



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2025

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--	--

Chemistry

StemUp Model Solution

Assessment Unit AS 3

assessing

Module 3: Practical Examination

Practical Booklet B (Theory)



[SCH32]

SCH32

THURSDAY 29 MAY, AFTERNOON

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 questions in black ink and use a dark HB pencil for drawings and graphs.

Do not write with a gel pen.

Answer all **five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 55.

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

You may use a scientific calculator.

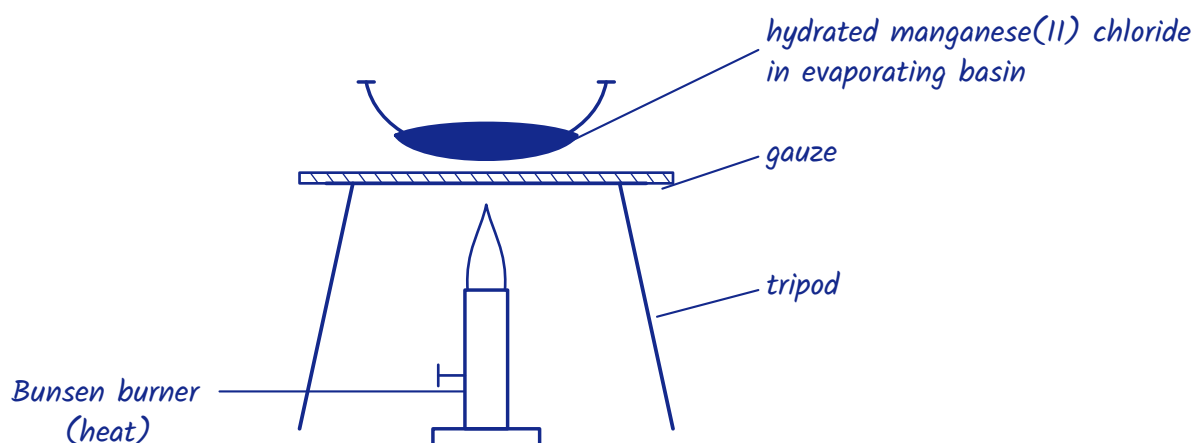
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

14554



- 1 A sample of hydrated manganese(II) chloride ($\text{MnCl}_2 \cdot x\text{H}_2\text{O}$) was heated to constant mass in an evaporating basin. The results were used to determine the formula of the hydrated manganese(II) chloride.

(a) Draw a labelled diagram of the assembled apparatus used to carry out this experiment.



[3]

(b) (i) State two masses which should be recorded before heating the sample.

1. Mass of the empty evaporating basin.

2. Mass of the evaporating basin and the hydrated salt.

[2]

(ii) Describe how the sample is heated to constant mass.

Heat, cool and weigh; repeat heating, cooling and weighing until
there is no further change in mass.

[2]



- (c) A sample of 4.00 g of hydrated manganese(II) chloride ($\text{MnCl}_2 \cdot x\text{H}_2\text{O}$) was heated to a constant mass of 2.55 g.
Determine the formula of the hydrated manganese(II) chloride.

$$\text{mass of water} = 4.00 - 2.55 = 1.45 \text{ g}$$

$$\text{moles of water} = 1.45 \div 18 = 0.0806 \text{ mol}$$

$$M_r \text{ MnCl}_2 = 55 + 2(35.5) = 126$$

$$\text{moles of anhydrous MnCl}_2 = 2.55 \div 126 = 0.0202 \text{ mol}$$

$$x = 0.0806 \div 0.0202 = 3.99 = 4$$

Formula $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ [3]

- (d) Describe how a sample of solid hydrated manganese(II) chloride could be tested to fully confirm the presence of chloride ions.

Dissolve the solid in deionised water, add a few drops of dilute nitric

acid, then add silver nitrate solution: a white precipitate forms.

Add dilute ammonia solution: the white precipitate disappears

(dissolves), confirming chloride ions.

[4]

[Turn over]



- 2 (a) The polarity of some liquids was investigated by observing the deflection of a stream of each liquid from a burette using a charged rod.

One result from the experiment is shown in the table below.

Liquid	Deflection	Polar/Non-polar
cyclohexane	No	<i>Non-polar</i>
water	<i>Yes</i>	<i>Polar</i>
tetrachloromethane	<i>No</i>	<i>Non-polar</i>

- (i) Complete the table.

[3]

- (ii) Suggest a suitable material for the charged rod.

