

ITL PUBLIC SCHOOL

Active Engagement of Young Minds during Summer Vacations 2026-27

Class : XII

Subject: Chemistry

1. INVESTIGATORY PROJECT : On any of the provided topics by CBSE for chemistry project file based on Computational Thinking (CT) and Artificial Intelligence (AI) .

2. PRACTICAL : All the experiments done are to be written in the practical file.

3. ASSIGNMENT : All the assignment questions:

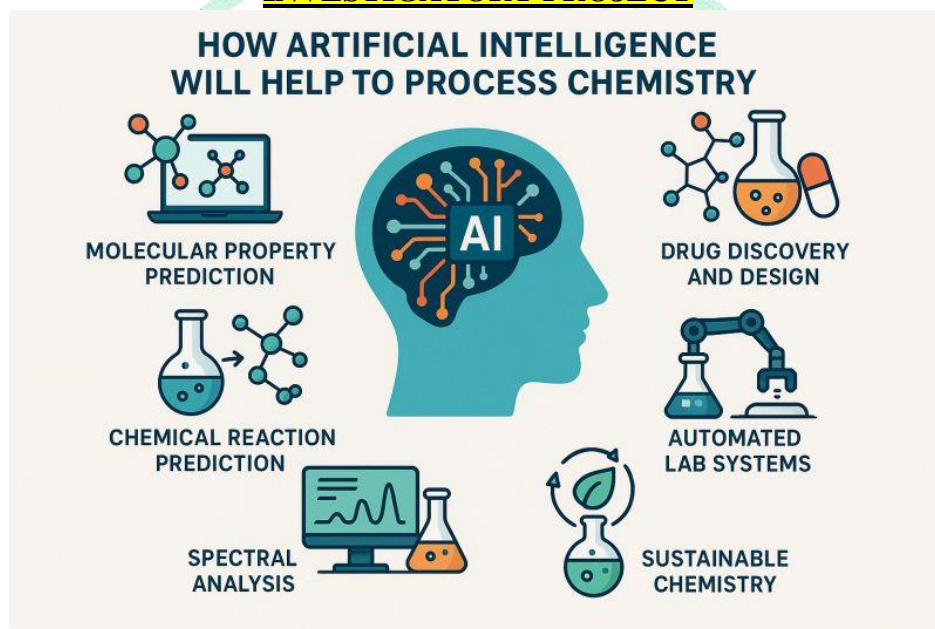
Chapter 1 (Solutions)

Chapter 2 (Electrochemistry),

Chapter 3 (Chemical Kinetics)

Chapter 6 (Haloalkanes & Haloarenes) to be solved in the chemistry register itself along with all solved and unsolved NCERT questions.

INVESTIGATORY PROJECT



A chemistry project bridges theoretical knowledge with real-world applications. It builds practical laboratory skills, critical thinking, and a deeper understanding of how the central science drives everyday life—from pharmacology and material science to environmental sustainability.

Computational thinking (CT) is a systematic problem-solving process that involves breaking down complex issues into manageable steps, identifying patterns, and designing step-by-step algorithms to find solutions.

Artificial Intelligence (AI) is a branch of computer science focused on building systems capable of performing tasks that typically require human intelligence.

Artificial Intelligence (AI) and Computational Techniques (CT) are revolutionizing chemistry by automating data analysis, optimizing reaction conditions, and predicting complex molecular properties.

Integrating Computational Thinking (CT) and Artificial Intelligence (AI) into your Class XII Chemistry Investigatory Project is an excellent way to align with modern [CBSE academic frameworks](#).

By using the four pillars of CT—

Decomposition, Pattern Recognition, Abstraction, and Algorithmic Thinking—along side Python or no-code AI tools (like Orange or Google Teachable Machine), you can upgrade a traditional laboratory experiment into a cutting-edge data science project.

Some TOP Chemistry-AI AND CT based investigatory Project Ideas

1. Predictive Chemical Kinetics & Reaction Rate Simulator

- **Traditional Core:** Measuring how concentration, temperature, or catalysts affect the rate of a chemical reaction (e.g., the reaction between Sodium Thiosulphate and Hydrochloric acid).
- **CT & AI Extension:** Collect laboratory reaction time data across various temperatures and concentrations. Use Python (pandas and scikit-learn) to build a Linear Regression model that predicts the reaction rate for values you haven't tested in the lab.
- **Pillars of CT:**
 - *Decomposition:* Breaking down the variables affecting reaction kinetics.
 - *Algorithmic Thinking:* Writing a Python script to compute rate constants and plot curves automatically.

