Chemical analysis Revision materials

Checklist

Key points:	☺	☹
Chemical analysis		
Hw to use melting point data to distinguish pure from impure substances		
How to identify examples of useful mixtures called formulation.		
How chromatography can be used to distinguish pure substances from impure substances		
How paper chromatography separates mixtures		
How to interpret chromatograms		
How to determine the R_F values from chromatograms		
Know the test and the positive results for the gases; hydrogen, oxygen, carbon dioxide and chlorine		

<u>Pure substances and formulation</u>

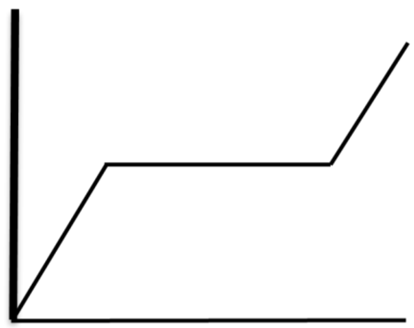
In chemistry, a **pure substance** is a **single element or compound not mixed** with any other substance.

An impure substance is a mixture of two or more different elements and compounds.

Pure substances have **specific** melting and boiling temperatures.

Melting point and boiling points data can be used to distinguish pure substances(specific fixed points) from mixtures(that melt o boil over a range of temperatures).

These can be used to distinguish pure substances from mixtures.



Melting point of a pure substance

Melting point of an impure substance

A **formulatio**n is a **mixture** that has been designed as a useful product.

Formulations are made by mixing the components in carefully measured quantities to ensures that the product has the required properties. Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods

<u>Exam practice 1</u>

Q1 (e) Fertilisers are formulations containing nitrogen.

What is a formulation?

____

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(1)

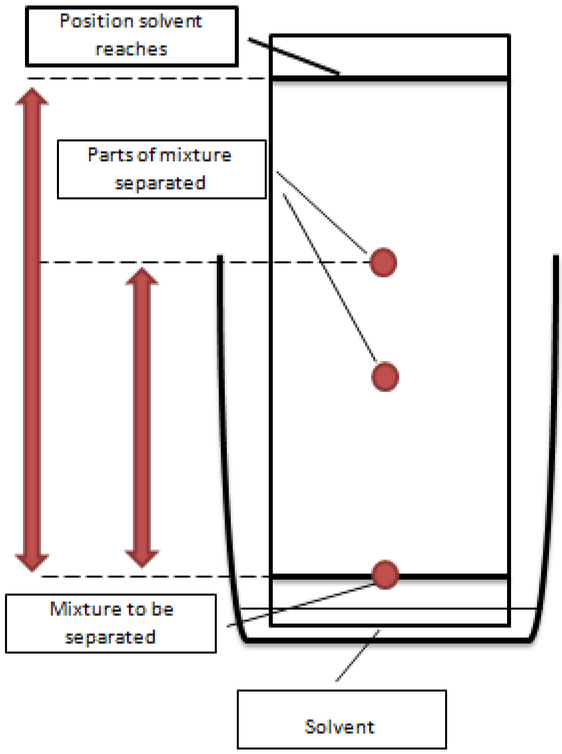
Chromatography (Required practical)

Chromatography can be used to **separate mixtures.**

Chromatography involves a **stationary phase** and a **mobile phase**.

Stationary phase is the filter paper and the mobile phase is the solvent used.

The mobile phase moves through the stationary phase, carrying components of the mixture with it. Each component in the mixture will have a different attraction for the mobile phase and stationary phase. A substance with a stronger forces of attraction between itself and the mobile phase will be carried a greater distance. A substance with a stronger attraction force to the stationary phase will not travel as far in the same time.



The ratio of the distance moved by a compound (centre of spot from origin) can be expressed as it's R_f value:

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

When calculating the R_f value remember the **solvent will always travel further than the substance** so the **R_f value can never be greater than 1**.

Different compounds have different Rf values in different solvents, which can be used to help identify the compounds. A pure compound will produce a single spot in all solvents.

What may they ask you about?

