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)

MV18

[AC234]

THURSDAY 22 JUNE, AFTERNOON

Time

1 hour 15 minutes, plus your additional time allowance.

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.
Complete in black ink only.
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 at the end of each question indicate the marks awarded to each question or part question.
A Periodic Table of Elements (including some data) is provided.

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 marks]

_____

(ii) Why must this reaction be carried out in a fume cupboard? [1 mark]

_____

(iii) State and explain a safety precaution when carrying out this reaction (other than safety goggles and the use of a fume cupboard). [2 marks]

_____

_____

(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 marks]

(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 marks]

(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. [6 marks]

	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	

(d) Describe a chemical test for copper(II) ions. [3 marks]

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 marks]	**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 mark]	**confirms Cl^- ions**
Add 5 cm^3 of dilute ammonia solution to the test tube.	[1 mark]	**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 mark]	**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.

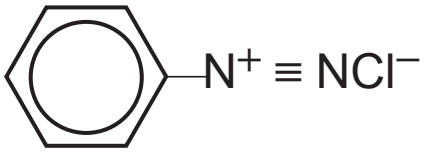
Test	Observations	Deductions
1 Make a solution of a spatula measure of **Y** in a beaker of deionised water.	**colourless solution**	**soluble in water**
2 Add 2 cm^3 of copper(II) sulfate solution to 2 cm^3 of the solution of **Y**.	**dark blue solution**	[1 mark]
3 Shine polarised light through the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

(ii) To which homologous series does **Y** belong?
[1 mark]

_____

(iii) Draw the structure of **Y**. [1 mark]

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 mark]

_____

(ii) Name the reagents required to form the nitrating mixture **in situ** and write an equation for its formation. [2 marks]

_____

_____

_____

(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 mark]

_____

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

(i) Name the reagents used to reduce nitrobenzene to phenylammonium chloride. [2 marks]

(ii) How is phenylamine obtained from phenylammonium chloride? [1 mark]

(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 marks]

(c) Phenylamine is then converted to benzenediazonium chloride by reaction with nitrous acid. Name the reagents used to form nitrous acid. [2 marks]

(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 marks]

(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. [3 marks]

Quality of written communication [2 marks]

THIS IS THE END OF THE QUESTION PAPER

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.

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THE PERIODIC TABLE OF ELEMENTS

I	II										III	IV	V	VI	VII	0
						Group										
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														

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}

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