Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

Centre Number | Candidate Number

# Pearson Edexcel International Advanced Level

## Friday 23 May 2025

Morning (Time: 1 hour 20 minutes)

Paper reference **WCH13/01**

# Chemistry

## International Advanced Subsidiary/Advanced Level
## UNIT 3: Practical Skills in Chemistry I

**You must have:**
Scientific calculator

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.
- Show all your working in calculations and include units where appropriate.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

P78744A


Y:1/1/1/1/

P 7 8 7 4 4 A 0 1 1 6

Pearson

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

**1** Two isomeric organic liquids, **P** and **Q**, with one functional group, contain only carbon, hydrogen and oxygen. They have the same functional group.

(a) Phosphorus(V) chloride is added to separate samples of **P** and **Q**.
A gas, **R**, is evolved in each reaction.

Identify **R**, by name or formula.

**(1)**

.....

(b) When a few drops of acidified potassium dichromate(VI) are added to separate samples of **P** and **Q** and the mixtures gently heated, a reaction occurs.

(i) Give the colour change of the mixtures during heating.

**(1)**

From .....

To .....

(ii) Identify the functional group present in **P** and **Q**.

**(1)**

.....

(c) Mass spectra of **P** and **Q** show a molecular ion peak at $m/z = 60$.
The mass spectrum of **P** has its most intense peak at $m/z = 31$ and this peak is not present in the mass spectrum of **Q**.
The spectrum of **Q** has its most intense peak at $m/z = 45$ which is less intense in the mass spectrum of **P**.
In the alternative isomer these peaks are very small.

For each of these peaks, give the formula of one **ion** that could be responsible for its formation.

**(3)**

60 .....

45 .....

31 .....

(d) Deduce the structural formulae of **P** and **Q**.

**(2)**

**P**

**Q**

**(Total for Question 1 = 8 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**2** Chemical tests can be used to identify the presence of ions, although sometimes the results are inconclusive or difficult to interpret.

(a) Flame tests can be used to identify the presence of some cations.
A flame test is carried out using an unreactive metal wire, for example a nichrome or a platinum wire.

(i) Describe how to carry out a flame test.

**(2)**

(ii) The flame test colours for the potassium ion and the rubidium ion are difficult to tell apart.
Give the flame test colours for the potassium ion and for the rubidium ion.

**(2)**

Potassium ion .....

Rubidium ion .....

(iii) Both lithium ions and strontium ions produce red flame colours, so further tests are required to identify these cations.

Explain how a chemical test could be used to distinguish between two solutions, one of lithium nitrate and the other of strontium nitrate.

**(2)**

(iv) In school laboratories, wooden splints are sometimes used in the flame test instead of the unreactive metal wires.

Give **one** advantage and **one** disadvantage of using wooden splints.

**(2)**

Advantage .....

.....

.....

Disadvantage .....

.....

.....

(b) Acidified silver nitrate solution is used to test for halide anions in solution, but the results can be difficult to interpret.

(i) State the expected observations when acidified silver nitrate is added to each of these ions.

**(2)**

Chloride ion .....

Bromide ion .....

Iodide ion .....

(ii) Explain how the identity of the halide ion can be confirmed.

**(2)**

.....

.....

.....

.....

.....

.....

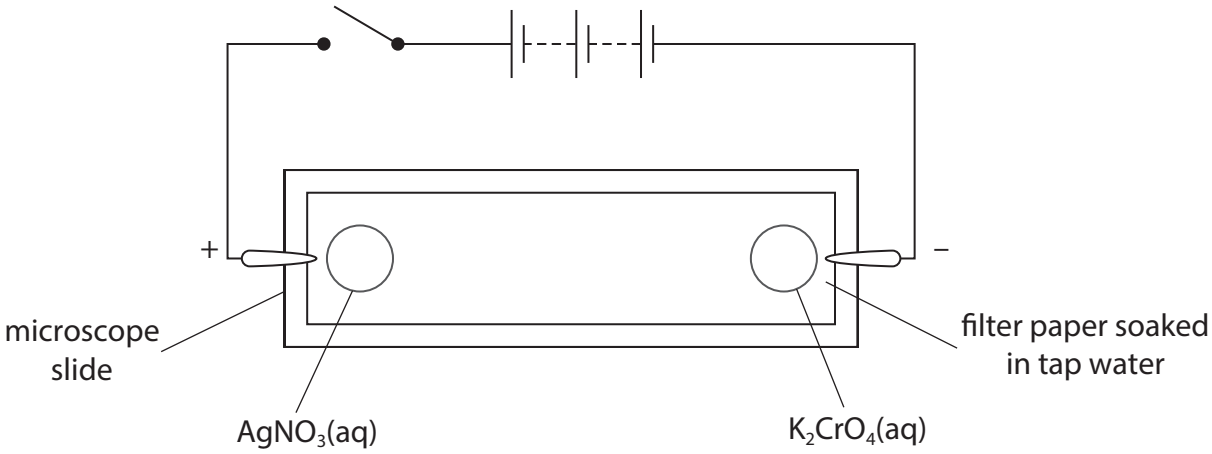
**(Total for Question 2 = 12 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**3** An experiment was set up as shown.