- Why must the start line be drawn in pencil? (*because pencil does not smudge/run in the solvent whereas pen would*)
- Why does there need to be a lid? (*to stop the solvent from evaporating*)
- Measure the R_f value – be accurate. Compare different substances with different R_f values. See what substances are contained in certain mixtures
- Sources of error, resolution or measurements etc

Exam practice 2

Q1.

The students then used paper chromatography to investigate the coloured pigments in a red cabbage leaf.

(d) Complete the sentences.

Choose answers from the box.

distil	**evaporate**	**filter**	**mobile**	**separate**	**solid**

Chromatography can be used to ___________________________ mixtures.

In paper chromatography, the paper is part of the stationary phase.

The solvent is called the ___________________________ phase.

(2)

Table 1 shows the students' results.

The distance each pigment moved was measured from the start line.

	Distance moved in mm	**R_f value**
Yellow-green pigment	17	**X**
Yellow pigment	46	0.42
Orange pigment	100	0.91

The R_f value is calculated using the equation:

$$R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent}}$$

(e) The solvent moved 110 mm from the start line.

Calculate R_f value **X** in **Table 1**.

Give your answer to 2 significant figures.

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R_f value **X** = ______________________

(2)

(f) The known ranges of R_f values of some pigments are shown in **Table 2**.

Table 2

Pigment	**R_f value range**
Carotene	0.89 to 0.98
Chlorophyll a	0.24 to 0.30
Chlorophyll b	0.20 to 0.26
Xanthophyll	0.04 to 0.28

The R_f value for the orange pigment in red cabbage leaves is 0.91

What is this orange pigment most likely to be?

Tick **one** box.

Carotene ☐

Chlorophyll a ☐

Chlorophyll b ☐

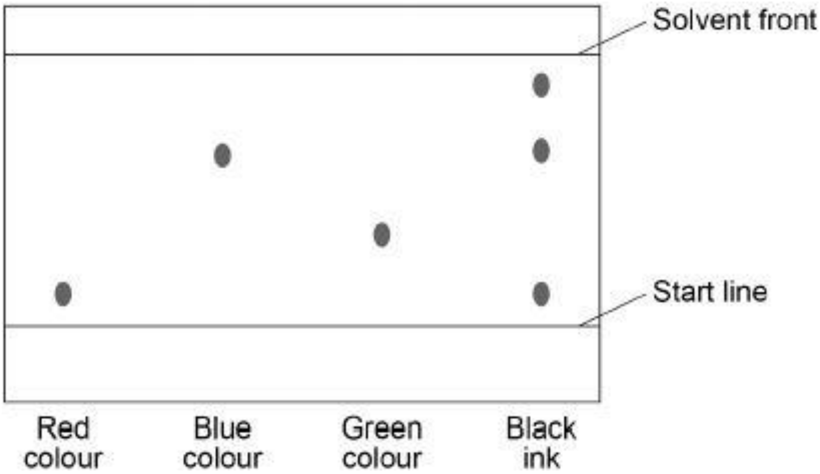
Xanthophyll ☐

(1)
(Total 8 marks)

Q2.

A student used paper chromatography to identify the colours in a black ink.

The diagram below shows the student's results.



(a) What colours are in the black ink?

____

____

(2)

(b) Suggest which colour is least soluble in the solvent.

Give a reason for your answer.

Colour ____________________

Reason ____

____

(2)

(c) Use the diagram above to complete the table below.

	Distance in mm
Distance moved by green colour	
Distance moved by solvent	

Calculate the R_f value for the green colour.

Use the equation:

$$R_f = \frac{\text{distance moved by green colour}}{\text{distance moved by solvent}}$$

____

____

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R_f value = ______________________

(4)

