



Attempt all questions before checking the answer key. Specify whether basicity comparisons refer to aqueous solution or the gas phase. Include reaction conditions.

A. Very short answers - 1 mark each

1. Classify $(\text{CH}_3)_2\text{NH}$ as a primary, secondary or tertiary amine.
2. Name $\text{CH}_3\text{CH}_2\text{NH}_2$ by IUPAC rules.
3. Why is aniline less basic than methylamine in aqueous solution?
4. What is diazotisation?
5. Which class of amines gives the carbylamine test?
6. Why are aromatic diazonium salts usually prepared at 273–278 K?

B. Short answers / practice - 2 marks each

7. Write preparation of ethylamine by reduction of ethanenitrile, checking the carbon count and correct name of the product.
8. Write Hofmann bromamide degradation of ethanamide and identify the product.
9. Explain why Gabriel synthesis does not prepare primary aromatic amines such as aniline.
10. Write the reaction of aniline with bromine water and state the observation.
11. Write the carbylamine reaction of methylamine.
12. Explain why acetylation of aniline is useful before nitration.
13. Does a secondary amine give the carbylamine test?
14. Name $(\text{CH}_3)_3\text{N}$.
15. How many carbon atoms remain after Hofmann degradation of propanamide?
16. Can aniline be prepared by the usual Gabriel synthesis?
17. Predict product of benzene diazonium chloride with CuCN .
18. Explain why methylamine is more basic than aniline in aqueous solution.

C. Short answers - 3 marks each

19. Arrange ammonia, methylamine, dimethylamine and trimethylamine by basicity in aqueous solution, explaining alkyl and solvation effects.
20. Distinguish primary, secondary and tertiary amines using Hinsberg's test, including solubility behaviour.

21. Write benzene diazonium chloride reactions producing phenol, chlorobenzene and iodobenzene.

22. Give conversions: nitrobenzene to aniline, aniline to benzene diazonium chloride, and that salt to benzene.

23. Explain why aniline undergoes ortho/para substitution readily but direct nitration in strongly acidic medium can give appreciable meta product.

24. Write azo coupling of benzene diazonium chloride with phenol in alkaline medium, indicating the major coupling position.

D. Long answers - 5 marks each

25. Compare preparation of amines by ammonolysis of haloalkanes, reduction of nitriles and Hofmann bromamide degradation. Discuss carbon-number changes and limitations with equations.
26. Explain basicity of aliphatic and aromatic amines using inductive effect, resonance and solvation. Compare aniline, p-nitroaniline and p-methylaniline and justify the order.
27. Describe diazotisation and show how benzene diazonium chloride provides routes to fluorobenzene, chlorobenzene, phenol, benzonitrile and benzene, giving reagents.
28. A compound $\text{C}_3\text{H}_9\text{N}$ gives a carbylamine test and forms propan-1-ol with nitrous acid. Identify it, write both reactions and show its preparation from a nitrile and from an amide.
29. Write routes for aniline to p-bromoaniline, aniline to p-nitroaniline and nitrobenzene to phenol, explaining the need for protection or diazonium chemistry at the relevant steps.
30. Three isomeric amines of formula $\text{C}_3\text{H}_9\text{N}$ are propan-1-amine, N-methylethanamine and trimethylamine. Distinguish their classes and responses to nitrous acid and Hinsberg reagent, giving products or observations.

ANSWER KEY - Numerical / short answers

13) No; only primary amines do. 14) N,N-Dimethylmethanamine (trimethylamine). 15) 2; product ethanamine. 16) No; aryl halides resist the required $\text{S}_\text{N}2$ step. 17) Benzonitrile. 28) Propan-1-amine; reduce propanenitrile or use Hofmann degradation of butanamide.