your answer.

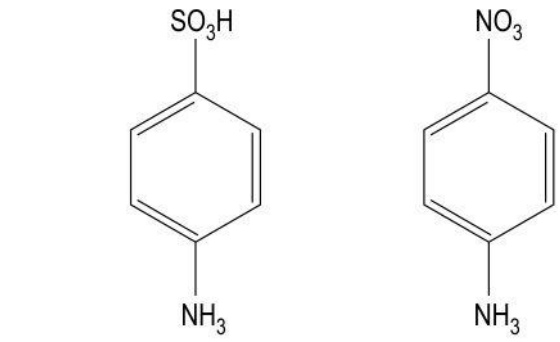
[Molecular formulae:

Glycine: H_2N- CH_2 - COOH

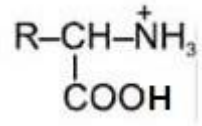
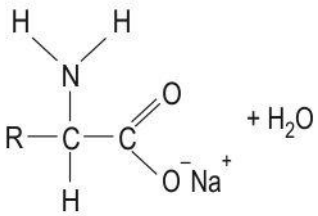
	Lysine: H_2N-$(CH_2)_4$ - $CH(NH_2)$ - COOH *Glutamic acid: HOOC-CH_2-CH_2 - $CH(NH_2)$ - COOH]*	
Q.214	The amino acid alanine, $CH_3CH(NH_2)COOH$, reacts with glycine, $H_2NCH_2CO_2H$. Show how this produces two dipeptides with different structures.	2
Q.215	How many possible sequences of tripeptides can be formed from the three amino acids Gly, Ala, and Ser, if each tripeptides contains all three amino acids? Also write down the name of all sequences of these tripeptides.	4
Q.216	Amino acids can act as buffers, stabilising the pH of a solution if excess acid or alkali is added. Show this with the help of reactions of acids with a acid (H^+) and a base (OH^-).	2
Q.217	Due to the formation of zwitter ions by amino acids, they show many of the typical reactions of amines and carboxylic acids like esterification, and acylation reactions. Based on this, complete the following reactions:  (i)  (ii)	3
Q.218	The image below shows a small part of single strand of DNA. The DNA continues bond at X and Y.  	4

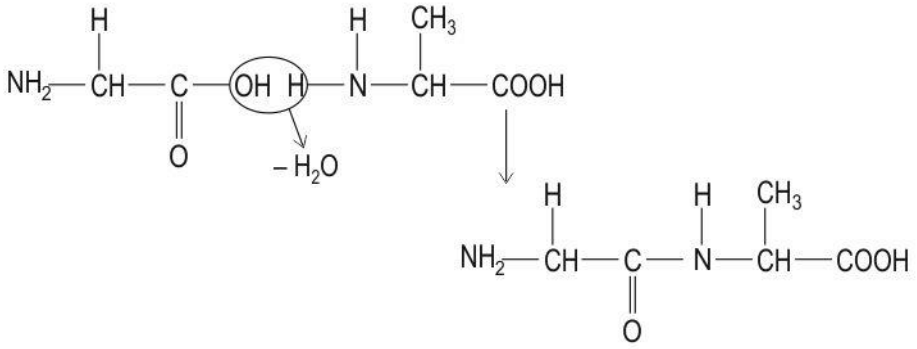
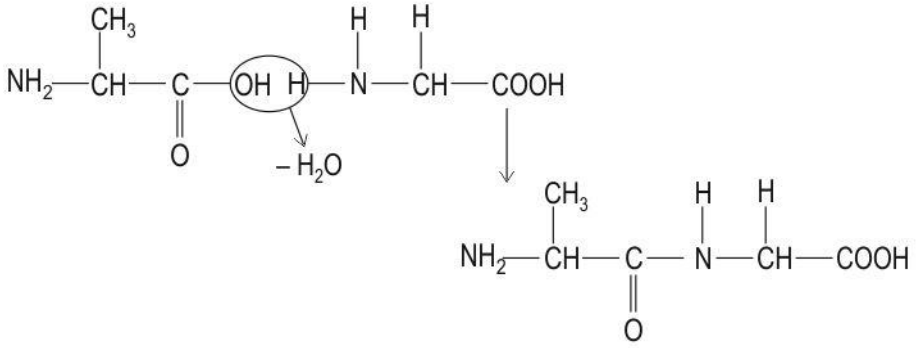
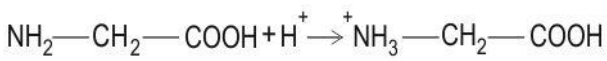
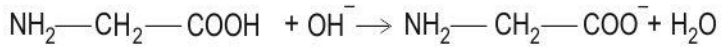
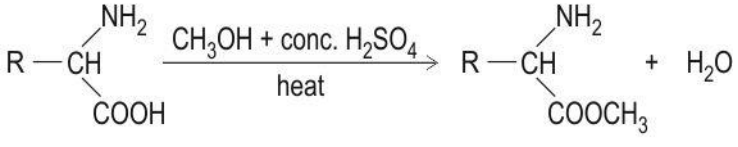
	The image below shows two other bases, cytosin and adenine which are also found in a DNA.  (i) Which of these two bases pairs with the guanine in first image when two seperate strands of DNA form a double helix? (ii) Explain how the base that you have selected in i, forms a base pair with guanine.	
Q.219	The structure of the amino acid alanine is shown below.  Draw the structure of the organic products formed when alanine reacts with: (i) CH_3OH in the presence of small amount of conc. H_2SO_4 (ii) Na_2CO_3	2
Q.220	Shown below is the tripeptide formed by three amino acids A, B, C.  (i) Is it possible to get the original amino acids from this structure? If yes, how? (ii) What will be the structure of the amino acid B in the aqueous solution?	2
Q.221	(i) Draw the structure of product, P in the below reaction.  Serine (ii) Draw the dipeptide formed by two molecules of serine.	2