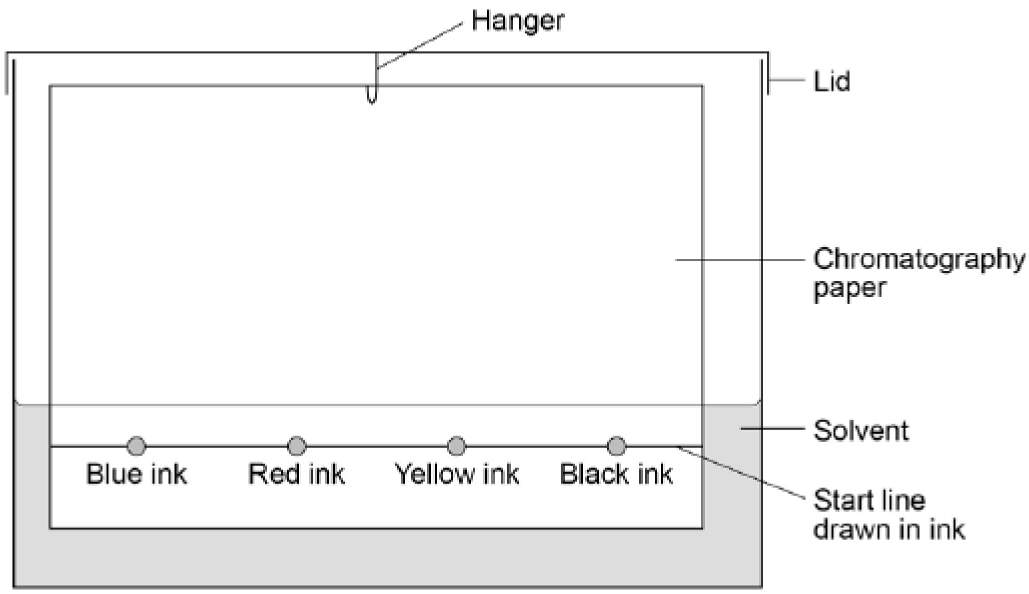
(Total 8 marks)

Q3.

A student used paper chromatography to investigate the colours in different inks.

Figure 1 shows the apparatus the student used.

Figure 1



(a) The student made **two** mistakes in setting up the apparatus.

Identify the **two** mistakes.

Describe the problem each mistake would cause.

Mistake 1 ____

Problem ____

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Mistake 2 ____

Problem ____

____

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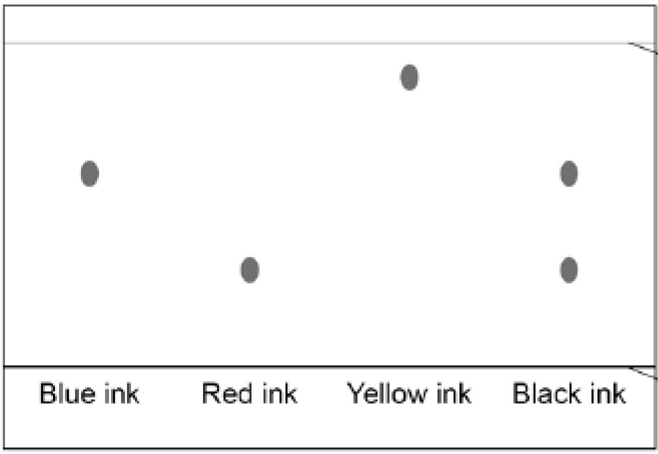
(4)

(b) The student then set up the apparatus without making any mistakes.

Figure 2 shows his results.

Figure 2



What colours are in the black ink?

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____

(1)

(c) Which of the inks is the most soluble in the solvent?

Give a reason for your answer.

Ink ____

Reason ____

____

(2)

(d) Use **Figure 2** to complete the table below, then calculate the Rf value for red ink.

	Distance in mm
Distance moved by red ink	____________
Distance from start line to solvent front	____________

The R_f value for red ink is calculated using the equation.

$$R_f = \frac{\text{distance moved by red ink from the start line}}{\text{distance moved by solvent from the start line}}$$

Give your answer to two significant figures.

____

____

R_f value = ____________________

(5)

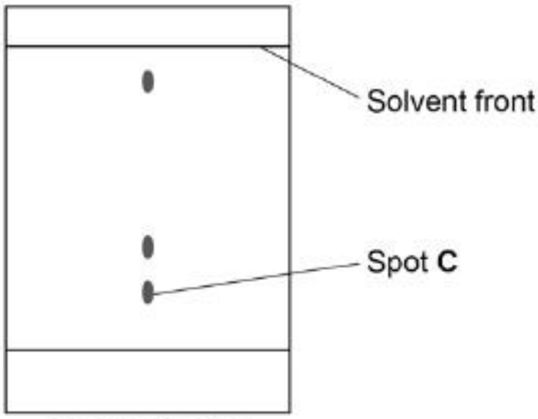
(e) How can you tell from **Figure 2** that the R_f value for the blue ink is greater than the

Rf value for the red ink?

