

Core practical 7: Identify unknown organic liquids and inorganic solids

Objective	
<ul style="list-style-type: none"> To identify several unknown colourless liquids and inorganic solids 	
Safety	Specification links
<ul style="list-style-type: none"> Wear eye protection. Unknown organic liquids must be treated as harmful and flammable. Unknown inorganic solids must be regarded as harmful. Potassium dichromate(VI) is corrosive, oxidising and carcinogenic. Potassium manganate(VII) is an oxidising agent. Ethanol is flammable. Silver nitrate solution is corrosive. Chlorine water is toxic. Dilute ammonia gives off an irritating gas. 0.1 mol dm⁻³ Barium chloride solution is harmful. 	<ul style="list-style-type: none"> Practical techniques 2, 4, 11 CPAC 1a, 2a, 3a, 3b, 4a
Procedure	Notes on procedure
<p>Part 1</p> <p>Perform the following tests on each of the organic liquids, A, B, and C:</p> <ol style="list-style-type: none"> Place 10 drops of each liquid into three separate test tubes. Add a 1 cm depth of bromine water to each test tube and shake the mixture. Place 10 drops of each liquid into three separate test tubes. Add 1 cm³ acidified potassium dichromate to each test tube and warm the mixture in a 60 °C water bath for 5 minutes. Place 10 drops of each liquid into three separate test tubes. Add 1 cm³ of Fehling's solution to each test tube and heat the resultant in the water bath. Place 10 drops of each liquid into three separate test tubes. Add 1 cm³ of ethanol and 1 cm³ of dilute sodium hydroxide solution to each test tube and warm the mixture in a water bath for five minutes. Acidify each mixture with dilute nitric acid and then add 5 drops of silver nitrate solution. 	<ul style="list-style-type: none"> This may be conducted over two lessons, if necessary.

Part 2

Perform the following tests on each of the inorganic solids, X, Y, and Z:

1. Conduct flame tests for each of the three solids.
2. Dissolve a spatula full of each solid in three separate test tubes containing 10 cm³ distilled water. Split each solution into three portions.
 - (a) To the first portion, add 5 cm³ dilute nitric acid followed by 10 drops of silver nitrate solution. Add dilute ammonia solution.
 - (b) To the second portion, add 5 cm³ dilute nitric acid followed by 10 drops of barium chloride solution.
 - (c) To the third portion, add 2 cm³ of chlorine water.

Answers to questions

1. **Test 1** B produces a 1,2-dibromo compound
Test 2 A produces a ketone/aldehyde/carboxylic acid
Test 3 No reactions
Test 4 C produces a bromoalkane
2. $\text{CO}_3^{2-} + 2\text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
 $\text{Ag}^+ + \text{Br}^- \rightarrow \text{AgBr}$
 $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$
 $2\text{Br}^- + \text{Cl}_2 \rightarrow \text{Br}_2 + 2\text{Cl}^-$
3. to destroy/react with any carbonate ions
so that a precipitate of silver carbonate does not form.

Sample data

Substance	Flame test	Reaction with nitric acid followed by silver nitrate solution and dilute ammonia	Reaction with nitric acid followed by barium chloride solution	Reaction with chlorine water
X	red-orange	no change with acid cream precipitate with silver nitrate (which did not dissolve in dilute ammonia)	no change	orange solution formed
Y	yellow	no change	no change with acid white precipitate with barium chloride solution	no change
Z	lilac	fizzed then no further change	fizzed then no further change	slight fizzing

Part 1

Substance A reacts only in test 2, resulting in a colour change from orange to green.

Substance B reacts only in test 1, resulting in a colour change from orange to colourless.

Substance C reacts only in test 4, resulting in the formation of a cream precipitate.

Part 2

X gives a red-orange flame test

Y gives a yellow flame test

Z gives a lilac flame test

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- Unknown inorganic solids must be regarded as harmful.
- Potassium dichromate(VI) is corrosive, oxidising and carcinogenic.
- Potassium manganate(VII) is an oxidising agent.
- Ethanol is flammable.
- Silver nitrate solution is corrosive.
- Chlorine water is toxic.
- Dilute ammonia gives off an irritating gas.
- 0.1 mol dm⁻³ Barium chloride solution is harmful.