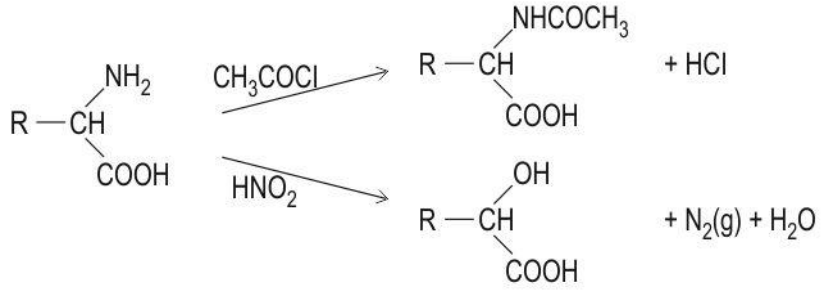
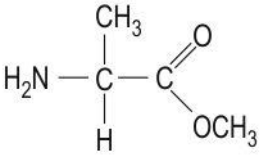
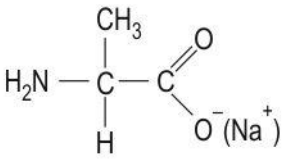
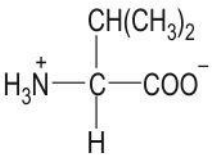
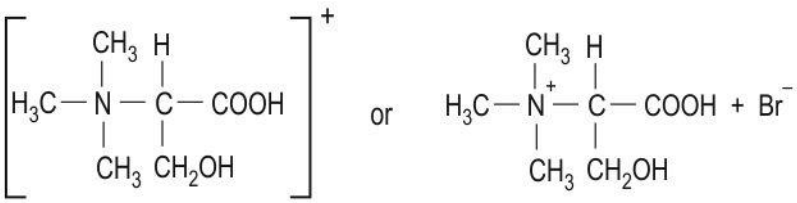
Q.222	The image shows the steps to synthesize an unknown amino acid X.  (i)Name the reagent used in step 3. What is the necessary condition for this reaction to take place? Name the mechanism. (ii) At room temperature, the amino acid X exists as a solid. Draw the structure of the solid amino acid. (iii) With reference to your answer to part (ii), explain why the melting point of the amino acid X is higher than the melting point of $CH_3CH_2CH(OH)COOH$	4
Q.223	Peptides can be hydrolysed into individual amino acids, for example:  (i) How many water molecules would be required to hydrolyse a peptide made from 'n' amino acid molecules? (ii) Write down the hydrolysis equation for Ala-Ser-Gly. ** Note the formula for Gly (Glycine) is $H_2N\text{-}CH_2\text{-}COOH$*	2
Q.224	Mr. Chatterjee was having pain in his joints. The shape of one his canines and some of his toes got deformed a bit. He visited the doctor. Along with the medications he was asked to take ample amounts of milk, and eggs. He was also asked to take cod liver oil capsules. The doctor asked Mr. Chatterjee to expose himself to sufficient sunlight every day. (a) What is the most probable disease that Mr. Chatterjee is suffering from?	4

