CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7903948761

CHEMISTRY **9701/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2026**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION
- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.
- Important values, constants and standards are printed in the question paper.

This document has **12** pages.

DC (CJ) 354708/5

1 Solid **X** is a mixture of three salts, potassium chloride, KCl, sodium chloride, $NaCl$, and sodium nitrate, $NaNO_3$, only.

The mass of each substance in **X** is investigated by two experiments. In each experiment, a different ion is precipitated out of an aqueous solution of **X**. The mass of each precipitate is measured.

(a) A student weighs a sample bottle containing **X** and transfers **X** into a small beaker.
The student reweighs the sample bottle.
The measurements are shown in Table 1.1.

Table 1.1

mass of sample bottle and **X** / g	7.235
mass of sample bottle after transfer / g	6.035
mass of **X** transferred to small beaker / g	

Complete Table 1.1 to determine the mass of **X** in the small beaker. [1]

(b) **(i)** Calculate the percentage error in the measurement of the mass of the sample bottle and **X** shown in Table 1.1.
Show your working.

percentage error = ... % [1]

(ii) Without changing any apparatus, suggest how the percentage error calculated in **1(b)(i)** can be reduced.

....

.... [1]

(c) Describe the steps the student should take to prepare $250.0\,cm^3$ of an aqueous solution of **X**, starting from the mass of **X** calculated in **1(a)** supplied in the small beaker.

Give the name and capacity of any apparatus used.
Write your answer using a series of numbered steps.

....

....

....

....

....

.... [3]

(d) Aqueous sodium tetraphenylborate, $NaB(C_6H_5)_4(aq)$, reacts with aqueous potassium ions to form a precipitate.

The ionic equation for this reaction is shown.

$$B(C_6H_5)_4^-(aq) + K^+(aq) \rightarrow KB(C_6H_5)_4(s)$$

$KB(C_6H_5)_4(s)$ is an irritant.

Figure 1.1 shows a Gooch crucible with a porous glass disc. The porous glass disc acts as a fine filter to separate the precipitate from the aqueous reaction mixture.

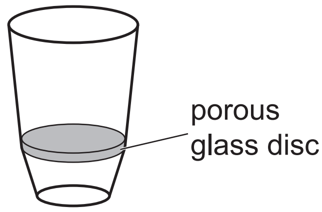

Figure 1.1

The solution formed from solid **X** in **1(c)** is labelled solution **X**.

In the first experiment, the student carries out the following steps.

step 1 Transfer 25.0 cm^3 of solution **X** to a 250 cm^3 conical flask labelled **D**.

step 2 Use a measuring cylinder to add approximately 40 cm^3 of 0.0180 $mol\,dm^{-3}$ $NaB(C_6H_5)_4(aq)$ to conical flask **D**. Stir slowly as the precipitate forms.

Leave conical flask **D** in an ice bath for 20 minutes.

step 3 Place a clean Gooch crucible in an oven at 120 °C.

step 4 After 20 minutes, remove the Gooch crucible from the oven, allow to cool and record its mass.

step 5 Pour the mixture from conical flask **D** into the Gooch crucible and filter.

step 6 Wash the residue in the Gooch crucible.

step 7 Transfer the Gooch crucible and residue to the oven and leave for one hour at 120 °C.

step 8 Remove the Gooch crucible from the oven and allow to cool. Record the mass of the Gooch crucible and the residue.

(i) Other than wearing safety goggles, give **one** safety precaution that the student must take when handling $KB(C_6H_5)_4(s)$.

.... [1]

(ii) Identify a suitable piece of apparatus to transfer $25.0\,cm^3$ of solution **X** in step 1.

.... [1]

(iii) Suggest why the volume of $NaB(C_6H_5)_4(aq)$ does **not** need to be measured accurately in step 2.

.... [1]

(iv) Suggest **one** reason why conical flask **D** is kept cool in an ice bath in step 2.

....

.... [1]

(v) Suggest **one** reason why the Gooch crucible is placed in an oven at 120 °C in step 3.

....

.... [1]

(vi) The mass of residue is 0.3579 g.

Calculate the amount, in mol, of potassium ions, K^+, in solid **X** in the small beaker in **1(a)**.

[M_r: $KB(C_6H_5)_4$, 357.9]

amount of K^+ in solid **X** = ... mol [1]

(vii) Use your answer to **1(d)(vi)** to determine the mass of KCl in solid **X**.

mass of KCl in solid **X** = ... g [1]

(e) Aqueous silver nitrate, $AgNO_3$(aq), reacts with aqueous chloride ions, Cl^-(aq), to form a precipitate of silver chloride, $AgCl$(s).

The ionic equation for this reaction is shown.

$$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$$

In a second experiment, the student repeats steps 1 to 8 using aqueous silver nitrate, $AgNO_3$(aq), instead of $NaB(C_6H_5)_4$(aq).

The mass of $AgCl$(s) recorded in step 8 is 0.2151 g.

