



Delhi Public School, Howrah

PERIODIC TEST - II (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. The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5 g when added to 39.0 g of benzene (molar mass 78 g mol^{-1}). Vapour pressure of the solution, then, is 0.845 bar. What is the molar mass of the solid substance? 1
A. 123 g mol^{-1}
B. 246 g mol^{-1}
C. 340 g mol^{-1}
D. 170 g mol^{-1}
2. For the cell, $\text{Zn} | \text{Zn}^{2+} (0.1 \text{ M}) || \text{Cu}^{2+} (1 \text{ M}) | \text{Cu}$, $E^\circ_{\text{cell}} = 1.10 \text{ V}$, determine the cell potential. 1
A. 1.10 V
B. 1.12 V
C. 1.08 V
D. 1.05 V
3. For a first-order reaction, the time taken for 50% completion is 2 hours. Estimate the time for 75% completion. 1
A. $2 \log_2 \text{ h}$
B. 4 h
C. 3 h
D. $\log_2 \text{ h}$
4. Identify which of the following is not a property of transition elements. 1
A. Variable oxidation states
B. Coloured compounds
C. Formation of interstitial compounds
D. Non-metallic dullness
5. Identify the correct order of reactivity towards an $\text{S}_\text{N}1$ reaction: 1
A. Benzyl chloride > tert-butyl chloride > ethyl chloride
B. tert-butyl chloride > benzyl chloride > ethyl chloride
C. tert-butyl chloride > ethyl chloride > benzyl chloride
D. Ethyl chloride > tert-butyl chloride > benzyl chloride

6. Detect the alcohol that will not undergo oxidation under mild conditions. 1
- A. Methanol
B. 1-Propanol
C. 2-Methyl-2-propanol
D. Ethanol
7. Recognise which compound will give a silver mirror test with Tollen's reagent. 1
- A. Acetone
B. Formaldehyde
C. Benzophenone
D. Acetophenone
8. Identify which types of amines can be distinguished using Hinsberg's reagent. 1
- A. Primary and secondary amines
B. Primary and tertiary amines
C. Secondary and tertiary amines
D. Primary, secondary and tertiary amines
9. Henry's law constant for CO_2 in water at 298 K is 3.3×10^7 Pa. Calculate the amount of CO_2 dissolved in 1 L of water when the partial pressure is 3.0×10^5 Pa. 1
- A. 9.09×10^{-3} mol
B. 1.0×10^{-3} mol
C. 3.03×10^{-3} mol
D. 1 mol
10. Point out the incorrect statement about galvanic and electrolytic cells. 1
- A. Oxidation occurs at the anode in a galvanic cell.
B. Reduction occurs at the cathode in a galvanic cell.
C. Cathode is negative in a galvanic cell.
D. Anode is positive in an electrolytic cell.
11. State whether the rate constant at 300 K and 350 K will be equal or different. 1
- A. Always equal.
B. Always different.
C. Maybe equal or may not be equal.
D. Cannot be determined.
12. Identify the product formed when KMnO_4 reacts in alkaline medium. 1
- A. Mn^{2+}
B. Mn^{3+}
C. MnO_2
D. MnO_4^{2-}

Given below are two statements labelled 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.

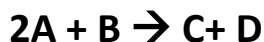
13. **Assertion (A):** Aryl halides are less reactive towards nucleophilic substitution than alkyl halides. 1
Reason (R): The C–X bond in aryl halides has partial double-bond character due to resonance.
14. **Assertion (A):** Phenol reacts with bromine water to give 2,4,6-tribromophenol readily at room temperature. 1
Reason (R): Phenol produces 2-bromophenol and 4-bromophenol in CS_2 medium.
15. **Assertion (A):** Aldehydes are more reactive than ketones towards nucleophilic addition. 1
Reason (R): Aldehydes have greater +I effect from two alkyl groups.
16. **Assertion (A):** Aniline is less basic than ethylamine. 1
Reason (R): Lone pair on nitrogen in aniline is delocalised into the benzene ring.

SECTION: B**Question No. 17 to 21 are very short answer questions carrying 2 marks each.**

17. **Attempt either option A or B** 2X1
 A. I. Explain why it is not possible to obtain pure ethanol by fractional distillation.
 II. State the significance of Henry's law constant (K_H).
OR
 B. I. Describe the reason of anoxia at high altitude.
 II. Differentiate between an ideal solution and a non-ideal solution by any one factor.
18. I. Identify the condition under which $E_{\text{cell}} = 0$ and $\Delta_r G = 0$. 2X1
 II. Which reference electrode is used to measure the electrode potential of other electrodes?
19. Discuss whether a reaction can have: 2X1
 I. zero activation energy
 II. negative activation energy.
 Justify your answers.
20. Describe the oxidising action of potassium dichromate and write the ionic equations for its reaction with 2X1
 I. iodine
 II. hydrogen sulphide.
21. Explain why ($\pm$)-butan-2-ol is optically inactive. 2

