SOLUTION TO 5070/42/M/J/19

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Q1

	ANSWER	NOTES
a	A = conical flask / Erlenmeyer flask B = pipette C = burette	
b (i)	↓	

titration number	1	2	3	4
final burette reading / cm^3	24.1	47.5	**23.6**	24.4
initial burette reading / cm^3	0.0	23.7	**0.3**	**0.8**
volume of 0.600 mol / dm^3 hydrochloric acid used / cm^3	**24.1**	23.8 ✓	**23.3**	23.6 ✓

(ii)	Average volume = (23.8 + 23.6) ÷ 2 = 23.7 cm^3	
(iii)	Addition of distilled water only changes the concentration of the solution in A. It does not affect the amount or moles of $Mg(OH)_2$.	
c (i)	Average volume = 23.3 cm^3 = 0.0233 dm^3 n (HCl) = 0.600 × 0.0233 = 0.01398	1 dm^3 = 1000 cm^3 n = C × V

Q1		
	ANSWER	**NOTES**
c (ii)	**mole ratio** 1 $Mg(OH)_2$: 2 HCl ½ $Mg(OH)_2$: 1 HCl n $Mg(OH)_2$ = ½ × 0.01398 = 0.00699	
(iii)	Molar mass of Magnesium hydroxide, M = 24 + (16 + 1) × 2 = 58 g Mass of Magnesium hydroxide, m = 0.00699 × 58 = 0.405 g	m = n × M
(iv)	mass of 5.0 cm^3 of the Milk of Magnesia = 2.34 × 5 = 11.7 g	
(v)	percentage by mass of magnesium hydroxide in the Milk of Magnesia $= \frac{0.405}{11.7} \times 100$ = 3.47 %	

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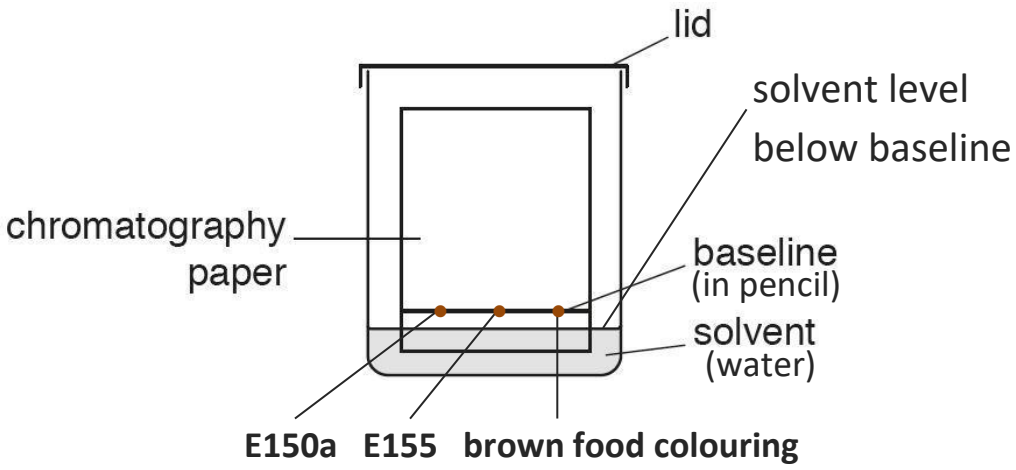
Q2

	ANSWER	NOTES
	Technique used: **Chromatography** The experiment is set up as shown in the diagram below. The chromatogram is run until the solvent reaches near the top of the chromatography paper. The position of spot(s) from the sample brown food colouring is compared with that of spots from E150a / E155 **OR** the R_f values are calculated and compared. R_f value = distance travelled by solute (spot) ÷ distance travelled by solvent The spots with the same R_f values / same level on the chromatogram are produced by the same food colourings.	

