

2026 H2 Chemistry Prelim Paper 4 Student Answers

1 (a) (i)

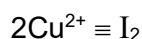
Titration number	1	2
Final burette reading/ cm ³	24.25	44.15
Initial burette reading/ cm ³	0.00	20.00
Volume of FA 2 used/ cm ³	24.25	24.15
	✓	✓

(ii) Average volume of **FA 2** used = $\frac{24.25 + 24.15}{2}$
= 24.20 cm³

(b) Amount of S₂O₃²⁻ in 24.20 cm³ of **FA 2** = $\frac{24.20}{1000} \times 0.100$
= 2.420×10^{-3} mol



Amount of I₃⁻ reacted = $2.420 \times 10^{-3} \div 2$
= 1.210×10^{-3} mol
= amount of I₂



Amount of Cu²⁺ in 25.0 cm³ of **FA 1** = $1.210 \times 10^{-3} \times 2$
= 2.420×10^{-3} mol

Amount of Cu in 1.00 dm³ of **FA 1** = $2.420 \times 10^{-3} \times \frac{1000}{25.0}$
= 9.680×10^{-2} mol

Mass of copper in 11.54 g of alloy = $9.680 \times 10^{-2} \times 63.5 = 6.147$ g = 6.15 g

Percentage by mass of copper in alloy = $\frac{6.147}{11.54} \times 100\% = \underline{53.3\%}$

(c) In (a)(i), amount of Cu²⁺ in 25.0 cm³ of **FA 1** = 2.420×10^{-3} mol
 $2\text{Cu}^{2+} \equiv 4\text{I}^-$

Amount of I⁻ required to reduce Cu²⁺ in titration = $2.420 \times 10^{-3} \times 2$
= 4.840×10^{-3} mol

Amount of I⁻ added in each titration = $\frac{40}{1000} \times 0.220 = 0.00880$ mol

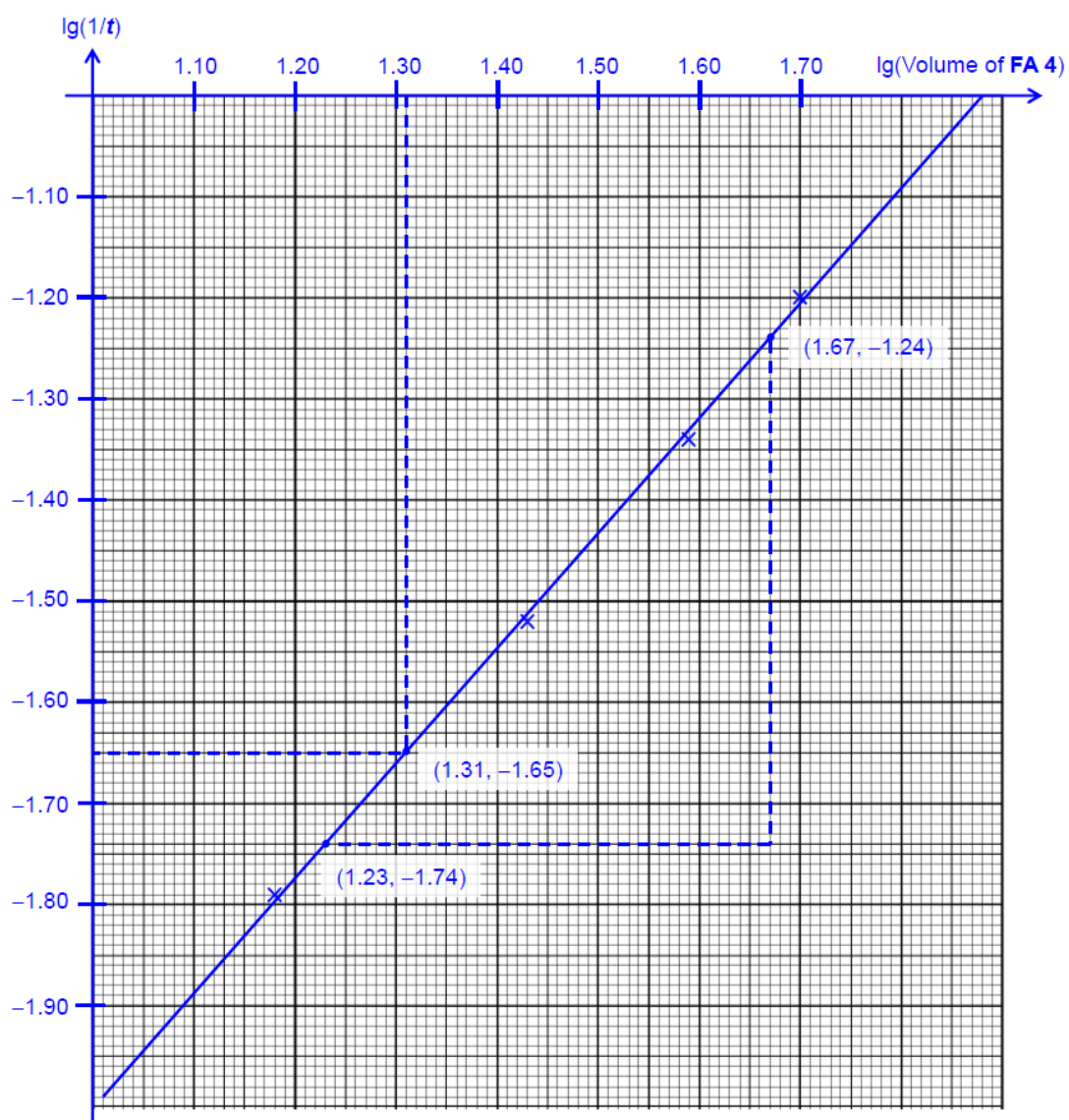
Ratio of amount of I⁻ added: amount of I⁻ required
= $0.00880 : 4.840 \times 10^{-3}$
= 1.82 : 1

