Write your name here

| Surname | Other names |
|---|---|
| | |

**Pearson Edexcel**
**International**
**Advanced Level**

Centre Number | | | | | |

Candidate Number | | | | |

# 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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6/6/6/6/3/

P 4 2 9 8 1 A 0 1 1 2

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)**

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(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)**

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(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.

$$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s) \quad \textbf{Equation 1}$$

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

$$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s) \qquad E^{\ominus} = +0.34\,V$$

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

$$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$$

**(2)**

(ii) For the half-reaction

$$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s) \qquad E^{\ominus} = -0.44\,V$$

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

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

where ln is the natural logarithm and $[Fe^{2+}]$ 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 $cm^3$ 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)**

$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow$

(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 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 mol $dm^{-3}$.

**(1)**

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

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)**

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

**(1)**

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(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)**

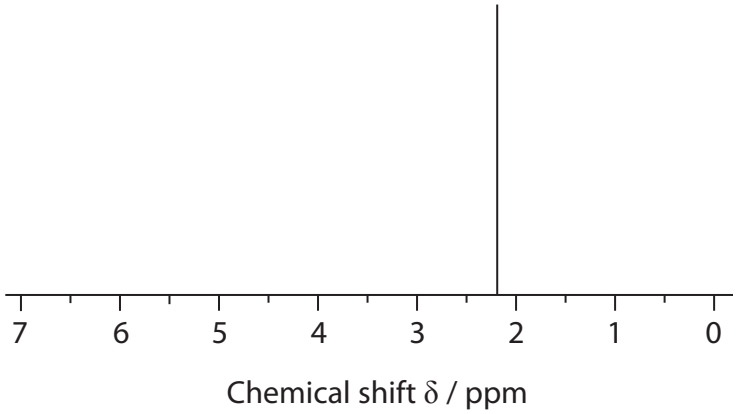
.....

(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)**

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

**(2)**

**(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 | | | | | | | | | | (18) 4.0 He helium 2 |
| (1) | (2) | | Key | | | | | | | | | (13) | (14) | (15) | (16) | (17) | |
| 6.9 Li lithium 3 | 9.0 Be beryllium 4 | | relative atomic mass<br>atomic symbol<br>name<br>atomic (proton) number | | | | | | | | | 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 | | | | | | | |

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 |