

Write your name here

Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Wednesday 14 May 2014 – Morning

Time: 1 hour 15 minutes

Paper Reference

WCH06/01

Candidates may use a calculator.

Total Marks

Instructions

- Use **black** ink or 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.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- 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.

Turn over ►

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PEARSON

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

1 H is an aqueous solution of chromium(III) sulfate.

(a) What is the colour of the solution?

(1)

(b) Describe what you would **see** when sodium hydroxide solution is added to H, drop by drop, until the sodium hydroxide is in excess.

(2)

(c) When hydrogen peroxide is added to the reaction mixture formed in (b), a yellow solution is formed.

Give the formula of the ion responsible for the yellow colour and state the type of reaction which has produced this ion.

(2)

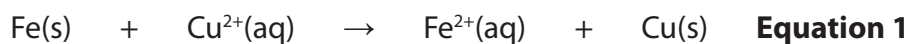
Ion formula

Reaction type

(Total for Question 1 = 5 marks)



- 2 A student wishes to measure the E_{cell} value of an electrochemical cell in which the following reaction occurs.



The solutions and apparatus available to the student are listed below.

Solution A :	copper(II) sulfate	1.00 mol dm ⁻³
Solution B :	iron(II) sulfate	concentration unknown
Solution C :	potassium nitrate	saturated
Solution D :	barium chloride	saturated

Copper foil electrodes
Iron foil electrodes
Platinum foil electrodes

Voltmeter **W**: low resistance
Voltmeter **X**: high resistance
Ammeter **Y**: low resistance
Ammeter **Z**: high resistance

Beakers
Connecting leads
Crocodile clips
Strips of filter paper

- (a) Draw a labelled diagram of the cell that the student should set up to measure E_{cell} for the reaction in **Equation 1**.

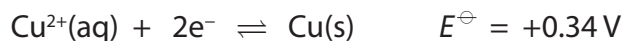
Only use items selected from the list above.

(4)



- (b) (i) The student measured E_{cell} as +0.79 V. The electrode dipping into the copper(II) sulfate solution was the positive electrode.

For this half-reaction

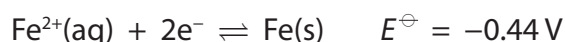


where E^{\ominus} is the **standard** electrode potential.

Use the above information to calculate the electrode potential (E) in the student's cell for the half-reaction



- (ii) For the half-reaction



where E^{\ominus} is the **standard** electrode potential.

For this half-reaction, the electrode potential (E) at a particular concentration is related to the standard electrode potential (E^{\ominus}) by the equation

$$E = E^{\ominus} + 0.013 \ln [\text{Fe}^{2+}] \quad \text{Equation 2}$$

where \ln is the natural logarithm and $[\text{Fe}^{2+}]$ is the concentration of Fe^{2+} ions in mol dm^{-3} .

Use **Equation 2**, and your answer to (b)(i), to calculate the concentration of Fe^{2+} ions in solution **B**.

(2)



- (c) The concentration of another solution of iron(II) sulfate, **Q**, was found by titration. 25.0 cm³ samples of **Q** were titrated with a solution of acidified potassium manganate(VII), concentration 0.0300 mol dm⁻³.

The results are as follows:

Titration	Rough	1	2	3
Burette reading (final) / cm ³	25.00	24.40	24.40	25.70
Burette reading (initial) / cm ³	1.00	2.10	1.60	3.30
Titre / cm ³				
Titres used to calculate mean (✓)				

- (i) Complete the table and calculate the mean titre. Indicate with a (✓) the titres that you have used in your calculation.

(2)

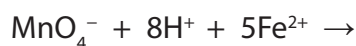
Mean titre

- (ii) State the colour change at the end-point.

(1)

- (iii) Complete the equation for the reaction occurring during the titration. State symbols are not required.

(2)



(iv) Calculate the concentration, in mol dm^{-3} , of the iron(II) sulfate solution, **Q**.

Give your answer to **three** significant figures.

(4)

(v) The concentration of the iron(II) sulfate solution, **Q**, was also measured on a previous day using the method described in part (a).

The concentration was found to be $0.157 \text{ mol dm}^{-3}$.

Calculate the percentage difference between this value and the value you calculated in (c)(iv). You should assume that the correct concentration is $0.157 \text{ mol dm}^{-3}$.

(1)



(vi) In the titration, the volume delivered by the pipette is accurate to $\pm 0.06 \text{ cm}^3$.
Each burette reading is accurate to $\pm 0.05 \text{ cm}^3$.

Calculate the percentage error of the pipette for a volume of 25.00 cm^3 and of the burette for your mean titre.

(2)

Pipette

Burette

(vii) Comment on the magnitudes of the values you have calculated in (c)(v) and (c)(vi).
(1)

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(viii) Suggest why the concentration of iron(II) sulfate in solution Q calculated in (c)(iv) is lower than the value given in (c)(v).