SECTION : C**Question No. 22 to 28 are short answer questions, carrying 3 marks each.**

22. The following results have been obtained during the kinetic study of the reaction, 3



Sl. No.	[A] (mol L ⁻¹)	[B] (mol L ⁻¹)	Initial rate of formation of D (mol L ⁻¹ min ⁻¹)
1	0.1	0.1	6.0×10^{-3}
2	0.3	0.2	7.2×10^{-2}
3	0.3	0.4	2.88×10^{-1}
4	0.4	0.1	2.4×10^{-2}

Determine the rate law from the given data.

23. Give reasons for the following observations. 3X1
 I. Benzoic acid is a stronger acid than acetic acid.
 II. Methanal is more reactive towards nucleophilic reaction addition than ethanal.
 III. Only one NH_2 of semicarbazide takes part in nucleophilic addition reaction with carbonyl.
24. Propose a chemical test to distinguish between each of the following pairs 3X1
 I. Ethylamine and aniline.
 II. Aniline and benzylamine.
 III. Aniline & benzene diazonium chloride.
25. I. Boiling point of water at 750 mm Hg is 99.63°C. How much sucrose must be added to 500 g of water such that it boils at 100°C under same condition? 2X1.5
 II. The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90g of benzene, the boiling point is raised to 354.11 K. Determine the molar mass of the solute. K_b for benzene is 2.53 K kg mol⁻¹.
26. Two half-cell reactions of an electrochemical cell are given below, 3
 $\text{MnO}_4^- (\text{aq}) + 8\text{H}^+ (\text{aq}) + 5\text{e}^- \rightarrow \text{Mn}^{2+} (\text{aq}) + 4\text{H}_2\text{O} (\text{l}), E^\circ = + 1.51 \text{ V}$
 $\text{Sn}^{2+} (\text{aq}) \rightarrow \text{Sn}^{4+} (\text{aq}) + 2\text{e}^-, E^\circ = + 0.15 \text{ V}$
 Construct the overall redox equation and predict whether the reaction favours the formation of the products.
27. Carry out the following conversions. (Attempt any 3) 3X1
 A. Propene to propanol
 B. Ethanal to propan-2-ol

- C. Ethanol to diethyl ether
D. Phenol to Anisole

28. I. State what happens when ethyl chloride is treated with aqueous KOH.
II. Explain the role of a polar protic solvent in an S_N1 reaction.
III. Draw the structure of neopentyl bromide.

3X1

SECTION: D

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

29. **Variation of oxidation states in transition elements**

1+1+
2

The elements which give the greatest number of oxidation states occur in or near the middle of the series. Manganese, for example, exhibits all the oxidation states from +2 to +7. The lesser number of oxidation states at the extreme ends stems from either too few electrons to lose or share (Sc, Ti) or too many d electrons (hence fewer orbitals available in which to share electrons with others) for higher valence (Cu, Zn). Thus, early in the series scandium (II) is virtually unknown and titanium (IV) is more stable than Ti(III) or Ti(II). At the other end, the only oxidation state of zinc is +2 (no d electrons are involved). The maximum oxidation states of reasonable stability correspond in value to the sum of the s and d electrons upto manganese ($Ti^{IV}O_2$, $V^{VO_2^+}$, $Cr^{VI}O_4^{2-}$, $Mn^{VII}O_4^-$) followed by a rather abrupt decrease in stability of higher oxidation states, so that the typical species to follow are $Fe^{II,III}$, $Co^{II,III}$, Ni^{II} , $Cu^{I,II}$, Zn^{II} .

The variability of oxidation states, a characteristic of transition elements, arises out of incomplete filling of d orbitals in such a way that their oxidation states differ from each other by unity, e.g., V^{II} , V^{III} , V^{IV} , V^V . This is in contrast with the variability of oxidation states of non-transition elements where oxidation states normally differ by a unit of two.

- I. Explain why manganese exhibits a greater variety of oxidation states compared to zinc.
II. Select the correct reason for the large number of oxidation states in transition elements:
(a) Complete filling of p orbitals
(b) Availability of only s electrons for bonding
(c) Incomplete filling of d orbitals
(d) Low ionisation enthalpy of s electrons only

OR

Justify why titanium(IV) is more stable than titanium(III) or titanium(II).