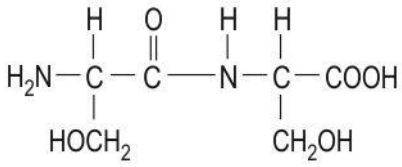
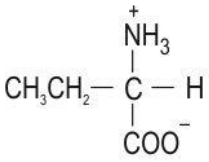
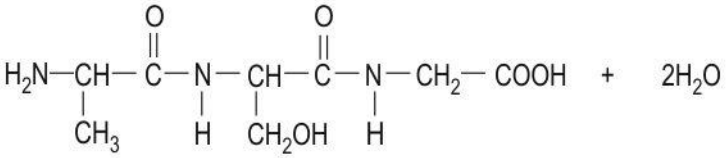
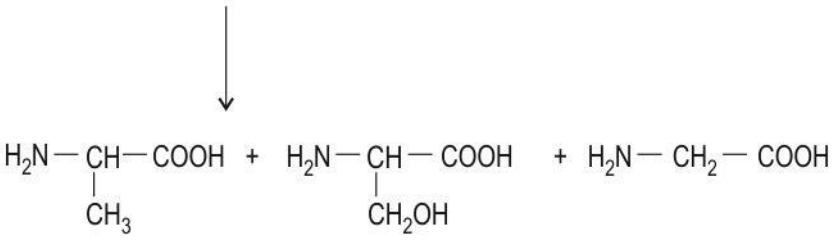
	(b) Mr. Chatterjee found one morning the milk had curdled. What could be a probable reason for his observation? Explain the observation. (c) How can exposure to sunlight help in improving the health condition of Mr. Chatterjee?	
Q.225	(a) Amongst the following amino acids, which is the most basic in nature? Why? **Amino acid** / **Side chain** Glycine / H Lysine / $H_2N-(CH_2)_4$ Serine / $HO - CH_2$ (b) How do acids such as lemon juice tenderise the meat while using it in a marinade?	3
Q.226	A zwitter ion is a dipolar ion in aqueous solution.  p-amino benzenesulphonic acid p-nitroanilic Of p-aminobenzene sulphonic acid and p-nitroaniline, which will give rise to a zwitter ion in aqueous solution? Explain why.	2

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.203	B. Compound A is basic in nature.	1
Q.204	D. Assertion (A) is false and Reason (R) is true.	1
Q.205	C. Assertion (A) is false and Reason (R) is true.	1
Q.206	B. iii only	1
Q.207	A. Both A and R are true and R is the correct explanation of A.	1
Q.208	D. D	1
Q.209	D. D	1
Q.210	C. ii and iii only	1
Q.211	A. Primary	1
Q.212	(i)  (ii) 	2
Q.213	- At pH 7, glutamic acid carries an extra negative charge and moves towards the positive electrode – it is responsible for spot D. - At pH 7, glycine carries one of each type of charge, so it is attracted equally to both electrodes and does not move – it is responsible for spot E. - At pH 7, lysine carries an extra positive charge, and hence moves towards the negative electrode – it is responsible for spot F.	3
Q.214	First way:	2

	 Second way: 	
Q.215	- Total number = 6 [1] - 6 sequences: Gly-Ala-Ser, Gly-Ser-Ala, Ala-Gly-Ser, Ala-Ser-Gly, Ser-Ala-Gly, Ser-Gly-Ala *(give 0.5 marks for each correct combination)*	4
Q.216	Reaction of amino acid with an acid:  Reaction of amino acid with a base: 	2
Q.217	(i) 	3

	 (ii)	
Q.218	(i) cytosin (ii) For hydrogen bonding to happen, cytosin's top N–H forms hydrogen bonds to lone pair on O of guanine [1] - The lone pair of electrons on N bonds to H–N of guanine [1] -A lone pair of electrons on O bonds to lower H–N of guanine [1] *[give marks if they show it by diagram instead of text]*	4
Q.219	 (i)  (ii)	2
Q.220	(i) yes, through hydrolysis reaction *don't give marks for hydration*  (ii)	2
Q.221	 (i)	2

