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Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Advanced

Unit 7: Chemistry Practical Examination (SET A)

Monday 8 May 2017 – Morning
Time: 2 hours

Paper Reference
WCH07/01

Candidates must have: Scientific calculator
Ruler

Total Marks

Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.
- Eye protection and laboratory coats should be worn throughout the exercise. Follow any safety precautions given by the teacher. The normal health and safety rules of the Chemistry Department must be followed.

Turn over ▶

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Answer ALL the questions. Write your answers in the spaces provided.

1. Introduction

In this exercise, you will prepare a solution of compound **A** which contains iron(II) ions.
You will dissolve **A** in dilute sulfuric acid and make up the solution to 250.0 cm^3.

You will titrate acidified portions of solution **A** against 0.0250 mol dm^{-3} potassium manganate(VII) solution. The equation for the reaction is

$$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$$

You will use your results to calculate the formula mass of compound **A**.

You are supplied with

- a sample of solid **A** in a stoppered container
- 0.0250 mol dm^{-3} solution of potassium manganate(VII)
- dilute sulfuric acid
- distilled (or deionised) water
- apparatus to carry out the exercise.

Procedure

1. Weigh the stoppered container of solid **A**. Record the mass to at least 0.01 g in Table 1.

2. Tip the solid into a 250 cm^3 beaker and then reweigh the emptied stoppered container. Record the mass in Table 1.

3. Add about 100 cm^3 of dilute sulfuric acid to the beaker. Stir the mixture with a glass rod until all the solid has dissolved.

4. Using a funnel, transfer the solution and washings into a 250.0 cm^3 volumetric flask. Make up the solution to the mark with distilled water. Stopper the volumetric flask and then invert it a number of times to mix the contents thoroughly.

5. Rinse a burette with a small quantity of the potassium manganate(VII) solution and then fill the burette with this solution.

6. Using a safety filler, rinse a 25.0 cm^3 pipette with a small quantity of solution **A** and then transfer 25.0 cm^3 of this solution into a clean 250 cm^3 conical flask.
   Use a measuring cylinder to add 15 cm^3 of dilute sulfuric acid to the conical flask, swirling to mix the solution.
   Place the conical flask on a white tile.

7. Titrate the solution in the conical flask with the potassium manganate(VII) solution until the end-point is reached. Record your burette readings and titres to the nearest 0.05 cm^3 in Table 2.

8. Repeat the titration until you obtain concordant results.
   Record all your readings in Table 2.

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Results

Measurement	Mass / g
Mass of stoppered container plus **A**	
Mass of emptied stoppered container	
Mass of **A**	

Table 1

(2)

Titration number	1	2	3	4	5
Burette reading (final) / cm^3					
Burette reading (initial) / cm^3					
Titre / cm^3					

Table 2

(2)

List the numbers of the titrations that you will use to calculate the mean titre.

(1)

.....

Calculate the mean titre, giving your value to the nearest 0.05 cm^3 or to **two** decimal places.

(1)

Accuracy (6)
Range (3)

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Calculations and question

For each of the following calculations, give your answer to **three** significant figures and show your working as fully as possible.

(a) Calculate the number of moles of potassium manganate(VII) in your mean titre.

(1)

(b) Use your answer to (a), and information from the **Introduction**, to calculate the number of moles of Fe^{2+} in the 25.0 cm^3 of solution **A** in the conical flask.

(1)

(c) Use your answer to (b) to calculate the number of moles of Fe^{2+} in the 250.0 cm^3 of solution in the volumetric flask.

(1)

(d) Use your answer to (c), the mass of **A** from Table 1, and the fact that the formula of **A** contains one Fe^{2+} ion, to calculate the formula mass of **A**.

(1)

(e) A student fills the volumetric flask above the mark with distilled water in step **4**. State what effect this would have on the calculated formula mass of **A**.

(1)

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(Total for Question 1 = 20 marks)

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2. Introduction

You are provided with three compounds **B**, **C** and **D**.
B and **C** are non-cyclic organic compounds each containing one functional group.
B and **C** have the same number of carbon atoms.
D is an inorganic salt which contains one cation and one anion.

Tests

Carry out the following tests, recording your observations and inferences.

(a) Working in a fume cupboard, add half a spatula of phosphorus(V) chloride to 2 cm^3 of **B** in a **dry** test tube. Test any gas given off using damp blue litmus paper.

(2)

Observations

(b) Mix approximately 2 cm^3 of potassium dichromate(VI) solution and about 5 cm^3 of dilute sulfuric acid in a test tube. Add 8 drops of **B** and place the test tube in a hot water bath.

(1)

Observation

(c) Using the observations from (a) and (b) only, **name** the functional group present in **B**.

(1)

.....

(d) To 2 cm^3 of aqueous sodium hydroxide in a test tube, add 6 drops of **B**. Then add aqueous iodine, drop by drop, until a faint brown colour remains.
Allow the test tube to stand for a few minutes.

