Delhi Public School, Howrah

PERIODIC TEST III (2025-2026)

CLASS - XII

SUBJECT - CHEMISTRY (Code No. 043)

Care must be taken not to write anything on the question paper. All the questions must be attempted in the correct sequence.

TIME - 3 HOURS **F.M. - 70**

General Instructions:

Read the following instructions carefully.

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

SECTION – A

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

1. What would be the major product formed when $(CH_3)_3C–OH$ is heated at 358 K in the presence of H_3PO_4? 1
   A. $(CH_3)_3COOH$ B. $(CH_3)_3CHO$ C. $(CH_3)_2C=CH_2$ D. $(CH_3)_3C–O–C–(CH_3)_3$

2. The complex $[Co(NH_3)_5(NO_2)]Cl_2$ is obtained in yellow and red coloured forms. The difference in colour is attributed to which of the following type of isomerism? 1
   A. Coordination isomerism B. Facial isomerism C. Linkage isomerism D. Solvate isomerism

3. Which of the following purines are common to RNA and DNA? 1
   A. Adenine, Thymine B. Guanine, Thymine C. Thymine, Cytosine D. Adenine, Guanine

4. India's first pipeline was laid to transport crude oil in Digboi, Assam. The rusting of these iron pipelines was a cause of concern. Which method would prevent corrosion? 1
   A. Barrier protection B. Alloying C. Cathodic protection D. Anodising

5. Which of the following alkyl iodides cannot be produced by the reaction of HI with an appropriate ether? 1
   A. $(CH_3)_3C–CH_2–I$ B. $(CH_3)_2CH–I$ C. $C_6H_5CH_2–I$ D. $C_6H_5–I$

6. What is the order and molecularity of hydrolysis of sucrose if the rate law is Rate = $k'[C_{12}H_{22}O_{11}]$? 1
   A. Order-0, molecularity-1 B. Order-2, molecularity-2
   C. Order-2, molecularity-1 D. Order-1, molecularity-2

7. The electronic configuration of Ni in $Ni(CO)_4$ would be: 1
   A. $t_2^6e^4$ B. $t_2^6e^2$ C. $e^4t_2^6$ D. $e^4t_2^4$

8. Ankit has been given four organic compounds: a primary amine, a secondary amine, a secondary alcohol and a tertiary alcohol. Which of the following can Ankit use to identify all the compounds? 1
   A. Tollen's reagent and bromine water B. 2,4-DNP and Lucas reagent
   C. Hinsberg's reagent and Lucas reagent D. Sodium metal and Hinsberg's reagent

9. Which of the following is not true about enzymes? 1

A. All enzymes are fibrous proteins B. Enzymes are needed in small quantities

C. Enzymes reduce activation energy D. They are specific for a reaction and the substrate

10. Identify the products (I) and (II) in the following reactions. 1

$C_2H_5Cl + KCN \rightarrow$ (I) and $C_2H_5Cl + KNO_2 \rightarrow$ (II)

A. (I) C_2H_5CN (II) $C_2H_5NO_2$ B. (I) C_2H_5NC (II) $C_2H_5NO_2$

C. (I) C_2H_5CN (II) C_2H_5ONO D. (I) C_2H_5NC (II) C_2H_5ONO

11. "Greater number of electrons from (n–1)d in addition to the ns electrons are involved in the interatomic metallic bonding." Which of the following case is result of the above statement? 1

A. Vanadium forms complexes.

B. Platinum acts as catalyst.

C. Chromium is having higher melting point than Vanadium and Manganese.

D. Manganese show oxidation states ranging from +2 to +7.

12. Which of the following reactions can be used to obtain benzaldehyde from benzene? 1

A. Rosenmund's Reduction B. Stephen's Reaction C. Etard's Reaction D. Gatterman–Koch Reaction

Given below are two statements labeled as Assertion A. and Reason (R):
Select the most appropriate answer from the options given below:

A. Both A and R are true and R is the correct explanation of A.
B. Both A and R are true but R is not the correct explanation of A.
C. A is true but R is false.
D. A is false but R is true.

