SOLUTION TO 5070/41/O/N/19

QUICK ACCESS GRID

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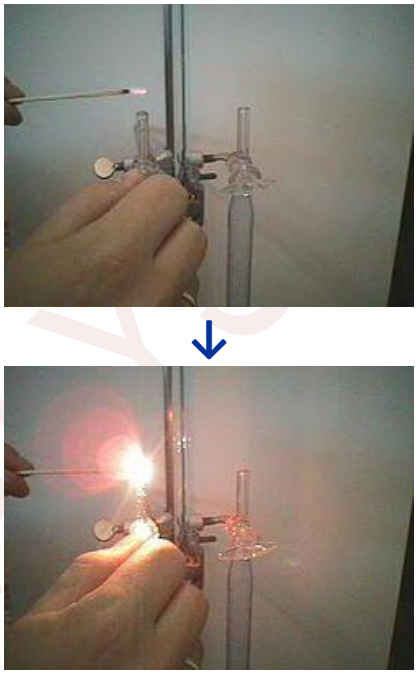
Q1

	ANSWER	NOTES
a		In the electrolysis of aqueous Copper(II) sulfate, hydroxide ions get oxidised at the anode forming Oxygen gas. Copper ions get reduced at the cathode in preference to hydrogen ions as Copper is below Hydrogen on the reactivity series.
		In the electrolysis of aqueous potassium iodide, Hydrogen ions get discharged at the cathode in preference to Potassium ions as Potassium is above Hydrogen on the reactivity series. Iodide ions get oxidised at the anode forming Iodine (brown liquid).
		In the electrolysis of dilute Sulfuric acid, hydrogen ions get reduced at the cathode forming Hydrogen gas while hydroxide ions get oxidised at the anode forming Oxygen gas.

name of product at the anode(+)	observation at the anode(+)	name of product at the cathode(–)	observation at the cathode(–)
oxygen	bubbles of colourless gas	copper	pink / brown solid(1)
iodine(1)	brown liquid	hydrogen (1)	bubbles of colourless gas(1)
oxygen(1)	bubbles of colourless gas	hydrogen (1)	bubbles of colourless gas

Q1		
	ANSWER	**NOTES**
b	**Test:** bring a glowing splint close to the gas **Result:** the splint relights	Oxygen supports combustion. The glowing splint therefore relights in Oxygen. 

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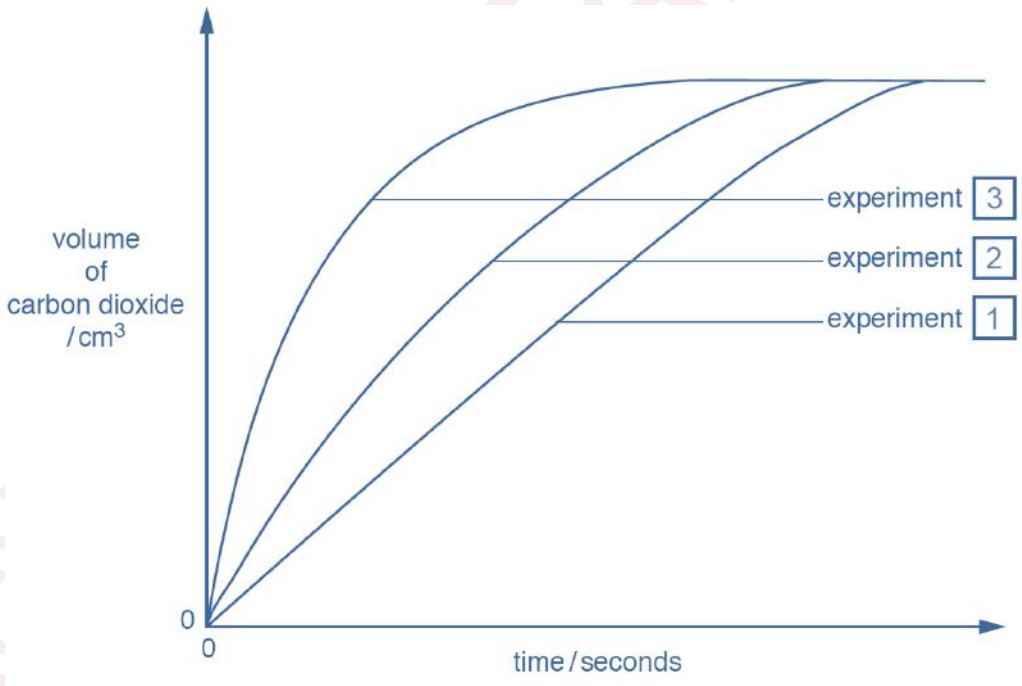
Q2		
	ANSWER	**NOTES**
a	Excess means more than enough needed for reaction	The excess remains unreacted.
b	**A** conical flask **B** gas syringe	
c	Water bath	
d	particle size / surface area of calcium carbonate concentration of dilute Hydrochloric acid	
e		
(i)	The gradient of the graph indicates the reaction rate. The steepest gradient indicates the fastest reaction. Alternatively, the graph which levels off first indicates the fastest reaction.	