The amount, n, in mol, of $NaCl$ in solid **X** can be calculated using equation 1.

equation 1 n = **Q** – amount, in mol, of K^+ in solid **X** in **1(d)(vi)**

Q is the amount, in mol, of $AgCl$(s) produced when **all** the Cl^-(aq) ions in 250 cm^3 of solution **X** react with $AgNO_3$(aq).

(i) Calculate **Q**.

Q = ... mol [1]

(ii) Use equation 1 to calculate the mass, in g, of $NaCl$ in solid **X**.

[If you were unable to obtain an answer to **1(e)(i)**, use **Q** = 0.014 mol. This is **not** the correct answer.]

mass of $NaCl$ in solid **X** = ... g [1]

(iii) Calculate the mass of $NaNO_3$ in solid **X** using your answers to **1(d)(vii)**, **1(e)(ii)** and the information given.

mass of $NaNO_3$ in solid **X** = ... g [1]

(f) Complete Table 1.2 to show the effect, if any, on the calculated masses of KC*l* and NaC*l* if the residue of $KB(C_6H_5)_4$ was **not** washed in step 6 of the first experiment.

Use the words higher, lower or no effect in your answer.

Table 1.2

effect on calculated mass of KC*l* in **1(d)(vii)**	
effect on calculated mass of NaC*l* in **1(e)(ii)**	

[1]

(g) Another student repeated the first experiment but heated the Gooch crucible to 320 °C in step 7.

Suggest why the mass of precipitate collected by this student was significantly lower than the mass of precipitate collected by the first student.

....

.... [1]

[Total: 18]

Turn over

2 Blood plasma contains a number of different cations. Many of these cations emit a different colour of light when placed in a flame.

Flame emission photometry is a method of determining the concentration of cations in a sample using the intensity of light emitted.

In an experiment, a sample of blood plasma is placed into a colourless flame. K^+ ions in the blood plasma absorb energy from the flame and emit light with a lilac colour. The intensity of the light emitted is measured.

To determine the concentration of K^+ ions in the sample, a calibration graph showing the relationship between known concentration of K^+ ions and light intensity is required.

(a) A solution of potassium chloride, KCl(aq), is prepared.

The concentration of aqueous potassium ions, K^+, in this solution is 0.100 g dm^{-3}.

Different volumes of the solution of KCl(aq) are taken and diluted by adding specific volumes of distilled water to prepare solutions of specific concentrations.

Each prepared solution of known [K^+(aq)] is tested using flame emission photometry.

Table 2.1 shows the relative light intensity measured for each prepared solution.

Table 2.1

volume of KCl(aq) / cm^3	**volume of distilled water added / cm^3**	**[K^+(aq)] / g dm^{-3}**	**relative light intensity**
0.00	50.00	0.00×10^{-3}	0.0
0.50		1.00×10^{-3}	2.1
1.00		2.00×10^{-3}	4.2
1.50		3.00×10^{-3}	6.7
2.00		4.00×10^{-3}	8.8
2.50		5.00×10^{-3}	11.0
3.00		6.00×10^{-3}	11.2
3.50		7.00×10^{-3}	15.7
4.00		8.00×10^{-3}	17.1
4.50		9.00×10^{-3}	17.1
5.00		10.00×10^{-3}	17.1

(i) Complete Table 2.1 to show the volume of distilled water added to make each prepared solution of known [K^+(aq)]. [1]

(ii) Identify a suitable piece of apparatus for adding the distilled water.

.... [1]

(iii) Identify the dependent variable in this experiment.

.... [1]

(iv) Plot a calibration graph on the grid in Figure 2.1 to show the relationship between $[K^+(aq)]$ and relative light intensity.

Use a cross (×) to plot each data point.

Draw **one** line of best fit for $[K^+(aq)]$ from 0.00×10^{-3} to $7.00 \times 10^{-3}\,g\,dm^{-3}$. Draw a second line of best fit for $[K^+(aq)]$ from 8.00×10^{-3} to $10.00 \times 10^{-3}\,g\,dm^{-3}$. Extend both lines so they meet.

