

Victoria School
2021 Chemistry O Levels / 6092
Suggested Answer Key

PAPER 3

X is ammonium ferrous sulfate.

QA video <https://www.youtube.com/watch?v=hUOpnteRwOs>

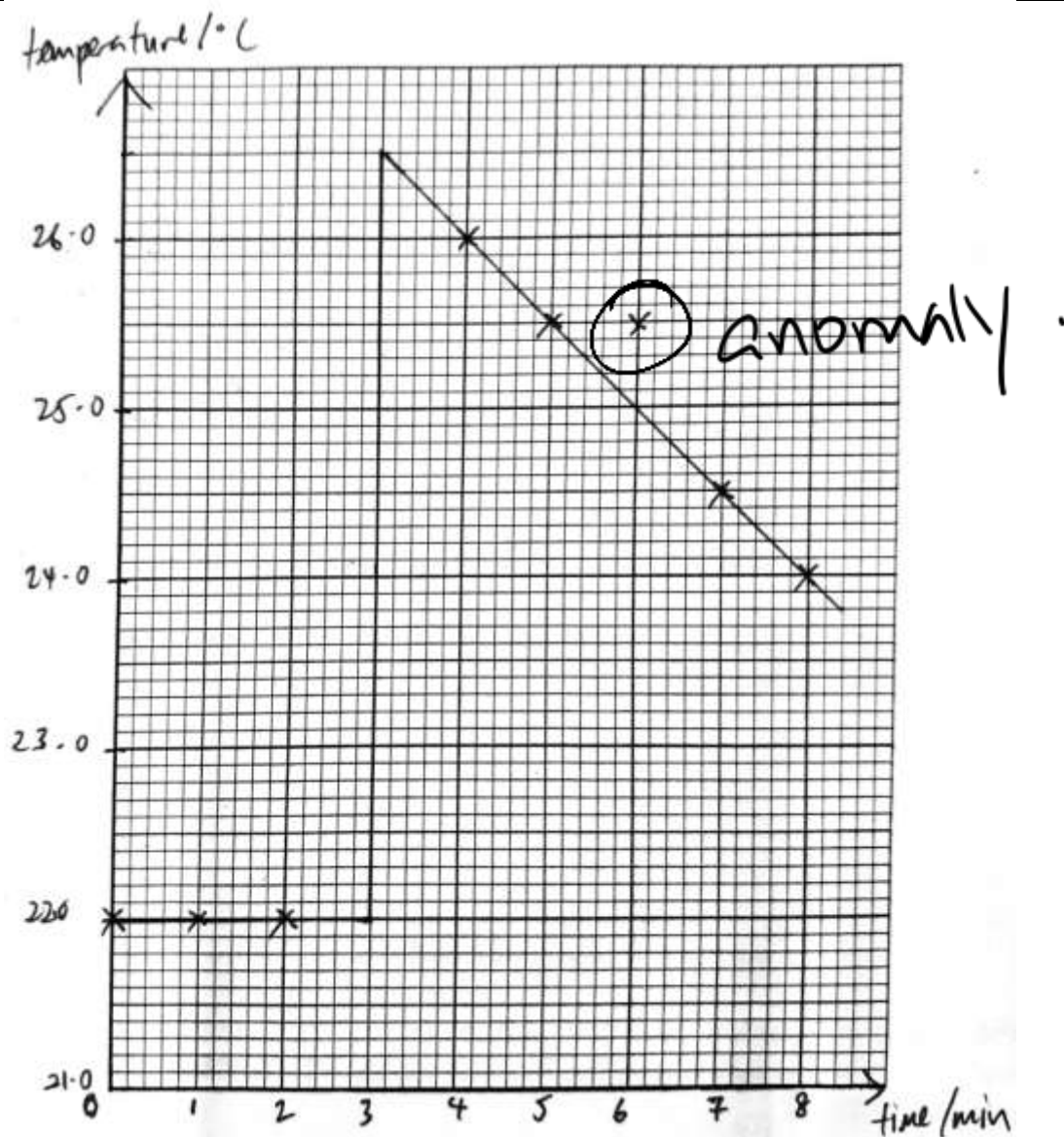
Question		Answer	Mark			
1	a	Remove the stopper from the sample of X in a test-tube. Heat the sample in the test-tube gently for about 1 minute at first and then strongly for about 1 minute. Record all your observations including testing the gas produced with damp red litmus paper. • On gentle heating, the light green solid turned white. [reject blue solid for X] • Condensation occurred. • On strong heating, the white solid turn yellow. • Colourless pungent gas produced turned damp red litmus paper blue. 2pts -1m	2			
	bi	(a) Use a measuring cylinder to transfer about 30 cm³ of deionised water to the 100 cm³ beaker. Add the sample of X from the capped container to the beaker. Stir to ensure all the solid has dissolved, producing solution X. Use solution X to carry out the following tests. You are also provided with Y, hydrogen peroxide. You should test and identify any gases evolved. Record all your observations in the table. The volumes given below are approximate and should be estimated rather than measured unless instructed otherwise. <table><tr><th>test</th><th>observation</th></tr><tr><td> </td><td> </td></tr></table>	test	observation		
test	observation					

