Rewarding Learning

ADVANCED
General Certificate of Education
2022

Centre Number

Candidate Number

Chemistry

Assessment Unit A2 3
assessing
Further Practical Chemistry
Practical Booklet A

ACH31

[ACH31]
THURSDAY 12 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 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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1 You are provided with a sample of an iron(II) salt and an iron(III) salt and are required to investigate their chemistry.

All volumes of 3 cm^3 or less in this question may be measured approximately using the graduations on a disposable pipette.

(a) Dissolve all of the sample of each iron salt in separate 50 cm^3 portions of deionised water in the labelled 100 cm^3 beakers. Describe the appearance of both solutions.

iron(II) salt: _____

iron(III) salt: _____ [2]

(b) Test each of the salt solutions formed in **(a)** with universal indicator paper and complete the table below.

Salt solution	Colour with universal indicator paper	Approximate pH
iron(II) salt		
iron(III) salt		

[4]

(c) Add 2 cm^3 of each iron salt solution from **(a)** to separate test tubes. Add 1 cm^3 of sodium hydroxide solution to each test tube. Note any observations in each test tube.

iron(II) salt: _____

iron(III) salt: _____ [2]

(d) Light a Bunsen burner. Add 2 cm^3 of the iron(III) salt solution from **(a)** to a test tube. Add a spatula measure of sodium carbonate to the test tube, shake gently and immediately place a lit splint in the mouth of the test tube. Note any observations.

_____

_____

_____ [3]

(e) Add 2 cm^3 of each iron salt solution from **(a)** to separate test tubes. Add 1 cm^3 of potassium iodide solution, followed by 2 cm^3 of cyclohexane, to each test tube. Insert a bung into each test tube and shake each test tube gently. Note the appearance of the upper layer in each test tube.

iron(II) salt: _____

iron(III) salt: _____ [2]

(f) Add 2 cm^3 of each iron salt solution from **(a)** to separate test tubes. Add 1 cm^3 of ammonium thiocyanate solution to each test tube and note any observations.

iron(II) salt: _____

iron(III) salt: _____ [2]

[Turn over

(g) **(i)** Add 2 cm^3 of each iron salt solution from **(a)** to separate test tubes. Add 1 cm of magnesium ribbon to each test tube and shake gently. State **one** observation that is the same in each test tube.

_____ [1]

(ii) Explain how the observations from both test tubes in **(g)(i)** support the deduction that magnesium is more reactive with iron(III) salt solutions than iron(II) salt solutions.

_____ [1]

(h) The iron(III) salt solution can be used to follow the conversion of salicylic acid to aspirin as the solution turns purple in the presence of salicylic acid but does not turn purple in the presence of aspirin.

Add a spatula measure of solid **A** and solid **B** to separate test tubes.
Add five drops of the iron(III) solution from **(a)** to each test tube and use your observations to identify and explain whether solid **A** or **B** contains more salicylic acid.

_____

_____ [1]

2 You are required to carry out a back titration using an indigestion tablet.

(a) Weigh an indigestion tablet and record the mass to 1 decimal place. Crush the tablet in a mortar using a pestle and then transfer all of the crushed tablet into a 250 cm^3 beaker.

Mass of tablet: _____ [1]

(b) Measure 50 cm^3 of 1.0 mol dm^{-3} hydrochloric acid using a measuring cylinder and add to the 250 cm^3 beaker with stirring. Note any observations.

_____

_____ [1]

(c) Filter the mixture through filter paper into a 250 cm^3 volumetric flask, ensuring the beaker and glass rod are rinsed with deionised water and the washings are transferred into the flask. Describe the appearance of the residue and the filtrate.

residue: _____

filtrate: _____ [1]

(d) Make up the solution to the mark with deionised water, then stopper and invert the flask. Titrate three 25.0 cm^3 portions from the volumetric flask with 0.20 mol dm^{-3} sodium hydroxide solution using phenolphthalein indicator. Complete the following table and calculate the mean titre.

Rough titration			
First accurate titration			
Second accurate titration			

mean titre = _____ [5]

[Turn over

3 You are provided with a solid, labelled **M**, which contains a transition metal ion.

All volumes of 3 cm^3 or less in this question may be measured approximately using the graduations on a disposable pipette.

(a) Dissolve all of the sample of **M** in 30 cm^3 of 2.0 mol dm^{-3} sulfuric acid in a 100 cm^3 beaker. State the colour of the solution.

_____ [1]

(b) Add 2 cm^3 of the solution of **M** to a test tube. Add 2 cm^3 of ammonium iron(II) sulfate solution and shake the test tube gently. State the colour of the solution.

_____ [1]

(c) **(i)** Add 2 cm^3 of the solution of **M** to a test tube. Add 2 cm^3 of potassium iodide solution and shake gently. State the colour of the solution.

_____ [1]

(ii) Add 2 cm^3 of sodium thiosulfate solution to the solution formed in **(c)(i)** and shake the test tube gently. State **one** observation.

_____

_____ [1]

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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.

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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

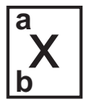
chemistry

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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