



Rewarding Learning

ADVANCED
General Certificate of Education
2024

Centre Number

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Candidate Number

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Chemistry

StemUp Model Solution

Assessment Unit A2 3

assessing

Further Practical Chemistry

Practical Booklet A



[ACH31]

ACH31

THURSDAY 9 MAY, MORNING

TIME

1 hour 15 minutes.

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 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.

14243



- 1 You are required to weigh a sample of a solid labelled **X**, dissolve it in deionised water and make the solution up to 250 cm³ in a volumetric flask.

You will then titrate 25.0 cm³ portions of a solution of sodium hydroxide with the solution you have prepared.

- (a) (i) Describe the appearance of the solid labelled **X**.

A white crystalline solid. [1]

- (ii) Weigh out between 1.50 g and 1.60 g of the solid labelled **X** in a small beaker. Record the mass to 2 decimal places.

Mass of **X** 1.56 g [2]

Dissolve the weighed sample in approximately 75 cm³ of deionised water. Transfer the solution to a 250 cm³ volumetric flask, add any washings, and make up the volume to 250 cm³ using deionised water. Stopper the flask and invert to mix.

The solution of X prepared here will be used throughout the remainder of question 1 and also in question 2.



- (b) (i) Pipette 25.0 cm^3 portions of sodium hydroxide solution into three conical flasks. Add three drops of phenolphthalein indicator to each conical flask. Titrate the 25.0 cm^3 portions of sodium hydroxide solution with the solution of **X** you prepared in (a).

Carry out one rough titration and two accurate titrations.

In the space below, draw a suitable table and record your results to 1 decimal place.

Calculate and record the mean titre.

	<i>Rough</i>	<i>1st</i>	<i>2nd</i>
<i>Final burette reading / cm^3</i>	<i>25.9</i>	<i>25.2</i>	<i>25.3</i>
<i>Initial burette reading / cm^3</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>
<i>Titre / cm^3</i>	<i>25.9</i>	<i>25.2</i>	<i>25.3</i>

$$\begin{aligned}\text{Mean titre} &= (25.2 + 25.3) \div 2 \\ &= 25.25\text{ cm}^3\end{aligned}$$

Mean titre 25.25 cm^3 [8]

- (ii) State the colour change observed at the end point of your titration.

From pink to colourless [2]

[Turn over]



2 Carry out the following tests using the solution of **X** prepared in question 1.

- (a) Place the piece of universal indicator paper onto a white tile. Add one drop of the solution of **X** onto the universal indicator paper. Record your observations. Use the universal indicator colour chart to determine the approximate pH of the solution.

Observations: The paper turns red/orange.

pH: pH = 2 [2]

- (b) Place 5 cm³ of the solution of **X** into a test tube. Add half a spatula measure of sodium hydrogencarbonate. Record your observations.

Bubbles of gas (effervescence, fizzing).

The white solid disappears, leaving a colourless solution. [2]

- (c) Place 5 cm³ of the solution of **X** into a test tube. Add a 2 cm strip of magnesium ribbon. Record your observations over a two-minute period.

Bubbles of gas form; the magnesium moves about.

The magnesium gets smaller; a colourless solution remains. [2]

- (d) (i) Place 5 cm³ of the solution of **X** into a boiling tube and record the temperature of the solution.

Temperature of solution = 19.0 °C [1]

- (ii) Add one granule of calcium to the boiling tube from (d)(i). Record your observations and the highest temperature reached.

Bubbles of gas (effervescence); the calcium moves and dissolves.

A white solid (white precipitate) forms; the mixture goes cloudy.

Highest temperature reached = 27.5 °C [3]



- (e) (i) Place 10 cm³ of the solution of **X** into a boiling tube. Add 10 cm³ of 2 M sulfuric acid to the boiling tube. Add 5 cm³ of potassium manganate(VII) solution. Stopper and shake the boiling tube to ensure thorough mixing. Record the colour changes over several minutes, until there is no further change.

At first the solution is purple.

It then turns pink/red/brown as the reaction proceeds.

Finally the solution becomes colourless (no further change). [3]

- (ii) Place 10 cm³ of the solution of **X** into a boiling tube. Add 10 cm³ of 2 M sulfuric acid to the boiling tube. Place the boiling tube in a beaker of freshly boiled water for approximately 2 minutes.

Add 5 cm³ of potassium manganate(VII) solution and start a stopclock. Stopper and shake the boiling tube to ensure thorough mixing. Record the time taken, to the nearest second, to obtain the final colour you observed in (e)(i).

Time taken = 38 s [1]

- (iii) State the effect of temperature on the rate of this reaction.

As the temperature increases, the rate of reaction increases.

[1]

- (iv) Using the equation below, calculate the rate of the reaction in (e)(ii) and state the unit.

$$\text{rate of reaction} = \frac{1}{\text{time taken}}$$

$$\begin{aligned}\text{rate} &= 1 \div 38 \\ &= 0.026 \text{ s}^{-1}\end{aligned}$$

Answer *0.026 s⁻¹* [2]



THIS IS THE END OF THE QUESTION PAPER

14243





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14243



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For Examiner's use only	
Question Number	Marks
1	
2	

Total Marks	
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Examiner Number

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will be happy to rectify any omissions of acknowledgement in future if notified.