	(ii) 	
Q.222	(i) - Reagent: ammonia or NH_3 [0.5] - Conditions: excess (ammonia) [0.5] *[ignore concentrated]* - Name of mechanism: Nucleophilic substitution [1] (ii)  (iii) Due to presence of ionic bonding in X	4
Q.223	(i) n-1 [1]   (ii)	2
Q.224	(a) Mr. Chatterjee is suffering from osteomalacia. *[Give 1 mark for the correct answer.]* (b) If the pH of milk is increased it curdles. The change in pH leads to breaking of the hydrogen bond and salt bridges in the protein molecules of milk. Thus the proteins in milk get denatured and the milk curdles. *[Give 1 mark for each correct answer. Students may write the answer in their own words.]*	4

	(c) Vitamin D helps in treating osteomalacia. It can be produced below the skin by irradiation of sterols with the UV rays present in sunlight. Thus, exposure to sunlight helps in improving the health condition *[Give 1 mark for each correct structure. Students may write the answer in their own words.]*	
Q.225	(a) Lysine - It has one more amine group which makes it basic. (b) Acidic ingredients in the marinade, like lemon juice, will tenderise meat by denaturing or unwinding the long protein in the meat by breaking apart the amino acids.	3
Q.226	- Out of p-aminobenzene sulphonic acid and p-nitroaniline, it is p-aminobenzene sulphonic acid which will give rise to a zwitter ion in aqueous solution. [1] - In aqueous solution the lone pair of electrons on the N-atom in amino group accepts a proton from sulphonic group and zwitter ion is formed. [1]	2

14. CHAPTER: POLYMERS

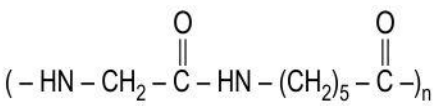
<table>
<tr><th>Q.No</th><th>Question</th><th>Marks</th></tr>
<tr><td colspan="3">Multiple Choice Question</td></tr>
<tr><td>Q.227</td><td>Which of the following monomers will be best suited for preparing a polymer used for manufacturing non-stick cookware?

A. ethene
B. acrylonitrile
C. tetrafluoroethene
D. terephthalic acid</td><td>1</td></tr>
<tr><td>Q.228</td><td>Two different polymers are made from the same monomer unit. Polymer 1 is used to make flexible pipes while polymer 2 is used to make dustbins.

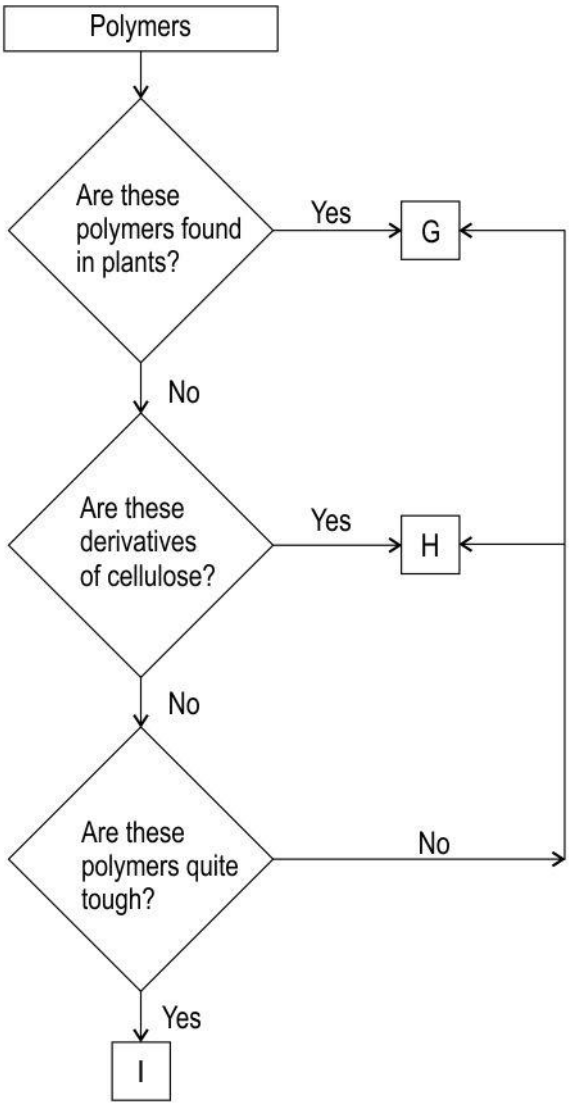
Choose the option which correctly matches each polymer to the reaction condition which is appropriate for its preparation.