13. **Assertion A.:** Phenol on treatment with Br_2 in CS_2 gives ortho and para bromophenol. 1
Reason (R): Carbon disulphide is a solvent of low polarity, hence leads to monobromination of phenols.

14. **Assertion A.:** At high pressure, decomposition of ammonia on the catalyst surface is a first-order reaction. 1
Reason (R): At high pressure, on changing the reaction conditions, the concentration of ammonia on the surface of the catalyst does not change.

15. **Assertion A.:** Ionisation enthalpy of Fe^{2+} is lower than Mn^{2+}. 1
Reason (R): Fe^{2+} has $3d^5 4s^1$ configuration, making the state highly stable.

16. **Assertion A.:** Halogens are ortho and para-directing groups. 1
Reason (R): Halogens are electron-withdrawing groups.

SECTION – B

Question No. 17 to 21 are very short answer questions carrying 2 marks each.

17. Answer the following questions: 1+1

A. Out of Co^{3+} and Cr^{2+}, which one liberates hydrogen from dilute acid and why? [$E°Co^{3+}/Co^{2+}$ = +1.97 V, $E°Cr^{3+}/Cr^{2+}$ = –0.41 V]

B. The transition metals and their compounds are known for their catalytic activity. Give a reason for their effectiveness as catalysts and name the transition element used as a catalyst in Haber's process. 2

18. In metal carbonyls, metal–ligand bonds possess both sigma and pi characters. Comment whether the statement is correct. Give reasons for your answer.

19. Give an example of: 1+1

A. An amine each with basic strength greater than and less than N-Methylmethanamine in gaseous state.

B. An isomeric amine each with boiling point less than and more than N-Ethylethanamine.

20. **<u>Attempt either part A or B</u>**

A. Consider the following reaction, 1+1

$H_2O_2 + I^- \rightarrow H_2O + IO^-$

$H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$

In the above reaction, the rate of formation of the intermediate is slow.

I. Write the rate law.

II. How will the rate of the reaction be affected if the concentration of peroxide is doubled?

OR

B. The half-life of a sample P (t½ = 100 days) does not change with concentration of P. The half-life of another sample Q (t½ = 120 days) decreases with decrease in concentration of Q. Draw the graphs of initial concentration vs t½ for the samples P and Q.

1+1

21. Arrange the following as indicated. 1+1

A. n-Butane, Propan-1-ol, Propanal, Acetone, Methoxymethane (in increasing order of boiling point)

B. Acetaldehyde, Acetone, Acetophenone (in increasing order of reactivity towards nucleophilic addition reaction)

SECTION – C

Question No. 22 to 28 are short answer questions, carrying 3 marks each.

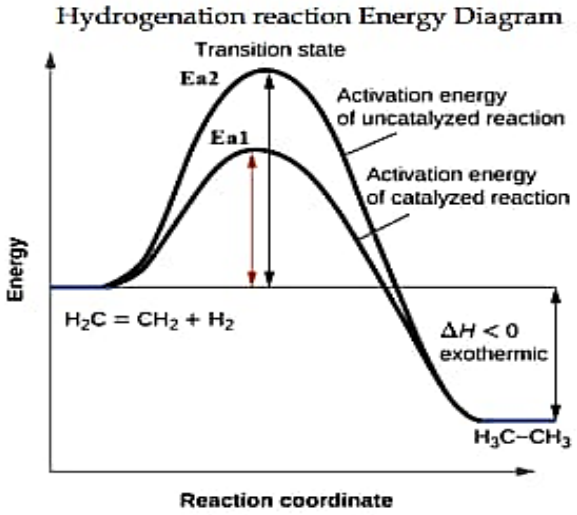
22. Answer the following questions: 1+1+1

A. Give an example of liquids that, when mixed, result in an endothermic process. What will be the change in volume when the liquids are mixed?

