Rewarding Learning

Advanced Subsidiary (AS)
General Certificate of Education
2017

Centre Number

Candidate Number

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination

Practical Booklet B (Theory)

MV18

[AC134]

FRIDAY 9 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 four** questions.

Information for Candidates

The total mark for this paper is 66.
Section A
Question 1 is worth 14 marks. Question 2 is worth 16 marks.
Section B
Question 3 is a planning exercise worth 20 marks.
Question 4 is a written question worth a total of 16 marks, testing aspects of experimental chemistry.
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.

Section A

1 The percentage of water of crystallisation in a sample of hydrated sodium carbonate was determined by dissolving 5.72 g of hydrated sodium carbonate in deionised water and making the solution up to 500 cm^3 in a volumetric flask. 25.0 cm^3 samples of this solution were titrated with 0.1 mol dm^{-3} hydrochloric acid. The results are given in the following table.

	Rough	**Accurate 1**	**Accurate 2**
Final burette reading/cm^3	20.5	40.6	19.9
Initial burette reading/cm^3	0.0	20.5	0.0
Titre/cm^3			

(a) (i) Complete the table by calculating the titre values. [1 mark]

(ii) Calculate the average titre. [1 mark]

_____

(b) Name a suitable indicator for the titration and give the colour change at the end point.

Indicator [1 mark]

_____

Colour change [2 marks]

_____

(c) Write the equation for the reaction between hydrochloric acid and sodium carbonate. [2 marks]

_____

(d) Using the following headings calculate the percentage of water of crystallisation in the sample of hydrated sodium carbonate. [6 marks]

moles of hydrochloric acid used in the titration

_____

moles of sodium carbonate in 25.0 cm^3

_____

moles of sodium carbonate in 500 cm^3

_____

mass of sodium carbonate in 500 cm^3

_____

mass of water in the sample

_____

percentage of water of crystallisation in the sample

_____

(e) Suggest an alternative method to determine the percentage of water of crystallisation in the sample. [1 mark]

_____

_____

2 **(a)** A mixture of **two** salts, labelled **A**, have a common cation. The following tests were carried out on **A**. Complete both columns in the table and identify the two salts.

Test	Observations	Deductions
1 Describe the appearance of **A**.	White solid	[1 mark]
2 Dip a nichrome wire into concentrated hydrochloric acid, touch sample **A** with the wire, then hold it in a blue Bunsen flame.	Lilac flame	[1 mark]
3 Add concentrated sulfuric acid to a spatula measure of **A** in a boiling tube in a fume cupboard. Heat the boiling tube.	A grey-black solid forms A purple vapour forms Smell of rotten eggs	[2 marks]
4 Add a spatula measure of **A** to a test tube half filled with dilute nitric acid. Add a few drops of silver nitrate solution.	A colourless solution forms with no effervescence A yellow precipitate forms	[2 marks]

Test	Observations	Deductions
5 Add a spatula measure of **A** to a test tube half filled with deionised water. Add chlorine water.	A colourless solution forms [1 mark]	
6 Add a spatula measure of **A** to a test tube half filled with dilute nitric acid. Add a few drops of barium chloride solution.	A colourless solution forms with no effervescence White precipitate forms	

Name the **two** salts present in **A**. [1 mark for each]

_____

_____

(b) The following tests were carried out on an organic liquid **B**.

(i) Complete the table, giving observations and deductions.

Test	Observations	Deductions
1 Add 1 cm^3 of **B** to 1 cm^3 of deionised water in a test tube.	A single layer forms	[1 mark]
2 Add a spatula measure of phosphorus(V) chloride to 4 cm^3 of **B** in a boiling tube in a fume cupboard.	Solid disappears Steamy fumes produced Hissing sound	[1 mark]
Test any gas produced using damp blue litmus paper.	Paper turns red	[1 mark]
Test any gas produced using a glass rod which has been dipped in concentrated ammonia solution.	[1 mark]	[1 mark]
3 Add 1 cm^3 of **B** to 2 cm^3 of acidified potassium dichromate solution in a test tube. Warm the mixture gently in a water bath.	The solution remains orange	[1 mark]

(ii) Suggest the structure of **B** which contains four carbon atoms. [1 mark]

Section B

3 Planning

You are required to plan an experiment to determine the enthalpy change for the endothermic reaction which occurs when potassium hydrogencarbonate, $KHCO_3$, is added to an excess of dilute sulfuric acid. An appropriate procedure would involve adding 5.0 g of potassium hydrogencarbonate to 50.0 cm^3 of 2.0 mol dm^{-3} sulfuric acid in a polystyrene cup.