(1)
(Total 13 marks)

Q4.

The diagram shows a chromatogram for a food colouring.



(a) How does the chromatogram show that the food colouring is a mixture?

(1)

(b) A student makes measurements for spot **C**.

The table shows the results.

	Distance in mm
Distance moved by spot **C**	7
Distance moved by solvent	39

Calculate the R_f value for spot **C**.

Give your answer to 2 significant figures.

Use the results in the table.

R_f value = ____________________

(3)

(c) Plan a chromatography experiment to investigate the colours in an ink.

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(6)

(Total 10 marks)

Testing for gases

You must learn all of these tests, including how the gas is tested and the positive result that proves that the chemical is the gas you are testing for.

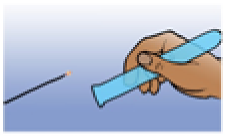
Test For Hydrogen

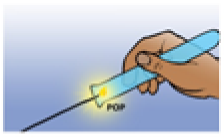
The reaction between zinc and dilute acid

Zinc + sulfuric acid $\longrightarrow$ zinc sulfate + hydrogen

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

The test for hydrogen uses a **burning splint** held at the open end of a test tube of the gas. Hydrogen burns rapidly with a **pop sound**.





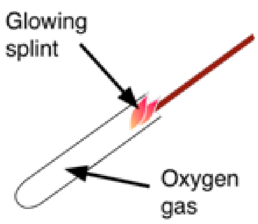
Test For Oxygen

A convenient way to make oxygen gas to test is the decomposition of hydrogen peroxide solution, with a little manganese (IV) oxide added as a catalyst.

Hydrogen peroxide $\longrightarrow$ water + oxygen

$2H_2O \longrightarrow 2H_2O + O_2$

The test for oxygen uses a **glowing splint** inserted into a test tube of the gas. The splint **relights** in oxygen.



Test For Carbon Dioxide

Carbon dioxide gas can be produced and tested by reacting marble chips (calcium carbonate) and diluted hydrochloric acid.

Calcium carbonate + hydrochloric acid ⟶ calcium chloride + water + carbon dioxide

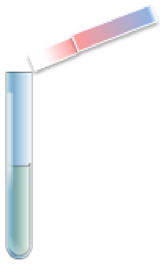
$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

The test for carbon dioxide uses an aqueous solution of calcium hydroxide (**lime water**). When carbon dioxide is shaken or bubbled through limewater the limewater turns **milky** (**cloudy**).

Test For Chlorine

The test for chlorine uses **litmus paper**. When **damp** litmus paper is put into chlorine gas the litmus paper is bleached and turns **white**.

Chlorine is a toxic gas.



Exam practice 3

Q1.

Bleach is a solution of sodium hypochlorite (NaClO).

Chlorine gas is produced when bleach reacts with hydrochloric acid.

$$NaClO(aq) + 2HCl\ (aq) \rightleftharpoons NaCl(aq) + H_2O(l) + Cl_2(g)$$

(a) Give the test and result for chlorine gas.

____

____

(2)

Q2.

(c) A gas which bleaches litmus paper can be added to the water to make it potable.

Name this gas and explain why it is added.

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____

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(2)

Q3.

When a metal carbonate reacts with an acid, a salt, carbon dioxide and water are produced.

(a) Describe how you would test for carbon dioxide gas.