Several drops of aqueous silver nitrate and aqueous potassium chromate(VI), both of concentration 1.0 mol $dm^{-3}$, were placed on the filter paper and the switch closed. After a short while, a red precipitate formed in the centre of the filter paper.

(a) Explain what the experiment tells us about the structure of silver nitrate and potassium chromate(VI), including an equation for the reaction which occurs. State symbols are not required.

**(3)**

(b) (i) The filter paper was soaked in tap water prior to the experiment and then gently shaken to remove excess water before use.

Suggest the reason that deionised or distilled water was not used in this experiment.

**(1)**

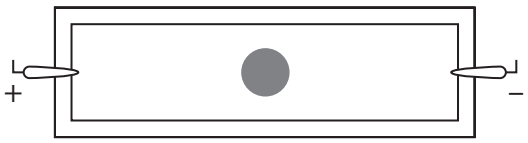
(ii) Identify, by name or formula, one ion which might be present in tap water that might cause the formation of a white precipitate on the left-hand side of the filter paper.

**(1)**

(iii) Give the reason that the formation of any precipitate in part (b)(ii) will not interfere significantly with the formation of the red precipitate.

**(1)**

(c) The experiment was repeated but this time using a spot of copper(II) chromate(VI) in the centre of the filter paper, as shown.




The central spot of copper(II) chromate(VI) is green.
Describe what would be seen when the switch is closed on the circuit and current is allowed to flow.