(a) Suggest **one** advantage of using a polystyrene cup. [1 mark]

(b) The polystyrene cup is often placed inside a beaker. Give **one** advantage of this method. [1 mark]

(c) Identify **three** pieces of apparatus which are used to take measurements in this experiment. [3 marks]

(d) Write an equation for the reaction which occurs.
[2 marks]

(e) Suggest why an excess of sulfuric acid is used.
[1 mark]

(f) Describe the method that you would use. Include the apparatus identified in **(c)** and the measurements you would take. [6 marks]

(g) A student added 5.0 g of potassium hydrogencarbonate to 50.0 cm^3 of 2.0 mol dm^{-3} sulfuric acid and then used the following equation

heat energy absorbed (in J)
= volume of acid (in cm^3) × 4.18 × ΔT

to calculate that the enthalpy change for the reaction was +30 kJ mol^{-1}.

The initial temperature of the acid was 18.0 °C. Use the following steps to calculate the final temperature of the solution. [5 marks]

Number of moles in 5.0 g of potassium hydrogencarbonate

_____

Heat energy (in kJ) absorbed from the solution

_____

Heat energy (in J) absorbed from the solution

_____

Temperature change (ΔT)

_____

Final temperature of solution (°C)

_____

(h) Other than a temperature change, what is observed when potassium hydrogencarbonate is added to the sulfuric acid? [1 mark]

_____

_____

4 The compound 2-bromopropane can be prepared in a two-stage process.

Stage 1: The preparation of hydrobromic acid by the reaction of potassium bromide with concentrated sulfuric acid.

Potassium bromide is dissolved in water. The beaker containing potassium bromide solution is placed in an ice-bath and concentrated sulfuric acid is added very slowly. Potassium hydrogensulfate precipitates out of solution and is removed by suction filtration. The hydrobromic acid is purified by distillation.

(a) (i) Write the equation for the reaction of potassium bromide with concentrated sulfuric acid. [1 mark]

_____

(ii) Draw a labelled diagram to show how the suction filtration is carried out. [3 marks]

(iii) Suggest safety precautions which should be taken when using concentrated sulfuric acid. [1 mark]

Stage 2: Reaction of a large excess of hydrobromic acid with isopropyl alcohol.

$(CH_3)_2CHOH(l) + HBr(aq) \rightarrow (CH_3)_2CHBr(l) + H_2O(l)$

Isopropyl alcohol and aqueous hydrobromic acid are mixed together in a round-bottomed flask. The flask is heated electrically and the product is collected by distillation at 60 °C. The crude product is shaken with water in a separating funnel. The lower layer is separated and treated with anhydrous magnesium sulfate. The liquid is then decanted off.

(b) What is the IUPAC name for isopropyl alcohol? [1 mark]

(c) Apart from isopropyl alcohol and hydrobromic acid, what else should be added to the round-bottomed flask? [1 mark]

(d) Suggest an advantage of heating electrically. [1 mark]

(e) Name an impurity which is removed from the 2-bromopropane by shaking with water. [1 mark]

(f) How could you confirm that the lower layer was the organic layer? [2 marks]

(g) What is the function of the anhydrous magnesium sulfate? [1 mark]

(h) Assuming a 75% yield, calculate the minimum mass of isopropyl alcohol which would be needed to produce 10.0 g of 2-bromopropane. [4 marks]

THIS IS THE END OF THE QUESTION PAPER

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
Total Marks	

Examiner Number

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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