<u>IGCSE Chemistry (0620) Practical Opportunities</u>

This document contains additional syllabus information for the Practical (0620/05) and Alternative to Practical (0620/06) examinations. This information should be used in tandem with examination papers from previous years and associated Principal Examiner's reports.

It contains three sections:

Section 1: An outline of practical opportunities for each topic of the syllabus to help develop students' practical skills

Section 2: Examples of the sorts of activities that students are expected to have experienced to be able to carry out the practical examination.

Section 3 : A list of required apparatus

Section 1

An outline of practical opportunities for each topic of the syllabus to help develop students' practical skills. These are directed specifically for preparation for the Practical or Alternative to Practical examination. Teachers may prefer to demonstrate some of these activities. There is overlap between different sections of the syllabus, which could be built into schemes of work.

Opportunities for Practical Activities	
Syllabus reference	Practical Activity
Section 2 Experimental techniques	
2.1 Measurement	Routine use of apparatus such as thermometers, burettes, measuring cylinders, pipettes etc.
2.2(a) Criteria of purity	Paper chromatography of leaf extracts and dyestuffs from e.g. jam and fruits.
Determination of melting and boiling points	Boiling point of pure water.
2.2(b) Methods of purification • use of suitable solvent/filtration • distillation • fractional distillation	Separation of salt and sand using water i) separation of pure water from aqueous sodium chloride ii) separation of ethanol/water mixture.
Section 5 Electricity and chemistry	
Electrolysis Electroplating	Electrolysis of aqueous copper sulfate using copper electrodes and carbon electrodes Electrolysis of dilute hydrochloric acid. Teacher demo/video. Electrolysis of molten lead bromide and concentrated aqueous sodium chloride.

Section 6 Chemical changes	
Syllabus reference	Practical Activity
6.1 Energetics of a reaction Exothermic and endothermic reactions	Measure temperature changes. e.g. addition of ammonium chloride, sodium hydrogencarbonate, anhydrous sodium carbonate, and calcium oxide to cold water.
6.2 Production of energy Burning fuels	Use spirit burners to compare energy produced by different alcohols.
Section 7 Chemical Reactions	
Syllabus reference	Practical Activity
7.1 Speed of reaction Effect of concentration, particle size, catalysts and temperature.	Investigate following reactions • sodium thiosulfate/dilute hydrochloric acid • calcium carbonate/dilute hydrochloric acid • hydrogen peroxide/manganese (IV) oxide Magnesium/dilute sulfuric acid or metal carbonate/dilute hydrochloric acid
Investigating rate of gas evolution	Heat hydrated copper sulfate crystals. Cool. Add water.
7.2 Reversible reactions	Burn magnesium in air. Mix acidified iron(II) sulfate solution and potassium manganate(VII) solution.
7.3 Redox	

Section 8 Acids, bases and salts	
Syllabus reference	Practical Activity
8.1 Properties of acids and bases Properties of acids	React dilute acids with i) metals e.g. Mg, Zn, Fe ii) carbonates e.g. $MgCO_3$, $ZnCO_3$ iii) metal oxides e.g. CuO iv) indicators e.g. litmus and universal indicator
Properties of bases	React dilute sodium hydroxide with i) dilute acids – see 8.3 ii) indicators iii) ammonium salts repeat i and ii with aqueous ammonia
8.2 Types of oxides Classification of oxides	Test oxides for acid-base character e.g. MgO,CaO,Al_2O_3,CO_2 and SO_2
8.3 Preparation of salts Soluble salts and crystallisation	Use dilute sulfuric acid and magnesium/magnesium oxide or zinc carbonate to prepare crystals of hydrated magnesium sulfate or zinc sulfate. Use of glass rod to show saturated solution. Lots of practical opportunities to test for aqueous cations and anions and gases as specified.
8.4 Identification of ions and gases	

Section 9 The Periodic Table	
Syllabus reference	Practical Activity
9.3 Transition elements Formation of coloured compounds Catalytic behaviour	An opportunity to look at a selection of transition metal compounds and non transition metal compounds. e.g. Na_2CO_3,MgO,$ZnSO_4$,$CuCl_2$,$NiSO_4$, $CuSO_4$ and $KMnO_4$ Mix metal oxides with aqueous hydrogen peroxide-test gas e.g. ZnO,CuO,MnO_2,MgO .
Section 10 Metals	
 10.2 Reactivity series	Add metals e.g. Zn, Mg, Fe and Cu to dilute hydrochloric acid. Teacher demo. Reactions of Na, Ca, Mg with cold water, Mg/steam reaction. Displacement reactions e.g. Mg, Zn, Fe, and Cu with aqueous copper sulphate Use anhydrous copper sulfate and/or cobalt chloride paper. Set up rusting experiment with iron nails using different conditions
Section 11 Air and Water	
Chemical test for water Rust prevention	Heat a marble chip strongly. On cooling add cold water. Filter solution and breathe through it with a straw.

Section 13 Carbonates	
Syllabus reference	Practical Activity
Lime and slaked lime	Use cyclohexane. Mix with water. Test with bromine water. Test flammability. Prepare ethane by passing ethanol vapour over heated aluminium oxide. Test ethene with bromine water.
Section 14 Organic Chemistry	
Alkanes Alkenes Alcohols Ethanoic acid	Ferment sugar solution with yeast. Distil ethanol and ignite a sample. Test dilute ethanoic acid- see section 8.1 properties

Section 2

To illustrate the sorts of activities that students are expected to have experienced to be able to carry out the practical examination.

