Rewarding Learning

ADVANCED
General Certificate of Education
2023

Centre Number

Candidate Number

Chemistry

Assessment Unit A2 3
assessing
Further Practical Chemistry
Practical Booklet A

ACH31

[ACH31]
THURSDAY 11 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 **all three** 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.

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1 Sodium thiosulfate solution may be used in titrations to determine the concentration of oxidising agents such as potassium iodate(V).

The method below describes how to carry out such a titration. You should follow the method and record the results of **one rough titration and two concordant titrations**.

1. Pipette 25.0 cm^3 of the potassium iodate(V) solution into each of three conical flasks.
2. Add 10 cm^3 of dilute sulfuric acid to each conical flask.
3. Add a 1 g portion of solid potassium iodide to each conical flask and swirl gently to mix.
4. Fill the burette with the 0.075 mol dm^{-3} sodium thiosulfate solution and titrate the contents of a conical flask until straw coloured.
5. Add a few drops of starch indicator and continue to add the sodium thiosulfate solution until the end point.

(a) Draw a suitable table and record your results to 1 decimal place.

[6]

(b) Use your results to calculate the mean titre.

Answer _____ [2]

(c) State the colour change observed at the end point.

_____ [2]

[Turn over

2 You are provided with a compound labelled **A**.

(a) (i) Describe the appearance of **A.**

_____ [1]

(ii) Place 1 spatula measure of **A** in a boiling tube. Heat gently in a Bunsen flame. Record all observations.

_____

_____ [2]

(b) Make a solution of **A** by dissolving two spatula measures of **A** in approximately 50 cm^3 of deionised water in a 100 cm^3 beaker and carry out the following tests.

All volumes in the questions which follow are approximate and may be measured using a measuring cylinder or a graduated disposable pipette.

(i) Place 2 cm^3 of the solution of **A** in a test tube, add 10 drops of **dilute** ammonia solution and record your observations.

_____

_____ [1]

Retain the contents of this test tube for use in (b)(ii).

(ii) In a fume cupboard, add 5 cm^3 of **concentrated** ammonia solution to the contents of the test tube from **(b)(i)** and record your observations.

_____

_____ [2]

(iii) Place 2 cm^3 of the solution of **A** in a test tube and slowly add 2 cm^3 of 1,2-diaminoethane. Record your observations.

_____

_____ [1]

(iv) Place 2 cm^3 of the solution of **A** in a test tube and add 2 cm^3 of barium chloride solution. Allow to stand and record your observations.

_____

_____ [2]

(v) Place 2 cm^3 of the solution of **A** in a test tube and in a fume cupboard, add 1 cm^3 of concentrated hydrochloric acid. Record your observations.

_____

_____ [1]

(vi) Place 2 cm^3 of the solution of **A** in a test tube. Record the temperature. Add 1 granule of calcium using tweezers. Record the temperature after 2 minutes and record any other observations.

_____

_____

_____

_____ [4]

(vii) Place 2 cm^3 of the solution of **A** in a test tube and add 1 spatula measure of potassium iodide. Record your observations.

_____

_____ [1]

[Turn over

3 You are provided with an organic solid labelled **X**.

(a) Describe the appearance of **X**.

_____ [1]

(b) Carry out the following tests on **X** and record your observations in the table below.

All volumes up to 3 cm^3 in the tests which follow are approximate and may be measured using a measuring cylinder or a graduated disposable pipette.

Test	Observations
1. Make a solution of **X** by dissolving two spatula measures of **X** in 50 cm^3 of deionised water in a 100 cm^3 beaker. **Retain** this solution for use in tests 2–5.	
2. Test the solution of **X** using universal indicator paper.	
3. Place 2 cm^3 of the solution of **X** in a test tube and add 2 cm^3 of copper(II) sulfate solution.	
4. Add a spatula measure of solid sodium hydrogencarbonate to a test tube one quarter filled with the solution of **X**.	