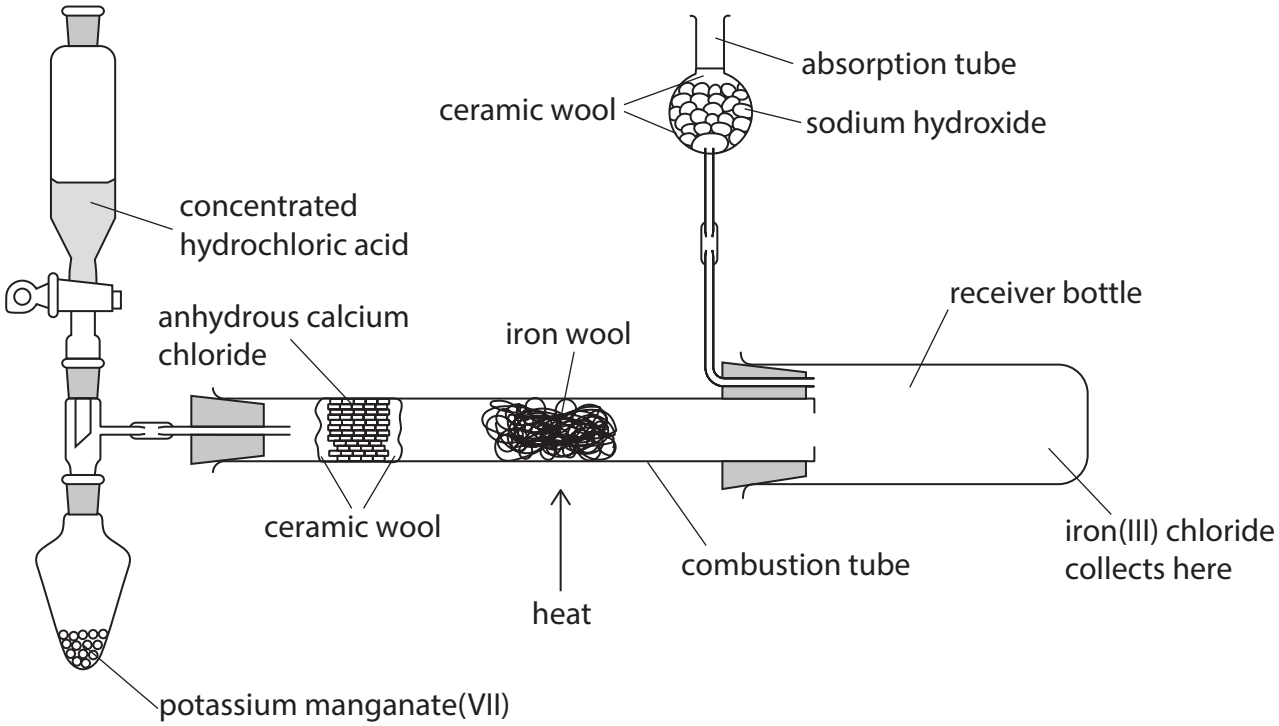
**(2)**

**(Total for Question 3 = 8 marks)**

**4** Anhydrous iron(III) chloride can be synthesised by the direct reaction of iron metal with chlorine. It reacts vigorously with water to produce hydrates.
The apparatus shown can be used for this synthesis.
The equation for the formation of iron(III) chloride is

$$2Fe(s) + 3Cl_2(g) \rightarrow 2FeCl_3(s)$$

The iron(III) chloride that is formed sublimes and is collected in the receiver bottle.
The product is rapidly transferred to a weighing bottle, then sealed with a lid.




(a) Chlorine is generated by the vigorous redox reaction between concentrated hydrochloric acid and potassium manganate(VII).
The chlorine moves through the apparatus as it is generated.

Justify the fact that the reaction between the concentrated hydrochloric acid and the potassium manganate(VII) is a redox reaction.
Include the ionic half-equation for the formation of chlorine.

State symbols are not required.

**(2)**

.....

.....

.....

(b) State the purpose of both the anhydrous calcium chloride and the ceramic wool in the combustion tube.

**(2)**

(c) Give the reason why the iron wool must not be heated until about half a minute after the reaction to produce chlorine has begun.

**(1)**

(d) State the purpose of the sodium hydroxide.

**(1)**

(e) The experiment was carried out using 2.00 g of iron wool.

(i) Calculate the maximum mass of iron(III) chloride that could be produced.

**(3)**

(ii) Explain why, during an experiment using 2.00 g of accurately weighed out iron wool, the mass of product measured in the weighing bottle was greater than your answer to (e)(i).

**(2)**

.....

.....

.....

.....

.....

.....

**(Total for Question 4 = 11 marks)**

**5** A student planned an experiment to determine the enthalpy change of reaction for the displacement of zinc from zinc sulfate solution by magnesium metal.

$$Mg(s) + Zn^{2+}(aq) \rightarrow Mg^{2+}(aq) + Zn(s)$$

**Procedure**

Step **1** Transfer 50.0 $cm^3$ of a 1.00 mol $dm^{-3}$ aqueous solution of zinc sulfate into a glass beaker using a measuring cylinder.

Step **2** Put a thermometer in the beaker and leave it to stand for 5 minutes and then record the temperature.

Step **3** Add 2.20 g of magnesium metal powder to the beaker.

Step **4** Stir the mixture and record the maximum temperature reached.

(a) Show, by calculation, that magnesium was in excess.

**(2)**

(b) The student carried out the reaction.
The starting temperature recorded was 19.4°C.
The maximum temperature recorded was 55.2°C.

Calculate the value for the enthalpy change of reaction.
Include a sign and unit in your answer.

[Assume: mass of solution = 50.0 g
specific heat capacity = 4.18 J $g^{-1}$ °$C^{-1}$]

**(4)**

(c) A second student repeated the experiment using the procedure described. The value obtained from this enthalpy change was considerably less exothermic than that quoted in a data book.

Suggest the most likely reason for this large difference in values.

**(1)**

(d) Justify how the equipment and the procedure could be improved to give a more **accurate** value for the enthalpy change of the reaction.

**(4)**

**(Total for Question 5 = 11 marks)**

**TOTAL FOR PAPER = 50 MARKS**

**BLANK PAGE**

**BLANK PAGE**

**BLANK PAGE**

# The Periodic Table of Elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 (8) (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1.0 H hydrogen 1 | | | | | | | | | | 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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

* Lanthanide series

* Actinide series