Area of Investigation	Explanation	Example
Simple quantitative experiments involving the measurement of volumes.	It is intended that candidates should be able to perform titrations involving the use of a burette. The burette readings should be recorded to one decimal place. The use of a pipette is not always required and a measuring cylinder may be used. Students to measure volumes of liquids and solutions should use measuring cylinders routinely. Students need to appreciate the difference in precision when measuring volumes using a burette as compared to a measuring cylinder. It is intended that candidates should be able to measure the volume of gas produced during a reaction by displacement of water using an inverted measuring cylinder in a trough of water. It is important that candidates have the experience of the manipulative skills required to carry out these procedures.	Example 1 (a) Titration (b) Volumes of gas
Speeds of reaction	It is intended that candidates should be able to use a timer e.g. clock to record the time taken for a reaction. It is important that the time taken for a reaction should be clearly recorded in the units specified in the question. The readings may involve measurement of volumes of gas at a set time or over a range of time intervals. Other measurements may involve the rate of formation or appearance of precipitates, colour changes etc.	Example 2 ‘Disappearing cross’ experiment

Area of Investigation	Explanation	Example
Measurement of temperature	It is intended that candidates should be able to measure temperatures of reaction mixtures. A thermometer with $1^{o}C$ graduations should be used. It is important that candidates have experience of measuring initial and final temperatures of liquids and solutions of reactants. Exothermic and endothermic changes should be investigated to record maximum and minimum temperatures at set time intervals. Candidates will be expected to appreciate the problem of heat losses and the use of polystyrene containers to reduce these heat losses.	Example 3 Temperature changes
Problems of an investigatory nature, possibly including suitable organic compounds	Both questions on the practical exam will involve problems of an investigatory nature. In question 1 titrations are often set which may involve reactants that students are not familiar with. It is important that students are able to follow instructions and carry out procedures as advised. Question 2 can involve analysis of metallic salts, acids and alkalis, organic compounds etc. The tests to be carried out are given. It is expected that candidates will be able to record clear detailed observations when carrying out these tests and draw appropriate conclusions.	Example 4 Investigation of two liquids C is aqueous zinc sulfate D is cyclohexane

Area of Investigation	Explanation	Example
Simple paper chromatography and filtration	Questions involving chromatography are not set on the practical paper. However, it is expected that students will have practical experience of paper chromatography. Questions on this topic are set on the Alternative to Practical paper. It is important that students understand how coloured extracts are obtained using a suitable solvent and in some cases a pestle and mortar followed by filtration. The separation of insoluble material from a solution by filtration should be a routine operation for students. Students are expected to be able to draw and identify a filter funnel and filter paper. Candidates are also expected to describe the successful separation of mixtures of coloured extracts with a chromatogram showing the separation of the components.	Example 5 Chromatography of dyes from sweets
Identification of ions and gases as specified in section 8.4 of the syllabus	It is important that students are familiar with the notes on qualitative analysis in section 6.3 appendix of the syllabus. The practical question paper includes these notes on the last page. It is expected that candidates taking the Alternative to Practical paper will learn the tests. It is intended that candidates should be able to perform the tests specified and be encouraged to follow efficient and safe practice. It is intended in both options that candidates can follow the instructions given and give clear accurate descriptions of the observations and draw appropriate conclusions.	Example 6 Qualitative analysis of two salt solutions

Area of Investigation	Explanation	Example
Record readings from apparatus and complete tables of data	For the practical examination candidates will be expected to measure and record their readings in a table to the appropriate degree of accuracy. The candidates' results will be compared to those submitted by the supervisor. In the alternative to practical option candidates will record the results in a table from the apparatus diagrams provided. These diagrams could include thermometers, burettes, measuring cylinders, gas syringes and possibly involve measuring the heights of precipitates. Candidates will be expected to be able to work out differences in results and calculate average values.	Example 7 Thermometer diagram
Describe, explain or comment on experimental arrangements and techniques	Students' experience of practical work could be gained from working as an individual, from group work or from teacher demonstration. It is important that candidates are able to recognise laboratory apparatus and standard equipment such as Bunsen burners, tripods etc. Full and correct names should be used for apparatus e.g. 'cylinder' should be describes as a measuring cylinder. It is expected that students carry out experiments using safe and effective procedures. These involve the use of protective clothing and the awareness of toxic and flammable chemicals. Questions often involve diagrams showing separation of mixtures, collection and preparation of gases and electrolysis	Example 8 Ethene preparation

Area of Investigation	Explanation	Example
Draw conclusions from observations and/or from information given Interpret and evaluate observations and experimental data Identify sources of error and suggest possible improvements	Drawing conclusions involves the interpretation of observations and results using knowledge and understanding of chemical facts and concepts, and practical techniques. It is important that students have experience of applying common practical techniques to unfamiliar situations. It is intended that when candidates are asked to evaluate and suggest possible improvements to the procedure the questions to be asked are: what would be the point of repeating the test? was the test fair? which variables are kept constant and which variables will be changed?	Example 9 Decomposition of hydrogen peroxide
Plot graphs and/or interpret graphical information	Examination questions requiring a graph to be drawn will include a grid. Axes are often labelled and the scale included. It is expected that when a blank grid is provided that candidates will need to choose an appropriate scale and label the axes clearly including units. It is important that candidates plot points as small crosses with a sharp pencil. Best-fit lines should be drawn leaving out any anomalous points. The graphs will be smooth curves or straight lines. Tie lines should be clearly drawn when using graphs to obtain numerical information. Sometimes candidates will be asked to represent the results by drawing a bar chart.	Example 9 shows a question involving a graph.
Plan an investigation, including suitable techniques and apparatus	The last question on the alternative to practical paper can involve a planning exercise. It is important that candidates include: • details of apparatus to be used; • conditions to be employed; • measurements to be made and recorded; • comparison of experiments to ensure a fair test; • interpretation of results to make conclusions.	Example 10 Comparing oven cleaners

