



Rewarding Learning

ADVANCED
General Certificate of Education

Centre Number

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Candidate Number

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Chemistry

Assessment Unit A2 3

assessing

Further Practical Chemistry

Practical Booklet A



[ACH31]

ACH31

Assessment

TIME

1 hour 15 minutes.

Assessment Level of Control:

Tick the relevant box (✓)

Controlled Conditions	
Other	

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **both** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 30.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A Periodic Table of the Elements (including some data) is provided.

You may not have access to notes, textbooks and other material to assist you.

Safety glasses must be worn at all times and care should be taken during the practical examination.

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08ACH3101

1 You are provided with substance **S** both as a solid and as an aqueous solution **S(aq)**. You are required to carry out the following tests.

(a) Place two spatula measures of solid **S** in a boiling tube. Heat gently using a Bunsen burner flame. Record **four** observations made.

[4]

(b) (i) Weigh out approximately 5.0g of solid **S** using a balance and transfer it to a 250 cm³ conical flask. Add approximately 200 cm³ of deionised water and stir using a glass rod to dissolve. Add 10 cm³ of dilute sodium hydroxide solution and swirl the flask. Add approximately 4 cm³ of potassium manganate(VII) solution and place on a white tile. Watch the conical flask carefully and then record **four** colours observed.

1. _____

2. _____

3. _____

4. _____ [4]

(ii) Using the colour observations made in (b)(i) and your knowledge of transition metal chemistry, suggest why this reaction can be described as a redox reaction.

[1]



(c) Measure out approximately 10 cm³ of **S**(aq) and transfer to a boiling tube. Add approximately 5 cm³ of Fehling's solution to the boiling tube. Place the boiling tube in a hot water bath for a few minutes. State what you observe.

_____ [1]

(d) Measure out approximately 10 cm³ of **S**(aq) and transfer it to a boiling tube. Add approximately 5 cm³ of dilute hydrochloric acid to the boiling tube. Place the boiling tube in the hot water bath for five minutes. Remove it from the water bath and add sodium carbonate solution dropwise until effervescence stops. Divide the resulting solution equally between two test tubes.

(i) To the first test tube add approximately 3 cm³ of Fehling's solution. Place the test tube in the hot water bath. Describe what you observe in the test tube after five minutes.

_____ [2]

(ii) To the second test tube add 5 cm³ of 2,4-dinitrophenylhydrazine solution. Place the test tube in the hot water bath and record the observations made.

_____ [2]

(iii) A reaction occurs when dilute hydrochloric acid is heated with sample **S**(aq). Explain how the observations you have recorded in parts (c) and (d)(i) support this statement.

_____ [2]

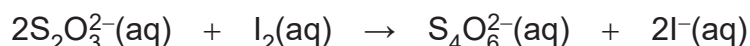
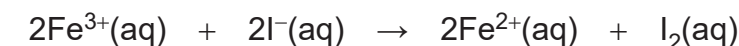
(iv) What evidence is there that an aldehyde is formed in part (d)?

_____ [1]

[Turn over



- 2 You are required to carry out four experiments which may be used to determine the order of reaction with respect to iodide ions. In each experiment iron(III) ions react with iodide ions to produce iodine. The iodine formed reacts with a fixed amount of sodium thiosulfate solution. When all the thiosulfate ions have reacted, a blue-black colour is observed.



(a) Carry out the following procedure:

- Fill a burette with potassium iodide solution.
- Transfer 8.0 cm^3 of potassium iodide solution to a 250 cm^3 conical flask.
- Using a dropping pipette, carefully measure out 5 cm^3 of sodium thiosulfate solution into a 10 cm^3 measuring cylinder.
- Add the 5 cm^3 of sodium thiosulfate solution to the conical flask.
- Measure out 21 cm^3 of deionised water and transfer to the conical flask.
- Add 10 drops of starch solution to the conical flask.
- Swirl the flask and place on a white tile.
- Measure out 6 cm^3 of iron(III) chloride solution into a 10 cm^3 measuring cylinder.
- Transfer the iron(III) chloride solution to the conical flask and start the stop clock.
- Swirl the mixture and record the time taken, to the nearest second, for the blue-black colour to appear. Record this value in the table provided.



Repeat this procedure for experiments **2**, **3** and **4** using the volumes of reagents shown below.

Experiment 2 will be the slowest.

experiment no.	volume of KI solution /cm ³	volume of S ₂ O ₃ ²⁻ solution /cm ³	volume of H ₂ O /cm ³	volume of Fe ³⁺ solution /cm ³
2	5.0	5	24	6
3	6.0	5	23	6
4	10.0	5	19	6

Record your times in the table below.

experiment number	1	2	3	4
volume of KI solution /cm ³	8.0	5.0	6.0	10.0
time /s				
initial rate of reaction /s ⁻¹				
(volume of KI solution) ² /cm ⁶	64.0	25.0	36.0	100.0

[2]

(b) Using the time values recorded, calculate the initial rate of reaction, using initial rate = $\frac{1000}{\text{time}}$, to 1 decimal place and enter the values in the table.