Test

____

____

Result

____

____

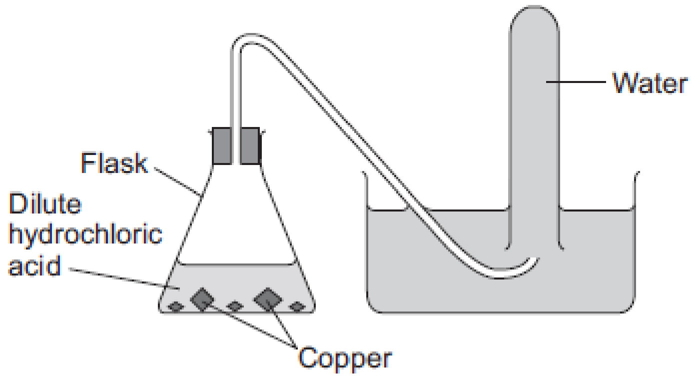
(2)

Q4.

A student was trying to produce hydrogen gas.

Figure 1 shows the apparatus she used.

Figure 1



(a) No gas was produced.

The student's teacher said that this was because the substances in the flask did **not** react.

(i) Suggest why the substances in the flask did **not** react.

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(1)

(ii) Which two substances could the student have put in the flask to produce hydrogen safely?

Tick (✓) **one** box.

Gold and dilute hydrochloric acid ☐

Potassium and dilute hydrochloric acid ☐

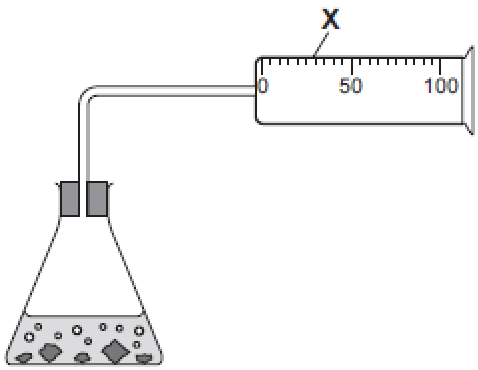
Zinc and dilute hydrochloric acid ☐

(1)

(b) Another student did produce hydrogen from two substances.

Figure 2 shows the apparatus the student used to collect and measure the volume of the hydrogen gas.

Figure 2



Give the name of the apparatus labelled **X**.

____

(1)

(c) The student did the experiment four times. Her results are shown in the table below.

Experiment	**Volume of hydrogen collected in one minute in cm^3**
1	49
2	50
3	35
4	48

(i) One of the results is anomalous.

Which result is anomalous? Write your answer in the box.

Give a reason for your choice.

____

(2)

(ii) Calculate the mean volume of hydrogen collected in one minute.

____

____

Mean volume = ____________________ cm^3

(2)

(iii) Give a reason why the experiment should be repeated several times.

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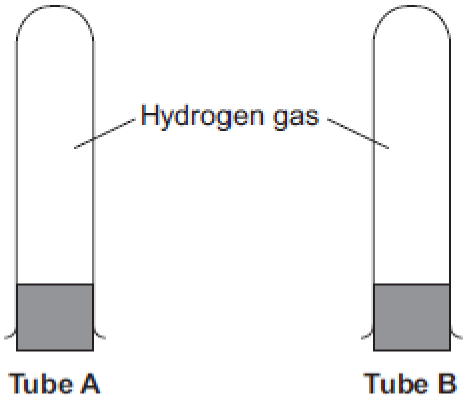
(1)

(d) A teacher collected two tubes full of hydrogen gas, as shown in **Figure 3**.

Figure 3



She tested tube **A** with a lighted splint as soon as she took the bung out.

She tested tube **B** with a lighted splint a few seconds after taking the bung out.

(i) Suggest why tube **B** gave a much louder pop than tube **A**.

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(1)

(ii) Complete and balance the chemical equation for the reaction that takes place when the hydrogen reacts in this test.

$$H_2 + O_2 \longrightarrow$$

(2)

(Total 11 marks)

Q5.

Hydrogen peroxide, H_2O_2, is often used as a bleach. It decomposes forming water and oxygen.

(a) (i) Write the balanced chemical equation for the decomposition of hydrogen peroxide.

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(3)

(ii) Give a test for oxygen.

Test

____

Result of test

____

____

(2)

(b) The rate of decomposition of hydrogen peroxide at room temperature is very slow. Manganese oxide is a catalyst which can be used to speed up the decomposition. Complete the sentence.

A catalyst is a substance which speeds up a chemical reaction.

At the end of thereaction, the catalyst is

____

(1