<table>
<tr><th></th><th>Polymer 1</th><th>Polymer 2</th></tr>
<tr><td>L</td><td>High temperature, low pressure</td><td>Low temperature, high pressure</td></tr>
<tr><td>M</td><td>High temperature, low pressure</td><td>Low temperature, low pressure</td></tr>
<tr><td>N</td><td>High temperature, high pressure</td><td>Low temperature, low pressure</td></tr>
<tr><td>O</td><td>Low temperature, low pressure</td><td>High temperature, low pressure</td></tr>
</table>

A. L
B. M
C. N
D. O</td><td>1</td></tr>
<tr><td>Q.229</td><td>Which of the options correctly identifies the characteristics of the polymer formed from the monomer unit given below.

 
<table>
<tr><th></th><th>Is it a natural polymer?</th><th>Is it non-biodegradable?</th><th>Is it manufactured from urea and formaldehyde?</th></tr>
<tr><td>P</td><td>√</td><td>√</td><td>√</td></tr>
</table></td><td>1</td></tr>
</table>

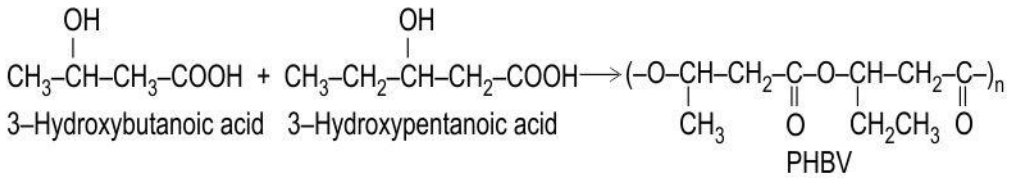
	Q	×	×	×	
	R	√	×	√	
	S	×	√	√	
	A. P B. Q C. R D. S				
Q.230	Which of the following objects are generally made from polymers prepared by the free radical mechanism of polymerisation? A. Buckets B. Conveyor belts C. Non-stick utensils D. Bristles for brushes				1
Q.231	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A):** Condensation polymerisation generally involves a repetitive condensation reaction between two bi-functional or trifunctional mono-meric units. **Reason (R):** Condensation polymerisation may result in the loss of some simple molecules such as water, alcohol, hydrogen chloride, etc., Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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				1
Q.232	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). **Assertion (A):** The growth of the polymer chain during their synthesis is dependent upon the availability of the monomers in the reaction mixture. **Reason (R):** The rate of the reaction of the monomers depends only on the temperature of the reaction mixture. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct and (R) is not the correct explanation of (A)				1

	C. (A) is true but (R) is false D. (A) is false but (R) is true	
Free Response Questions/Subjective Questions		
Q.233	Piyush stretched a rubber band and then released it. He saw the rubber revert to its original shape. When he applied a bit more force the rubber band snapped. Give an explanation for both these observations.	2
Q.234	Give one example of the polymers G, H, and I from the flowchart given below:  	3
Q.235	Read the passage and answer the questions that follow: Plastic waste can accumulate in the ecosystem. It happens due to the accumulation of marine litter, fragments or microparticles of plastics, and non-biodegradable fishing nets, plastic products, etc. Ingestion of these wastes or getting trapped in the waste causes the death of animals.	5

	Microplastics and microbeads of plastics can enter the human body from cosmetic and body care products. These plastics are made from polymers that are quite resistant to environmental degradation processes and are thus responsible for the accumulation of polymeric solid waste materials. Biodegradable plastics and polymers were first introduced in the 1980s. Biodegradable plastics can be synthetic or natural polymers. Biodegradation takes place through the action of enzymes and/or chemical deterioration associated with living organisms. These polymers contain functional groups similar to the functional groups present in biopolymers.  (a) Name the class of biodegradable polymers. What is the similarity of this polymer with the biopolymers? (b) Name a copolymer that is biodegradable and write an equation showing its formation. State any two of its uses. (c) State the advantage of the polymer described in (b) over the polymers seen in the image.	