		Test 1 Put about 1 cm depth of solution X in a clean test-tube. Add 1cm depth of Y (hydrogen peroxide). Shake the test-tube. Keep this solution for Test 4.	• Colourless solution turns red-brown. [1m] • Effervescence of colourless gas was observed. Gas relighted a glowing splint. Oxygen was produced. [1m] • Test-tube feels warm.	
		Test 2 Put about 1 cm depth of solution X in a clean test-tube. Add a few drops of aqueous sodium hydroxide with shaking, then add excess aqueous sodium hydroxide.	• Green ppt formed, ppt was insoluble in excess aqueous sodium hydroxide. [1m for here & test 2]	
		Test 3 Put about 1 cm depth of solution X in a clean boiling tube. Add an equal depth of aqueous sodium hydroxide and warm the mixture gently.	• green ppt was formed. [1m for here & test 2] • Upon warming, a colourless pungent gas was produced which turned most red litmus paper blue. Ammonia gas was produced. [1m] • Upon standing, green ppt turns red-brown.	
		Test 4 To the mixture from Test 1 add a few drops of aqueous sodium hydroxide with shaking, then add excess aqueous sodium hydroxide.	• Red-brown ppt formed, ppt was insoluble in excess aqueous sodium hydroxide. [1m for test 4 and 5]	
		Test 5 Put about 1 cm depth of solution X in a clean test-tube. Add an equal depth of dilute nitric acid and then add a few drops of aqueous barium nitrate.	No reaction was observed when dilute nitric acid was added. • White ppt was formed when aqueous barium nitrate was added. [1m for test 4 and 5]	
	bii	Cation: NH_4^+ and Fe^{2+} [1m] Anion: SO_4^{2-} [1m]		2

	biii	Redox reaction; Hydrogen peroxide was reduced to form water and <u>iron(II) ions were oxidised to iron(III) ions which turns from colourless to brown</u>			1 1	
2	ai	Titration number	1	2	Titration video: https://www.youtube.com/watch?v=jgBix7HHUYs	5
		Final burette reading / cm ³	22.30	22.30		
		Initial burette reading / cm ³	0.00	0.00		
		Volume of P / cm ³	22.30	22.30		
		Best titration results	✓	✓		
	1m: correct headings & correct subtraction 1m: readings to nearest 0.05 cm ³ 1m: readings used are within ±0.20 cm ³ 2m: readings are within ±0.20 cm ³ of supervisor's readings					
	aii	Average volume of P = (22.30 + 22.30) ÷ 2 = 22.30 cm³ (2 d.p)				1
	bi	Number of moles of thiosulfate ions = 0.120 x (22.30/1000) = 0.00268 mol				1
bii	Number of moles of iodine = 0.00268 ÷ 2 = 0.00134 mol Number of moles of Cu ²⁺ = 0.00134 x 2 = 0.00268 mol Number of moles of Cu ²⁺ in 1 dm ³ = 0.00268 ÷ 25/1000 = 0.107 mol				2	
biii	Mass of copper in brass screw = 0.107 x 64 = 6.85 g				1	
biv	Percentage by mass of copper = 6.85 ÷ 9.50 x 100% = 72.1% [1m] 1m for units for biii & biv 1m for 3 s.f.				3	
c	Potassium iodide becomes the limiting reactant, resulting in a <u>smaller number of moles of Cu²⁺ ions</u> being involved in the reaction, leading to <u>a smaller mass of Cu calculated</u> . Hence, the calculated value for percentage by mass of copper will <u>be lower than expected</u> .				1 1	

3	a	Concentration of acid in $\text{mol/dm}^3 = 36.5 \div 36.5 = 1.00 \text{ mol/dm}^3$ Measure <u>10 cm³ of hydrochloric acid using a 10 cm³ measuring cylinder</u> and add it into a 100 cm³ beaker. Measure <u>90 cm³ of water using a 100 cm³ measuring cylinder</u> and add it to the beaker. Using a glass rod, <u>stir and mix the 100 cm³ of 0.100 mol/dm³ hydrochloric acid well.</u>	1 1 1
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bi



4

bii Maximum temperature rise = $26.5 - 22.0 = 4.5\text{ }^{\circ}\text{C}$

1

biii Amount of heat released = $50 \times 4.5 \times 4.2 = 945\text{ J}$

1

	biv	Mass of calcium carbonate = $24.8 - 21.3 = 3.50$ g Number of moles of calcium carbonate = $3.50 \div 100 = \mathbf{0.0350 \text{ mol}}$	1
	bv	Amount of heat released = $0.945 \div 0.0350 = \mathbf{27.0 \text{ kJ/mol}}$	1
	bvi	The <u>extrapolation of the graph</u> would allow the temperature rise to be more accurately calculated as the <u>highest temperature measured may not be accurate due to heat loss to the surroundings</u> .	1
	c	Add <u>excess nitric acid</u> to the sample. Effervescence is observed and the <u>white solid is completely dissolved</u> .	1
		Add <u>aqueous ammonia</u> to the solution. If a <u>white ppt is formed</u> , which <u>dissolves in excess</u> , zinc cations are present.	1