Examples:

Example 1 (a) Titration

1 You are going to investigate the reaction between potassium manganate(VII) and a metallic salt solution.

Read all the instructions below carefully before starting the two experiments.

Experiment 1

(a) Pour a little of the metal salt solution **A** into a test-tube. Add about 1 cm^3 of aqueous sodium hydroxide and note your observation.

observation [1]

(b) Fill the burette provided up to the 0.0 cm^3 mark with the potassium manganate(VII) solution. Using a measuring cylinder, pour 25 cm^3 of solution **A** of the salt solution into the conical flask provided. Shake the flask to mix the contents.

From the burette add 1 cm^3 of the potassium manganate(VII) solution to the flask, and shake to mix thoroughly. Continue to add potassium manganate(VII) solution to the flask until there is a pale pink colour in the contents of the flask. Record the burette readings in the table.

Experiment 2

(c) Pour away the contents of the flask and rinse with distilled water. Fill the burette up to the 0.0 cm^3 mark with the potassium manganate(VII) solution. Repeat Experiment **1(b)** exactly using solution **B** instead of solution **A**. Record your burette readings in the table and complete the table.

(d) Pour a little of the solution in the flask into a test-tube. Add about 1 cm^3 of aqueous sodium hydroxide and note your observation.

observation [1]

Table of results

Burette readings / cm^3

	Experiment 1	**Experiment 2**
final reading		
initial reading		
difference		

Mark Scheme:

1 Experiment **1(a)** green precipitate (1) [1]

Experiment **2(d)** brown/orange/rust precipitate (1) [1]

Table of results

Experiment 1

initial and final volume boxes correctly completed (1)

Experiment 2

initial and final volume boxes correctly completed (2)

differences completed correctly (1)

comparable to Supervisor's results ± 5 cm^3 (2) [6]

Example 1 (b) Volumes of gas

1 You are going to investigate the speed of reaction when aqueous hydrogen peroxide breaks down using a catalyst. Manganese(IV) oxide is the catalyst. A catalyst remains unchanged at the end of the reaction.

Read all the **Instructions** below carefully before starting the experiments.

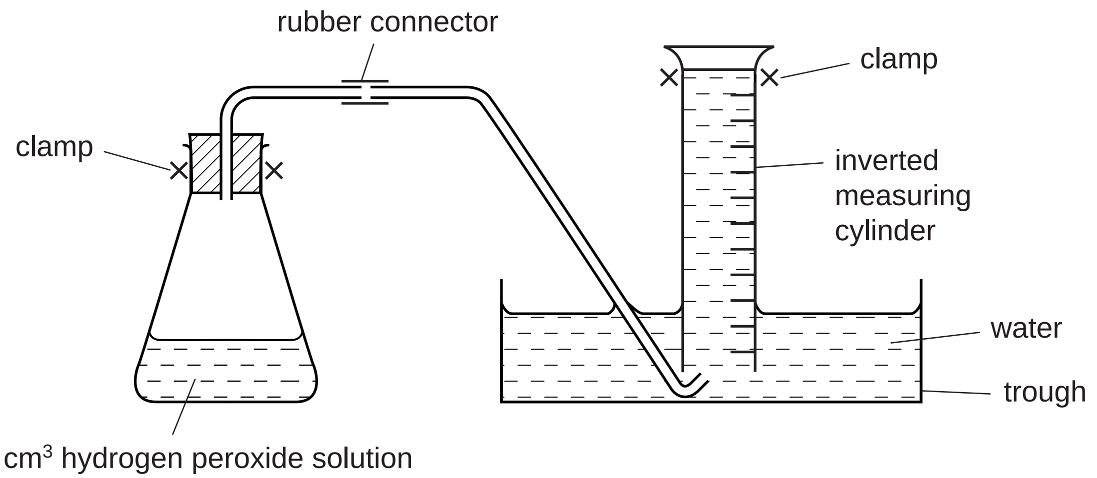
Instructions

<u>Experiment 1</u>

Using a measuring cylinder, pour 20 cm^3 of the hydrogen peroxide solution labelled **A** into the conical flask. Fill the 50 cm^3 measuring cylinder provided with water and set up the apparatus as in the diagram below. Add one spatula measure of manganese(IV) oxide to the conical flask, quickly put the bung in the flask and start your timer.

Measure the volume of gas collected in the measuring cylinder at 10 seconds and at 20 seconds and record the results in the table opposite.

Pour away the contents of the conical flask and rinse the flask with distilled water.



Experiment 2

Using the measuring cylinder, pour 15 cm^3 of the solution **A** of aqueous hydrogen peroxide into the conical flask. Now add 5 cm^3 of distilled water to the flask. Set up the apparatus as in Experiment 1. Repeat the instructions as given for Experiment 1, adding one spatula measure of manganese(IV) oxide to the flask and measuring the volume of gas given off at 10 seconds and 20 seconds. Record your results in the table.

