Please check that this question paper contains 12 printed pages.

Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

Please check that this question paper contains 30 questions.

Please write down the Serial Number of the question before attempting it.

15 minutes time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

Time allowed : 3 hours

Maximum Marks : 70
General Instructions:

(i) All questions are compulsory.

(ii) Marks for each question are indicated against it.

(iii) Questions number 1 to 8 are very short-answer questions and carry 1 mark each.

(iv) Questions number 9 to 18 are short-answer questions and carry 2 marks each.

(v) Questions number 19 to 27 are also short-answer questions and carry 3 marks each.

(vi) Questions number 28 to 30 are long-answer questions and carry 5 marks each.

(vii) Use Log Tables, if necessary. Use of calculators is not allowed.

1. किसी आंतर अर्थचालक की चालकता कैसे बढ़ाई जाती है?
   How may the conductivity of an intrinsic semiconductor be increased?

2. ‘पेप्टीकरण’ पद को परिभाषित कीजिए।
   Define ‘peptization’.

3. निम्न श्रेणी के अपने अवस्थाओं से कॉपर का निक्षरण कैसे किया जाता है?
   How is copper extracted from a low grade ore of it?
4. SbH₃ and BiH₃ are common reducing agents in an aqueous phase. What is the stronger reducing agent, SbH₃ or BiH₃, and why?

5. When CH₂ = CH – CH₂ – C = CH is exposed to bromine, what happens? What happens when bromine attacks CH₂ = CH – CH₂ – C = CH?

6. Write the IUPAC name of the following:

\[
\begin{align*}
O \\
\mid
\end{align*}
\]

\[
\begin{align*}
\text{CH₃} - \text{CH₂} - \text{CH} = \text{CH} - \text{C} - \text{H}
\end{align*}
\]

7. Write the structure of the product obtained when glucose is oxidised with nitric acid.

8. Differentiate between disinfectants and antiseptics.

9. Two solutions, one with a higher concentration of ions, move in opposite directions, causing a chemical reaction. Explain the mechanism of this process. How could you verify that the reaction is occurring?

Additional

Express the relation among cell constant, resistance of the solution, and conductivity of the solution. How is molar conductivity of a solution related to its conductivity?

OR

The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm² mol⁻¹. Calculate the conductivity of this solution.
10. A reaction is of second order with respect to a reactant. How is its rate affected if the concentration of the reactant is (i) doubled (ii) reduced to half?

11. Which methods are usually employed for purifying the following metals:
(i) Nickel
(ii) Germanium
Mention the principle behind each one of them.

12. Explain the following facts giving appropriate reason in each case:
(i) $\text{NF}_3$ is an exothermic compound whereas $\text{NCl}_3$ is not.
(ii) All the bonds in $\text{SF}_4$ are not equivalent.

13. Complete the following chemical reaction equations:
(i) $\text{Cr}_2\text{O}_7^{2-} + I^- + H^+ \rightarrow$
(ii) $\text{MnO}_4^- + \text{NO}_2^- + H^+ \rightarrow$

Complete the following chemical reaction equations:
(i) $\text{Cr}_2\text{O}_7^{2-} + I^- + H^+ \rightarrow$
(ii) $\text{MnO}_4^- + \text{NO}_2^- + H^+ \rightarrow$
14. Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol.

15. Explain the following behaviours:
(i) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.
(ii) Ortho-nitrophenol is more acidic than ortho-methoxyphenol.

16. Describe the following giving the relevant chemical equation in each case:
(i) Carbylamine reaction
(ii) Hofmann's bromamide reaction

17. Complete the following reaction equations:
(i) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{H}_3\text{PO}_2 + \text{H}_2\text{O} \rightarrow$
(ii) $\text{C}_6\text{H}_5\text{NH}_2 + \text{Br}_2 (\text{aq.}) \rightarrow$

18. What are food preservatives? Name two such substances.
19. Copper crystallises with face centred cubic unit cell. If the radius of copper atom is 127.8 pm, calculate the density of copper metal.

\[(\text{Cu ka paramanu} \ \text{prakaryam} = 63.55 \text{ u} \ \text{and} \ \text{Avogadro's number} \ N_A = 6.02 \times 10^{23} \text{ mol}^{-1})\]

OR

Iron has a body centred cubic unit cell with the cell dimension of 286-65 pm. Density of iron is 7.87 g cm\(^{-3}\). Use this information to calculate Avogadro's number. (Atomic mass of Fe = 56.0 u)

20. The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is \(5.55 \times 10^3\) ohm. Calculate its resistivity, conductivity and molar conductivity.