(1)

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(Total for Question 2 = 22 marks)



3 Substance **G** is a colourless organic liquid with one functional group.

(a) A few drops of **G** are tested by the addition of 2,4-dinitrophenylhydrazine solution (Brady's reagent). A **positive** result is obtained.

(i) Describe what you would see when a positive result is obtained for this test. (1)

(ii) What can you deduce about **G** from this test? (1)

(b) Substance **G** is tested with Tollens' reagent. The test is **negative**.

(i) Identify the solutions used to make Tollens' reagent.

What condition is essential for this test to work?

What would you see when a **positive** result is obtained? (4)

Solutions

Condition

Positive result

(ii) Based on the results of the tests in (a)(i) and (b)(i), name the functional group present in **G**. (1)

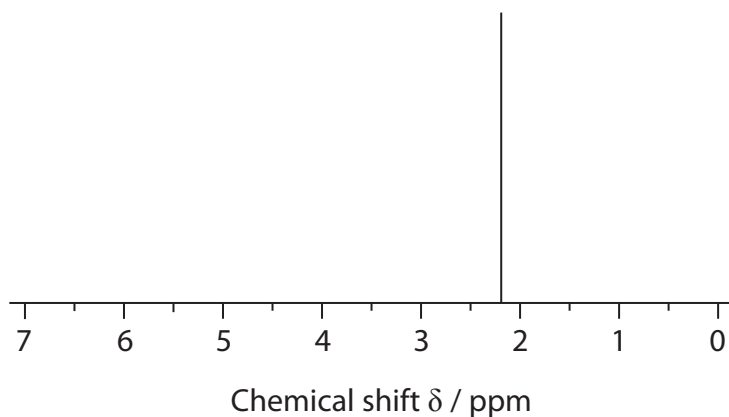
(c) A few drops of substance **G** are tested using iodine in the presence of alkali (iodoform test). A positive result is obtained.

(i) What would be **seen** when a positive result is obtained? (1)

(ii) What information does a positive result give about substance **G**? (1)



(d) The high resolution nmr spectrum of **G** is shown below.



Give **two** pieces of information about substance **G** that can be deduced from this spectrum. Use this information and your previous deductions to draw the displayed formula of **G**.

(3)

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Displayed formula of **G**:



(e) The identity of substance **G** can be confirmed by making a larger quantity of the solid product from the reaction of **G** with 2,4-dinitrophenylhydrazine solution and then purifying the product by recrystallization from ethanol.

(i) The solid product is removed from the solution by filtration under reduced pressure. Give **two** advantages of the use of filtration under reduced pressure compared with normal filtration.

(2)

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(ii) Draw a labelled diagram of the apparatus used for filtration under reduced pressure.

(3)



(iii) Outline all the steps of the **recrystallization** procedure. You should assume that the product contains impurities, some of which are very soluble in ethanol and others which are not soluble.

(4)

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(iv) How would you use the purified product to confirm the identity of **G**?
Practical details are not required.

(2)

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(Total for Question 3 = 23 marks)

TOTAL FOR PAPER = 50 MARKS



The Periodic Table of Elements

	1	2	3	4	5	6	7	0 (8)
	1.0 H hydrogen 1							4.0 He helium 2
(1)	6.9 Li lithium 3	9.0 Be beryllium 4						19.0 F fluorine 9
(2)	23.0 Na sodium 11	24.3 Mg magnesium 12						16.0 O oxygen 8
(3)	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
(4)	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
(5)	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
(6)	[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
(7)								
(8)								
(9)								
(10)								
(11)								
(12)								
(13)	10.8 B boron 5	27.0 Al aluminium 13	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	118.7 In indium 49	127.6 Te tellurium 52
(14)	12.0 C carbon 6	28.1 Si silicon 14	65.4 Zn zinc 30	63.5 Cu copper 29	58.7 Ni nickel 28	58.9 Co cobalt 27	106.4 Pd palladium 46	126.9 I iodine 53
(15)	14.0 N nitrogen 7	31.0 P phosphorus 15	65.4 Zn zinc 30	63.5 Cu copper 29	58.7 Ni nickel 28	58.9 Co cobalt 27	106.4 Pd palladium 46	[210] At astatine 85
(16)	16.0 O oxygen 8	32.1 S sulfur 16	65.4 Zn zinc 30	63.5 Cu copper 29	58.7 Ni nickel 28	58.9 Co cobalt 27	106.4 Pd palladium 46	[209] Po polonium 84
(17)	19.0 F fluorine 9	35.5 Cl chlorine 17	65.4 Zn zinc 30	63.5 Cu copper 29	58.7 Ni nickel 28	58.9 Co cobalt 27	106.4 Pd palladium 46	[222] Rn radon 86
(18)								

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

* Actinide series