2. AI-Based Food Adulteration and Purity Classifier

- **Traditional Core:** Testing for common adulterants in daily food items (e.g., starch in milk, metanil yellow in turmeric, argemone oil in mustard oil).
- **CT & AI Extension:** Take photographs of pure samples and intentionally adulterated samples under consistent lighting. Train an AI Image Classification model using Google Teachable Machine or Python OpenCV to instantly identify and classify whether a sample food image is "Pure" or "Adulterated".
- **Pillars of CT:**
 - *Pattern Recognition:* Spotting subtle color anomalies or texture changes in pure vs. impure substances.
 - *Abstraction:* Filtering out background noise from photos to isolate the food item.

3. Water Quality Index (WQI) Prediction using COMPUTATIONAL THINKING

- **Traditional Core:** Analyzing local water samples for pH, Total Dissolved Solids (TDS), and Hardness.
- **CT & AI Extension:** Gather a dataset of water chemical parameters (you can mix your lab data with open-source public datasets like Kaggle's Water Potability dataset). Build a K-Nearest Neighbors (KNN) or Random Forest classifier using no-code tools like Orange Data Mining to classify whether a given chemical combination makes water "Safe" or "Unsafe" for drinking.
- **Pillars of CT:**
 - *Pattern Recognition:* Correlating combinations of high TDS and low pH with toxic water profiles.
 - *Algorithmic Thinking:* Designing a clear decision-tree workflow for water safety approval.

4. Molecular Property & Boiling Point Predictor for Hydrocarbons

- **Traditional Core:** Studying the structural properties and functional groups of organic compounds (Alcohols, Carboxylic Acids, Hydrocarbons).
- **CT & AI Extension:** Create a dataset linking the number of carbon atoms, molecular weight, and branching type to the boiling points of alkanes/alcohols. Use a Multiple Linear Regression model in Python to predict the boiling points of complex organic structures.
- **Pillars of CT:**
 - *Pattern Recognition:* Observing how molecular symmetry and surface area alter intermolecular forces (Van der Waals forces).
 - *Abstraction:* Representing real physical molecules as numeric inputs (vectors) for a computer code.

5. Optimization of Biodiesel Production Efficiency

- **Traditional Core:** Extracting essential oils or creating biodiesel from used cooking oil or vegetable waste.
- **CT & AI Extension:** Conduct experiments altering variables like oil-to-methanol ratio, catalyst concentration (NaOH/KOH), and temperature. Feed this multi-variable chemistry data into a Regression Machine Learning model to find the absolute optimized mathematical formula for maximizing biodiesel yield.
- **Pillars of CT:**
 - *Decomposition:* Separating independent physical variables (heat, catalyst weight) from dependent variables (yield efficiency).

6. Green chemistry in household products

- **Decomposition:** Breaking down a cleaning product into its functional components (e.g., surfactants, chelating agents, enzymes, and fragrances).
- **Pattern Recognition:** Using AI to analyze massive databases of chemical properties, identifying which natural extracts (like fruit enzymes) are the most effective at breaking down grease or neutralizing odors.
- **Abstraction:** Removing unnecessary experimental variables and focusing purely on molecular structures that yield high performance while maintaining a low carbon and toxicity footprint.
- **Algorithm Design:** Developing specific formulas that optimize dilution ratios, minimize water usage, and ensure the final product degrades safely in water treatment systems.

Apart from all the above-mentioned topics, students can also do research on the following topics-

1. **Ascorbic Acid (Vitamin C) Depletion:** Quantifying Vitamin C in fresh citrus juices using iodometric titration and studying degradation over heat exposure.
2. **Analysis of food preservatives and find their E numbers.**
3. **Toothpaste analysis and finding the presence of different mentioned ions.**
4. **Chemical kinetics in art conservation.**
5. **Analysis of biscuits and finding their nutritional benefits.**