(1)

Observation

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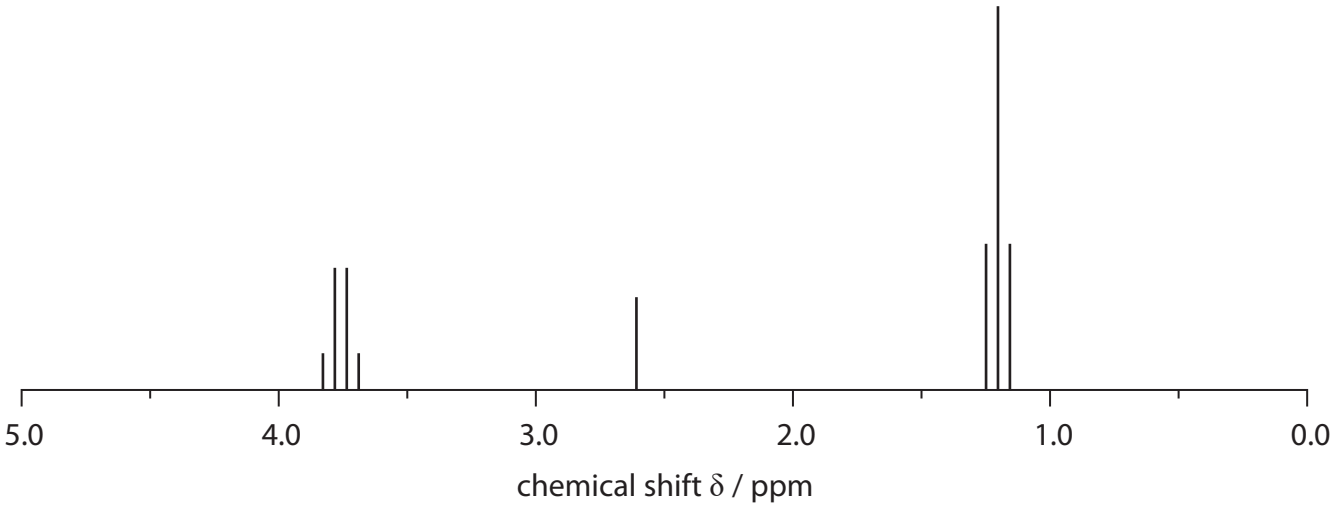
(e) What **further** information can you deduce about the structure of **B** from your observation in (d)?

(1)

.....

.....

(f) The high resolution proton nmr spectrum of **B** is shown.



Use your deductions in (c) and (e), the nmr spectrum and the fact that **B** has two, three, or four carbon atoms, to identify **B**.
Draw the displayed formula of **B** and use it to explain how the nmr spectrum enables you to identify **B**.

(4)

Displayed formula of **B**

Explanation

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(g) Add 2 cm^3 of 2,4-dinitrophenylhydrazine solution to a test tube, followed by 8 drops of **C**. Shake the test tube gently.

(1)

Observation

(h) To 3 cm^3 of aqueous silver nitrate in a test tube, add dilute sodium hydroxide solution, drop by drop, until a precipitate forms. Allow the precipitate to settle and then carefully pour off the liquid, leaving the precipitate in the test tube. To this precipitate, add dilute aqueous ammonia solution until the precipitate just dissolves. Add 6 drops of **C**, shake the test tube gently and place it in a warm water bath.

(1)

Observation

(i) Using the observations from (g) and (h), identify the functional group present in **C**.

(1)

.....

(j) Use your deduction in (i), and the fact that **C** has the same number of carbon atoms as **B**, to identify **C** by name or formula.

(1)

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(k) Add a few drops of concentrated hydrochloric acid to about half the sample of **D** on a watch glass. Carry out a flame test on the mixture formed. In the inference column, write the **formula** of the cation present in **D**.

(2)

Observation	Inference

(l) (i) Dissolve the rest of **D** in about 5 cm^3 of distilled water in a boiling tube. Add 2 cm^3 of dilute nitric acid and about 10 drops of silver nitrate solution. Keep the resulting mixture for part (ii).

(1)

Observation

(ii) To the mixture from (l)(i), add about 10 cm^3 of dilute ammonia solution. Stopper and shake the tube. In the inference column, write the name or formula of the anion present in **D**.

(2)

Observation	Inference

(m) Give the **formula** of **D**.

(1)

(Total for Question 2 = 20 marks)

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3. Introduction

In this exercise, you will mix ethanol and water together. You will measure the temperatures of the two liquids before mixing and then the temperature of the mixture. You will use your results to find the temperature change.

You are supplied with

- ethanol
- distilled (deionised) water
- apparatus to carry out the exercise.

Procedure

Record all temperatures to the nearest 0.5 °C.

1. Using a dry measuring cylinder, transfer 5.0 cm^3 of ethanol to a boiling tube.
2. Measure the temperature of the ethanol and record the value in Table 3. Dry the thermometer.
3. Using another measuring cylinder, transfer 5.0 cm^3 of distilled water to a separate boiling tube.
4. Measure the temperature of the distilled water and record the value in Table 3. Calculate the mean starting temperature.
5. Pour the distilled water into the boiling tube containing the ethanol and stir the mixture with the thermometer. Record the maximum or minimum temperature. Calculate the temperature change.

(6)

Measurement	Temperature / °C
Ethanol starting temperature	
Distilled water starting temperature	
Mean starting temperature	
Maximum or minimum temperature reached	
Temperature change	

Table 3

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Name **all** the intermolecular forces present in ethanol and in water. State which of these is most significant in each liquid. Suggest an explanation for the temperature change when the liquids are mixed.

(4)

Ethanol .....

.....

Water .....

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Explanation .....

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(Total for Question 3 = 10 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
							1.0 H hydrogen 1										(18) 4.0 He helium 2
(1)	(2)											(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	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	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
* Actinide series	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

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