



Attempt all questions before checking the answer key. Draw complete structures where needed; write reagents, conditions and observations for reactions/tests.

A. Very short answers - 1 mark each

1. Define a homologous series.
2. What is a functional group?
3. Name $\text{CH}_3\text{CH}_2\text{CHO}$ by IUPAC rules.
4. Distinguish a nucleophile from an electrophile.
5. What type of bond cleavage produces free radicals?
6. Define resonance in an organic molecule.

B. Short answers / practice - 2 marks each

7. Name $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$ and $\text{CH}_3\text{COCH}_2\text{CH}_3$ by IUPAC rules.
8. Draw all chain isomers of C_5H_{12} and name them.
9. Distinguish inductive effect from resonance effect.
10. Identify nucleophiles/electrophiles among OH^- , CN^- , H^+ and BF_3 , giving reasons.
11. Explain why a tertiary carbocation is generally more stable than a primary carbocation.
12. State the principles of simple distillation and chromatography.
13. How many chain isomers does C_4H_{10} have? Draw them.
14. Can a nucleophile donate an electron pair?
15. Find carbon percentage in CH_4 using $\text{C}=12, \text{H}=1$.
16. Name $\text{CH}_3\text{CH}_2\text{COOH}$.
17. What is the hybridisation of carbon in a methyl carbocation?
18. Explain why a benzyl carbocation is resonance-stabilised.

C. Short answers - 3 marks each

19. Draw functional isomers with formula $\text{C}_3\text{H}_6\text{O}$, identify their functional groups and name them.
20. Explain homolytic and heterolytic cleavage using a C-Cl bond. Show the charges or unpaired electron on each product.
21. Compare the acidic strengths of CH_3COOH , ClCH_2COOH and CCl_3COOH using inductive effects.

22. Describe the sodium-fusion test for nitrogen and explain why fusion is necessary.

23. An organic sample of 0.30 g gives 0.44 g CO_2 and 0.18 g H_2O on complete combustion. Calculate percentages of carbon and hydrogen; use C 12, H 1, O 16.

24. Choose suitable purification methods for camphor mixed with salt, two miscible liquids with close boiling points and a heat-sensitive steam-volatile liquid. Explain each choice.

D. Long answers - 5 marks each

25. Explain structural isomerism: chain, position, functional and metamerism. Give a named pair for each, showing structures and checking identical molecular formulae within each pair.
26. Explain inductive effect, resonance and hyperconjugation with one structural example each. Apply them to compare the stability of methyl, primary, secondary, tertiary and benzyl carbocations qualitatively.
27. Describe qualitative tests for nitrogen, sulphur and halogens in organic compounds using sodium extract. Include key equations and the reason for acidifying the halogen-test solution appropriately.
28. Explain crystallisation, fractional distillation, steam distillation and chromatography. State which physical property each uses and give a suitable example for each.
29. A compound contains only C, H and O. A 0.46 g sample gives 0.88 g CO_2 and 0.54 g H_2O . Find composition and empirical formula; if its molar mass is 46 g/mol, find the molecular formula and draw two functional isomers.
30. Classify substitution, addition, elimination and rearrangement reactions. Illustrate the first three using balanced organic equations; explain the role of bond cleavage and attacking reagents in reaction mechanisms.

ANSWER KEY - Numerical / short answers

13) Two: butane and 2-methylpropane. 14) Yes. 15) 75%. 16) Propanoic acid. 17) sp^2 . 23) Carbon 40.0%; hydrogen 6.67%. 29) C 52.17%, H 13.04%, O 34.78%; empirical=molecular $\text{C}_2\text{H}_6\text{O}$; ethanol and methoxymethane.