6. Comparison between natural food color and synthetic food color.
7. Comparing fresh coconut water and packed coconut water and comparing their nutritional benefits.
8. Chemicals of aromatherapy.
9. Analysis of packed milk and identify the presence of different nutrients as mentioned on the label.
10. Photography and light sensitive materials.
11. To find out the presence of Nickel in different samples of chocolates through qualitative and quantitative analysis.
12. Natural pigments and dyes.
13. Chemical analysis of different samples of water.
14. Analysis of different samples of packed juices.
15. Alternative energy sources from biomass.
16. Food adulteration in packed food items and loose items . . .
17. Identifying various components used in manufacturing cosmetic products.
18. Identifying the presence of Oxalate Ions in packed Guava Fruit juice ripened fruit and comparing the data with different stages of ripening.
19. Comparison of herbal and non-herbal products.
20. Hydrogen sulfide implications on easing NaCl induced toxicity in egg plant and tomato seedlings.

The project should have the following outline:

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- Cover page
- Certificate
- Acknowledgement
- Index
- **Abstract-** Include the keywords
- **Statement of Problem-** A clear statement of the problem/need that has given rise to the project
- **Objectives-**General & specific objectives of topic
- **Introduction-** Purpose, scientific principle involved, reactions, advantages, disadvantages, current examples, case presentation and beneficiary satisfaction.
- **Problem question-** (specific, concrete questions to which concrete answers can be given) and/ or hypotheses
- Materials/Resources required
- **Procedure-** Describe the experiments proposed or the observations planned to make and the detailed process of analysis of data/observations. Methods proposed should be feasible and be able to adequately answer problem question.
- **Observations/Data gathered-** Using the procedures mentioned in introduction, experiments should be conducted and data should be recorded. Interesting things that happened during the conduct of experiments should also be recorded.
- **Testing & analysis-** Data should be interpreted in terms of proposed hypothesis. It should be tabulated and interpreted with the help of graphs if possible. The interpretation should be done in an honest manner even if it does not support proposed hypothesis.
- Discussion of result
- **Conclusion-** Reporting and writing up the report. Discussion of new learning from the study may be covered under conclusion. This may have possible suggestions for future studies.

- **Limitation of the study-** The limitations of the study are those features of design or procedure that might have affected the interpretation of the results of study. The limitations are alternatively interpreted as flaws.
- **Summary** or shortcomings due to flawed methodology, observations, small number of experiments or non-peer reviewed nature of study etc.
- **Evidence-** Photos showcasing the student performing the experiment.
- **References-** Google, Slideshare, Scribd, American Chemical Society, Science Direct and NCERT textbooks etc.

Rubrics for Assessment of Project

<i>Parameters</i>	<i>Exemplary (3)</i>	<i>Developing (2)</i>	<i>Beginner (1)</i>
Presentation of Factual Information	<ul style="list-style-type: none"> • Relevant to the topic. • Well designed with good flow and appropriate use of pictures and graphs. • Content covers the research well. 	<ul style="list-style-type: none"> • Relevant to the topic. • Well designed with appropriate use of pictures and graphs, but not organised. • Content covered well but has few errors. 	<ul style="list-style-type: none"> • Not relevant to the topic. • Not so well designed. Inappropriate use of pictures and graphs. • Content does not cover all the research.
Sources	<ul style="list-style-type: none"> • Multiple sources used (books, different websites, journals, etc) 	<ul style="list-style-type: none"> • Few sources used. 	<ul style="list-style-type: none"> • Relied on only one source.
Project report & Data collection	<ul style="list-style-type: none"> • Well defined problem with clear cut objectives and methodology. • Key concepts clearly specified and explained technically. • Work is well summarized and concluded. 	<ul style="list-style-type: none"> • Well defined problem and methodology but objectives are not clear. • Key concepts specified and explained technically. • Work is well summarized and concluded. 	<ul style="list-style-type: none"> • Poorly defined problem with un-clear objectives and not so appropriate methodology. • Key concepts specified but not explained technically. • Work is not summarized and concluded properly.
Depth of understanding	<ul style="list-style-type: none"> • Good understanding of the relevance of the project. • Extensive knowledge of not only the project but the related domain as well. 	<ul style="list-style-type: none"> • Fair understanding of the relevance of the project. • Extensive knowledge of the project but not of the related domain. 	<ul style="list-style-type: none"> • Poor understanding of the relevance of the project. • Little knowledge of the project and the domain around but not sufficient.
Interpretation and conclusion	<ul style="list-style-type: none"> • In correlation with data and aim of project. • Clear conclusions based on findings. 	<ul style="list-style-type: none"> • In correlation with data and aim of project. • Conclusions not based on findings. 	<ul style="list-style-type: none"> • Not in correlation with data and aim of project. • No conclusions.
Journal	<ul style="list-style-type: none"> • Daily entries with details of discussions and brainstorming sessions with the teacher. 	<ul style="list-style-type: none"> • Daily entries without details. 	<ul style="list-style-type: none"> • Random entries.

