

General Instructions

- (i) This question paper contains 26 questions. All questions are compulsory.
- (ii) It comprises 6 single-correct multiple-choice questions.
- (iii) Attempt every question; detailed solutions are provided in the companion solutions booklet.

1. Which of the following solutions will have a maximum boiling point?

- (A) 1% glucose in water
 - (B) 1% CaCl_2 in water
 - (C) 1% sucrose in water
 - (D) 1% NaCl in water
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2. The order of reaction for which the unit of the velocity (rate) constant is $\text{mol L}^{-1} \text{s}^{-1}$ is:

- (A) First order
 - (B) Second order
 - (C) Zero order
 - (D) None of these
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3. The most active metal among the following is:

- (A) Fe
 - (B) Zn
 - (C) Ni
 - (D) Cu
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4. The velocity (rate) constant of a second order reaction is generally expressed as:

- (A) mole litre second
 - (B) $\text{mole}^{-1} \text{litre}^{-1} \text{second}^{-1}$
 - (C) $\text{mole litre}^{-1} \text{second}^{-1}$
 - (D) $\text{mole}^{-1} \text{litre second}^{-1}$
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5. The distinction between aldehydes and ketones can be made using:

- (A) Conc. H_2SO_4
 - (B) Anhydrous ZnCl_2
 - (C) Schiff reagent
 - (D) Resorcinol
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6. In which cell does the following reaction take place?



- (A) Lead accumulator battery
- (B) Fuel cell
- (C) Dry cell
- (D) None of these

7. How will you obtain the following from phenol? (i) Picric acid (ii) Benzoquinone.

8. Write chemical equations of the Etard reaction and the Gattermann-Koch reaction.

9. Is the following reaction possible or not? Explain with reasons.



10. What is Lanthanide contraction? What are the consequences of Lanthanide contraction?

11. The velocity constant K for a first order reaction was found to be $5.5 \times 10^{-14} \text{ s}^{-1}$. Calculate the half life of this reaction.

12. Draw a diagram to show the splitting of d-orbitals in an octahedral crystal field.

13. 0.32 g of a new compound was dissolved in 25 g of water. The freezing point of this solution was found to be -0.201°C . Determine the molecular weight of this new compound. For water $K_f = 1.86^\circ\text{C kg mol}^{-1}$.

14. Explain with reasons:

(i) Transition metals show variable valency (variable oxidation states).

(ii) Copper is considered a transition metal even though it has a completely filled d-orbital ($3d^{10}$) in its +1 state.

15. Explain electrode potential and standard electrode potential. The following reaction takes place in a cell:



Calculate the standard cell potential E_{cell}° of the cell. Given: $E_{(\text{Zn} \rightarrow \text{Zn}^{2+})}^{\circ} = 0.76 \text{ V}$ and $E_{(\text{Co} \rightarrow \text{Co}^{2+})}^{\circ} = 0.28 \text{ V}$ (oxidation potentials).

16. Discuss the factors that affect the velocity (rate) of a chemical reaction.

17. Explain the type of isomerism shown by the following complexes and give the structure of the isomers:

(i) $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)](\text{NO}_3)_2$

(ii) $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$

(iii) $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^{-}$

18. Explain the structure of Nucleic Acid.

19. Explain the ring structure of glucose. What happens when D-glucose reacts with the following reagents? (i) Bromine water (ii) Hydroxylamine.

20. (i) Write the IUPAC name of the following coordination compounds: (a) $K_3[Cr(C_2O_4)_3]$ (b) $[Co(NH_3)_5(CO_3)]Cl$. (ii) Write the electronic configuration of the following: (a) Cr^{3+} (b) Cu.

21. Describe the method of identification of primary, secondary and tertiary amines. Classify the following compounds into primary, secondary and tertiary amines: (i) $C_6H_5NHCH_3$ (ii) $CH_3(CH_2)_2NH_2$ (iii) $(CH_3CH_2)_2NCH_3$.

22. (i) Explain the nature of the C-X bond. Give an example of a compound having sp^3 C-X bonding. (ii) Write chemical equations of the following: (a) Carbylamine reaction (b) Hinsberg reaction.

23. Describe two methods of preparation of alkyl halides. Also give equations. Explain the following reactions of alkyl halides with examples: (i) Nucleophilic substitution reaction (ii) Elimination reaction.

OR

Write chemical equations of chlorination, nitration, sulphonation, Friedel-Crafts reaction and Wurtz (Fittig) reaction of chlorobenzene.

24. Write chemical equations of three methods of preparation and two chemical properties of benzaldehyde.

OR

Write short notes on the following: (i) Aldol condensation (ii) Cross aldol condensation (iii) Cannizzaro reaction (iv) Hell-Volhard-Zelinsky reaction (v) Kolbe electrolysis.

25. Explain by giving four examples that the alkoxy group (-OR) activates the aromatic ring towards electrophilic substitution.

OR

Describe two methods of preparation of phenol. Give two reactions that demonstrate the acidic nature of phenol. Compare the acidity of phenol with that of ethanol.

26. Define Molal depression constant. 48 g of ethylene glycol ($C_2H_6O_2$) is dissolved in 600 g of water. Calculate (i) depression in freezing point and (ii) freezing point of the solution. [Given $K_f(\text{water}) = 1.86 \text{ }^\circ\text{C kg mol}^{-1}$]

OR

Define molality and explain mole fraction. Calculate the mole fraction of solute and solvent of a 20% aqueous $C_2H_6O_2$ solution.