(d) Not all the Cu²⁺ will be reacted and less I₂ will be produced. Lower amount of I₂ requires less amount of thiosulfate ions for titration, giving lower titre values.

2 (b)

Expt	Volume of FA 4 /cm ³	Volume of H ₂ O /cm ³	t /s	1/t /s ⁻¹	lg(1/t)	lg(Volume of FA 4)
1	50.00	0.00	16	0.0625	-1.20	1.70
2	15.00	35.00	62	0.0161	-1.79	1.18
3	27.00	23.00	33	0.0303	-1.52	1.43
4	39.00	11.00	22	0.0455	-1.34	1.59

(c)



(i)
$$\text{Gradient} = \frac{-1.24 - (-1.74)}{1.67 - 1.23} = 1.14$$

$$m = \underline{1}$$

(ii) $\lg(\text{volume of FA 4}) = 1.31$

From graph, when $\lg(\text{volume of FA 4}) = 1.31$,

$$\lg(1/t) = -1.65$$

$$t = 10^{-1.65} = 45 \text{ s}$$

(iii)

Expt	Volume of FA 4 /cm ³	Volume of H ₂ O /cm ³	Volume of FA 5 /cm ³	t /s
2	15.00	35.00	5.0	62
5	15.00	30.00	10.0	61

Order of reaction with respect to $\text{H}^+ = 0$

Comparing expt 2 and 5, time taken is approximately the same when V_{FA5} is doubled (while keeping V_{FA4} and V_{total} the same). Rate of reaction is independent of $[\text{H}^+]$.

(iv) effect on t increases

explanation water in beaker will decrease the concentration of reactants/ dilute the reaction mixture, decreasing rate of reaction, increasing t .

(v) Experiment 1.

Time taken for experiment 1 is shorter. Uncertainty due to human reaction time becomes more significant in experiment 1.

OR

Experiment 2.

The obscuring of the print is gradual which makes it difficult to judge when to stop the stopwatch. Absolute uncertainty in experiment 2 is higher, giving rise to higher percentage uncertainty.

Table 3.1

(a)

<i>test</i>		<i>observations</i>	
		FA 6	FA 7
(i)	Add an equal volume of aqueous potassium iodide.	FA 6 is a greyish-blue/ violet solution. [✓] No observable change. [✓]	FA 7 is a yellow/ pale orange solution. [✓] FA 7 turns reddish brown/ red-brown/ brown solution. [✓]
(ii)	Add half a small spatula measure of zinc powder. Leave the mixture to stand for 3 min.	Bubbles of gas observed. [✓] Solution remains greyish-blue/ violet. [✓] OR Colour of solution remains the same.	Effervescence observed. [✓] Colourless, odourless gas evolved that gives a pop sound with a lighted splint. [✓] Gas is H ₂ . [✓] Solution turns pale green/ colourless. [✓] OR Colourless solution formed.
(iii)	Add a few drops of aqueous silver nitrate.	White ppt formed. [✓]	White ppt formed. [✓]
(iv)	Add aqueous sodium hydroxide.	Grey-green ppt formed, [✓] soluble in excess NaOH(aq) giving dark green solution. [✓]	Red-brown ppt formed, insoluble in excess NaOH(aq). [✓]

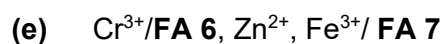
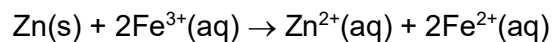
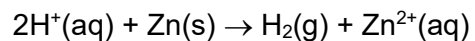
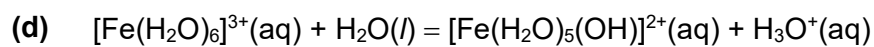
(b) Fill in the boxes below the identity of the metal cations in **FA 6** and **FA 7**.