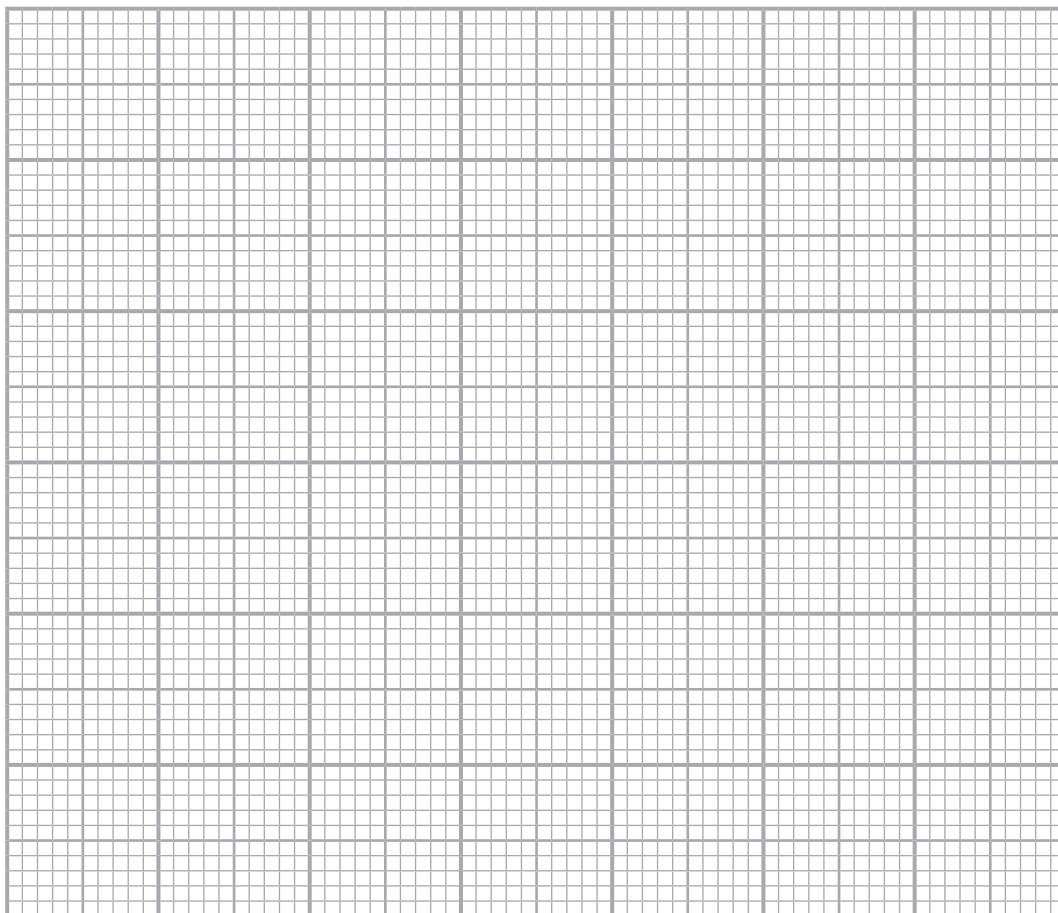
[2]

[Turn over



(c) Plot a graph of initial rate of reaction against (volume of KI solution)². Draw a best-fit straight line.

[5]



(d) (i) Explain the formation of the blue-black colour formed in each experiment.

_____ [1]

(ii) Explain why the same total volume of solution was used in the reaction mixture in all four experiments.

_____ [1]

(iii) Identify **one** source of inaccuracy in the experimental procedure.

_____ [1]

(iv) Suggest how the reliability of the results could be improved.

_____ [1]

THIS IS THE END OF THE QUESTION PAPER



DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	Marks
1	
2	

Total Marks	
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Examiner Number

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08ACH3108



General Information

1 tonne = 10^6 g

1 metre = 10^9 nm

One mole of any gas at 293 K and a pressure of 1 atmosphere (10^5 Pa) occupies a volume of 24 dm³

Avogadro Constant = 6.02×10^{23} mol⁻¹

Planck Constant = 6.63×10^{-34} Js

Specific Heat Capacity of water = 4.2 J g⁻¹ K⁻¹

Speed of Light = 3×10^8 ms⁻¹



Characteristic absorptions in IR spectroscopy

Wavenumber/cm ⁻¹	Bond	Compound
550–850	C–X (X = Cl, Br, I)	Haloalkanes
750–1100	C–C	Alkanes, alkyl groups
1000–1300	C–O	Alcohols, esters, carboxylic acids
1450–1650	C=C	Arenes
1600–1700	C=C	Alkenes
1650–1800	C=O	Carboxylic acids, esters, aldehydes, ketones, amides, acyl chlorides
2200–2300	C≡N	Nitriles
2500–3200	O–H	Carboxylic acids
2750–2850	C–H	Aldehydes
2850–3000	C–H	Alkanes, alkyl groups, alkenes, arenes
3200–3600	O–H	Alcohols
3300–3500	N–H	Amines, amides