ACH31/4
290256



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 dm^3

Avogadro Constant = $6.02 \times 10^{23} \text{ mol}^{-1}$

Planck Constant = $6.63 \times 10^{-34} \text{ Js}$

Specific Heat Capacity of water = $4.2 \text{ J g}^{-1} \text{ K}^{-1}$

Speed of Light = $3 \times 10^8 \text{ ms}^{-1}$



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
	$\text{C}_6\text{H}_5\text{–CH}$	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_6H_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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COUNCIL FOR THE CURRICULUM, EXAMINATIONS AND ASSESSMENT

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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

THE PERIODIC TABLE OF ELEMENTS																	
Group																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen																	4 He Helium
7 Li Lithium	9 Be Beryllium											11 B Boron	12 C Carbon	14 N Nitrogen	16 O Oxygen	19 F Fluorine	20 Ne Neon
23 Na Sodium	24 Mg Magnesium											27 Al Aluminium	28 Si Silicon	31 P Phosphorus	32 S Sulfur	35.5 Cl Chlorine	40 Ar Argon
39 K Potassium	40 Ca Calcium	45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	59 Ni Nickel	64 Cu Copper	65 Zn Zinc	70 Ga Gallium	73 Ge Germanium	75 As Arsenic	79 Se Selenium	80 Br Bromine	84 Kr Krypton
85 Rb Rubidium	88 Sr Strontium	89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	98 Tc Technetium	101 Ru Ruthenium	103 Rh Rhodium	106 Pd Palladium	108 Ag Silver	112 Cd Cadmium	115 In Indium	119 Sn Tin	122 Sb Antimony	128 Te Tellurium	127 I Iodine	131 Xe Xenon
133 Cs Caesium	137 Ba Barium	139 La [*] Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	186 Re Rhenium	190 Os Osmium	192 Ir Iridium	195 Pt Platinum	197 Au Gold	201 Hg Mercury	204 Tl Thallium	207 Pb Lead	209 Bi Bismuth	210 Po Polonium	210 At Astatine	222 Rn Radon
223 Fr Francium	226 Ra Radium	227 Ac [†] Actinium	261 Rf Rutherfordium	262 Db Dubnium	266 Sg Seaborgium	264 Bh Bohrium	277 Hs Hassium	268 Mt Meitnerium	271 Ds Darmstadtium	272 Rg Roentgenium	285 Cn Copernicium						
			140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	145 Pm Promethium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	159 Tb Terbium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium	
			232 Th Thorium	231 Pa Protactinium	238 U Uranium	237 Np Neptunium	242 Pu Plutonium	243 Am Americium	247 Cm Curium	245 Bk Berkelium	251 Cf Californium	254 Es Einsteinium	253 Fm Fermium	256 Md Mendelevium	254 No Nobelium	257 Lr Lawrencium	
			90	91	92	93	94	95	96	97	98	99	100	101	102	103	
			^aX_b a = relative atomic mass (approx) x = atomic symbol b = atomic number														



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Chemistry
Assessment Unit A2 3
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[ACH31]
THURSDAY 9 MAY, MORNING

**APPARATUS
AND
MATERIALS
LIST**

To be accessed by Head of Department only

Advice for centres

- All chemicals used should be at least laboratory reagent specification and labelled with appropriate safety symbols, e.g. flammable.
- 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 including a check of hazard labelling advice. Up to date information can be obtained at www.cleapss.org.uk and from suppliers' safety information.

Practical Examination

Each candidate must be supplied with safety goggles or glasses.

Question No. 1

Each candidate must be supplied with:

- 1 × spatula
- 1 × 100 cm³ beaker
- 1 × 250 cm³ beaker (waste)
- 1 × wash bottle containing deionised water
- 1 × 250 cm³ volumetric flask
- 1 × filter funnel
- 1 × glass rod
- 1 × graduated disposable pipette
- 1 × 25 cm³ pipette of at least class B quality
- 1 × safety pipette filler
- 3 × 250 cm³ conical flasks
- 1 × white tile
- 1 × 50 cm³ burette of at least class B quality
- 1 × filter funnel for filling the burette
- 1 × retort stand and burette clamp
- Approximately 1.70 g of ethanedioic acid-2-water labelled **X** in a sealed container and with the hazard symbol for **health hazard (exclamation mark label)**.
- Approximately 150 cm³ of 0.1 M sodium hydroxide solution in a 250 cm³ beaker labelled **sodium hydroxide solution**.
- Phenolphthalein indicator labelled **phenolphthalein** and with the hazard symbol for **flammable**.
- Access to an electronic balance (measuring to 2 decimal places).

