

Qualitative & Quantitative Analysis

Question Paper 1

Level	Pre U
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Qualitative and quantitative analysis
Booklet	Question Paper 1

Time Allowed: 43 minutes

Score: /36

Percentage: /100

Grade Boundaries:

1. (a) Chemists have recently established that four molecules of water are required for the dissociation of a single molecule of HCl (reported in *Science*, 2009).

Given that 1.00 dm^3 of water contains 55.6 mol of H_2O , calculate the maximum mass of hydrogen chloride, HCl , that should therefore dissociate in 1.00 dm^3 of water.

..... g [1]

- (b) Commercial concentrated hydrochloric acid, $\text{HCl}(\text{aq})$, fumes strongly on exposure to moist air and so is also known as ‘fuming hydrochloric acid’.

1.00 cm^3 of fuming hydrochloric acid was transferred with a graduated pipette to a 100 cm^3 volumetric flask. The volume was made up to 100 cm^3 with deionised water. The solution was labelled **F**. 10.0 cm^3 of solution **F** was neutralised by 24.75 cm^3 of $0.0500 \text{ mol dm}^{-3}$ of aqueous sodium hydroxide.

Calculate the concentration of HCl in the fuming hydrochloric acid in mol dm^{-3} . Give your final answer to **three** significant figures.

..... mol dm^{-3} [4]

(c) Historically, hydrochloric acid, $\text{HCl}(\text{aq})$, was produced by mixing concentrated sulfuric acid with sodium chloride and dissolving the gas produced in water.

(i) Write an equation for the production of gaseous hydrogen chloride by this method.

..... [1]

Hydrobromic acid, $\text{HBr}(\text{aq})$, cannot be prepared in the same way as hydrochloric acid because a redox reaction occurs between hydrogen bromide and sulfuric acid.

(ii) Write a balanced equation for the reaction of hydrogen bromide with sulfuric acid.

..... [1]

(iii) Identify the oxidising agent in the reaction. Justify your answer using oxidation numbers.

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..... [2]

(d) (i) State and explain the trend in bond strength for the gases hydrogen chloride, hydrogen bromide and hydrogen iodide, in that order.

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..... [1]

(ii) State and explain the trend in acidic strength of hydrochloric acid, hydrobromic acid and hydroiodic acid.

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..... [1]

(iii) Describe and explain the variation in boiling point of the gases hydrogen fluoride, hydrogen chloride, hydrogen bromide and hydrogen iodide.

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..... [2]

[Total: 13]

2. (a) The following six organic liquids are in unlabelled bottles.

1-chloropropane

propan-1-ol

propanal

1-iodopropane

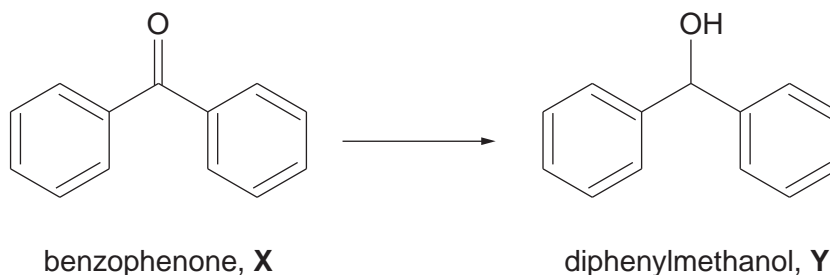
propan-2-ol

hexane

Propose a series of **wet chemical** tests, using a flowchart or otherwise, whose results could be used to identify each of the organic liquids.

Your answer should include the tests, observations and deductions. You have enough of the samples for multiple tests, and access to reagents commonly available in school laboratories.

- (b) Benzophenone, **X**, is a white crystalline solid with a melting point of 48 °C. It can be reduced to form diphenylmethanol, **Y**, a white solid with a melting point of 69 °C.



Outline a laboratory scale method to prepare a **pure** sample of **Y** from a sample of **X**.

You will need to specify:

- a suitable reducing agent
- the experimental techniques involved
- solvents used at each stage
- how the raw product is separated
- how the raw product is purified
- how the purity of the product is checked

Specific quantities are not required. Diagrams are not necessary.

The following solvents are available: water, ethanol, ether (ethoxyethane) and hexane.

The solubility of **X** and **Y** in the solvents is shown in Table 7.1.

Table 7.1

solvent	solubility of X	solubility of Y
water	insoluble	slightly soluble
ethanol	very soluble	very soluble
ether (ethoxyethane)	very soluble	very soluble
hexane	slightly soluble when cold appreciably soluble when hot	slightly soluble when cold appreciably soluble when hot

You may wish to express your answer as a series of bullet points.

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