Experimental set-up



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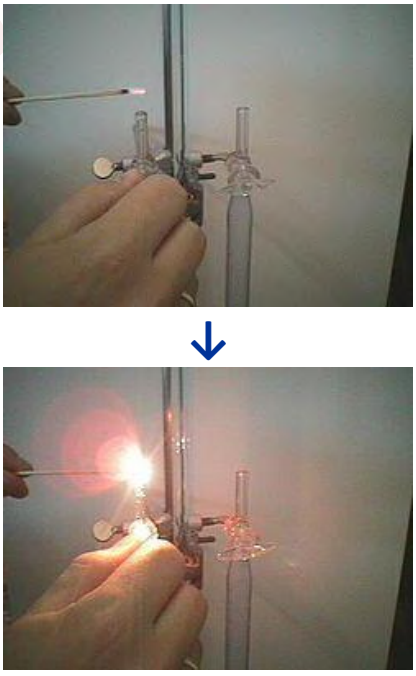
Q3		
	ANSWER	**NOTES**
a (i)	cathode: pink / brown solid deposits at the cathode anode: bubbles / fizzing / effervescence	Cu^{2+} ions from the electrolytic solution get discharged by reduction at the cathode forming Cu metal which has a pink/brown appearance. $Cu^{2+} + 2e^- \rightarrow Cu$ Hydroxide ions get oxidised at the anode forming Oxygen gas, hence bubbles are seen. $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
(ii)	Test: glowing splint (into tube of gas) Observation: relights / rekindles	Oxygen supports combustion. The glowing splint therefore relights in Oxygen. 

Q3

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	ANSWER	NOTES
a (iii)	Description: the colour fades away and becomes paler blue. The solution eventually goes colourless towards the end of the electrolysis. Explanation: as Cu^{2+} / copper ions concentration falls	Cu^{2+} ions are blue-coloured. As the concentration of Cu^{2+} ions from the solution decreases by discharge at the cathode, the colour of the solution fades away.
b (i)	The colour remains the same (does not fade away).	Cu atoms from the Cu anode get oxidised to Cu^{2+} ions and enter the electrolytic solution to replace the Cu^{2+} ion lost by way of discharge at the cathode. The colour therefore remains unchanged.
(ii)	**mass of cathode:** increases **mass of anode:** decreases **explanation:** copper removed from anode by oxidation and copper forms on cathode by reduction	Mass of cathode increases due to deposition of Cu on the cathode formed by reduction of Cu^{2+} ions. $Cu^{2+} + 2e^- \rightarrow Cu$ Mass of anode decreases as Cu atoms from the anode get oxidised and enter the solution as Cu^{2+} ions.
(iii)	Electrorefining of blister Copper Electroplating with Copper	

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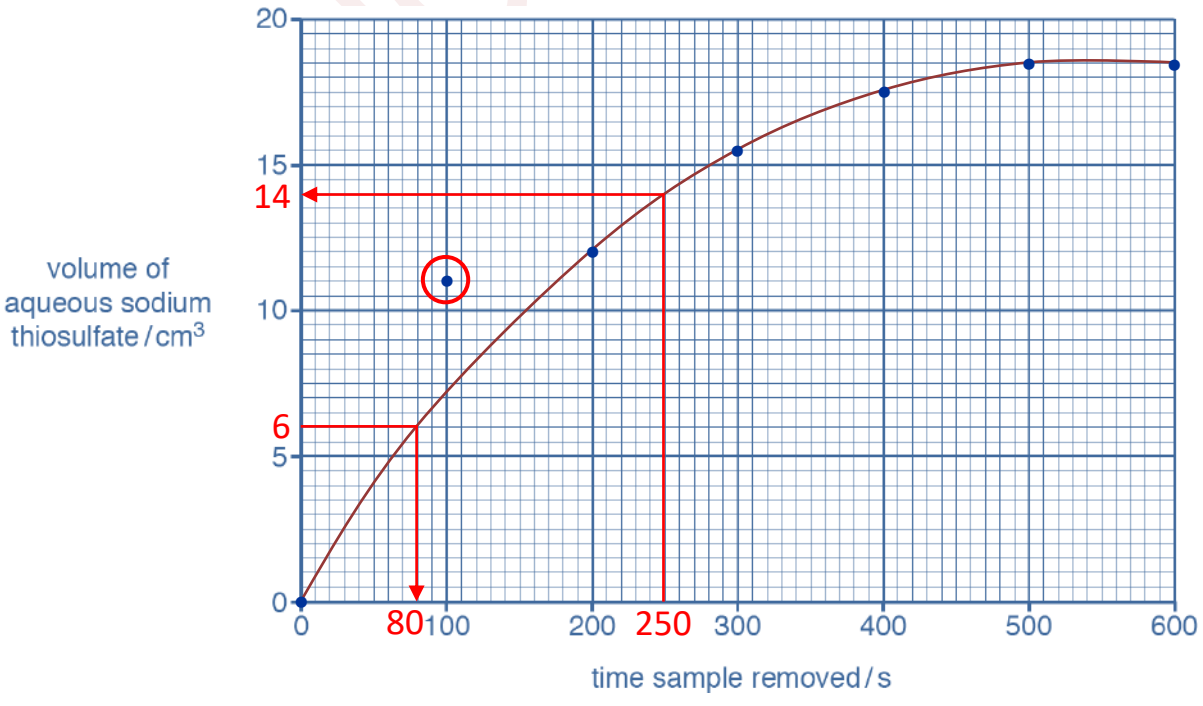
Q4		
	ANSWER	**NOTES**
a	The colour of the solution changes from colourless to brown.	Iodide ions are colourless. Aqueous I_2 is brown.
b (i)	Calcium carbonate neutralises the acid.	Calcium carbonate is basic. It can neutralise acids.
(ii)	This increases the reaction rate.	Powdered Calcium carbonate has a greater surface area. The collision rate increases resulting in faster reaction.
(iii)	The Calcium carbonate dissolves with fizzing / effervescence.	Calcium carbonate reacts with the acid to form the corresponding salt in addition to water and carbon dioxide gas. It therefore appears to dissolve in the sample with fizzing.
c (i)	↓	