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.227	C. tetrafluoroethene	1
Q.228	C. N	1
Q.229	B. Q	1
Q.230	B. Conveyor belts	1
Q.231	B. Both (A) and (R) are correct but (R) is not the correct explanation of (A)	1
Q.232	C. (A) is true but (R) is false	1
Q.233	- Rubber is a polymer that has a few 'crosslinks' which help the polymer to retract to its original position after a small force that is applied is released. [1] - The polymer chains are held together by the weak intermolecular forces that help in the stretching of rubber. But when stretched beyond a limit, these weak forces break and the rubber band snaps. [1]	2
Q.234	0.5 marks each for any two examples of each type of polymer: G: cellulose, starch or any other correct example of a natural polymer. H: cellulose acetate or rayon, cellulose nitrate or any other correct example of a semi-synthetic polymer I: polythene, nylon 6,6 or any correct example of synthetic polymer	3
Q.235	(a) - Aliphatic polyester. [0.5 marks] - The similarity of this polymer with the biopolymer is that, these polymers contain functional groups similar to the functional groups present in biopolymers. [0.5 marks] (b) A copolymer that is biodegradable is Poly β-hydroxybutyrate – co-β-hydroxy valerate (PHBV). (1 mark) Equation showing its formation is:	5



PHBV

(1 Mark)

Some of its uses are:

- In speciality packaging
- Orthopaedic devices
- In the controlled release of drugs.

(0.5 mark each for any 2 uses. Marks to be awarded for any other correct answer.)

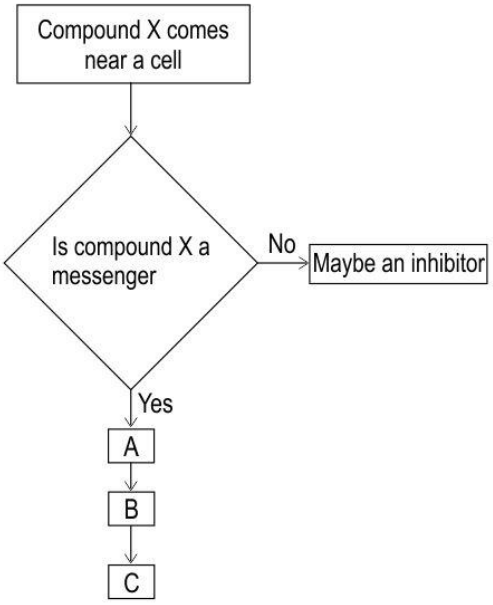
(c) - These solid wastes seen in the image cause acute environmental problems and remain undegraded for quite a long time. [0.5 marks]

- The PHBV polymer undergoes bacterial degradation in the environment. [0.5 marks]

15. CHAPTER: CHEMISTRY IN EVERYDAY LIFE

<table>
<tr><th>Q.No</th><th>Question</th><th>Marks</th></tr>
<tr><td colspan="3">Multiple Choice Question</td></tr>
<tr><td>Q.236</td><td>Riya was cleaning her tiffin box after returning home. She used a liquid for the purpose. Which of the following is MOST LIKELY to be present in the liquid used by Riya?

A. Glycerol ester of stearic acid and sodium hydroxide
B. Stearic acid and polyethylene glycol
C. Sodium stearate and glycerol
D. Soap and calcium chloride</td><td>1</td></tr>
<tr><td>Q.237</td><td>Aparna is a baker. She is preparing a cake for her customer's birthday. The cake will take at least a day or two to reach her customer. Apart from flour, baking soda and other ingredients, she added salt of propionic acid and alitame. The probable reason for the last two additions is:
<table>
<tr><th></th><th>Salt of propionic acid</th><th>alitame</th></tr>
<tr><td>P</td><td>To defer the expiry of the cake</td><td>The customer is diabetic and has asked for restricted sweetness in the cake</td></tr>
<tr><td>Q</td><td>To make the cake soft and fluffy</td><td>As a taste enhancer</td></tr>
<tr><td>R</td><td>To defer the expiry of the cake</td><td>The customer is non-diabetic and has asked for extra sweetness in the cake</td></tr>
<tr><td>S</td><td>The customer is non-diabetic and has asked for extra sweetness in the cake</td><td>To maintain the decoration of the cake till it reaches the customer</td></tr>
</table>
A. P
B. Q
C. S
D. R</td><td>1</td></tr>
<tr><td>Q.238</td><td>Which of the following options correctly fills up the blanks?</td><td>1</td></tr>
</table>