21. The reaction, \(\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{NO}(\text{g})\) contributes to air pollution whenever a fuel is burnt in air at a high temperature. At 1500 K, equilibrium constant \(K\) for it is \(1.0 \times 10^{-5}\). Suppose in a case \([\text{N}_2] = 0.80 \text{ mol L}^{-1}\) and \([\text{O}_2] = 0.20 \text{ mol L}^{-1}\) before any reaction occurs. Calculate the equilibrium concentrations of the reactants and the product after the mixture has been heated to 1500 K.
22. प्रत्येक के लिए एक-एक उपयुक्त उदाहरण देते हुए, निम्नलिखित पदों की व्याख्या कीजिए:
(i) एयरोसॉल (Aerosol)
(ii) एम्बल्शन (Emulsion)
(iii) मिसेल (Micelle)

Explain the following terms giving a suitable example for each:
(i) Aerosol
(ii) Emulsion
(iii) Micelle

23. निम्नलिखित को आप कारण सहित कैसे स्पष्ट करेंगे?
(i) लांथानाइडों में Ln (III) यौगिक प्रमुख होते हैं। परन्तु कभी-कभी विलयनों अथवा ठोस यौगिकों में, +2 और +4 आयन भी पाए जाते हैं।
(ii) \( E_{M^{2+}/M}^\text{r} \) का मान कॉपर के लिए धनात्मक (0.34 V) है। संक्रमण तत्त्वों के प्रथम श्रेणी में ऐसा व्यवहार दिखाने वाला कॉपर अकेला थात है।
(iii) संक्रमण धातुओं की तृतीय (5d) श्रेणी की धातिक त्रिज्याएं लगभग बहसी हैं जो दूसरी श्रेणी में तत्पर्यन्तित सदस्यों की हैं।

How would you account for the following:
(i) Among lanthanoids, Ln (III) compounds are predominant. However, occasionally in solutions or in solid compounds, +2 and +4 ions are also obtained.
(ii) The \( E_{M^{2+}/M}^\text{r} \) for copper is positive (0.34 V). Copper is the only metal in the first series of transition elements showing this behaviour.
(iii) The metallic radii of the third (5d) series of transition metals are nearly the same as those of the corresponding members of the second series.
24. Name the following coordination entities and draw the structures of their stereoisomers:
(i) \([\text{Co(en)}_2 \text{Cl}_2]^+\) (en = ethan-1,2-diamine)
(ii) \([\text{Cr(C}_2\text{O}_4)_3]^{3-}\)
(iii) \([\text{Co(NH}_3)_3 \text{Cl}_3]\)
(Atomic numbers Cr = 24, Co = 27)

25. Answer the following questions:
(i) What is meant by chirality of a compound? Give an example.
(ii) Which one of the following compounds is more easily hydrolyzed by KOH and why?
\[\text{CH}_3\text{CHClCH}_2\text{CH}_3\] or \[\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}\]
(iii) Which one undergoes \(S_N2\) substitution reaction faster and why?
\[\text{I}\] or \[\text{Cl}\]

26. What is essentially the difference between \(\alpha\)-glucose and \(\beta\)-glucose? What is meant by pyranose structure of glucose?

