Rewarding Learning

ADVANCED
General Certificate of Education
2024

Centre Number

Candidate Number

Chemistry

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 cm^3 in a volumetric flask.

You will then titrate 25.0 cm^3 portions of a solution of sodium hydroxide with the solution you have prepared.

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

_____ [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** _____ [2]

Dissolve the weighed sample in approximately 75 cm^3 of deionised water. Transfer the solution to a 250 cm^3 volumetric flask, add any washings, and make up the volume to 250 cm^3 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.

Mean titre _____ [8]

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

From _____ to _____ [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: _____

pH: _____ [2]

(b) Place 5 cm^3 of the solution of **X** into a test tube. Add half a spatula measure of sodium hydrogencarbonate. Record your observations.

_____

_____ [2]

(c) Place 5 cm^3 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.

_____

_____ [2]

(d) **(i)** Place 5 cm^3 of the solution of **X** into a boiling tube and record the temperature of the solution.

_____ [1]

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

_____

_____

_____ [3]

(e) (i) Place 10 cm^3 of the solution of **X** into a boiling tube. Add 10 cm^3 of 2 M sulfuric acid to the boiling tube. Add 5 cm^3 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.

_____

_____

_____ [3]

(ii) Place 10 cm^3 of the solution of **X** into a boiling tube. Add 10 cm^3 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 cm^3 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)**.

_____ [1]

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

_____

_____ [1]

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

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

Answer _____ [2]

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	**Marks**
1	
2	
Total Marks	

Examiner Number

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 = 6.02×10^{23} mol^{-1}
Planck Constant = 6.63×10^{-34} J s
Specific Heat Capacity of water = 4.2 J g^{-1} K^{-1}
Speed of Light = 3×10^8 m s^{-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	–C**H**	Saturated alkanes
0.5–5.5	–O**H**	Alcohols
1.0–3.0	–N**H**	Amines
2.0–3.0	–CO–C**H**	Ketones
	–N–C**H**	Amines
	C_6H_5–C**H**	Arene (aliphatic on ring)
2.0–4.0	X–C**H**	X = Cl or Br (3.0–4.0)
		X = I (2.0–3.0)
4.5–6.0	–C=C**H**	Alkenes
5.5–8.5	RCON**H**	Amides
6.0–8.0	–C_6**H**$_5$	Arenes (on ring)
9.0–10.0	–C**H**O	Aldehydes
10.0–12.0	–COO**H**	Carboxylic acids

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

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

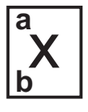
chemistry

THE PERIODIC TABLE OF ELEMENTS

I	II											III	IV	V	VI	VII	0
Group																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen 1																	4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	98 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	266 Sg Seaborgium 106	264 Bh Bohrium 107	277 Hs Hassium 108	268 Mt Meitnerium 109	271 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series



a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

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General Certificate of Education
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Chemistry

Assessment Unit A2 3

assessing

Further Practical Chemistry
Practical Booklet A

[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 cm^3 beaker
- 1 × 250 cm^3 beaker (waste)
- 1 × wash bottle containing deionised water
- 1 × 250 cm^3 volumetric flask
- 1 × filter funnel
- 1 × glass rod
- 1 × graduated disposable pipette
- 1 × 25 cm^3 pipette of at least class B quality
- 1 × safety pipette filler
- 3 × 250 cm^3 conical flasks
- 1 × white tile
- 1 × 50 cm^3 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 cm^3 of 0.1 M sodium hydroxide solution in a 250 cm^3 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 cm^3 measuring cylinders
- 1 × 250 cm^3 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 cm^3) labelled **2 M sulfuric acid** and with the hazard symbol for **corrosive**.
- Access to 0.02 M potassium manganate(VII) (just over 10 cm^3) labelled **potassium manganate(VII) solution**.
- Candidates will require access to boiling water which may be provided from a kettle in the laboratory.

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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
71

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 . . . . . .