III. Explain why scandium(II) is virtually unknown, referring to its electronic configuration.

30. **Photodecomposition of NO_2 in the Atmosphere**

1+1+
2

Nitrogen dioxide (NO_2) is a common atmospheric pollutant produced from combustion processes. In sunlight, NO_2 undergoes photochemical decomposition according to the following mechanism:

- $NO_2 + h\nu \rightarrow NO + O$ (slow, rate-determining step)
- $O + O_2 \rightarrow O_3$ (fast)

In an experiment, the initial rate of decomposition of NO_2 was measured at different temperatures, and the data is given below:

Temperature (K)	Rate ($\text{mol L}^{-1}\text{s}^{-1}$)
300	2.5×10^{-5}
310	4.1×10^{-5}

The activation energy for the reaction is assumed to be constant in this temperature range.

($R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$, $\log 2 = 0.3010$, $\log 1.64 = 0.2148$)

- I. Predict and explain qualitatively what will happen to the rate constant if the temperature is increased to 330 K.

OR

Explain the effect on the reaction rate if the intensity of sunlight decreases during the reaction.

II. Identify the molecularity of the rate-determining step.

III. Using the Arrhenius equation, calculate the activation energy (E_a) for the decomposition of NO_2 from the given data.

SECTION: E

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

31. **Attempt either A or B**

5X1

A. Answer the following:

- I. Identify an aromatic amine "X" (molar mass = 93 g/mol) that reacts with benzene sulphonyl chloride in alkaline medium to give a product soluble in NaOH.
- II. Compound "Y" ($C_6H_5NH_2$) reacts with $NaNO_2$ and dilute HCl at 273–278 K to form an unstable compound "Z". State why the reaction temperature is kept low.
- III. Outline the steps to convert 4-bromoaniline into 4-bromoacetanilide.
- IV. Convert propanamide into ethylamine.
- V. Why cannot aniline be prepared using Gabriel Phthalimide reaction?

OR

B. Answer the following:

- I. Plan the synthesis of 4-nitrophenol from aniline in not more than three steps.
- II. Convert: Nitrobenzene to aniline.
- III. Classify the amine "M" that evolves nitrogen gas instantly when treated with aqueous nitrous acid at room temperature.
- IV. Aniline reacts with chloroform and alcoholic KOH to give a foul-smelling product. Which reaction is involved in this case?
- V. Explain why aniline does not undergo Friedel–Crafts alkylation easily.

32. **Attempt either A or B**

5X1

A. Answer the following questions:

- I. An organic compound "P" (C_8H_8O) gives a positive 2,4-DNP test and forms a yellow precipitate with iodine and sodium hydroxide. It does not react with Tollens' reagent or Fehling's solution. On oxidation with alkaline $KMnO_4$, it produces benzoic acid. Identify compound "P" (C_8H_8O) from the given test results and reactions.
- II. Convert benzaldehyde into cinnamaldehyde.
- III. Explain why p-nitrobenzoic acid is more acidic than benzoic acid.
- IV. Prepare methyl benzoate from benzoic acid.
- V. How will you distinguish between acetophenone and benzophenone using a simple chemical test?

OR

B. Answer the following questions:

- I. Compound "Q" (CH_2O) gives a positive 2,4-DNP test, reduces Tollens' reagent, and undergoes Cannizzaro reaction. Identify compound "Q" (CH_2O) from its given reactions and properties.
- II. Propose a synthesis of p-bromoacetophenone from benzene in not more than three steps.
- III. Explain why benzaldehyde does not respond to the iodoform test.
- IV. Illustrate the aldol condensation between acetaldehyde and propanal.
- V. Give a chemical test to distinguish between formic acid and acetic acid, and write the reactions involved.

33. **Attempt either A or B**

3+2

A. Answer the following questions:

- I. The activation energy for the reaction



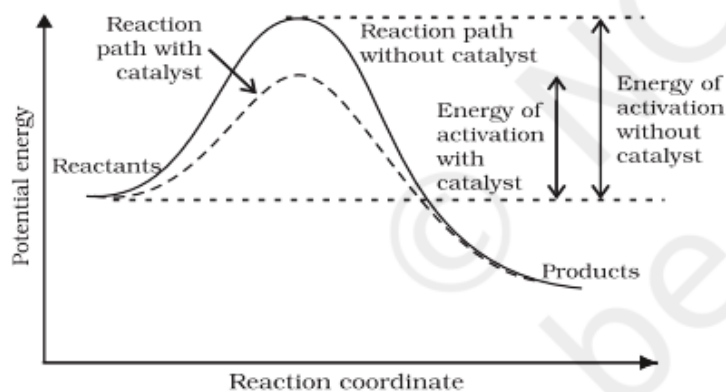
is $209.5 \text{ kJ mol}^{-1}$ at 581K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy?

- II. Explain why the decomposition of NH_3 on a Pt surface is a zero-order reaction.

OR

B. Answer the following questions:

I. Interpret the given graph showing the effect of a catalyst on activation energy.



II. The time required to decompose a radioactive element to half its initial amount is 60 minutes. If the decomposition follows first-order kinetics, calculate the rate constant using the integrated rate equation.