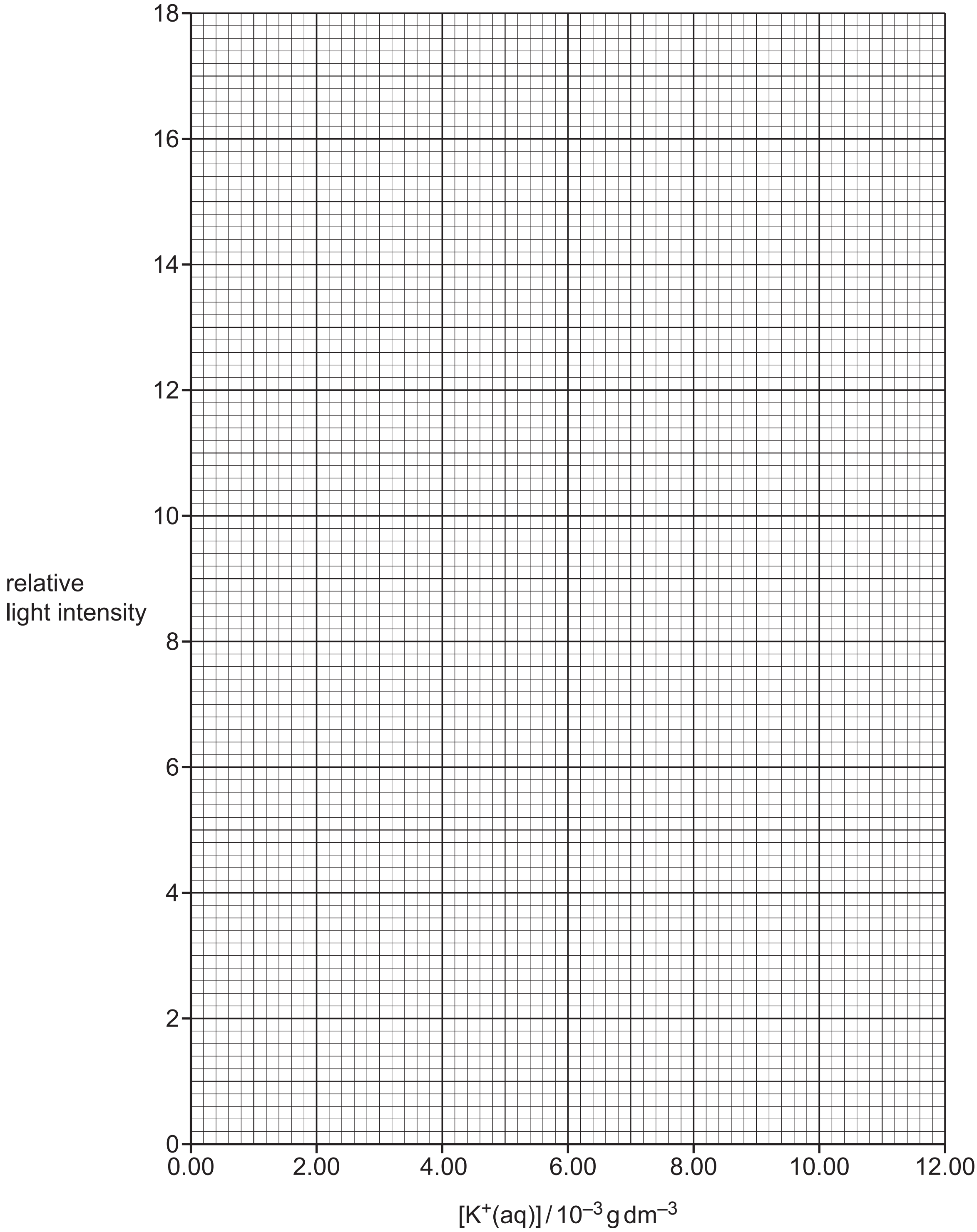

Figure 2.1 [2]

(v) Describe how the graph shows that $[K^+(aq)]$ from 0.00×10^{-3} to $7.00 \times 10^{-3}\,g\,dm^{-3}$ is directly proportional to relative light intensity.

.... [1]

(vi) Circle the most anomalous point on your graph in Figure 2.1. Suggest **one** reason to explain the anomalous point you have circled.

.... [1]

(b) **(i)** A sample of blood plasma is diluted 100 times and tested using flame emission photometry. The relative light intensity recorded is 3.8.
Use your graph in Figure 2.1 to determine the $[K^+(aq)]$, in $g\,dm^{-3}$, in the sample.

$[K^+(aq)]$ in diluted blood plasma = ... $g\,dm^{-3}$ [1]

(ii) The healthy range for $[K^+(aq)]$ in blood plasma is between 0.100 and $0.200\,g\,dm^{-3}$.

State whether the sample of blood plasma tested in **2(b)(i)** is within the healthy range, too high or too low. Explain your answer.

....

.... [1]

(iii) When testing samples of blood plasma, a coloured light filter needs to be used which only allows lilac-coloured light emitted from the sample to reach the detector.

Suggest why this coloured light filter is needed when testing blood plasma but is not necessary when testing $KCl(aq)$.

.... [1]

(c) Explain why flame emission photometry is **not** suitable for measuring $[K^+(aq)]$ at $8.00 \times 10^{-3}\,g\,dm^{-3}$ and above.

....

.... [1]

(d) State whether the data used for the calibration graph in Figure 2.1 is reliable.
Explain your answer.

....

.... [1]

[Total: 12]

Important values, constants and standards

molar gas constant	$R = 8.31\,J\,K^{-1}\,mol^{-1}$
Faraday constant	$F = 9.65 \times 10^{4}\,C\,mol^{-1}$
Avogadro constant	$L = 6.022 \times 10^{23}\,mol^{-1}$
electronic charge	$e = -1.60 \times 10^{-19}\,C$
molar volume of gas	$V_m = 22.4\,dm^3\,mol^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0\,dm^3\,mol^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14}\,mol^2\,dm^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18\,kJ\,kg^{-1}\,K^{-1}$ ($4.18\,J\,g^{-1}\,K^{-1}$)

The Periodic Table of Elements

Key

atomic number atomic symbol name relative atomic mass

Group

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3											13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –