

2026 RI YEAR 6 PRELIMINARY EXAMINATION Paper 4 Practical [Answers]**1 (a)(i) Titration results**

Final burette reading / cm ³	22.00	42.50
Initial burette reading / cm ³	0.00	20.50
Volume of FA 2 used / cm ³	22.00	22.00
Values used (✓)	✓	✓

1 (a)(ii) Average volume of **FA 2** used = $\frac{22.00 + 22.00}{2} = \underline{22.00 \text{ cm}^3}$ (2d.p.)

1 (b)(i) Amount of NaOH used = $\frac{22.00}{1000} \times 0.100 = \underline{2.20 \times 10^{-3} \text{ mol}}$

1 (b)(ii) Amount of H⁺ in HC/ and CH₃COOH
 = Amount of OH⁻ used = $2.20 \times 10^{-3} \text{ mol}$
 Total [HC/] + [CH₃COOH] = $\frac{2.20 \times 10^{-3}}{\frac{25.0}{1000}} = \underline{0.0880 \text{ mol dm}^{-3}}$

1 (b)(iii) [CH₃COOH] in **FA 1** = $0.0880 - 0.0300 = \underline{0.0580 \text{ mol dm}^{-3}}$

1 (b)(iv) $K_1 = \frac{[\text{CH}_3\text{COOH}][\text{ROH}]}{[\text{CH}_3\text{COOR}]}$

1 (b)(v)

	CH ₃ COOR(aq)	+	H ₂ O(l)	⇌	CH ₃ COOH(aq)	+	ROH(aq)
Initial conc / mol	0.0600		-		0		0
Change in conc / mol	-0.0580		-		+0.0580		+0.0580
Equilibrium conc / mol	0.002		-		0.0580		0.0580

$$K_1 = \frac{0.0580 \times 0.0580}{0.002} = \underline{1.68 \text{ mol dm}^{-3}}$$

1 (c) $K_2 = \frac{[\text{CH}_3\text{COOR}][\text{H}_2\text{O}]}{[\text{CH}_3\text{COOH}][\text{ROH}]}$

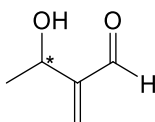
[H₂O] is not constant since it is a product and not a solvent. Therefore, the student is incorrect.

1 (d) Maximum total % error = $\left(\frac{\pm 0.06}{25.0} + \frac{2(\pm 0.05)}{20.00} \right) \times 100\% = \underline{\pm 0.740\%}$

1 (e)(i)

test		observations with FA 3
1	Add 1 cm depth of FA 3 into a clean test-tube. To this test-tube add 10 drops of sodium hydroxide followed by iodine solution, dropwise, until a permanent yellow/orange colour is present. Warm the test-tube in the beaker of hot water for 2 minutes.	<u>Yellow ppt</u> formed. Orange solution decolourised.
2	Add 1 cm depth of FA 3 into a clean test-tube. Add 8 drops of Fehling's solution. Warm the test-tube in the beaker of hot water for 3 minutes.	<u>Reddish-brown / brick-red ppt</u> observed.
3	Test solution FA 3 with Universal Indicator paper.	Universal Indicator paper turns <u>green / yellow-green</u>. <u>pH 6 / 7</u>

1 (e)(ii)



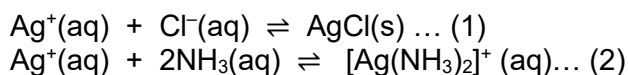
2 (a)

tests		observations
1	Add 1 cm depth of FA 4 into a clean test-tube. Add 1 cm depth of aqueous sodium carbonate.	<u>*White and pink ppt/ light pink/ pink ppt</u> formed in a pink solution. <u>Effervescence of CO₂ which gave a white ppt with limewater</u> is produced.
2	Add 1 cm depth of FA 4 into a clean test-tube. Add 2 cm depth of aqueous sodium hydroxide to the mixture. Filter the mixture. Add dilute nitric acid dropwise to the filtrate until no further change.	<u>*White and pink ppt/ light pink/ pink ppt</u> formed. <u>White ppt dissolved</u> in excess sodium hydroxide, leaving behind a pink ppt in a colourless solution. <u>**Pink/pale pink/pale purple residue and colourless filtrate.</u> <u>White ppt</u> reformed which <u>dissolved</u> in excess dilute nitric acid to form a <u>colourless solution</u> .
3	Add 1 cm depth of FA 4 into a clean test-tube. Add 1 cm depth of aqueous silver nitrate. Add 2 cm depth of aqueous ammonia to the mixture. To a separate clean test-tube, add 1 cm depth dilute nitric acid. Filter the mixture into this dilute nitric acid.	<u>White ppt.</u> <u>White and pink ppt insoluble</u> in excess aqueous ammonia. Pink residue and colourless filtrate. <u>White ppt</u> formed in dilute nitric acid.

2 (b)

cation present	Al ³⁺
anion present	Cl ⁻

2 (c)

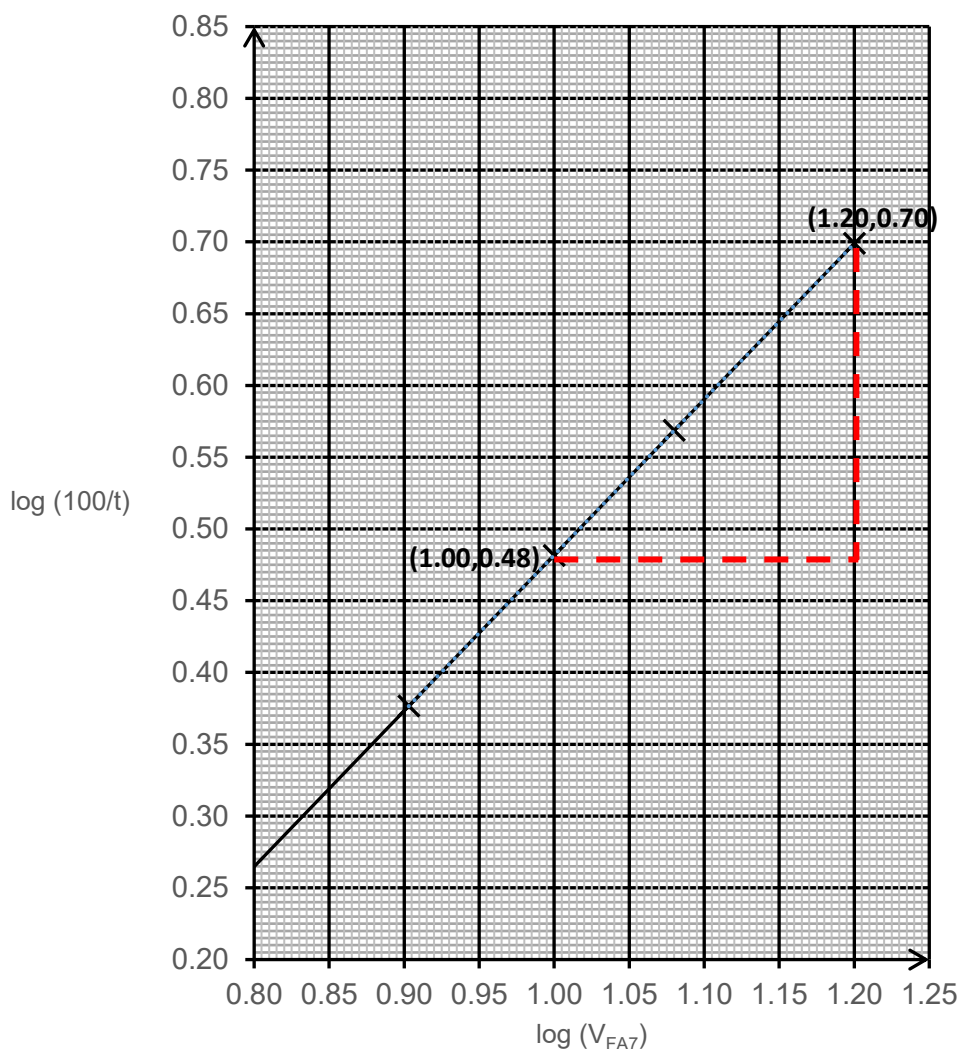


On filtering into dilute nitric acid, the acid reacts with aqueous ammonia. This causes [NH₃] to decrease and position of equilibrium of (2) shifts to the left, increasing [Ag⁺]. This causes position of equilibrium (1) to shift to the right, reforming AgCl precipitate.

3 (a)

	V_{FA7} / cm^3	$V_{\text{water}} / \text{cm}^3$	t / s	$\log\left(\frac{100}{t}\right)$	$\log(V_{FA7})$
1	8.0	14.0	42	0.377	0.903
2	10.0	12.0	33	0.481	1.00
3	12.0	10.0	27	0.569	1.08
4	16.0	6.0	20	0.699	1.20

3 (b)(i)



3 (b)(ii) Using coordinates (1.20, 0.70) and (1.00, 0.48),

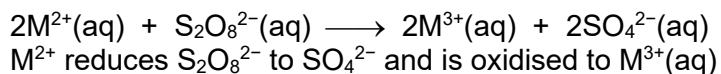
$$\text{Gradient} = \frac{0.70 - 0.48}{1.20 - 1.00} = \underline{1.10}$$