ASSIGNMENT QUESTIONS

CHAPTER 1 - SOLUTIONS

SECTION A (1 mark)

- The rate of dissolution of a solid solute in a volatile liquid solvent is
 - less than the rate of crystallisation
 - greater than the rate of crystallisation
 - equal to the rate of crystallisation
 - zero
- 50 mL of an aqueous solution of glucose $C_6H_{12}O_6$ (molar mass 180 g/mol) contains 6.02×10^{22} molecules. The concentration of the solution will be
 - 0.1. M
 - 0.2 M
 - 1.0 M
 - 2.0 M
- The value of Henry's constant K_H is
 - greater for gases with higher solubility
 - greater for gases with lower solubility
 - constant for all gases
 - not related to the solubility of gases
- Intermolecular forces between two benzene molecules are nearly of same strength as those between two Toluene molecules. For a mixture of benzene and Toluene, which are the following, are not true.
 - $\Delta H_{mix} = 0$
 - $\Delta V_{mix} = 0$
 - These will form minimum boiling azeotrope
 - These will not form ideal solution
- Which of the following aqueous solutions should have the highest boiling point?
 - 1 molar NaOH
 - 1 molar Na_2SO_4
 - 1 molar NH_4NO_3
 - 1 molar KNO_3

In the following questions, two statements are given, one labelled as assertion and the other labelled as reason. Select the correct answer to these questions from the codes given below.

- Both assertion and reason are correct statements and reason is the correct explanation of the assertion.
 - Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
 - Assertion is correct, but reason is incorrect statement.
 - Assertion is incorrect, but reason is correct statement.
- Assertion:** If more volatile, liquid is added to another liquid, vapour pressure of solution will be greater than that of your solvent.
Reason: Vapour pressure of solution is entirely due to solvent molecules.
 - Assertion:** The boiling point of pure solvent is always higher than the boiling point of solution.
Reason: The vapour pressure of the solvent decreases in the presence of non-volatile solute.

SECTION B (2 marks)

- At $25^\circ C$, the saturated vapour pressure of water is 3.165 kPa. Find the saturated vapour pressure of a 5% aqueous solution of urea at the same temperature.
- Give reasons:
 - Cooking is faster in pressure cooker than in cooking pan.
 - Red blood cells shrink when placed in saline water, but swell in distilled water.
- On mixing liquid X and liquid Y, volume of the resultant solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?

SECTION C (3 marks)

11. Give reasons for the following-

- (a) Mercuric iodide is added to an aqueous solution of KI, the freezing point is raised.
- (b) a decrease in temperature is observed on mixing ethanol and acetone
- (c) potassium chloride solution freezes at a lower temperature than water.

12. A glucose solution, which boils at 104.04°C at 1 atm. What will be the relative lowering of vapour pressure of an aqueous solution of urea which is equimolar to the given glucose solution?

(given- k_b for water is $0.52\text{ K Kg mol}^{-1}$ and boiling point of water = 100°C)

13. Dhruv took two aqueous solutions, one containing 7.5 g of urea (molar mass = 60 g/mol) and the other containing 42.75 g of substance Z in 100 g of water, respectively. It was observed that both the solutions froze at the same temperature. Calculate the molar mass of Z.

(given- k_f for water is $1.86\text{ K Kg mol}^{-1}$)

SECTION D (4 marks)

14. Properties such as boiling point, freezing point and vapour pressure of a pure solvent change when solute molecules are added to get homogeneous solution. These are called colligative properties. Applications of colligative properties are very useful in day-to-day life. One of its examples is the use of ethylene glycol and water mixture as anti-freezing liquid in the radiators of automobiles.

A solution M is prepared by mixing ethanol and water. The mole fraction of ethanol in the mixture is 0.9.