A. A: the shape of the receptor changed, B: the receptor receives a chemical messenger, C: the structure of the receptor remained deformed after the messenger leaves.
B. A: the receptor receives a chemical messenger, B: the shape of the receptor changes after attachment of the messenger, C: the receptor regains structure after removal of a chemical messenger.
C. A: the receptor receives a chemical messenger, B: the shape of the receptor changes after attachment of the messenger, C: the structure of the receptor remained deformed after the messenger leaves
D. A: the receptor receives a chemical messenger, B: the shape of the receptor changes after attachment of the messenger, C: the structure of the receptor remained deformed after the messenger leaves

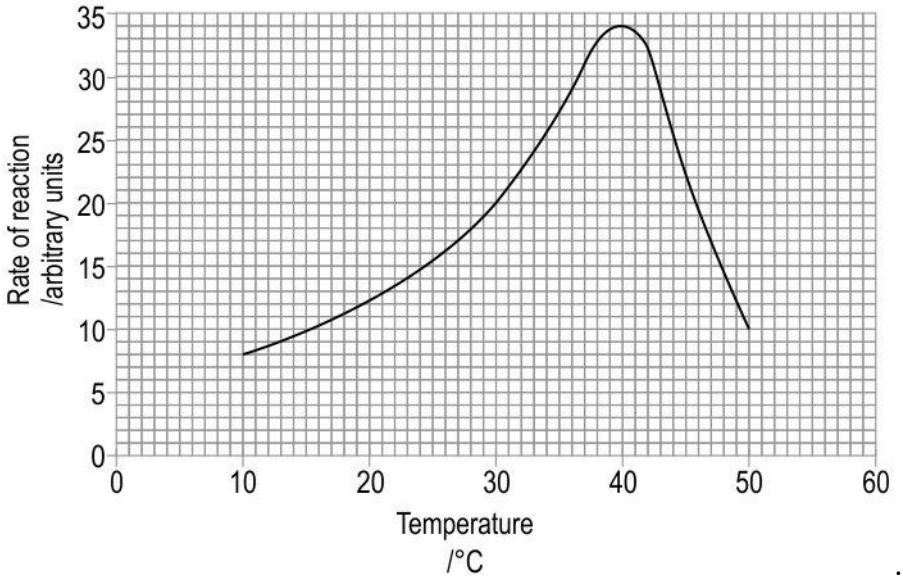
Q.239

Compound T binds itself to a certain point of a cell membrane. The positive end of compound T is attracted to the negative end of the cell membrane. Which of the following identifies compound T, the point on the cell membrane, and the interaction between them correctly?

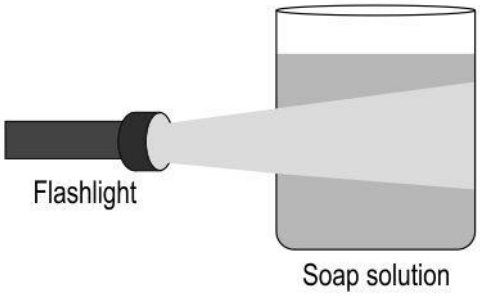
1

	Compound T	A certain point on the cell membrane	Type of interaction
L	Substrate	Active site	Van der Waal's interaction
M	Enzyme	Allosteric site	Hydrogen bonding
N	Inhibitor	Allosteric site	Hydrogen bonding
O	Enzyme	Active site	Dipole-dipole interaction

A. L
B. M
C. N

	D. O	
Q.240	Prantik plotted the graph showing the rate of activity of an enzyme on a substrate over a certain range of temperatures  Four students interpreted the graph as follows: **Student** | **Interpretation** **I** | the rate of the reaction is inversely proportional to the concentration of the substrate. **J** | the rate of the reaction is inversely proportional to the rise in temperature. **K** | the rate of the reaction is independent of the rise in temperature. **L** | the rate of the reaction first increases and then decreases with the rise in temperature. Which of the student(s) made the correct inference? A. Only student I B. Both students J and K C. Only student J D. Only student L	1
Q.241	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): The competitive inhibitors compete with the natural substrate for their attachment on the allosteric sites of enzymes.	1