Experiment 3

Repeat Experiment 1 using 10 cm^3 of solution **A** and 10 cm^3 of distilled water. Record your results in the table.

Experiment 4

Repeat Experiment 1 using 5 cm^3 of solution **A** and 15 cm^3 of distilled water. Record your results in the table.

Table of results

Experiment	volume of gas collected after 10 seconds / cm^3	volume of gas collected after 20 seconds / cm^3
1		
2		
3		
4		

Mark Scheme:

1 Table of results

Volumes completed for 10 seconds (1) and 20 seconds (1)

Volumes decreasing (1)

Comparable to supervisor (2) [5]

Example 2 'Disappearing cross' experiment

1 You are going to investigate the effect of temperature on the speed of reaction between hydrochloric acid and aqueous sodium thiosulfate. When these chemicals react they form a precipitate, which makes the solution go cloudy. The formation of this precipitate can be used to show how fast the reaction proceeds.

You are going to carry out five experiments.

Experiment 1

Using the large measuring cylinder pour 50 cm^3 of aqueous sodium thiosulfate into the conical flask. Measure the temperature of the solution and record it in the table. Place the conical flask on the printed insert provided.

Place 10 cm^3 of the hydrochloric acid provided into the small measuring cylinder. Add the acid to the liquid in the flask and immediately start your timer and shake the flask. Record in the table of results the time taken for the printed words to disappear from view. Measure and record the final temperature of the liquid.

Wash out the flask **thoroughly** with water and rinse with distilled water.

Experiment 2

Pour 50 cm^3 of aqueous sodium thiosulfate into the conical flask. Heat the solution gently until the temperature is about 30 °C. Remove the flask from the heat, measure the temperature of the solution and record it in the table.

Place 10 cm^3 of hydrochloric acid into the small measuring cylinder and repeat Experiment 1.

Measure and record the final temperature of the liquid.

Wash out the flask **thoroughly** with water and rinse with distilled water.

Experiment 3

Repeat Experiment 2, this time heating the sodium thiosulfate solution to about 40 °C before adding the hydrochloric acid.

Measure the temperatures and record them in the table.

Experiment 4

Repeat Experiment 2, this time heating the sodium thiosulfate solution to about 50 °C before adding the hydrochloric acid.

Measure and record the temperatures in the table.

Experiment 5

Repeat Experiment 2, this time heating the sodium thiosulfate solution to about 60 °C before adding the hydrochloric acid.

Measure and record the temperatures in the table.

Complete the table of results.

Table of results

experiment number	initial temperature of solution / °C	final temperature of solution / °C	average temperature / °C	time for printed words to disappear / s
1				
2				
3				
4				
5				

[5]

Mark Scheme:

1 Table of results

Initial temperature boxes completed correctly i.e. increasing downwards (1)

Final temperature boxes correctly completed i.e. lower or the same (1)

Average temperature boxes correctly completed (1)

Times completed correctly i.e. descending (1) in seconds (1) [5]

Example 3 Temperature changes

1 You are going to investigate the addition of four different solids, **A**, **B**, **C** and **D**, to water. 4 g of each solid will be used.

Read **all** the instructions below carefully **before** starting the experiments.

Instructions

Experiment 1

By using a measuring cylinder, pour 30 cm^3 of distilled water into one of the polystyrene cups provided. Measure the initial temperature of the water and record it in the table below. Add solid **A** to the water in the cup and stir the mixture with the thermometer. Record the temperature reached after 2 minutes.

Remove the thermometer and rinse with water.

Experiment 2

Repeat Experiment 1 using solid **B** instead of solid **A** and a clean polystyrene cup. Record the initial and final temperatures in the table.

Keep the solution for Experiment 5.

Experiment 3

Repeat Experiment 1, using solid **C** and a clean polystyrene cup. Record the temperatures

in the table.

Experiment 4

Repeat Experiment 1 using solid **D** and a clean polystyrene cup. Record the temperatures

in the table.

Experiment 5

Pour about 2 cm^3 of the solution from Experiment 2 into a test-tube. By using a teat pipette add a little of the solution from Experiment 4 to the test-tube. Record your observations.

Table of results

experiment	initial temperature / °C	final temperature / °C	difference / °C
1			
2			
3			
4			

[5]

Mark Scheme:

1 Experiment 5 observations

rapid/vigorous o.w.t.t.e (1) bubbles/fizz (1)

blue precipitate (1) [max 2]

Table of results

initial boxes correctly completed (1)

final boxes correctly completed (1)

differences correctly completed (1) signs correct (1)

comparable to Supervisor's results (1) [5]

