3.3.6 Organic Analysis

3.3.6.1 *Identification of functional groups by test-tube reactions.*

Alkene: bromine water decolourised (orange → colourless).

Alcohol: burns cleanly; reacts with PCl5 → steamy white HCl fumes (misty white in cold air).

Aldehyde: Fehling's = brick-red ppt; Tollens' = silver mirror; K2Cr2O7/H2SO4 goes orange → green.

Ketone: no reaction with Fehling's, Tollens', or K2Cr2O7.

Carboxylic acid: turns blue litmus red; fizzes with Na2CO3 (CO2 produced — limewater goes milky).

3.3.6.2 *Mass spectrometry: molecular formula from precise atomic masses. High-resolution MS. Common fragment losses.*

High-resolution mass spectrometry measures Mr to many decimal places — distinguishes compounds with the same integer Mr.

M■ peak = molecular ion → gives Mr of the molecule.

Common fragment losses: –15 (CH3), –17 (OH), –28 (CO), –29 (CHO), –31 (CH2OH), –45 (OC2H5).

Fragmentation pattern: characteristic for each compound — used alongside other data for structure determination.

3.3.6.3 *Infrared spectroscopy: bond absorptions, fingerprinting, functional group identification. Global warming link.*

Key IR absorptions (wavenumber, cm■¹):

O–H alcohol: broad, ~3230–3550. O–H acid: very broad, ~2500–3300.

C=O (carbonyl): ~1680–1750. C–H: ~2850–2960. N–H: ~3300–3500.

Fingerprint region (below ~1500 cm■¹): unique to each compound. Used for positive identification by comparison with database.

Global warming: CO2, CH4, H2O absorb IR radiation emitted by Earth's surface. Their bonds vibrate at frequencies matching IR wavelengths → heat is trapped in the atmosphere (greenhouse effect).

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Tests for Alcohol, Aldehyde, Alkene and Carboxylic Acid

Method: prepare small samples in clean test tubes.

1. Alkene test: add bromine water. Orange → colourless = alkene present.

2. Alcohol test: add a few drops to PCl_5. Steamy white fumes = –OH present. Or warm with $K_2Cr_2O_7/H_2SO_4$ — orange → green = primary or secondary alcohol.

3. Aldehyde test: warm with Fehling's solution — brick-red ppt = aldehyde. Or warm Tollens' in clean glass tube — silver mirror = aldehyde. Ketones give no reaction.

4. Carboxylic acid test: add Na_2CO_3. Effervescence (CO_2, limewater test) = carboxylic acid. Blue litmus turns red.

5. Record observations in a table.

Common errors: cross-contamination; not warming Fehling's/Tollens' enough; dirty glassware for Tollens'; confusing colour change with precipitate.

Improvements: clean test tubes (especially for Tollens'); warm gently in water bath; consistent reagent volumes; systematic order.