

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 formula is used to calculate osmotic pressure?

- (A) $\pi = CRT$
- (B) $\pi = VRT$
- (C) $\pi = PVT$
- (D) $\pi = nRT$

2. What is the coordination number of Co in the complex $K_3[Co(C_2O_4)_3]$?

- (A) 3
- (B) 4
- (C) 5
- (D) 6

3. Which of the following is not a transition metal?

- (A) Cu
 - (B) Cr
 - (C) Fe
 - (D) Na
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4. Which of the following is an aldehyde?

- (A) $\text{CH}_3\text{--CO--H}$ (acetaldehyde)
 - (B) $\text{CH}_3\text{--CH}_2\text{--CO--CH}_3$ (butan-2-one)
 - (C) $\text{CH}_3\text{--CH}_2\text{--CO--CH}_2\text{--CH}_3$ (pentan-3-one)
 - (D) $\text{CH}_3\text{--CO--CH}_3$ (acetone)
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5. Which test is used to differentiate between primary, secondary and tertiary amines?

- (A) Brady test
 - (B) Tollen's test
 - (C) Hinsberg test
 - (D) Lucas test
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6. Match the vitamins given in Column (I) with the diseases caused by their deficiency in Column (II):

Column (I): A) Vitamin A, B) Vitamin B₁, C) Vitamin C, D) Vitamin K, E) Vitamin B₁₂.

Column (II): a) Increase in clotting time of blood, b) Night blindness, c) Beri-beri, d) Pernicious anaemia, e) Scurvy.

- (A) A-(d), B-(c), C-(e), D-(a), E-(b)
(B) A-(b), B-(c), C-(e), D-(a), E-(d)
(C) A-(a), B-(b), C-(c), D-(d), E-(e)
(D) A-(b), B-(a), C-(e), D-(d), E-(c)
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7. What is an ideal solution? Mention the characteristics of an ideal solution.

8. Transition metals, with a few exceptions, are extremely hard and less volatile. Explain.

9. Write the IUPAC names of the following coordination compounds:
(i) $[\text{Co}(\text{en})_2\text{ClBr}]\text{NO}_3$
(ii) $[\text{Ni}(\text{NH}_3)_4][\text{Pt}(\text{CN})_4]$

10. Write the reaction mechanism of the unimolecular nucleophilic substitution ($\text{S}_{\text{N}}1$) reaction of 2-bromo-2-methylpropane.

11. 45 g ethylene glycol is mixed with 600 g H_2O . Calculate the depression of freezing point of this solution. ($K_f = 1.86 \text{ K kg mol}^{-1}$)

12. Represent $\alpha\text{-D-(+)-glucopyranose}$ and $\beta\text{-D-(+)-glucopyranose}$ by Haworth structure.

13. Complete the following chemical reaction:



14. Write the effect of catalyst on the rate of reaction.

15. Write short notes on the following:

(i) Aldol condensation

(ii) Cannizzaro's reaction

16. What is the colligative property? Write an expression for the determination of molar mass of solute using relative lowering in vapour pressure.

17. For the following cell reaction, write the half reactions occurring at the anode and cathode and determine the electromotive force (EMF) of the cell:



(Given, $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$ and $E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40 \text{ V}$)

18. What is Lanthanoid contraction? Write in increasing order of basic nature of oxides (Ln_2O_3) and hydroxides $[\text{Ln}(\text{OH})_3]$ of Lanthanoids.

19. Write short notes on Etard reaction and Gattermann-Koch reaction. (2 + 2)

20. Explain the crystal field splitting in octahedral complexes with the help of a diagram. (4)

21. Explain Kohlrausch's law. If Λ_m° for NaCl, HCl and NaAc are 126.4, 425.9 and 91.0 S cm² mol⁻¹, calculate Λ° for HAc. (4)

22. Write short notes on the following: (i) Denaturation of proteins (ii) Name and structural formula of bases present in the nucleic acid. (2 + 2)

23. Write the products of the following reactions:

(i) Phenol (C₆H₅OH) + CHCl₃ + aq. NaOH → ?

(ii) Phenol (C₆H₅OH) + Zn / Δ → ?

OR

(i) Explain hydrogen bonding in o-nitrophenol and p-nitrophenol.

(ii) What is formed in the nitration of phenol with concentrated HNO₃?

24. Write short notes on the following:

(i) Gabriel phthalimide reaction

(ii) Hoffmann bromamide reaction

OR

Write the following chemical reactions:

(i) Reaction of ethanolic NH₃ with C₂H₅Cl.

(ii) Reaction of ammonia with benzyl chloride, followed by reaction with two moles of CH₃Cl.

25. Rate constant K for a first order reaction is found $5.5 \times 10^{-14} \text{ s}^{-1}$. Calculate the half-life of this reaction.

OR

For the following first order reaction — $\text{N}_2\text{O}_5(\text{g}) \rightarrow 2\text{NO}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g})$ — the initial concentration of N_2O_5 at 318 K was $1.24 \times 10^{-2} \text{ mol L}^{-1}$. After 60 min it became $0.20 \times 10^{-2} \text{ mol L}^{-1}$. Calculate the rate constant at 318 K.

26. Reactivity of haloarene increases if an electron withdrawing group (— NO_2) is present at the ortho or para position. Explain it with an example and give the reaction mechanism.

OR

Write short notes on the applications of the following: (i) DDT (ii) Freon (iii) Carbon tetrachloride (iv) Chloroform (v) Dichloromethane.