Example 4 Investigation of two liquids

C is aqueous zinc sulfate

D is cyclohexane

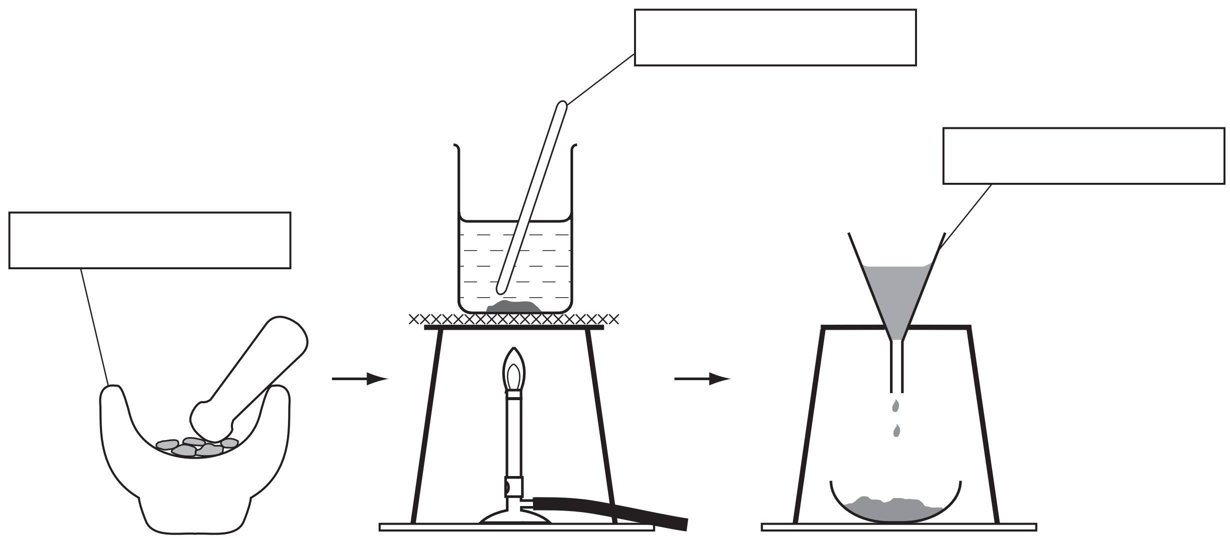
2 You are provided with two liquids, **C** and **D**. Carry out the following tests on the liquids, recording all of your observations in the table. Do **not** write any conclusions in the table.

Tests	*Observations*
(a) Test a little of solution **C** with Universal Indicator paper. Record the pH.	colour .... pH ....[2]
(b) Describe liquid **D**.	....[2]
(c) **(i)** To 1 cm^3 of solution **C**, add a few drops of dilute hydrochloric acid and then aqueous barium chloride.	....[2]
(ii) To 1 cm^3 of liquid **D**, add a few drops of dilute hydrochloric acid and then aqueous barium chloride.	....[2]
(d) **(i)** To 1 cm^3 of solution **C**, add aqueous sodium hydroxide one drop at a time.	....[2]
Now add an excess of aqueous sodium hydroxide.	....[1]
(ii) To 1 cm^3 of solution **C**, add aqueous ammonia one drop at a time.	....[1]
Now add an excess of aqueous ammonia.	....[1]
(e) By using a teat pipette, add a **few** drops of liquid **D** to a watch glass. Touch the surface of the liquid with a lighted splint.	....[1]

Example 5 Chromatography of dyes from sweets

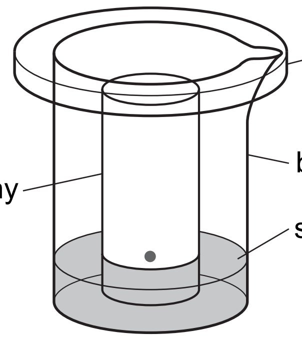
1 The colours present in some blackcurrant sweets can be separated by chromatography. The colours are water-soluble dyes.

The diagrams show how the colours can be extracted from the sweets.



(a) Complete the empty boxes to name the pieces of apparatus. [3]

The apparatus below was used to carry out the chromatography.



(b) (i) Name the solvent used.

[1]

(ii) Label, with an arrow, the origin on the diagram. [1]

(c) Sketch, in the box, the chromatogram you would expect if two different colours were present in the sweets.

[1]

[Total: 6]

Mark Scheme:

1 **(a)** mortar (1)

stirrer/(glass) rod (1) not metal rod or thermometer

funnel (1) not filter or filter paper [3]

(b) **(i)** water [1]

(ii) origin correctly labelled on diagram i.e. at dot [1]

(c) two spots/dots at different levels in vertical line [1]

allow three spots if one is origin

[Total: 6]

Example 6 Qualitative analysis of two salt solutions

5 Two salt solutions **K** and **L** were analysed. Each contained the same chloride anion but different metal cations. **K** was a copper(II) salt.

The tests on the solutions and some of the observations are in the following table. Complete the observations in the table.

tests	observations
(a) Appearance of the solutions.	
solution **K**	
solution **L**	
	[1]
	yellow

(b) The pH of each solution was tested.

solution **K**

solution **L**

pH 3
pH 2

<u>tests on solution **K**</u>

(c) **(i)** Drops of aqueous sodium hydroxide were added to solution **K**. Excess aqueous sodium hydroxide was then added to the test-tube.

(ii) Experiment **(c)(i)** was repeated using aqueous ammonia instead of aqueous sodium hydroxide.

(iii) A few drops of hydrochloric acid and about 1 cm^3 of barium chloride solution were added to a little of solution **K.**

[2]

drops [1]
excess

[2]
[1]

tests **observations**

(iv) A few drops of nitric acid and about 1 cm^3 of silver nitrate solution were added to a little of solution **K**.

[1]

<u>tests on solution **L**</u>

(d) **(i)** Experiment **(c)(i)** was repeated using solution **L**. Ex

(ii) Experiment **(c)(ii)** was repeated using solution **L**.

(iii) Experiment **(c)(iii)** was repeated using solution **L**.

