Rewarding Learning

ADVANCED
General Certificate of Education
2018

Centre Number

Candidate Number

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.

11602

1 A student prepared 250 cm^3 of a 0.10 mol dm^{-3} solution of ammonium iron(II) sulfate $(NH_4)_2Fe(SO_4)_2.6H_2O$ 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.

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____ [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 $g\,dm^{-3}$.

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____ [4]

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

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

(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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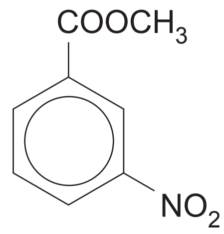
(Questions continue overleaf)

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.

____

____

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____

____

____ [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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For Examiner's use only		
Question Number	**Examiner Mark**	**Remark**
1		
2		
3		
Total Marks		

Rewarding Learning

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)

THE PERIODIC TABLE OF ELEMENTS

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} J s
Gas Constant = 8.31 J mol^{-1} K^{-1}
Avogadro Constant = 6.02×10^{23} mol^{-1}

I	II	Group										III	IV	V	VI	VII	0
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	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															

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

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

a b x

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