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CSM—18/24

PART—II/PAPER—VI

CHEMISTRY

PAPER—I

Time : 3 Hours

Full Marks : 250

The question paper contains **18 (Eighteen)** *questions in* **GROUP—A, (12)** *and* **GROUP—B, (06)** *together.*

GROUP—A

Candidates to attempt **10** ***(ten)*** *questions within word limit of* **250**.

Each question carries **15** *marks.*

1. Why is the increase in Z_{eff} for a $2p$ electron smaller between N and O than between C and N?

2. Calculate the degrees of freedom in the system described by the following equation :

$$CaCO_3(s) \rightleftarrows CaO(s) + CO_2(g)$$

3. Dipole moments of the M — Cl bond in compounds MH_3Cl (where M = C or Si or Ge) show the following order : C > Si < Ge. Why?

4. Sodium hydroxide will always be a base, irrespective of the conditions. Is it true? Explain your answer.

5. 100 mL each of deionized water, 1M NaCl and 1M glucose are taken separately in three different 250 mL beakers. These beakers are then kept in a freezer at 253 K. Which of the above liquids will freeze first and why?

6. Chromium forms following oxides : CrO; CrO_2; CrO_3 and Cr_2O_3. Arrange these in the order of increasing basic strength. Validate your answer with a reason.

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7. What can be the reason behind the intense blue colour of copper aluminate spinel compared to calcium copper silicate (Egyptian blue), which is pale blue? Why?

8. Which electrochemical technique would you use to probe a reversible redox process in a coordination complex? Why?

9. Which one among BF_3, BCl_3, BBr_3 is the strongest Lewis acid and why?

10. Which of the following complexes will be structurally distorted? Why?

$[Cr(H_2O)_6]^{3+}$, $[Cr(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{3+}$, $[Mn(H_2O)_6]^{2+}$

11. Which of the following cobalt complex(es) will show isomerism and why?

(a) $[CoBr_2Cl_2]^-$

(b) $[CoBrCl_2(OH_2)]$

(c) $[CoBr(Cl)(I)(OH_2)]$

12. $Mn_2(CO)_{10}$ has only terminal carbonyl groups but $Co_2(CO)_8$ remains in an equilibrium between the structures having terminal and bridged carbonyl groups. Explain.

GROUP—B

Candidates to attempt **05 *(five)*** *questions within word limit of* **300**.

Each question carries **20** *marks.*

13. The standard reaction enthalpy for the hydrogenation of propene $CH_2 = CHCH_3(g) + H_2(g) \rightarrow CH_3CH_2CH_3(g)$ is -124 kJ mol^{-1}. The standard reaction enthalpy for the combustion of propane $CH_3CH_2CH_3(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$ is -2220 kJ mol^{-1}. Standard enthalpy of formation of $H_2O(l)$ is -286 kJ mol^{-1} at 298 K. Calculate the standard enthalpy of combustion of propene.

14. What are the basic differences between Orgel and Tanabe-Sugano diagrams? Draw them and label the axis for any M^{2+} case. What are the advantages of Tanabe-Sugano diagrams over Orgel diagrams?

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15. Name two lanthanides which have greatest tendency to deviate from the usual (3+) positive oxidation state and correlate this deviation with their electronic structures.

16. The mass of an electron is $9{\cdot}11 \times 10^{-31}$ kg and Planck's constant is $6{\cdot}63 \times 10^{-34}$ J sec. How much energy does an electron possess in each of its five lowest states, if it is placed in a cube of dimension 50 nm?

17. The standard electrode potentials of the electrodes Cu^{+2}/Cu and Ag^{+}/Ag are 0·337 V and 0·7991 V. What would be the concentration of Ag^{+} in a solution containing 0·06 M of Cu^{+2} ions, such that both the metals can be deposited together? Assume that activity coefficients are unity and both silver and copper do not dissolve among themselves.

18. In haemoglobin, the Fe^{2+} ion sits slightly above the plane of the porphyrin ring. However, after the binding of O_2, the metal ion falls into the plane of the ligand. Why? Draw a schematic and explain.

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SPACE FOR ROUGH WORK

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