	Reason (R): An enzyme and an inhibitor have a strong covalent bond between them. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	
Q.242	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): Blockage of nose when a person catches cold is because of histamines. Reason (R): Histamines relax the muscles in the walls of the fine blood vessels. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct 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	1
Free Response Questions/Subjective Questions		
Q.243	The people from the forest department injected a tiger as it entered a village in search of food. The tiger fell asleep and was carried back to the forest. The injection contained compound H. (a) To which specific class of compound does compound H belong- barbituatrates or tranquillizers? Give a reason. (b) Explain the mode of action of this drug.	4
Q.244	Vimla was administered a specific medication after her C-section. Sudipto checked the composition of the medicine and found that one of the ingredients was obtained from poppy seeds. (a) What could be the reason for this specific medication being given to Vimla after the C-section? (b) Name any two possible effects of this drug if administered in wrong amounts.	2
Q.245	(a) State the phenomenon observed in the given image and give a reason for it.	4

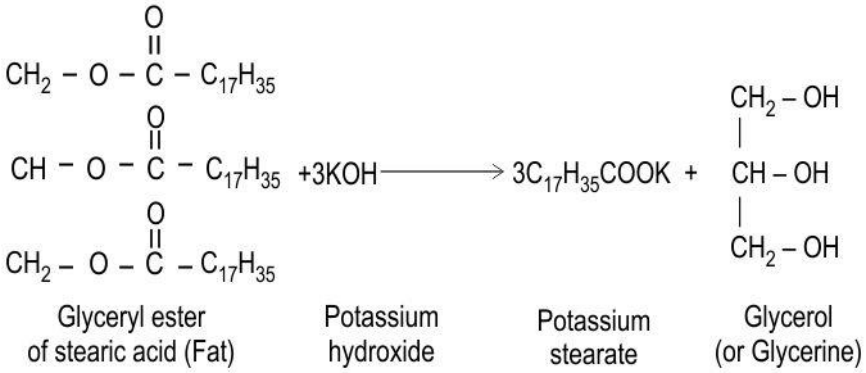


(b) Which alkali is likely to be used in the saponification process to manufacture soaps for pediatric uses? Give a reason. Write the saponification reaction for this type of soap.

(c) How is the glycerol from the saponification reaction above to be extracted?

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.236	B. Stearic acid and polyethylene glycol	1
Q.237	C. S	1
Q.238	B. A: the receptor receives a chemical messenger, B: the shape of the receptor changes after attachment of the messenger, C: the receptor regains structure after removal of a chemical messenger.	1
Q.239	D. O	1
Q.240	D. Only student L	1
Q.241	D. (A) is false but (R) is true	1
Q.242	B. Both (A) and (R) are correct and (R) is not the correct explanation of (A)	1
Q.243	(a) - Compound H belongs to the barbiturates. *[1]* -This is because barbituarates are hyptonic drugs which induce drowsiness or sleep. But tranquilizers only reduce anxiety without inducing sleep. *[1]* (b) -This drug inhibits the enzyme which catalyses the dehydration of the neurotransmitter noradrenaline. *[1]* -If the enzyme is inhibited, this important neurotransimitter is slowly metabolised and counteracts the effect of depression. *[1]*	4
Q.244	(a) -The medicine relieves post-operative pain [0.5] -The medicine induces sleep. [0.5] (b) 0.5 marks each for any two of the following effects: - stupor - coma - convulsions - ultimately death.	2
Q.245	(a) - When a beam of light is passed through the soap solution the phenomenon observed is the scattering of light. [0.5]	4

	- This is because the soap solution is colloidal in nature. The beam of light strikes the soap particles and this results in the scattering of the light beam. [1] (b) Potassium hydroxide should be used to manufacture soaps for pediatric uses. [1] This is because potassium soaps are soft on the skin. The reaction for saponification is:  [0.5 marks for the correct name of the alkali;0.5 marks for the reason;1 mark for the reaction] (c) The glycerol is extracted from the solution by fractional distillation. [0.5 marks for the correct name of the process]	

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