27. Differentiate between thermoplastic and thermosetting polymers. Give one example of each.
28. (a) Define the following terms:
(i) Mole fraction
(ii) Ideal solution

(b) 15.0 g of an unknown molecular material is dissolved in 450 g of water. The resulting solution freezes at \(-0.34^\circ C\). What is the molar mass of the material? (\(K_f\) for water = 1.86 K kg mol\(^{-1}\))

OR

(a) Explain the following:
(i) Henry’s law about dissolution of a gas in a liquid
(ii) Boiling point elevation constant for a solvent

(b) A solution of glycerol (\(C_3H_8O_3\)) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100-42°C. What mass of glycerol was dissolved to make this solution? (\(K_b\) for water = 0.512 K kg mol\(^{-1}\))
29. (a) Draw the molecular structures of the following compounds:
(i) \( \text{N}_2\text{O}_5 \)
(ii) \( \text{XeOF}_4 \)

(b) Explain the following observations:
(i) Sulphur has a greater tendency for catenation than oxygen.
(ii) ICl is more reactive than I\(_2\).
(iii) Despite lower value of its electron gain enthalpy with negative sign, fluorine (F\(_2\)) is a stronger oxidising agent than Cl\(_2\).
(a) Complete the following chemical equations:
(i) Cu + HNO₃ (dilute) →
(ii) XeF₄ + O₂F₂ →

(b) Explain the following observations:
(i) Phosphorus has greater tendency for catenation than nitrogen.
(ii) Oxygen is a gas but sulphur a solid.
(iii) The halogens are coloured. Why?

30. (a) उपयुक्त रासायनिक समीकरण को लिखकर निम्नलिखित प्रत्येक रूपांतरण को पूर्ण कीजिए:
(i) ब्यूटेन-1-ऑल को ब्यूटेनोइक अम्ल में
(ii) 4-मेथिलएसीटोफैनोन को बेन्जीन-1,4-डाइकार्बोक्सिलिक अम्ल में

(b) एक ऑर्गनिक यौगिक, जिसका आण्विक सूत्र C₉H₁₀O है, 2,4-DNP व्युत्पन्न बनता है, टॉलेन अभिकर्मक को अपचारित करता है, और कैनिजारो की अभिक्रिया करता है।
तीस्रा ऑक्सीकरण पर यह 1,2-बेन्जीनडाइकार्बोक्सिलिक अम्ल देता है। यौगिक की पहचान कीजिए।

अध्ययन

(a) निम्न के बीच अंतर करने के लिए रासायनिक जौचों को दीजिए:
(i) प्रोपेनोल और प्रोपेनोन में
(ii) बेन्जील्डहाइड और एसीटोफैनोन में

(b) निम्नलिखित यौगिकों को उनके सामने दिए गए गुणधर्मों के बढ़ते हुए क्रम में व्यवस्थित कीजिए:
(i) एसीट-एल्डहाइड, एसीटोन, मेथिल टर्ट-एल्डिटल ट्रियोल (HCN के प्रति
क्रियाशीलता)
(ii) बेन्जोइक अम्ल, 3,4-डाइनाट्रोबेन्जोइक अम्ल, 4-मेथॉक्सीबेन्जोइक अम्ल
(अम्ल सामग्री)
(iii) CH₃CH₂CH(Br) COOH, CH₃CH(Br) CH₂COOH,
(CH₃)₂CH COOH (अम्ल सामग्री)
(a) Write a suitable chemical equation to complete each of the following transformations:

(i) Butan-1-ol to butanoic acid
(ii) 4-Methylacetophenone to benzene-1,4-dicarboxylic acid

(b) An organic compound with molecular formula \( \text{C}_9\text{H}_{10}\text{O} \) forms 2,4-DNP derivative, reduces Tollens's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1,2-benzenedicarboxylic acid. Identify the compound.

OR

(a) Give chemical tests to distinguish between

(i) Propanol and propanone
(ii) Benzaldehyde and acetophenone

(b) Arrange the following compounds in an increasing order of their property as indicated:

(i) Acetaldehyde, Acetone, Methyl tert-butyl ketone (reactivity towards HCN)
(ii) Benzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxybenzoic acid (acid strength)
(iii) \( \text{CH}_3\text{CH}_2\text{CH} (\text{Br}) \text{COOH} \), \( \text{CH}_3\text{CH} (\text{Br}) \text{CH}_2\text{COOH} \), \( \text{CH}_3\text{CH} (\text{Br}) \text{COOH} \) (acid strength)