[4]

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
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

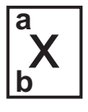
chemistry

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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Chemistry

Assessment Unit A2 3

assessing

Further Practical Chemistry
Practical Booklet A

[ACH31]

THURSDAY 11 MAY, MORNING

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.cleapss.org.uk

Practical Examination

Each candidate must be supplied with safety goggles or glasses.

Question No. 1

Each candidate must be supplied with:

- 1 × 50 cm^3 burette of at least class B quality
- 1 × funnel for filling the burette
- 1 × retort stand and clamp
- 1 × beaker for waste
- 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 × wash bottle containing deionised water
- 1 × 10 cm^3 measuring cylinder
- starch indicator with dropper labelled **starch indicator**
- 150 cm^3 of 0.075 mol dm^{-3} sodium thiosulfate solution labelled as **0.075 mol dm^{-3} sodium thiosulfate** in a 250 cm^3 beaker
- 150 cm^3 of 0.01 mol dm^{-3} solution of potassium iodate(V) labelled as **potassium iodate(V) solution** in a 250 cm^3 beaker
- approximately 40 cm^3 of 1.0 mol dm^{-3} dilute sulfuric acid labelled as **dilute sulfuric acid** and **irritant** in a small beaker
- 3 × 1 g portions of potassium iodide labelled as **potassium iodide** in suitable sealed containers

Question No. 2

- 1 × Bunsen burner
- 1 × boiling tube holder
- 1 × heat proof mat
- 1 × thermometer (–10 to 100°C)
- 1 × boiling tube
- 1 × test tube rack
- 1 × boiling tube rack
- 6 × test tubes
- 1 × 50 cm^3 (or 100 cm^3) measuring cylinder
- 1 × 100 cm^3 beaker
- 1 × spatula
- 1 × wash bottle containing deionised water
- 1 × granule of calcium in sealed container
- 1 × tweezers
- 1 × glass rod
- 1 × stop clock
- several disposable pipettes
- 1.5 g of hydrated copper(II) sulfate labelled **A** and **corrosive** and **irritant** and **harmful to the environment**
- Approximately 1 g of potassium iodide labelled **potassium iodide** in a sealed container
- Approximately 10 cm^3 of 0.5 mol dm^{-3} ammonia solution labelled **dilute ammonia solution**
- Approximately 10 cm^3 of concentrated ammonia labelled **concentrated ammonia** and **corrosive** and **irritant** in a fume cupboard
- Approximately 10 cm^3 of 0.1 mol dm^{-3} barium chloride solution labelled **barium chloride** and **harmful**
- Approximately 1 cm^3 of concentrated hydrochloric acid labelled **concentrated hydrochloric acid** and **corrosive** and **irritant** in a fume cupboard
- Approximately 10 cm^3 of 0.1 mol dm^{-3} 1,2-diaminoethane solution labelled **1,2–diaminoethane** and **hazardous to health**

For reagents in the fume cupboard candidates may have access to shared reagent bottles

Question No. 3

- 1 × test tube rack
- 2 × test tubes
- 1 × wash bottle of deionised water
- 1 × 100 cm^3 beaker
- 1 × 50 cm^3 (or 100 cm^3) measuring cylinder
- 1 × spatula
- 1 × strip of universal indicator paper
- 1 × white tile
- Several disposable pipettes
- 1 × glass rod
- Approximately 2 g of glycine labelled **X**
- Approximately 10 cm^3 of 0.5 mol dm^{-3} copper(II) sulfate solution labelled **copper(II) sulfate solution for use in question 3** and **corrosive**
- Approximately 1 g of sodium hydrogencarbonate

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General Certificate of Education
2023

Chemistry

Assessment Unit A2 3

Practical Assessment

Practical Booklet A

[ACH31]

THURSDAY 11 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 Friday 5 May 2023.** 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 Friday 5 May 2023.**

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 11 May 2023

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 . . . . . .