(given- k_f for water is $1.86\text{ K Kg mol}^{-1}$, K_b for water is $0.512\text{ K Kg mol}^{-1}$,
 K_f for ethanol is 2.0 K Kg mol^{-1} , K_b for ethanol is 1.2 K Kg mol^{-1} ,
freezing point of water = 273 K , freezing point of ethanol = 155.7 K ,
boiling point of water = 373 K , boiling point of ethanol = 351.5 K ,
vapour pressure of pure water = 32.8 mm Hg , vapour pressure of pure ethanol = 40 mm Hg ,
molecular mass of water = 18 g/mol , molecular mass of ethanol = 46 g/mol)

Answer the following questions:-

- (a) What will be the freezing point of the solution M?
- (b) Calculate the vapour pressure of the solution M.
- (c) Water is added to the solution M such that the mole fraction of water in the solution becomes 0.9. calculate the boiling point of this solution.

SECTION E (5 marks)

15. Answer the following questions-

- (a) Will the elevation in boiling point be same if 0.1 mole of sodium chloride or 0.1 mole of sugar is dissolved in one L of water? Explain.
- (b) Why a person suffering from high blood pressure is advised to take minimum quantity of common salt?
- (c) A solution containing 1.9 g per 100 mL of KCl (molar mass = 74.5 g/mol) is isotonic with a solution containing 3 g per 100 mL of urea (molar mass = 60 g/mol). Calculate the degree of dissociation of KCl solution. Assume that both the solutions the same temperature.

CHAPTER 2 - ELECTROCHEMISTRY

Section A (1 mark)

- 1. Which of the following statements about a lead storage cell (or a lead-acid battery) is false?

- (a) It is a primary cell
(b) The cathode is made up of lead (IV) oxide
(c) The anode is made up of lead
(d) The electrolyte used is an aqueous solution of sulphuric acid
2. In a dry cell, which of the following is the electrolyte?
(a) Potassium hydroxide (c) Ammonium chloride
(b) Sulphuric acid (d) Manganese dioxide
3. The conductivity of electrolytic conductors is due to _____
(a) Flow of free mobile electrons
(b) Movement of ions
(c) Either movement of electrons or ions
(d) Cannot be said
4. **Assertion:** Cu is less reactive than hydrogen.
Reason : $E^0_{\text{Cu}^{2+}/\text{Cu}}$ is negative.
5. **Assertion :** Conductivity of all electrolytes decreases on dilution.
Reason : On dilution number of ions per unit volume decreases.

SECTION B (2 Marks)

6. The molar conductivity of a 1.5 M solution of an electrolyte is found to be $138.9 \text{ S cm}^2 \text{ mol}^{-1}$. Calculate the conductivity of this solution.
7. A solution of $\text{Ni}(\text{NO}_3)_2$ is electrolysed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode? (atomic mass of Ni = 59)
8. A zinc rod is dipped in 0.1 M solution of ZnSO_4 . The salt is 95% dissociated at this dilution at 298 K. Calculate the electrode potential.
9. The standard electrode potential (E°) for Daniel cell is +1.1 V. Calculate the ΔG° for the reaction
 $\text{Zn}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu}(\text{s})$
(1 F = 96500 C mol^{-1}).

SECTION C (3 Marks)

10. The conductivity of 0.001 M acetic acid is $4 \times 10^{-5} \text{ S/cm}$. Calculate the dissociation constant of acetic acid, if molar conductivity at infinite dilution for acetic acid is $390 \text{ S cm}^2/\text{mol}$.
11. When a certain conductance cell was filled with 0.1 M KCl, it has a resistance of 85 ohms at 25°C . When the same cell was filled with an aqueous solution of 0.052 M unknown electrolyte, the resistance was 96 ohms. Calculate the molar conductance of the electrolyte at this concentration.
[Specific conductance of 0.1 M KCl = $1.29 \times 10^{-2} \text{ ohm}^{-1} \text{ cm}^{-1}$]
12. Determine the values of equilibrium constant (K_c) and ΔG° for the following reaction :
 $\text{Ni}(\text{s}) + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Ni}^{2+}(\text{aq}) + 2\text{Ag}(\text{s}), \quad E^\circ = 1.05 \text{ V}, 1\text{F} = 96500 \text{ C mol}^{-1}$

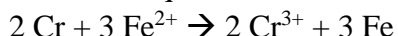
SECTION D (4 Marks)

13. Electrochemistry is the study of production of electricity from energy released during spontaneous chemical reactions and the use of electrical energy to bring about non-spontaneous chemical transformations. A

galvanic cell is an electrochemical cell that converts the chemical energy of a spontaneous redox reaction into electrical energy. In this device the Gibbs energy of the spontaneous redox reaction is converted into electrical work which may be used for running a motor or other electrical gadgets like heater, fan, geyser, etc. We can construct innumerable number of galvanic cells on the pattern of Daniell cell by taking combinations of different half-cells. Each half-cell consists of a metallic electrode dipped into an electrolyte. The two half-cells are connected by a metallic wire through a voltmeter and a switch externally. The electrolytes of the two half-cells are connected internally through a salt bridge. A secondary cell after use can be recharged by passing current through it in the opposite direction so that it can be used again. A good secondary cell can undergo a large number of discharging and charging cycles. The most important secondary cell is the lead storage battery.

Answer the following questions-

(a) Write Nernst equation for the reaction



(b) Why does the conductivity of the solution decrease with dilution?

(c) Calculate the equilibrium constant of the reaction:



SECTION E (5 Marks)

14. (a) A current of 1.5 amperes was passed through an electrolytic cell containing AgNO_3 solution with inert electrodes. The weight of Ag deposited was 1.5 g. How long did the current flow? Write the reaction taking place at the anode and cathode of the given cell.
 (b) Write the name of the cell which is generally used in hearing aids. Write the reaction taking place at anode and cathode of this cell.

CHAPTER 3 – CHEMICAL KINETICS

SECTION A (1 Marks)

- For a reaction: $\text{X} \rightarrow \text{Z}$, the rate of reaction becomes twenty seven times when the concentration of X is increased three times. What is the order of the reaction?
 (a) 0 (b) 1 (c) 2 (d) 3
- The unit of rate and rate constant are same for:
 (a) zero order reaction (c) second order reaction
 (b) first order reaction (d) third order reaction
- The decomposition of dimethyl ether is a fractional order reaction. The rate is given as

$$\text{Rate} = K (\text{P}_{\text{CH}_3\text{OCH}_3})^{3/2}$$
 If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constant?
 (a) bar min^{-1} , $\text{bar}^2 \text{ min}^{-1}$ (c) bar min^{-1} , $\text{bar}^{-1/2} \text{ min}^{-1}$
 (b) $\text{bar}^{1/2} \text{ min}^{-1}$, $\text{bar}^2 \text{ min}^{-1}$ (d) bar min^{-1} , $\text{bar}^{1/2} \text{ min}^{-1}$
- Assertion:** Activation complex for the forward reaction will have lower energy than that for the backward reaction in an exothermic reaction.
Reason: Reactants have greater energy than products for an exothermic reaction.
- Assertion:** In a first-order reaction, the concentration of the reactant is doubled, its half-life is also doubled.
Reason: The half-life of a reaction does not depend upon the initial concentration of the reactant in a first-order reaction.
- Assertion:** The slowest elementary step in a complex reaction decides the rate of the reaction.
Reason: The slowest elementary step always has the smallest molecularity.

SECTION B (2 Marks)

- For the reaction $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ the rate of formation of $\text{NO}_2(\text{g})$ is $2.8 \times 10^{-3} \text{ mol L}^{-1}\text{s}^{-1}$. Calculate the rate of disappearance of $\text{N}_2\text{O}_5(\text{g})$.
- For a first order reaction, show that time required for 99 % completion is twice the time required for the completion of 90 % of reaction.
- A first order reaction takes 40 min for 30 % decomposition. Calculate $t_{1/2}$.

SECTION C (3 Marks)

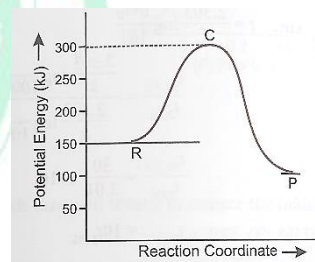
- The rate constant for a first order reaction is 60 s^{-1} . How much time will it take to reduce the initial concentration of the reactant to its $1/16^{\text{th}}$ value?
- Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with $t_{1/2} = 3.00$ hours. What fraction of sample of sucrose remains after 8 hours?
- The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

SECTION D (4 Marks)

- In chemical kinetics, potential energy diagrams, or reaction coordinate diagrams, depict how a reaction's energy changes as reactants transform into products. The vertical axis represents potential energy, while the horizontal axis, termed the reaction coordinate, illustrates the progression of the reaction from reactants to products. A key feature of these diagrams is the activation energy (E_a), which is the energy barrier that must be overcome for a reaction to proceed. This is represented by the peak of the diagram, known as the transition state, which corresponds to the highest energy point along the reaction path. The activation energy determines the reaction rate; a higher E_a indicates a slower reaction, as fewer molecules possess the necessary energy to reach the transition state.

