Rewarding Learning

ADVANCED
General Certificate of Education
2017

Centre Number

Candidate Number

Chemistry

Assessment Unit A2 3
assessing
Module 3: Practical Examination
Practical Booklet B (Theory)

[AC234]

AC234

THURSDAY 22 JUNE, 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 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 18 marks.
Question 2 is a practical exercise worth 12 marks.
Question 3 is a planning exercise worth 20 marks.
Quality of written communication will be assessed in **Question 3(d)(ii)**.
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.

10759

1 Titration

The percentage of copper in a coin can be determined by the following method:

- Accurately weigh the coin and react it with concentrated nitric acid in a beaker in a fume cupboard to form a solution of copper(II) ions.
- Place the mixture into a 250 cm^3 volumetric flask and make up to the mark with deionised water.
- Use a pipette and safety filler to transfer 25.0 cm^3 of this solution to a conical flask.
- Add pH 10 buffer solution to the conical flask.
- Titrate this solution with 0.5 mol dm^{-3} edta solution using murexide indicator.

(a) Copper reacts with nitric acid to produce copper(II) nitrate, nitrogen(IV) oxide and water.

(i) Write the equation for this reaction.

____ [2]

(ii) Why must this reaction be carried out in a fume cupboard?

____ [1]

(iii) State and explain a safety precaution when carrying out this reaction (other than safety goggles and the use of a fume cupboard).

____

____ [2]

(b) A solution of copper(II) ions reacts with edta according to the following equation:

$$[Cu(H_2O)_6]^{2+} + H_2(edta)^{2-} \rightleftharpoons [Cu(edta)]^{2-} + 2H^+ + 6H_2O$$

(i) Using this equation explain the role of the buffer solution when carrying out an edta titration.

____

____ [2]

(ii) State the colour change observed for Eriochrome Black T at the end point of an edta titration. Suggest why Eriochrome Black T is not used when titrating a solution of copper(II) ions with edta.

____

____

____ [2]

(c) The results below were recorded when the experiment was carried out using a coin of mass 7.0 g. Complete the table and calculate the percentage of copper in the coin.

	initial burette reading (cm^3)	**final burette reading (cm^3)**	**titre (cm^3)**
rough	0.0	20.1	
1st accurate	21.0	40.5	
2nd accurate	0.0	19.7	

____

____

____

____

____

____

____ [6]

(d) Describe a chemical test for copper(II) ions.

____

____

____ [3]

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(Questions continue overleaf)

2 Observation/Deduction

(a) The following tests are carried out on a solid sample of hydrated manganese(II) chloride, labelled **X**. Write the expected observations in the table below.

Test	Observations	Deductions
Make a solution of **X** in a beaker of deionised water.		
1 Add 5 drops of sodium hydroxide solution to a test tube one quarter filled with the solution of **X**.	[3]	*confirms* Mn^{2+} *ions*
2 Add 5 drops of dilute nitric acid and 5 drops of silver nitrate solution to a test tube one quarter filled with the solution of **X**.	[1]	*confirms* Cl^- *ions*
Add 5 cm^3 of dilute ammonia solution to the test tube.	[1]	*confirms* Cl^- *ions*
3 Place a spatula measure of solid **X** in a dry boiling tube and heat gently over a blue Bunsen burner flame.	[1]	*confirms solid is hydrated*

(b) **(i)** The following observations were recorded for a sample of an organic solid, **Y**. One molecule of **Y** contains three carbon atoms. Complete the deductions column in the table below.

Test	Observations	Deductions
1 Make a solution of a spatula measure of **Y** in a beaker of deionised water.	*colourless solution*	*soluble in water*
2 Add 2 cm^3 of copper(II) sulfate solution to 2 cm^3 of the solution of **Y**.	*dark blue solution*	[1]
3 Shine polarised light through the solution produced in **Test 1**.	*plane of polarisation is rotated*	[1]
4 Add a small spatula measure of solid **Y** to a test tube one quarter filled with sodium carbonate solution.	*fizzing*	[1]
5 Use melting point apparatus to determine the melting point of **Y**.	*melts at 258 °C*	[1]

(ii) To which homologous series does **Y** belong?

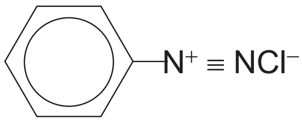
____ [1]

(iii) Draw the structure of **Y**.

[1]

[Turn over

3 Benzenediazonium chloride can be produced from benzene via nitrobenzene, $C_6H_5NO_2$, and phenylamine, $C_6H_5NH_2$.



benzenediazonium chloride

(a) Nitrobenzene is formed when benzene is heated under reflux with an aqueous nitrating mixture which is formed *in situ*. The mixture must be vigorously stirred throughout.

(i) Suggest what is meant by the term ***in situ***.

____ [1]

(ii) Name the reagents required to form the nitrating mixture *in situ* and write an equation for its formation.

____

____

____ [2]

(iii) After heating the reaction mixture under reflux the crude liquid product is separated. Why is this crude product then added to sodium carbonate solution?

____ [1]

(b) Phenylamine is produced from the reduction of nitrobenzene.

(i) Name the reagents used to reduce nitrobenzene to phenylammonium chloride.

____

____ [2]

(ii) How is phenylamine obtained from phenylammonium chloride?

____ [1]

(iii) If the percentage yield for the reduction of nitrobenzene to phenylamine is 60% what volume of nitrobenzene (density 1.2 g cm^{-3}) is required to produce 11.16 g of phenylamine?

____

____

____

____

____ [4]

(c) Phenylamine is then converted to benzenediazonium chloride by reaction with nitrous acid. Name the reagents used to form nitrous acid.

____

____ [2]

(d) The benzenediazonium ion reacts with water above 10 °C. The volume of nitrogen produced can be monitored in order to determine the rate of the reaction.

(i) Write an equation for the reaction of the benzenediazonium ion with water.

____ [2]

(ii) Explain how you could measure the volume of nitrogen produced and how you could use your measurements to determine the rate of reaction with respect to nitrogen.

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____

____ [3]

Quality of written communication [2]

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For Examiner's use only		
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)

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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