All the maths you need

- Recognise and make use of appropriate units in calculations.
- Use ratios, fractions and percentages.
- Translate information between graphical, numerical and algebraic forms.
- Plot two variables from experimental or other data.

Equipment

- | | |
|----------------------------|-------------------------------------|
| • dropping bottle of A | • acidified potassium dichromate |
| • dropping bottle of B | • apparatus to conduct a flame test |
| • dropping bottle of C | • silver nitrate solution |
| • solid X | • ethanol |
| • solid Y | • chlorine water |
| • solid Z | • dilute ammonia solution |
| • bromine water | • test tubes |
| • spatula | • 250 ml beaker |
| • distilled water | • nitric acid |
| • Fehling's solution | • dilute sodium hydroxide |
| • barium chloride solution | • kettle |

Procedure

Part 1

Perform the following tests on each of the organic liquids, A, B, and C:

- Place 10 drops of each liquid into three separate test tubes. Add a 1 cm depth of bromine water to each test tube and shake the mixture.
- Place 10 drops of each liquid into three separate test tubes. Add 1 cm³ acidified potassium dichromate to each test tube and warm the mixture in a 60 °C water bath for 5 minutes.
- Place 10 drops of each liquid into three separate test tubes. Add 1 cm³ of Fehling's solution to each test tube and heat the resultant in the water bath.

4. Place 10 drops of each liquid into three separate test tubes. Add 1 cm^3 of ethanol and 1 cm^3 of dilute sodium hydroxide solution to each test tube and warm the mixture in a water bath for five minutes. Acidify each mixture with dilute nitric acid and then add 5 drops of silver nitrate solution.

Part 2

Perform the following tests on each of the inorganic solids, X, Y, and Z:

1. Conduct flame tests for each of the three solids.
2. Dissolve a spatula full of each solid in three separate test tubes containing 10 cm^3 distilled water. Split each solution into three portions.
 - (a) To the first portion, add 5 cm^3 dilute nitric acid followed by 10 drops of silver nitrate solution. Add dilute ammonia solution.
 - (b) To the second portion, add 5 cm^3 dilute nitric acid followed by 10 drops of barium chloride solution.
 - (c) To the third portion, add 2 cm^3 of chlorine water.

Analysis of results

1. Tabulate your results for Part 1 and Part 2.
2. Which functional groups are in compounds A, B, and C?
3. Identify the inorganic solids X, Y and Z.

Learning tips

- Make sure you know the flame test colours for the ions of Group 1 and Group 2 elements.
- Negative test results are important as they inform you what your unknown substance is not.

Questions

1. State the type of organic liquid product that forms for any of the reactions that occur during tests 1 to 4.
2. Write ionic equations for the reactions of X, Y and Z in Part 2, test 2.
3. Why is nitric acid added in the test for halide ions using silver nitrate?

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- Ethanol is flammable.
- Silver nitrate solution is corrosive.
- Chlorine water is toxic.
- Dilute ammonia gives off an irritating gas.
- 0.1 mol dm⁻³ Barium chloride solution is harmful.

Equipment per student/group	Notes on equipment
dropping bottle of A	Dropping bottles labelled A should contain propan-1-ol.
dropping bottle of B	Dropping bottles labelled B should contain cyclohexene. The organic liquid must be dried before the lesson. Stand over anhydrous calcium chloride to dry.
dropping bottle of C	Dropping bottles labelled C should contain 2-bromobutane. The organic liquid must be dried before the lesson. Stand over anhydrous calcium chloride to dry.
solid X	Calcium bromide
solid Y	Sodium sulfate
solid Z	Potassium carbonate
bromine water	
distilled water	
barium chloride solution	0.1 mol dm ⁻³ is sufficient.
Fehling's solution	
spatula	
acidified potassium dichromate	
apparatus to conduct a flame test	
silver nitrate solution	
ethanol	
chlorine water	
dilute ammonia solution	
test tubes	
250 ml beaker	

kettle	Students need access to a source of hot water – a kettle is ideal.
nitric acid	0.5 or 1 mol dm ⁻³ is sufficient.
dilute sodium hydroxide	0.5 mol dm ⁻³ is sufficient.

Notes