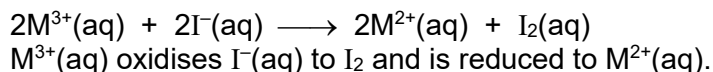
Order of reaction with respect to $\text{S}_2\text{O}_8^{2-} = \underline{1}$

3 (c)

V_{FA4} / cm^3	$V_{\text{water}} / \text{cm}^3$	V_{FA7} / cm^3	t / s
8.0	6.0	8.0	27

3 (d)



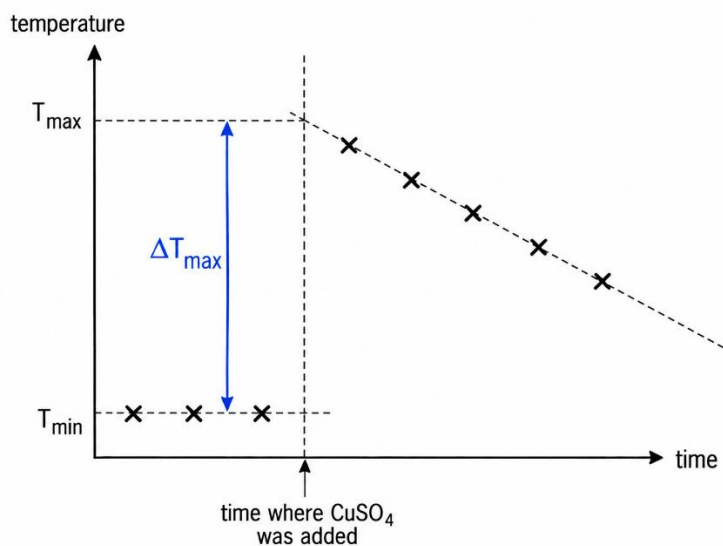


Each step involves a reaction between oppositely charged ions which attract each other. Hence M^{2+} acts as a homogenous catalyst by offering an alternative reaction pathway with a lower activation energy.

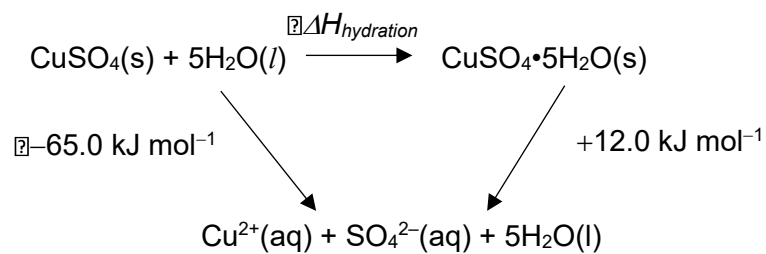
- 4 (a)** Heat evolved for temp. rise of $5^{\circ}\text{C} = 100 \times 4.18 \times 5 = 2090 \text{ J}$
Amount of CuSO_4 required $= \frac{2090}{65.0 \times 10^3} = 0.03215 \text{ mol}$
Minimum mass of CuSO_4 to use $= 0.03215 \times 159.6 = \underline{5.13 \text{ g (3 sf)}}$

- 4 (b)**
- Using an electronic balance, weigh accurately about 6.00 g of CuSO_4 into a clean and dry weighing bottle.
 - Record the total mass of CuSO_4 and the weighing bottle, $\mathbf{m_1}$.
 - Using a 100 cm³ measuring cylinder, transfer 100 cm³ of water into a dry Styrofoam cup, placed in a 250 cm³ beaker.
 - Place the lid on the cup, slip the thermometer through the lid and stir the water gently using the thermometer.
 - Record the initial temperature of the water. Start the stop-watch and record the temperature of the water every 30 seconds for 2.5 min.
 - At exactly 3 min, add the CuSO_4 in the weighing bottle to the Styrofoam cup. Cover the cup with a lid and continue to stir the mixture gently with the thermometer and record the temperature every 30s from 3.5 min to 10.0 min.
 - Reweigh the emptied weighing bottle and record its mass, $\mathbf{m_2}$. Take the difference in mass between $\mathbf{m_1}$ and $\mathbf{m_2}$ and hence record the actual mass of CuSO_4 that was transferred and dissolved in water.
 - Plot graph of temperature against time.
 - Extrapolate the graph to the third minute when CuSO_4 was added to water to obtain the highest temperature reached.
 - Repeat steps 1 to 9 to obtain another set of data to plot another graph. Obtain a second value of T_{max} and enthalpy change of reaction and find the average value for the enthalpy change of reaction.
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4 (c)(i)



4 (d)



$$\Delta H_{\text{hydration}} = -65.0 - (+12.0) = \underline{-77.0 \text{ kJ mol}^{-1}}$$