	FA 6	FA 7
cation	Cr ³⁺	Fe ³⁺

(c) Anion: Cl⁻

<i>test</i>	<i>observations</i>
To 1 cm ³ of FA 7 , <u>add excess NaOH(aq). Filter the aqueous mixture. To the filtrate, add excess HNO₃ (aq) followed by AgNO₃(aq), and then NH₃(aq).</u>	<u>White ppt soluble in excess NH₃(aq) to give a colourless solution.</u>
To 1 cm ³ of FA 6/ FA 7 , <u>add acidified KMnO₄ (aq) and warm the mixture.</u>	<u>(Pungent and yellow-green) gas evolved that turns moist blue litmus red and bleaches it. Gas is Cl₂.</u>

To 1 cm³ of FA 6/ FA 7, <u>add excess NH₃(aq). Filter the aqueous mixture. To the filtrate, add excess HNO₃ (aq) followed by AgNO₃(aq), and then NH₃(aq).</u>	<u>White ppt soluble in excess NH₃(aq) to give a colourless solution.</u>
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Zn reduces Fe^{3+} .

Zn does not reduce Cr^{3+} .

OR

Fe^{3+} oxidises Zn.

Cr^{3+} does not oxidise Zn.

4 (a) $n_{\text{propan-2-ol}} = \frac{5.00}{60.0} = 0.08333 \text{ mol}$

$$n_{\text{K}_2\text{Cr}_2\text{O}_7} = \frac{0.08333}{3} = 0.02778 \text{ mol}$$

$$\text{mass of K}_2\text{Cr}_2\text{O}_7 = 294.2 \times 0.02778 = \underline{8.17 \text{ g}}$$

(b) Procedure:

1. Weigh accurately about 5.00 g of propan-2-ol into a round bottom flask.
2. Add 8 drops of concentrated sulfuric acid to 5.00 g of propan-2-ol in the round bottom flask.
3. Weigh at least 8.17 g of potassium dichromate(VI) in a 250 cm³ beaker.
4. Using a 250 cm³ measuring cylinder, add 100 cm³ of deionised water into the beaker to dissolve the potassium dichromate(VI). (Volume of water must be enough or in excess.)
5. Add this aqueous potassium dichromate(VI) solution slowly to the mixture in the round bottom flask.
6. Heat the mixture using the water bath for 20 minutes under reflux.
7. Separate the propanone from the reaction mixture using simple distillation by maintaining the temperature at 56.5 °C.

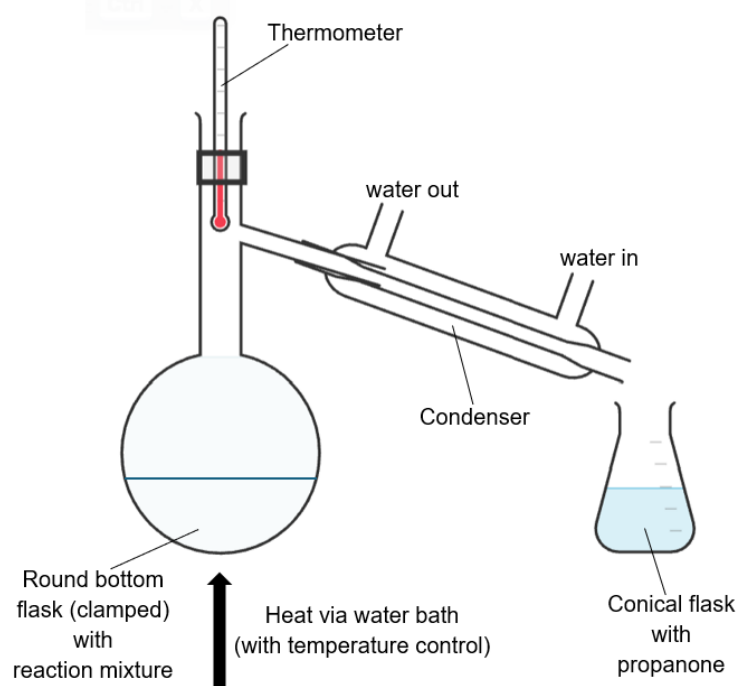
I: Correct sequence (1 to 5): Reaction mixture in RBF includes, alcohol, conc acid, K₂Cr₂O₇(aq). Allow “dissolves K₂Cr₂O₇ in DI in RBF first, then transfer 5 g of liquid propan-2-ol, with rinsing”.

II: Heating under reflux for at least 20 minutes.

III: Separation of propanone from reaction mixture using simple distillation at 56.5 °C.

IV: Correct quantities of reagents: 5.00 g of propan-2-ol, 6 to 10 drops of concentrated sulfuric acid, at least 8.17 g of K₂Cr₂O₇ in appropriate volume of water.

Diagram:



- Heating reaction mixture using water bath/ heating mantle (with temperature control) **(A)**
- Bulb of thermometer at the opening of condenser and correct drawing of condenser showing coolant (water in and water out in correct positions) **(B)**
- Sealed apparatus around the round bottomed flask and thermometer. No seal around collection flask. **(C)**
- Propanone is distillate in diagram or in procedure **(D)**

(c) Add sodium carbonate until no further effervescence is observed.

OR

Add solid base or metal until indicator shows that the reaction mixture is neutral or not acidic/ until some solid remains.

OR

Add alkali until indicator shows that the reaction mixture is neutral or not acidic.