Q4 (continued from previous page)		
	ANSWER	**NOTES**
c (ii)	shown on grid	
(iii)	shown on grid	
(iv)	14 cm^3	
(v)	80 s	
(vi)	**Difference in slope:** The slope of the curve at 50 seconds is much greater than that at 400 seconds. **Explanation:** The rate of the reaction is much greater at 50 s than at 400 s. The reaction is much faster at 50 seconds as the concentration of the reactants is higher resulting in greater collision rate. At 400 seconds, the reaction is nearing completion. The collision frequency decreases considerably, hence lower reaction rate.	Slope of the curve at a given point of time = reaction rate at that point The concentration of the reactants decreases with time resulting in a decrease in collision frequency and thereby in reaction rate.

Q5		
	ANSWER	**NOTES**
a	Add solid copper oxide (or copper carbonate or copper hydroxide) to warm dilute Sulfuric acid until some solid remains undissolved. Filter the solution to remove excess solid. Collect the filtrate in an evaporating dish and heat till it becomes saturated (some solid appears). Cool the solution for crystals to form. Dry the crystals by pressing gently between dry filter papers or by placing in a warm oven.	$CuO\ (s) + H_2SO_4\ (aq)$ $\rightarrow$ **$CuSO_4$ (aq)** + $H_2O\ (l)$
b	Mix equal volumes of equimolar solutions of aqueous Silver nitrate solution and aqueous Sodium chloride in a beaker. Filter off the white precipitate of Silver chloride formed upon mixing. Wash the residue (ppt.) with distilled water and dry by pressing gently between dry filter papers.	Equimolar $\rightarrow$ equal concentration in terms of mol/dm^3 $AgNO_3\ (aq) + NaCl\ (aq)$ $\rightarrow$ **AgCl (s)** + $NaNO_3\ (aq)$

Q6		
	ANSWER	**NOTES**
a	The gas given off is carbon dioxide. The solution contains carbonate ions.	Carbonate ions react with dilute Hydrochloric acid to produce carbon dioxide gas, hence the fizz / effervescence. Carbon dioxide gas turns limewater milky.
b	white precipitate formed	Ba^{2+} ions react with sulfate ions from dilute Sulfuric acid to form a white precipitate of Barium sulfate.
c	white precipitate formed	Ca^{2+} ions react with OH^- ions to form a white ppt. of $Ca(OH)_2$ which is insoluble in excess of aq. NaOH.
d	slight white ppt., or no precipitate	

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