B. At 300 K, what is the relation between the osmotic pressures of two equimolar solutions — one whose Van't Hoff factor is 2 and the other whose Van't Hoff factor is ½?

C. Which of the two aqueous solutions has a higher melting point: 2 molal glucose solution or 3 molal sucrose solution? Why?

23. Observe the potential energy diagram for the hydrogenation of ethene to give ethane. 1+1+1



A. For the same process, predict why there is a difference in Ea_1 and Ea_2?

B. Assuming both the reactions are reversible, then in which case will the backward reaction be faster?

C. Will the ΔG value of this reaction be different in the above two paths? Explain.

24. **Attempt either part A or B**

A. Give reason for the following: 1+1+1

I. The complex formed by Ca^{2+} with EDTA is more stable than the complex formed by Ca^{2+} with ethylenediamine.

II. In d^4 complexes, ligands for which $\Delta_o < P$ form high-spin complexes.

III. On removal of water from $[Ti(H_2O)_6]Cl_3$ by heating, it becomes colourless.

OR

B. I. What will be the colour of precipitate obtained when ionisation isomer of compound $[Co(NH_3)_5Br]SO_4$ reacts with $AgNO_3$? 1+1+1

II. An element M forms complex 'A' with ligand ethane-1,2-diamine and complex 'B' with chloride having coordination number six.

i. Which of the two complexes, will be more stable and why?

ii. If metal forms d^4 ion, which complex will have higher magnetic moment?

25. An organic compound 'A' has the molecular formula C_7H_8O. On oxidation with acidified $KMnO_4$, it forms 3

compound 'B'. Compound 'B' can also be obtained from compound 'C' on its reaction first with NaOH and then with CO_2 followed by hydrolysis. Compound 'C' itself can be easily formed when butylphenyl ether is made to react with HI. Identify the compounds A, B and C. Write the chemical reactions involved.

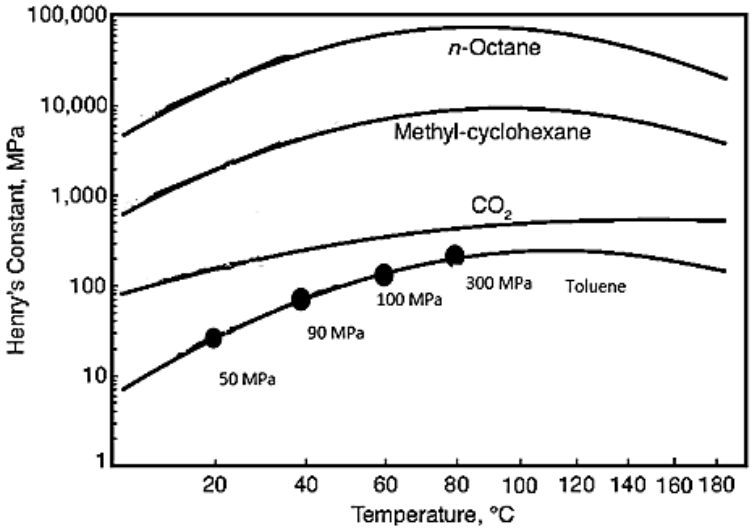
26. Rohan was carrying out the reaction of potassium iodide with potassium permanganate in acidic medium. Iodine gas was liberated from potassium iodide during the reaction. When he repeated the reaction for further study, he forgot to add acid. He observed that the products released during the second case were different from the previous one. 1+1+1
    A. Write the chemical reactions in both the cases.
    B. Give reason for the difference in observation.
    C. Draw the structure of MnO_4^-.
27. Answer the following questions: 1+1+1
    On passing electric current of type 'X' through aqueous $CuSO_4$ solution, electrolysis was observed. When electric current of type 'Y' was used, the conductivity of the solution could be measured.
    A. Identify 'X' and 'Y' type of current used.
    B. Write the electrolysis products of aqueous $CuSO_4$ solution on passing 'X'.
28. Convert Propanamide to the following compounds in not more than two steps: 1+1+1
    A. N-Ethylpropanamine
    B. Ethanol
    C. N-Propylethanamide

SECTION - D

Question No. 29 & 30 are case-based/data -based questions carrying 4 marks each.

29. Temperature Dependence of Henry's Law Constant

Henry's law and Henry's law constant are widely used in chemical and environmental engineering. Unfortunately, many people do not appreciate that Henry's constant is not a true constant but has a significant non-linear temperature dependence. The given figure illustrates some typical behaviour of Henry's constant vs temperature for several solutes in water. The Henry's constant typically increases with temperature at low temperatures, reaches a maximum, and then decreases at higher temperatures. The temperature at which the maximum occurs depends on the specific solute–solvent pair. Clearly, the use of a Henry's constant, that was derived at 25 °C could lead to serious errors during manufacturing at a different temperature. Even a variation as small as 10 K can cause the Henry's constant to change by a factor of two, which could have a serious impact on many process designs.



Based on the information provided above, answer the following questions:

A. Which of the following is *not* a true constant like Henry's constant? 1+1+2

I. Speed of light C. II. Planck's constant (h) III. Rate constant (k) IV. Gas constant (R)

Attempt either subpart B or C

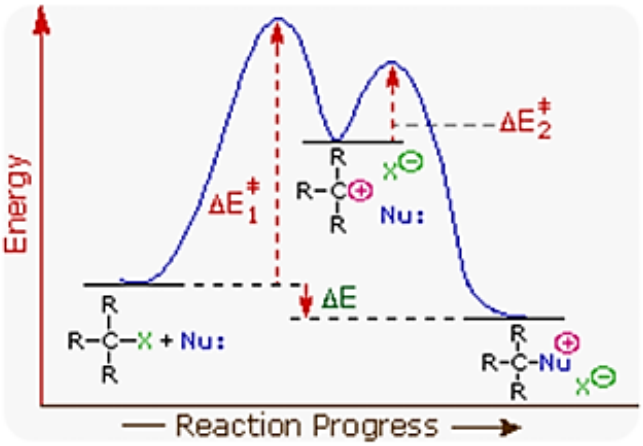
B. How will the solubility of n-octane vary with a change in temperature, provided the pressure is kept constant?

OR

C. Rishita works in an aerated-drinks factory. To increase the fizz in the drink, she proposes bottling the aerated drinks at 40 °C instead of 20 °C. Do you support her proposal? Give reason for your answer.

D. Find the ratio of solubilities of toluene in water at 20 °C and at 60 °C.

30. Nucleophilic Substitution Reactions



In nucleophilic substitution reactions, a bond between carbon and a leaving group (C–LG) is broken, and a new bond between carbon and a nucleophile (C–Nu) is formed. Nucleophilic substitution reactions of alkyl halides occur through two main pathways: S_N1 and S_N2. One way to visualise the differences between these two mechanisms is to sketch out their reaction-coordinate diagrams, where we plot changes in potential energy (vertical axis) as the starting materials pass along the "reaction coordinate" toward their conversion into products (horizontal axis). In these diagrams the "peaks" (local maxima) represent transition states whereas "valleys" (local minima) represent intermediates. The reaction-coordinate diagram of the S_N1 reaction has two peaks, representing the two transition states (Step 1 and Step 2, respectively) flanking a single "valley" representing the carbocation intermediate. Each step of the process has an activation energy represented by the difference in energy between the reactant and the transition state. The rate-determining step of a reaction is the step requiring the highest activation energy — that is, the largest change in potential energy from reactant to transition state.

Based on the information provided above, answer the following questions:

A. On the basis of the activation energies for Step 1 and Step 2 for S_N1 reaction, identify the rate-determining step and justify your answer. 1+1+2

Attempt either subpart B or C

B If the alkyl group in the alkyl halide depicted in the above figure remains unchanged, but the halogen bromine is replaced with chlorine, which of the following statements would be correct, and why?