Proton Chemical Shifts in Nuclear Magnetic Resonance Spectroscopy (relative to TMS)

Chemical Shift	Structure	
0.5–2.0	–CH	Saturated alkanes
0.5–5.5	–OH	Alcohols
1.0–3.0	–NH	Amines
2.0–3.0	–CO–CH	Ketones
	–N–CH	Amines
	C ₆ H ₅ –CH	Arene (aliphatic on ring)
2.0–4.0	X–CH	X = Cl or Br (3.0–4.0) X = I (2.0–3.0)
4.5–6.0	–C=CH	Alkenes
5.5–8.5	RCONH	Amides
6.0–8.0	–C ₆ H ₅	Arenes (on ring)
9.0–10.0	–CHO	Aldehydes
10.0–12.0	–COOH	Carboxylic acids

These chemical shifts are concentration and temperature dependent and may be outside the ranges indicated above.

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Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Advanced Subsidiary and
Advanced Level Examinations

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations

gce a/as examinations

chemistry



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Chemistry

Assessment Unit A2 3

assessing

Further Practical Chemistry

Practical Booklet A

[ACH31]

Assessment

APPARATUS AND MATERIALS LIST

Advice for centres

- All chemicals used should be at least laboratory reagent specification and labelled with appropriate safety symbols, e.g. irritant.
- For centres running multiple sessions – candidates for the later session should be supplied with clean, dry glassware. If it is not feasible then glassware from the first session should be thoroughly washed, rinsed with deionised water and allowed to drain.
- Ensure all chemicals are in date, otherwise expected observations may not be seen.
- It is the responsibility of the centre to be cognisant of all health and safety issues and to carry out a thorough risk assessment. Up-to-date information can be obtained at www.cleaps.org.uk

Practical Examination

Each candidate must be supplied with safety goggles or glasses.

Question No. 1

Each candidate must be supplied with:

- a spatula
- a Bunsen burner
- a heatproof mat
- three boiling tubes
- two test tubes
- a test tube rack
- a boiling tube rack
- a boiling tube holder
- one glass rod
- six measuring cylinders with 10 cm^3 capacity
- a beaker of 250 cm^3 capacity (for a hot water bath)
- a conical flask of 250 cm^3 capacity
- a kettle to supply hot water
- two wooden splints
- matches
- several disposable pipettes
- a wash bottle containing deionised water
- weighing boat
- 250 cm^3 measuring cylinder or 250 cm^3 beaker with calibrations
- white tile (also required for Question 2)
- stopclock/stopwatch (also required for Question 2)
- access to an accurate balance (reading to 2 decimal places)
- approximately 20 g of sucrose labelled **S**
- approximately 50 cm^3 of a 1% sucrose solution labelled **S (aq)**
- approximately 10 cm^3 of 0.02 mol dm^{-3} acidified potassium manganate(VII) solution labelled **potassium manganate(VII) solution** (solution should be freshly made)
- approximately 10 cm^3 of 1.0 mol dm^{-3} hydrochloric acid labelled **dilute hydrochloric acid** and **corrosive/irritant**
- approximately 20 cm^3 of 1.0 mol dm^{-3} sodium carbonate solution labelled **sodium carbonate solution**
- approximately 30 cm^3 of 1.0 mol dm^{-3} sodium hydroxide solution labelled **dilute sodium hydroxide solution** and **corrosive/irritant**
- approximately 20 cm^3 of Fehling's solution (a mix of equal volumes of Fehling's No.1 and Fehling's No.2) labelled **Fehling's solution** and **corrosive** (solution should be freshly made)
- approximately 10 cm^3 of 2,4-dinitrophenylhydrazine solution labelled **2,4-dinitrophenylhydrazine solution**.

Question No. 2

Each candidate must be supplied with:

- one 50 cm³ burette of at least B quality
- a funnel (for filling the burette)
- 100 cm³ beaker (waste beaker for burette)
- a white tile
- a retort stand and burette clamp
- a measuring cylinder with 25 cm³ capacity
- two measuring cylinders with 10 cm³ capacity
- four conical flasks of 250 cm³ capacity
- several disposable pipettes
- a wash bottle containing deionised water
- a stopclock/stopwatch
- approximately 100 cm³ of 0.04 mol dm⁻³ potassium iodide solution labelled **potassium iodide solution**
- approximately 50 cm³ of a 0.04 mol dm⁻³ iron(III) chloride solution labelled **iron(III) chloride solution**
- approximately 50 cm³ of 0.005 mol dm⁻³ sodium thiosulfate solution labelled **sodium thiosulfate solution**
- a dropper bottle containing 2% starch solution labelled **starch solution**