Polythene (rubbed with a cloth).

[1]

- (b) The experiment was repeated using ethanol and the result of the experiment proved that ethanol is a polar liquid.

Draw the structural formula of ethanol, showing all bonds. Identify the **most** polar bond in the ethanol molecule using partial charges.



[2]





BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

14554

[Turn over



3 (a) Chloroalkanes can be prepared by the reaction of phosphorus pentachloride with an alcohol.

(i) Write an equation for the reaction between butan-2-ol and phosphorus pentachloride.



(ii) State one observation which indicates the production of hydrogen chloride gas in the reaction in (a)(i).

Steamy (misty) fumes are given off. [1]

(iii) Describe the test for hydrogen chloride gas and state the result for a positive test.

Hold a glass rod dipped in concentrated ammonia solution (or the stopper from a bottle of concentrated ammonia solution) near the gas.

Positive result: white smoke (fumes) of ammonium chloride. [2]



(b) 1-chlorobutane reacts with ammonia. State two conditions for this reaction.

1. *Heat, in a sealed tube.*
2. *Ammonia dissolved in ethanol (ethanolic ammonia).* [2]

(c) 1-chlorobutane can be converted into butan-1-ol. Butan-1-ol reacts with acidified potassium dichromate(VI) solution producing two possible organic products depending on the method of preparation.

(i) Draw the skeletal formula of butan-1-ol.



[1]

(ii) Name the two possible organic products of the reaction between butan-1-ol and acidified potassium dichromate(VI) solution. State the method used to prepare each organic product.

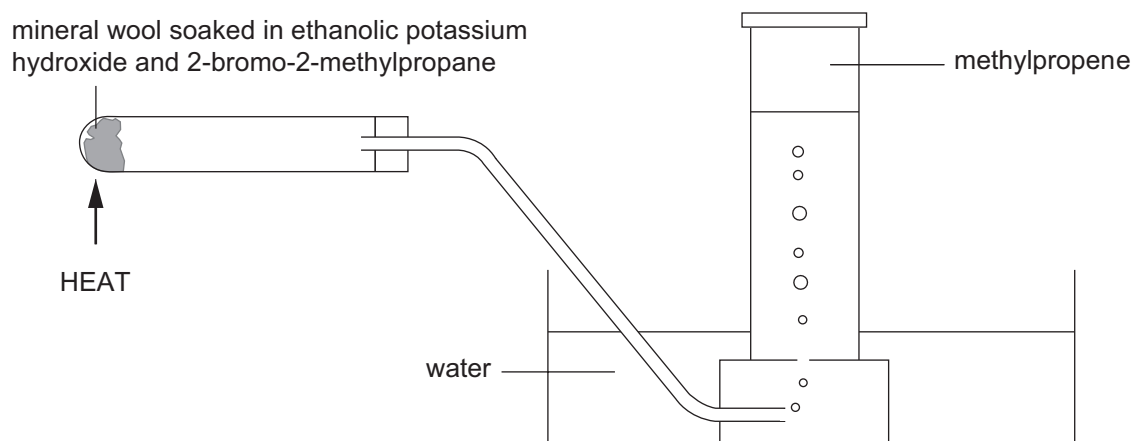
Name of product	Method of preparation
<i>butanal</i>	<i>distil (immediately as it forms)</i>
<i>butanoic acid</i>	<i>heat under reflux (excess oxidising agent)</i>

[4]

[Turn over]



- 4 In an experiment to prepare methylpropene gas, some mineral wool was soaked in 2-bromo-2-methylpropane (density 1.22 g cm^{-3}) and ethanolic potassium hydroxide.



- (a) (i) Suggest the purpose of the mineral wool.

To hold the liquid and keep the reactants in contact.

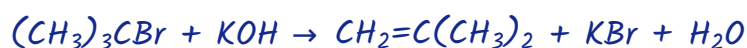
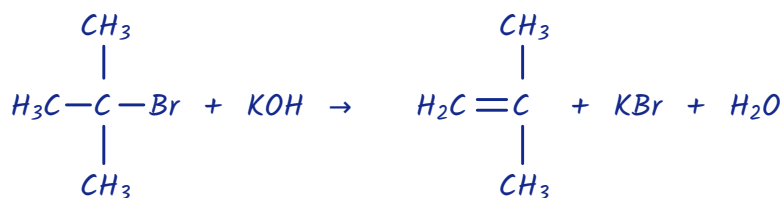
[1]

- (ii) Why can methylpropene be collected over water?