(iv) Experiment **(c)(iv)** was repeated using solution **L**.

red - brown precipitate

red – brown precipitate

[1]

[1]

(e) What does test **(b)** indicate?

[1]

(f) Identify the metal cation present in solution **L**.

[2]

[Total: 13]

Mark Scheme:

5 **(a)** <u>solution **K**</u> blue/green not precipitate [1]

(c) <u>tests on solution **K**</u>

(i) blue (1) precipitate (1) [2]

(ii) blue precipitate [1]

deep/royal (1) blue solution or precipitate dissolves (1) [2]

(iii) no reaction/change/nothing [1]

(iv) white precipitate [1]

(d) <u>tests on solution **L**</u>

(iii) no reaction/change/nothing [1]

(iv) white precipitate [1]

(e) acids [1]

(f) iron (1) (III) (1) or Fe^{3+} (2) ignore anions [2]

[Total: 13]

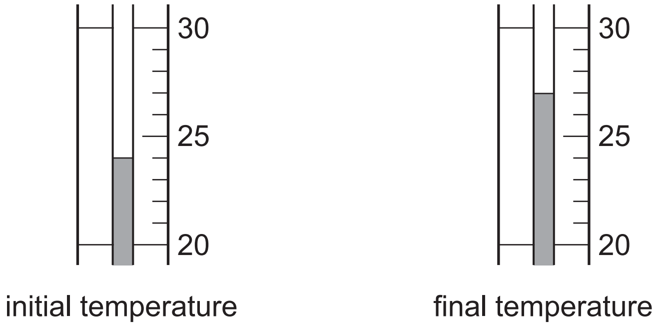
Example 7 Thermometer diagrams

4 A student investigated the addition of four different solids, **A**, **B**, **C** and **D**, to water.

Five experiments were carried out.

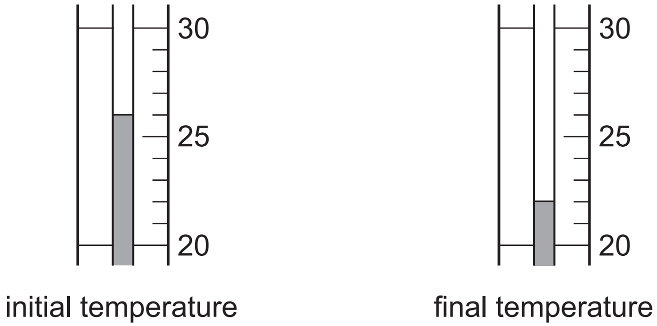
Experiment 1

By using a measuring cylinder, 30 cm^3 of distilled water was poured into a polystyrene cup and the initial temperature of the water was measured. 4 g of solid **A** was added to the cup and the mixture stirred with a thermometer. The temperature of the solution was measured after 2 minutes.



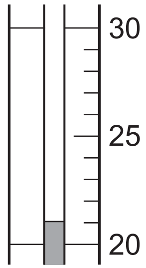
Experiment 2

Experiment 1 was repeated using 4 g of solid **B**.

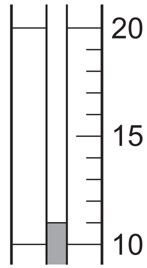


Experiment 3

Experiment 1 was repeated using 4 g of solid **C**.



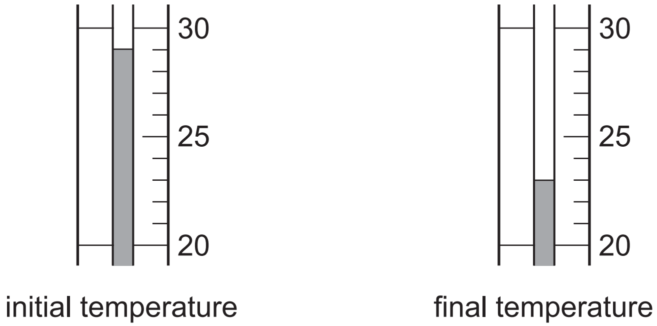
initial temperature



final temperature

Experiment 4

Experiment 1 was repeated using 4 g of solid **D**.



Experiment 5

A little of the solution from Experiment 4 was added to a little of the solution from Experiment 2 in a test-tube. The observations were recorded.

observations *A fast reaction. Vigorous effervescence and bubbles produced.*

(a) Use the thermometer diagrams for Experiments 1-4 to record the initial and final temperatures in Table 4.1.

Calculate and record the temperature difference in Table 4.1.

Table 4.1

experiment	initial temperature / °C	final temperature / °C	difference / °C
1			
2			
3			
4			

[4]