I. E_a for Step 2 will be more than shown in the figure.

II. E_a for Step 2 will be less than shown in the figure.

III. E_a for Step 2 will be same as shown in the Figure.

OR

C. Plot rate of reaction vs concentration of nucleophile for S_N1 reaction.

D. Draw the reaction-coordinate diagram for S_N2 reaction.

SECTION: E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31. Attempt either part A or B

A. I. Name an important carbohydrate which makes the cell wall of bacteria and plants. What is the basic unit of this carbohydrate? 1+1+1+1+1

II. How are these basic units linked to each other? Name the linkage.

III. Draw the Haworth structure of the basic unit.

IV. Identify the disaccharide with molecular formula $C_{12}H_{22}O_{11}$ which produces two moles of α-D(+)-glucose on hydrolysis. What will be the observation when Tollen's reagent is added to such a disaccharide?

V. Change in optical rotation is observed when sucrose is hydrolysed. What is the reason for the inversion of configuration observed?

OR

B. I. A polynucleotide chain is seen to produce pentose sugar, phosphoric acid, adenine, guanine, cytosine and thymine on complete hydrolysis. Name the nucleic acid having such a polynucleotide chain. How are the bases paired in this polynucleotide? 1+1+1+1+1

II. What links these nucleotides together in a polynucleotide?

III. Give one important function and one application of the above nucleic acid.

IV. Keratin is a hair protein. What kind of tertiary protein is this? Describe the structure and links present in this protein.

V. Comment on the solubility of keratin in water.

32. Attempt either part A or B

A. I. Draw the structure of the ethylene ketal of hexan-3-one. 1+2+2

II. Between benzoic acid and acetic acid, which is more acidic and why?

III. An optically active organic compound 'A' with molecular formula $C_5H_{10}O_2$ when treated with chlorine in the presence of red phosphorus forms compound 'B', $C_5H_9O_2Cl$, whereas when it is treated with thionyl chloride forms compound 'C', C_5H_9OCl. Compound C on further hydrogenation with palladium on $BaSO_4$ in the presence of S forms compound D, $C_5H_{10}O$. Compound D gives a positive result in Tollen's test and regenerates A. A can also be obtained by base hydrolysis and further acidification of C. Write the reaction for the formation of A from C and identify A, B, C, D.

OR

B. Complete the following conversion:

I. i. Propanal → 2-methyl pentanol ii. Iodobenzene → benzoic acid 2+1+2

II. Though carboxylic acids have >C=O group in their structure, they are not prone to nucleophilic addition reactions. Why?

III. An organic compound A with molecular formula C_9H_{12} is oxidised to a monocarboxylic acid B, $C_7H_6O_2$, on vigorous oxidation with $KMnO_4$, whereas when oxidised in presence of air and further treated with dilute acid forms phenol. Sodium salt of B finds use as a food preservative and esters of B are used in perfumery. Identify A and B and write the reactions involved.

33. Attempt either part A or B

I. Calculate the current and the thickness of the coating if the current was passed for 1 hr to deposit 2 g silver on a metal object of area 1 cm^2. (Ag = 108, 1 Faraday = 96 500 C, density of Ag = 10.5 g cm^{-3}) 3+2

II. Calculate the electrode potential of Cr^{3+}/Cr electrode at $[Cr^{3+}] = 0.001$ M.

Given: $Cr^{3+} + 3e^- \rightarrow Cr \quad E° = -0.74$ V

OR

B. The half-cell reactions of an electrochemical cell are given below: 3+2

Mn^{3+} (0.1 M) + e^- → Mn^{2+} (0.01 M) $E° = 1.50$ V

Ag^+ (0.001 M) + e^- → Ag(s) $E° = 0.80$ V

I. Formulate a galvanic cell using the above data. Calculate the emf of the cell at 25 °C.

II. The graph represents the variation of molar conductivity of an electrolyte with respect to concentration. Identify the type of electrolyte and determine the value of limiting molar conductivity (Λ_m^o).

