CHIJ SECONDARY

Sec 4 Preliminary Examination 20**24**

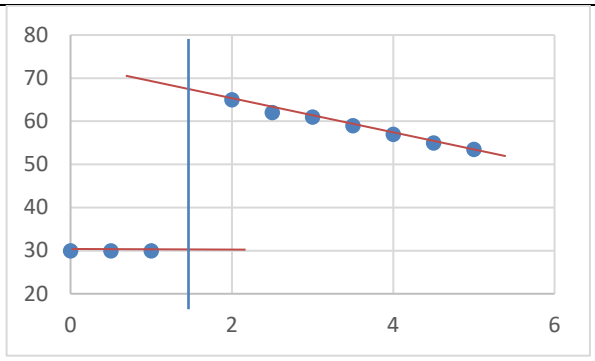
Chemistry 6092 **Mark Scheme**

Updated on 05/09/2024

Paper 3 (40 marks)

			Answers	Marks	Total
1	**(a)**	**(i)**	Results • correct headings and units [1] • burette readings to 2 d.p. [1] • accuracy within ±0.2 cm^3 [2] or ±0.3 cm^3 [1] of actual titre values • concordance within ±0.1 cm^3 [1]	5	**18**
		(ii)	Calculation of average volume using best 2 values to 2 d.p.	1	
	(b)		Volume of Q = **X** cm^3 No. of moles of Q = **X**/1000 × 0.100 = 0.0001**X** mol [1] No. of moles of of K_2CO_3 in 25 cm^3 = 0.0001**X** ÷ 2 = 0.00005**X** mol [1]	2	
	(c)		No. of moles of K_2CO_3 in 1 dm^3 = 1000/25 × 0.00005**X** mol = 0.002**X** mol	1	
	(d)	**(i)**	Mass concentration of of K_2CO_3 = 0.002**X** mol × 138 = 0.276**X** g/dm^3	1	
		(ii)	Mass of H_2O in 1dm^3 = 8.00 – 0.276**X** g	1	
		(iii)	No. of moles of H_2O = (8.00 – 0.276**X**) g ÷ 18	1	
		(iv)	***x*** = 0.09178 ÷ 0.046 ≈ 2	1	
	(e)		Every 2 points is 1 mark: 1. Measure the <u>mass</u> *[reject weight, penalize once]* of an empty <u>test-tube/ boiling tube/ evaporating dish/ crucible</u> *[reject beaker/ conical flask etc.]* (***p***) using an <u>electronic mass balance</u> *[reject weighing scale]* 2. Add the solid sample to the test-tube, measure the <u>initial mass of the test-tube and its contents</u> (***q***) *[accept measure the mass of hydrated K_2CO_3, if no apparatus mentioned point 1 not awarded] [reject measuring mass of solution]* 3. Calculate the mass of hydrated K_2CO_3 used by taking ***q*** – ***p*** 4. <u>Heat</u> the sample (at regular / 1-minute intervals) *[point only awarded if appropriate apparatus for heating was mentioned earlier; accept evaporate (to dryness)]* 5. until the mass of the remaining solid / residue is constant / to dryness / all the water has evaporated *[reject to saturation]* 6. Measure the <u>mass of the remaining residue and test-tube</u> (***r***) *[reject measure the mass of the test-tube after heating] [accept*	5	

			Answers	**Marks**	**Total**
			measure the mass of anhydrous K_2CO_3 as ecf if point 1 not mentioned] 7. Calculate the mass of the residue ***r*** – ***p*** *[reject **p** – **r**]* 8. Calculate the number of moles of K_2CO_3 by taking (***r*** – ***p***)/138. 9. Calculate the number of moles of H_2O by taking (***q*** – ***r***)/18. 10. The value is x is the number of moles of H_2O ÷ number of moles of K_2CO_3. OR 1. Using a burette/measuring cylinder/pipette, measure out 25.0 cm^3 of solution P 2. into a conical flask. Set up using rubber stopper with delivery tube, connected to gas syringe *[award point if set-up is drawn and labelled]* 3. Add solution Q / HCl 4. in excess 5. Measure the volume of gas *[reject amount/mass]* *6.* Calculate the number of moles of CO_2 by taking ***v***/24000 *[reject finding no. of moles by mass/M_r if never mention to measure the mass of gas collected using electronic mass balance]* 7. The number of moles of K_2CO_3 is also ***v***/24000 8. The value of x can be determined using steps **(c)** to **(d)(ii)** *(Max. 4 marks, because the method is not very different from the original question)*		
2	**(a)**		A lilac/purple/violet flame was observed.	1	**9**
	(b)		The white solid melted to form a colourless liquid / water droplets were observed on the sides of the test-tube / a white residue remains [1] A gas was evolved that relights a glowing splint. [1]	2	
	(c)		**Test 1** • Upon adding potassium iodide, the yellow solution turns yellow/brown/reddish-brown/dark orange. [1] • Upon adding starch, a blue-black solution forms. [1] **Test 2** • A white precipitate forms. [1] **Test 3** • No visible change observed. [1]	4	
	(d)		Nature: Oxidising agent (no mark) Reasoning: In Test 1, when potassium iodide is added, the solution changes to brown, [1] indicating that Y oxidised potassium iodide to form iodine. [1]	2	
3	**(a)**		Table • temperatures recorded to 1 d.p. [1] • correct trend: temperature decrease from t=2 to t=5.5 [1] *(accept if first 2 temperatures are the same)* • accuracy: temperature within 1°C difference at t=0, t=0.5 and t=1, and 66.0±3.0°C for highest temperature reading [1]	3	**13**
	(b)		Graph • correct axes labels and units, including scale [1] • temperature to 1 d.p., time to 1 d.p. or nearest whole number [1] • correctly plotted values [1] • best-fit lines [1]	4	

			Answers	**Marks**	**Total**
					
	(c)		Vertical line correctly drawn at 1.5 min [1] Temperature rise = 67.5 – 30.0 = 37.5°C [1]	2	
	(d)	**(i)**	Heat energy released = 25g × 37.5°C × 4.2 = 3937.5 J ≈ 3940 J	1	
		(ii)	Amount of $CuSO_4$ = 0.8 × 25/1000 = 0.02 mol	1	
		(iii)	Enthalpy change = 3.9375kJ ÷ 0.02 mol = –196.875 kJ/mol = –197 kJ/mol	1	
	(e)		Any 1: • Use a lid over the Styrofoam cup to minimize heat loss to the surroundings. • Use a burette/pipette to measure the volume of T *(accept: 25 cm^3 of T)* more accurately. • Use a data logger *(reject: machine)* with a temperature probe to measure the temperatures more accurately. • Use a magnetic stirrer *(reject: electronic stirrer, stirring machine)* to ensure more consistent stirring (even distribution of heat energy).	1	