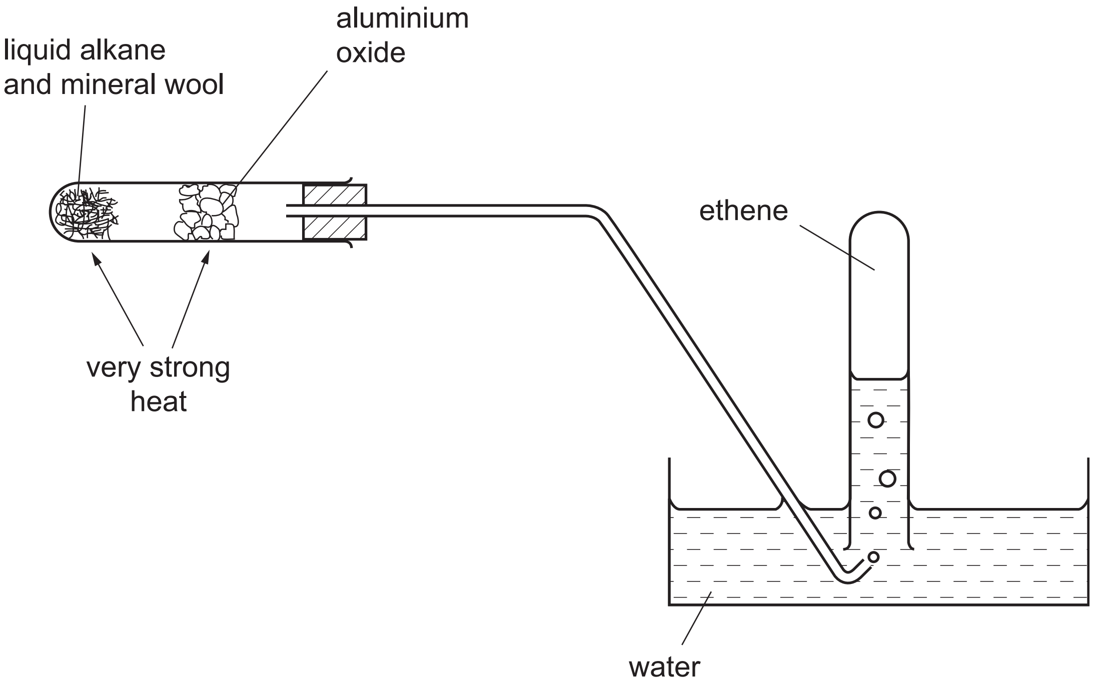
Mark Scheme:

4 **(a)** Table of results

Initial boxes correctly completed (1)	24	
	26	
	21	
	29	
Final boxes correctly completed (1)	27	
	22	
	11	
	23	
Differences correctly completed (1)	+3	signs correct (1)
	-4	
	-10	
	-6	[4]

Example 8 Ethene preparation

3 A liquid alkane was passed over heated aluminium oxide to make ethene.



(a) What is the purpose of the mineral wool? [1]

(b) What is this type of chemical reaction called? [1]

(c) Give a test for ethene.

test

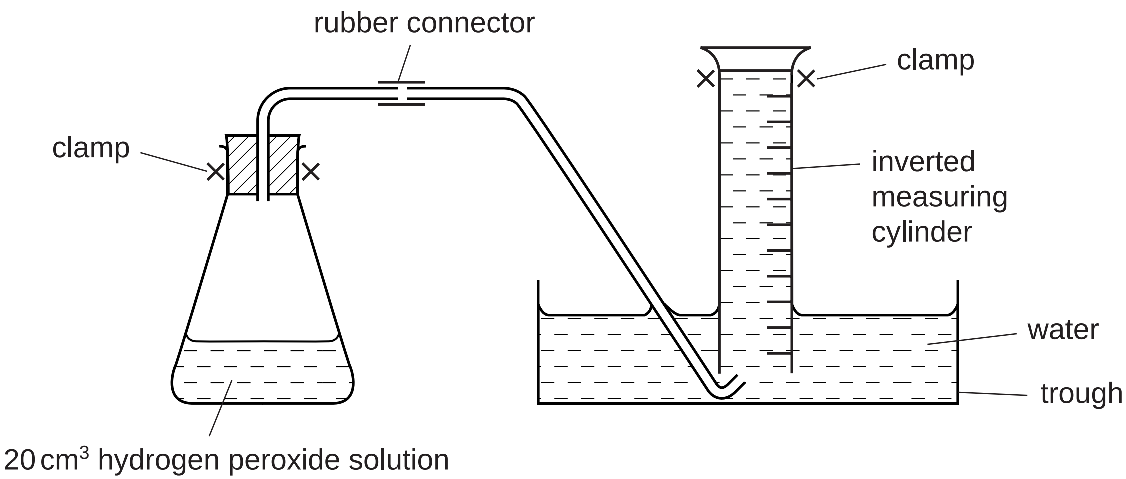
result [2]

(d) What precaution should be taken in the experiment when the heat is removed? Explain.

[2]

Example 9   Decomposition of hydrogen peroxide

4 A student investigates the speed of reaction when aqueous hydrogen peroxide breaks down using a catalyst, manganese(IV) oxide. The catalyst remains unchanged at the end of the reaction.
The apparatus was set up as shown in the diagram.

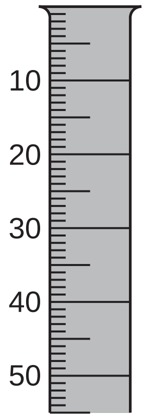
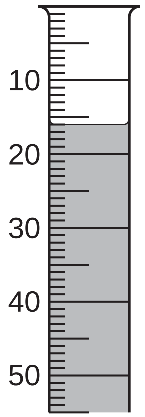
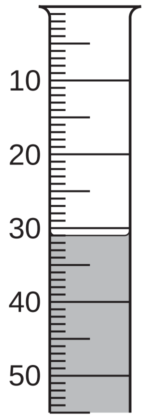
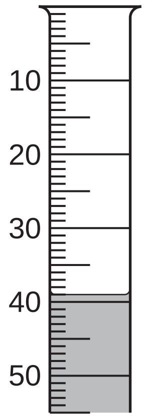


<u>Experiment 1</u>

By using a measuring cylinder, 20 cm^3 of hydrogen peroxide solution was poured into a conical flask. One spatula measure of manganese(IV) oxide was added to the flask, the bung was quickly put in the flask and the timer started.
The volume of gas collected in the measuring cylinder at 10 seconds, 20 seconds and 30 seconds was measured.