Methylpropene is insoluble in water.

[1]

- (iii) Write an equation for the reaction of 2-bromo-2-methylpropane with ethanolic potassium hydroxide forming methylpropene.



[1]



- (b) Calculate the theoretical volume, in cm^3 , of methylpropene gas formed at 293 K and 1 atm, when 1.08 cm^3 of 2-bromo-2-methylpropane reacts with excess ethanolic potassium hydroxide. Give your answer to 3 significant figures.

$$\text{mass} = 1.08 \times 1.22 = 1.3176 \text{ g}$$

$$M_r (\text{CH}_3)_3\text{CBr} = 4(12) + 9(1) + 80 = 137$$

$$\text{moles} = 1.3176 \div 137 = 0.00962 \text{ mol (1 : 1 ratio)}$$

$$\text{volume} = 0.00962 \times 24\,000 = 231 \text{ cm}^3$$

Answer 231 cm^3 [3]

- (c) If aqueous potassium hydroxide is used instead of ethanolic potassium hydroxide in the reaction with 2-bromo-2-methylpropane, the organic product is 2-methylpropan-2-ol.

- (i) Describe how you would experimentally show that 2-methylpropan-2-ol is a tertiary alcohol.

Add acidified potassium dichromate(VI) solution and warm: the
solution remains orange (not oxidised), so it is a tertiary alcohol.

[1]

- (ii) Write the equation for the reaction of 2-methylpropan-2-ol with sodium.



- (iii) State two observations for the reaction in (c)(ii).

- Fizzing (effervescence).
- The sodium disappears and heat is released.

[2] **[Turn over]**



- 5 (a) Complete the table below to give the colour of solid iodine and solid potassium iodide.

Substance	Colour
solid iodine	<i>grey-black</i>
solid potassium iodide	<i>white</i>

[2]

- (b) A spatula measure of solid iodine is added to deionised water. State an observation which would be made.

A pale yellow/brown solution forms (iodine only slightly soluble).

[1]

- (c) Starch solution is added to the resulting mixture from (b). State an observation which would be made.

A blue-black colour forms.

[1]

- (d) Describe how you would carry out a flame test on solid potassium iodide and state the result.

*Dip a nichrome wire in concentrated hydrochloric acid (to clean it),
then into the solid potassium iodide sample, and hold it in the hot
blue (roaring) Bunsen burner flame.*

*Result: a lilac flame (pink when viewed through blue cobalt glass),
showing K^+ ions.*

[4]



- (e) 10 cm³ of 0.15 M potassium iodide solution were added to 10 cm³ of 0.10 M lead(II) nitrate solution. A precipitate of lead(II) iodide is formed. The equation for the reaction is:



- (i) Write an ionic equation for this reaction.



- (ii) Calculate the mass of lead(II) iodide obtained. Give your answer, in mg, to 2 significant figures.

moles of KI = $(10 \times 0.15) \div 1000 = 1.5 \times 10^{-3} \text{ mol}$

moles of $\text{Pb}(\text{NO}_3)_2 = (10 \times 0.10) \div 1000 = 1.0 \times 10^{-3} \text{ mol}$

$\text{Pb}(\text{NO}_3)_2$ needs only $0.75 \times 10^{-3} \text{ mol}$, so KI is limiting

moles of $\text{PbI}_2 = 1.5 \times 10^{-3} \div 2 = 7.5 \times 10^{-4} \text{ mol}$

$M_r \text{ PbI}_2 = 207 + 2(127) = 461$

mass = $7.5 \times 10^{-4} \times 461 = 0.34575 \text{ g} = 345.75 \text{ mg}$

= 350 mg (2 s.f.)

Answer 350 mg [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	
4	
5	

Total Marks	
-------------	--

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA
will be happy to rectify any omissions of acknowledgement in future if notified.

SCH32/4
297162



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 = $4.2 \text{ J g}^{-1} \text{ K}^{-1}$

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



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	–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.

© CCEA 2017

COUNCIL FOR THE CURRICULUM, EXAMINATIONS AND ASSESSMENT

29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG

Tel: +44 (0)28 9026 1200 Fax: +44 (0)28 9026 1234

Email: info@ccea.org.uk Web: www.ccea.org.uk



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	

a

X

b

a = relative atomic mass (approx)

x = atomic symbol

b = atomic number

* 58 – 71 Lanthanum series

† 90 – 103 Actinium series

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

a

X

b

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