



Rewarding Learning

ADVANCED
General Certificate of Education
2018

Centre Number

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Candidate Number

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Chemistry

Assessment Unit A2 3

assessing

Module 3: Practical Examination

Practical Booklet B (Theory)



[AC234]

AC234

WEDNESDAY 20 JUNE, 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 50.

Question 1 is a practical exercise worth 17 marks.

Question 2 is a practical exercise worth 13 marks.

Question 3 is a planning exercise worth 20 marks.

Quality of written communication will be assessed in **Question 3(b)**.

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.

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- 1 A student prepared 250 cm^3 of a 0.10 mol dm^{-3} solution of ammonium iron(II) sulfate $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ by dissolving the solid in 100 cm^3 of dilute sulfuric acid and making the solution up to 250 cm^3 in a volumetric flask.

(a) Calculate the mass of ammonium iron(II) sulfate required.

[3]

(b) The student titrated 25.0 cm^3 portions of the 0.10 mol dm^{-3} solution with acidified potassium manganate(VII) and obtained the results given in the table.

titration	initial burette reading/ cm^3	final burette reading/ cm^3	volume added / cm^3
Rough	0.0	30.5	30.5
1	0.4	30.5	
2	0.6	30.5	

(i) Why is indicator not required in this titration?

[1]

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

[2]

(iii) Complete the results table and calculate the average titre.

[2]



- (c) (i) Write the half-equation for the reduction of acidified manganate(VII) ions to form manganese(II) ions.

_____ [2]

- (ii) Write the half-equation for the oxidation of iron(II) ions to iron(III) ions.

_____ [1]

- (iii) Write the ionic equation for the reaction.

_____ [2]

- (iv) Calculate the concentration of the acidified potassium manganate(VII) solution in g dm^{-3} .

_____ [4]

[Turn over



- 2 (a) Based on the following observations, make deductions for the organic liquids **A**, **B** and **C**.

Test	Observation	Deduction
<p>1 In a fume cupboard add a spatula measure of phosphorus(V) chloride to liquid A.</p> <p>Test any gas given off using a glass rod which has been dipped in concentrated ammonia solution.</p>	<p>Vigorous reaction. Heat produced. Steamy fumes given off.</p> <p>White smoke produced.</p>	[2]
<p>2 Add 2 cm³ of water to 2 cm³ of liquid A.</p> <p>Add 1 cm³ of dilute sulfuric acid followed by a few drops of potassium dichromate solution and heat.</p>	<p>A single layer forms.</p> <p>The solution remains orange.</p>	[2]
<p>3 Add 2 cm³ of water to 2 cm³ of liquid A followed by a spatula measure of sodium carbonate. Test any gas given off using limewater.</p>	<p>Bubbles of gas. Solid disappears.</p> <p>Limewater turns milky.</p>	[2]
<p>4 Add a few drops of liquid B to 2 cm³ of 2,4-dinitrophenyl hydrazine solution.</p>	<p>A yellow solid forms.</p>	[1]
<p>5 Heat B with Fehling's solution.</p>	<p>The solution remains blue.</p>	[1]



Test	Observation	Deduction
6 Add a few drops of liquid C to 2 cm ³ of 2,4-dinitrophenyl hydrazine solution.	An orange solid forms.	[1]
7 Heat C with Tollen's reagent.	A silver mirror forms.	[1]

(b) The nmr spectrum of **A** contains a quartet, a triplet and a singlet. Suggest a structure for **A**.

_____ [1]

(c) The nmr spectrum for **B** shows that it contains a quartet and a triplet only. Suggest a structure for **B**.

_____ [1]

[Turn over

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(d) The mass spectrum of **C** shows that the molecular ion occurs at an m/z value of 58. Suggest a structure for **C**.

[1]

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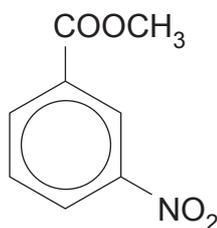
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- 3 Methyl 3-nitrobenzoate exists as a solid at room temperature. Its melting point is 78–79°C.



- (a) (i) Write the equation for the formation of methyl 3-nitrobenzoate from methyl benzoate using nitric acid.

[1]



(ii) Assuming a 60% yield, calculate the minimum mass of methyl benzoate required to produce 5.43 g of methyl 3-nitrobenzoate.

[3]

(b) Describe the laboratory preparation of methyl 3-nitrobenzoate up to and including the removal of the crude product from the reaction mixture.

[5]

Quality of written communication

[2]

[Turn over



- (c) (i) The crude product is recrystallised before its melting point is determined. Explain why recrystallisation is carried out and, giving experimental details, describe the process of recrystallisation naming a suitable solvent.

[4]

- (ii) What colour are the crystals?

[1]

- (iii) How could the crystals be dried before the melting point is determined?

[1]

- (iv) How would you use the melting point to determine whether the crystals are pure methyl 3-nitrobenzoate?

[1]



(d) The mass spectrum of the product showed two fragment peaks at m/z values of 59 and 150. Suggest the identities of the two fragments.

m/z value of 59

_____ [1]

m/z value of 150

_____ [1]

THIS IS THE END OF THE QUESTION PAPER



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Question Number	Examiner Mark	Remark
1		
2		
3		
Total Marks		

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Periodic Table of the Elements

For the use of candidates taking
Advanced Subsidiary and Advanced Level
Chemistry 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
(advanced)

I	II	THE PERIODIC TABLE OF ELEMENTS Group										III	IV	V	VI	VII	0						
1 H Hydrogen 1	One mole of any gas at 20°C and a pressure of 1 atmosphere (10 ⁵ Pa) occupies a volume of 24 dm ³ . Planck Constant = 6.63 × 10 ⁻³⁴ Js Gas Constant = 8.31 J mol ⁻¹ K ⁻¹ Avogadro Constant = 6.02 × 10 ²³ mol ⁻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	99 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																					

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

$\begin{matrix} a \\ b \end{matrix} x$ a = relative atomic mass (approx.)
x = atomic symbol
b = atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 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