Experiment 2

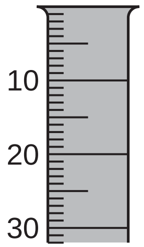
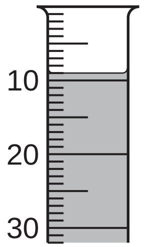
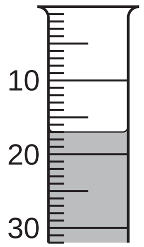
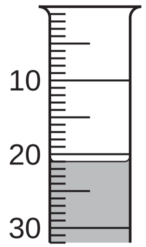
By using a measuring cylinder 15 cm^3 of hydrogen peroxide was poured into the conical flask. The instructions were repeated exactly as given for Experiment 1, but 5 cm^3 of distilled water was also added to the flask.
Use the diagrams to record your results in the table below.

time / s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder / cm^3				

[2]

Experiment 3

Experiment 1 was repeated using 10 cm^3 of hydrogen peroxide and 10 cm^3 of distilled water. Record your results in the table.

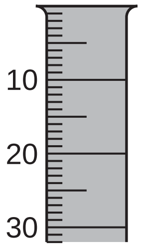
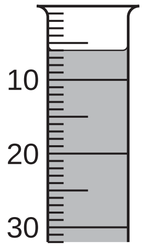
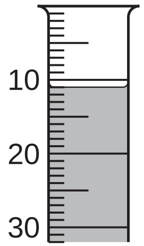
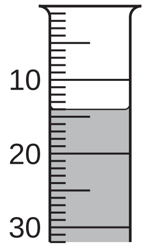
time / s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder / cm^3				

[2]

Experiment 4

Experiment 1 was repeated using 5 cm^3 of hydrogen peroxide and 15 cm^3 of distilled water.

Record your results in the table.

time / s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder / cm^3				

[2]

(a) Plot your results on the grid for each Experiment. Draw 4 graphs and label each clearly with the number of the Experiment.

[5]

(b) (i) Which Experiment has the fastest rate of reaction?

[1]

(ii) Explain, in terms of particles, why this Experiment has the fastest rate.

[2]

(c) (i) State two sources of error in the Experiments.

1

2

[2]

(ii) Suggest two improvements to reduce the sources of error in the Experiments.

1

2

[2]

(d) State a practical method you could use to prove that manganese(IV) oxide was a catalyst in Experiment 1.

[2]

Mark Scheme:

4 Volumes from cylinder diagrams

Experiment 2

0 16 31 39	all correct (2)	**[2]**

-1 for any incorrect

Experiment 3

0 9 17 21	all correct (2)	**[2]**

Experiment 4

0 6 11 14	all correct (2)	**[2]**

(a) Graph. All points plotted correctly (3). -1 for each incorrect

smooth curves (1), labels (1) **[5]**

(b) **(i)** Experiment 1 (1) **[1]**

(ii) Most concentrated solution (1), more collisions (1) **[2]**

(c) **(i)** Two errors (2)

e.g. amount of catalyst/timing/volume of solution **[2]**

(ii) Two improvements (2)

e.g. measure mass of catalyst/use burette or pipette/data logging **[2]**

(d) Filter (1), same mass of catalyst before and after (1)/repeat experiment and compare volumes of gas collected **[2]**

Example 10 Comparing oven cleaners

6 The diagram shows two bottles of liquid oven cleaner.

The oven cleaners contain sodium hydroxide solution. Plan an investigation to show which oven cleaner contains the highest concentration of sodium hydroxide.

[6]

Mark Scheme:

6 Measured volume of oven cleaner (1)

Add indicator/named indicator (1)

Add named acid (1), from a burette/pipette (1)

Until colour change/end point (1), measure/record volume of acid (1)

Repeat with other cleaner (1), compare (1)

Max 6 **[6]**

Section 3 Apparatus list

Students may require the following apparatus for the Practical examination.

- one burette, 50 cm^3 with retort stand and white tile
- one pipette. 25 cm^3
- one pipette filler
- two conical flasks within range 150 cm^3 to 250 cm^3
- measuring cylinders,50 cm^3 or 25 cm^3 and 10 cm^3
- trough to contain water when measuring volumes of gas
- filtration apparatus
- beakers, squat form with lip, 100 cm^3 and 250 cm^3
- a stirring thermometer,-10^oC to +110^oC at 1^oC graduations
- a polystyrene cup, or other plastic container
- clock(or wall clock) to measure to an accuracy of about 1s.
- Candidates may use stop clocks or their own wristwatch if they prefer.
- wash bottle/distilled water
- test-tube rack containing test-tubes, some of which should be Pyrex or hard glass for heating substances-approximately 125mm x16mm
- boiling tubes, approximately 150mm x 25mm with cork/bung to fit
- stirring/glass rod
- spatulas
- teat pipettes
- Bunsen burner/tripod/gauze

Students should have seen or experienced the use of the following apparatus.

- gas syringe
- balance
- pestle and mortar
- separating funnel
- distillation and fractional distillation apparatus
- crucible
- evaporating dish
- spirit burner
- electrolysis cells and circuits