Answer the following questions:

- What is the threshold energy for the reaction?
- What is the activation energy for the reaction?
- What is enthalpy change for the forward reaction?



SECTION E (5 Marks)

- (a) The first order rate constant for the decomposition of ethyl iodide by the reaction

$\text{C}_2\text{H}_5\text{I}(\text{g}) \rightarrow \text{C}_2\text{H}_4(\text{g}) + \text{HI}(\text{g})$ at 600 K is $1.60 \times 10^{-5} \text{ s}^{-1}$. Its energy of activation is 209 kJ/mol. Calculate the rate constant of the reaction at 700 K.

- The following results have been obtained during the kinetic studies of the reaction:
 $2\text{A} + \text{B} \rightarrow \text{C} + \text{D}$

Experiment	[A]/mol L ⁻¹	[B]/mol L ⁻¹	Initial rate of formation of D/mol L ⁻¹ min ⁻¹
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

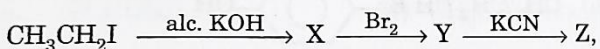
Determine the rate law and the rate constant for the reaction.

CHAPTER -6 (HALOALKANES AND HALOARENES)

SECTION A (1 Marks)

- Which of the following is optically inactive?
(a) (+) – Butan-2-ol
(b) (–) – Butan-2-ol
(c) (±) – Butan-2-ol
(d) (+) – 2 – Bromobutane
- Which of the following isomer of pentane (C₅H₁₂) will give three isomeric monochlorides on photochemical chlorination?
(a) 2,2-dimethylpropane
(b) 2-methylbutane
(c) n-pentane
(d) all of these
- Answer the following question-

In the reaction



Z is :

- (a) CH₃CH₂CN
(b) CNCH₂CH₂CN
(c) Br CH₂CH₂CN
(d) Br CH = CHCN.

- Assertion (A)**- Boiling point of alkyl halides decreases in the order : RI < RBr < RCl < RF
Reason (R)- Boiling point increases with increase in size of the molecule.
- Assertion (A)**- In the case of optically active alkyl halide, the product formed as a result of S_N2 mechanism has the inverted configuration as compared to the reactant.
Reason (R)- In S_N2 mechanism, the nucleophile attaches itself on the side opposite to the one where the halogen is present resulting in inversion in configuration of the product.

SECTION B (2 Marks)

- Haloalkanes on reaction with aqueous KOH undergo substitution reaction but on reaction with alcoholic KOH undergo elimination reaction. Why?
- (a) Why is vinyl chloride less reactive than ethyl chloride towards nucleophilic substitution reaction?
(b) Why is allyl chloride more reactive than n-propyl chloride towards nucleophilic substitution reaction?
- Write the various possible isomers of C₇H₇Cl containing benzene ring. Identify which one of them will have weakest C-Cl bond? Justify your answer.
- An alkyl halide (A) on reaction with magnesium in dry ether followed by treatment with water gives 2-methylbutane. Identify A and write all the reactions involved.

SECTION C (3 Marks)

- An organic compound A with molecular formula C₄H₉Br on treatment with alcoholic KOH gave two isomeric compounds B and C with the molecular formula C₄H₈ for both the isomers. On ozonolysis, B gave only one product CH₃CHO but C gave two different products. Identify A, B and C.
- Primary alkyl halide C₄H₉Br (a) reacted with alcoholic KOH to give compound (b). Compound (b) is reacted with HBr to give (c) which is an isomer of (a). When (a) is reacted with sodium metal it gives compound (d), C₈H₁₈ which is different from the compound formed when n-butyl bromide is reacted with sodium. Give the structural formula of (a) and write the equations for all the reactions.
- Do the following conversions-
 - Prop-1-ene to 1-fluoropropane
 - Chlorobenzene to 2-chlorotoluene
 - Ethanol to propano nitrile
 - Phenol to picric acid
 - 2-methylpropanol to 2-methylpropene
 - Propene to 1-propanol