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Functional Group Identification Tests

Experiment 3 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To select and interpret tests for the eleven functional classes listed in the syllabus.

Principle

Functional-group reactions provide class evidence. Identification requires a coherent pattern, appropriate controls and an independent physical or derivative confirmation; no universal colour test identifies every member of a class.

Requirements

- Teacher-assigned unknowns and known comparison compounds; clean tubes and separate portions.
- Prepared reagents for the selected tests, laboratory method sheet and prescribed fume-hood setup.

Procedure

1. Select a branch

Use appearance, solubility and elemental results to choose the relevant functional-group checks.

2. Run controls

Perform the chosen test on a known positive and the appropriate negative/reagent blank under the same conditions.

3. Test fresh portions

Follow the institution's reagent order, quantity and heating conditions; do not combine successive test mixtures.

4. Record the observation

Describe the colour, precipitate, gas or solubility before writing an inference. Note timing and any failure of the control.

5. Confirm

Select a second independent check and physical-constant/derivative evidence before assigning the candidate.

Test Guide

Carboxylic acids

- Test: Bicarbonate reaction.
- Supporting observation: Gas evolution and dissolution support formation of a carboxylate.
- Interpretation limit: An acid-base result is class evidence; confirm with physical data and an appropriate derivative.

Pharmaceutical Organic Chemistry

Phenols

- Test: Ferric-chloride complex on a suitable solution.
- Supporting observation: Violet, blue, green or other characteristic complex may develop.
- Interpretation limit: Enols and other complexing substances can interfere; not every phenol gives the same colour.

Amides

- Test: Instructor-controlled alkaline hydrolysis and product checks.
- Supporting observation: Suitable amides yield a carboxylate and an ammonia/amine-related product.
- Interpretation limit: Do not sniff evolved gas; use the assigned indicator/product test and a control.

Amines

- Test: Acid solubility and selected Hinsberg or aromatic-amine test.
- Supporting observation: Salt formation supports basicity. Hinsberg behaviour can help distinguish some primary, secondary and tertiary amines.
- Interpretation limit: Not all amines have identical solubility or reactivity; aromatic-primary tests do not apply to every amine.

Aldehydes

- Test: Prepared 2,4-DNP followed by fresh instructor-led Tollens.
- Supporting observation: Carbonyl derivative forms; an appropriate aldehyde may reduce the silver reagent.
- Interpretation limit: Tollens is prepared fresh and residues are removed immediately by the instructor; do not store it.

Ketones

- Test: Prepared 2,4-DNP with aldehyde-discrimination tests.
- Supporting observation: A hydrazone precipitate supports a reactive carbonyl; ordinary ketones are usually Tollens-negative.
- Interpretation limit: Alpha-hydroxy ketones and other reducing substances may give exceptions.

Alcohols

- Test: Assigned ceric reagent and, where appropriate, Lucas comparison.
- Supporting observation: A reagent-specific colour response supports alcohol; substitution-rate comparison is useful for selected aliphatic alcohols.
- Interpretation limit: Benzylic/allylic primary alcohols may react rapidly; Lucas timing is not a universal classification.

Esters

- Test: Hydroxamic-acid formation followed by ferric reagent.
- Supporting observation: A red/violet complex after the prescribed reaction can support an ester.
- Interpretation limit: Use reagent blanks; coloured starting material and other reactive groups can interfere.

Pharmaceutical Organic Chemistry

Aromatic hydrocarbons

- Test: Solubility, supplied spectrum and physical constant.
- Supporting observation: A neutral, non-polar pattern plus aromatic spectral evidence supports this class.
- Interpretation limit: A sooty flame is supporting at most and is not a safe universal test for unknowns.

Halogenated hydrocarbons

- Test: Prepared fusion-extract halogen test; supplied structural evidence.
- Supporting observation: A silver-halide reaction supports halogen in the compound.
- Interpretation limit: The elemental result does not identify the carbon skeleton or establish the halogen position.

Nitro compounds

- Test: Instructor-demonstrated reduction followed by amine evidence.
- Supporting observation: A changed response after the assigned reduction can support a nitro group.
- Interpretation limit: Nitrogen detection alone is insufficient; other reducible groups and reduction failure must be considered.

Observations and Record

Test / control	Observed result	Class inference / limitation
_____	_____	_____
_____	_____	_____

Result

State the functional class supported by the complete pattern and the independent confirmation used.

Precautions

- Use instructor-assigned quantities and prepared test reagents in the designated laboratory; wear eye protection and use the required fume hood.
- Do not taste unknowns, smell containers directly, burn unknown halogenated material or heat sealed vessels.
- Use fresh separate portions for independent tests. A single colour reaction does not establish molecular identity.
- Use commercially prepared wet 2,4-DNP reagent; do not dry or isolate the reagent. Diazonium, silver-reagent and reduction demonstrations follow the instructor's controlled method.

Viva Questions and Answers

1. Does 2,4-DNP distinguish aldehydes from ketones?

No. It supports a reactive carbonyl and requires additional discrimination.

2. Why test a reagent blank?

It shows whether the reagent itself contributes colour or precipitate.

3. Why use several kinds of evidence?

Class tests and physical constants can overlap, while their combined pattern is more informative.

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