Question No. 2

Each candidate must be supplied with:

- 1 × graduated disposable pipette
- 1 × piece of universal indicator paper (Johnson pH 1 to pH 11) and the colour chart
- 1 × white tile
- 2 × test tubes
- 1 × test tube rack
- 1 × spatula
- 3 × boiling tubes
- 1 × boiling tube rack
- 2 × stoppers for boiling tubes
- 3 × 10 cm³ measuring cylinders
- 1 × 250 cm³ beaker
- 1 × stopclock
- 1 × thermometer
- 1 × 2 cm strip of magnesium ribbon in a container labelled **magnesium** and with the hazard symbol for **flammable**.
- 1 × calcium granule in a sealed container labelled **calcium** and with the hazard symbol for **flammable**.
- Access to solid sodium hydrogencarbonate labelled **sodium hydrogencarbonate**.
- Access to 2 M sulfuric acid (just over 20 cm³) labelled **2 M sulfuric acid** and with the hazard symbol for **corrosive**.
- Access to 0.02 M potassium manganate(VII) (just over 10 cm³) labelled **potassium manganate(VII) solution**.
- Candidates will require access to boiling water which may be provided from a kettle in the laboratory.



Rewarding Learning

ADVANCED
General Certificate of Education
2024

Chemistry

Assessment Unit A2 3

Practical Assessment

Practical Booklet A

[ACH31]

THURSDAY 9 MAY, MORNING

Confidential Instructions to the Supervisor of the Practical Examination

INSTRUCTIONS TO THE SUPERVISOR OF THE PRACTICAL EXAMINATION

General

1. The instructions contained in this document are for the use of the Supervisor **and are strictly confidential**. Under no circumstances may information concerning apparatus or materials be given before the examination to a candidate or other unauthorised person.
2. In a centre with a large number of candidates it may be necessary for two or more examination sessions to be organised. **It is the responsibility of the schools to ensure that there should be no contact between candidates taking each session.**
3. A suitable laboratory must be reserved for the examination and kept locked throughout the period of preparation. Unauthorised persons not involved in the preparation for the examination must not be allowed to enter. Candidates must not be admitted until the specified time for commencement of the examination.
4. The Supervisor must ensure that the solutions provided for the candidates are of the nature and concentrations specified in the Apparatus and Materials List.
5. **The Supervisor is to be granted access to the Teacher's Copy of Practical Booklet A on Thursday 2 May 2024.** The Supervisor is asked to check, at the earliest opportunity, that the experiments and tests in the question paper may be completed satisfactorily using the apparatus, materials and solutions that have been assembled. **This question paper must then be returned to safe custody** at the earliest possible moment after the Supervisor has ensured that all is in order. **No access to the question paper should be allowed before Thursday 2 May 2024.**
6. Centres may need to carry out multiple sessions to accommodate all their candidates sitting Practical Booklet A in a laboratory. Supervision must take place from 30 minutes after the scheduled starting time of the examination, as set out in the timetable, until the time when the candidate(s) begin(s) their examination(s). This is in order to ensure that there is no contact with other candidates. The centre must appoint a member of staff from the centre to supervise the candidate(s) at all times while they are on the premises.
7. All apparatus should be checked before the examination, and there should be an adequate supply of spare apparatus in case of breakages. The Apparatus and Materials List should be regarded as a minimum and there is no objection to candidates being supplied with more than the minimum amount of apparatus and materials.
8. **Candidates may not use text books and laboratory notes for reference during the examination, and must be informed of this beforehand.**

9. Clear instructions must be given by the Supervisor to all candidates at the beginning of the examination concerning appropriate safety procedures and precautions. Supervisors are also advised to remind candidates that all substances in the examination must be treated with caution. **Only those tests specified in the question paper should be attempted. Candidates must not attempt any additional confirmatory tests.** Anything spilled on the skin should be washed off immediately with plenty of water. The use of appropriate eye protection is essential.
10. Supervisors are reminded that they may not assist candidates during the examination. However, if, in the opinion of the Supervisor, a candidate is about to do something which may endanger themselves or others, the Supervisor should intervene. A full written report must be sent to CCEA at once.
11. Upon request, a candidate may be given additional quantities of materials (answer paper, reagents and unknowns) without penalty. No notification needs to be sent to CCEA.
12. The examination room must be cleared of candidates immediately after the examination.
13. No materials will be supplied by CCEA.
14. All JCQ procedures for conducting examinations should be followed for this practical examination including displaying JCQ posters with examination information in the laboratory and removal of mobile phones. Posters should be available from your Examinations Officer.

Northern Ireland Council for the Curriculum, Examinations and
Assessment

General Certificate of Education

Advanced

Chemistry

Practical Booklet A

[ACH31]

Thursday 9 May 2024

Centre Number

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Candidate Number

This report must be completed by the Supervisor during the examination.
The complete report should include all candidates taking this Practical
Examination. This Supervisor's Report should be copied and attached to
Each Advice Note bundle and returned to CCEA in the normal way.

Comments:

Supervisor's Signature Date