Q2 continued from previous page		
	ANSWER	**NOTES**
e (ii)	shown on graph	
(iii)	The graphs level off (no change in volume of carbon dioxide).	
(iv)	The reaction stops when all of the dilute HCl has reacted.	Calcium carbonate is in excess, hence won't react completely.

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Q3		
	ANSWER	**NOTES**
	Add the mixture to warm dilute Sulfuric acid taken in a beaker. Stir well with a glass rod. The Copper(II) oxide dissolves in the acid forming a blue solution while Carbon does not. Filter the mixture. The residue is Carbon. The blue filtrate contains Copper(II) sulfate. Wash the residue with distilled water to remove traces of acid. Dry it by pressing between filter papers.	$CuO\ (s) + H_2SO_4\ (aq)$ $\rightarrow$ **$CuSO_4$ (aq)** + $H_2O\ (l)$

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Q4

ANSWER	NOTES

	sodium hydroxide	excess sodium hydroxide	barium nitrate and nitric acid	aluminium and sodium hydroxide + heat
aqueous zinc sulfate	white ppt (1)	Soluble (1)	white ppt	no reaction
aqueous copper(II) sulfate	blue ppt (1)	insoluble	white ppt (1)	no reaction (1)
aqueous calcium nitrate	white ppt (1)	Insoluble (1)	no reaction(1)	Ammonia (1) litmus blue (1)

	reagents			
solutions	**Test for metal ions**		**test for Sulfate ions**	**test for Nitrate ions**
	aqueous sodium hydroxide	aqueous sodium hydroxide in excess	aqueous barium nitrate and dilute nitric acid	Aluminium and aqueous sodium hydroxide + heat
aqueous zinc sulfate	✓	✓	✓	✗
aqueous copper(II) sulfate	✓	✓	✓	✗
aqueous calcium nitrate	✓	✓	✗	**positive result:** (Ammonia) gas produced upon warming, turns damp red litmus blue

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<table>
<tr><th colspan="3">Q5</th></tr>
<tr><th></th><th>ANSWER</th><th>NOTES</th></tr>
<tr><td>a</td><td>A pipette is more accurate than a measuring cylinder.</td><td></td></tr>
<tr><td>b</td><td>burette</td><td></td></tr>
<tr><td>c</td><td>Traces of water left in the burette post washing will dilute solution L.</td><td>The concentration of L will change resulting in errors in titre values.</td></tr>
<tr><td>d</td><td>↓</td><td></td></tr>
<tr><td></td><td colspan="2"><table>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>23.4</td><td>49.2</td><td>33.6</td></tr>
<tr><td>0.0</td><td>24.8</td><td>10.0</td></tr>
<tr><td>23.4</td><td>24.4</td><td>23.6</td></tr>
<tr><td>✓</td><td></td><td>✓</td></tr>
</table></td></tr>
<tr><td></td><td>Average volume of L
= (23.4 + 23.6) ÷ 2 = 23.5 cm^3</td><td>The best titration results are the ones that are very close to each other, generally within then range of $\pm$0.2 cm^3.</td></tr>
<tr><td>e</td><td>Average volume of L
= 23.5 cm^3 = 0.0235 dm^3

n ($Na_2S_2O_3$)
= 0.0500 × 0.0235
= 0.001175</td><td>n = C × V</td></tr>
<tr><td>f</td><td>mole ratio
2 $Na_2S_2O_3$: 1 I_2

n (I_2) = 0.001175 ÷ 2 = 0.0005875</td><td></td></tr>
</table>

Q5
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	ANSWER	NOTES
g	**mole ratio** 1 NaClO : 1 I_2 0.0005875 NaClO : 0.0005875 I_2 n (NaClO) = 0.0005875	
h	M_r of NaClO = 23 + 35.5 + 16 = 74.5	
i	Mass of NaClO = 74.5 × 0.0005875 = 0.04376875 g	
j (i)	Concentration in g/dm^3 $= \frac{0.04376875}{25} \times 1000$ = 1.75075	
(ii)	Concentration in mol/dm^3 $= \frac{0.0005875}{25} \times 1000$ = 0.0235	

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Q6		
	ANSWER	**NOTES**
a (i)	The reaction is exothermic.	Exothermic → heat energy is given out
(ii)	Once the reaction is over, the temperature starts decreasing as the reaction mixture starts cooling due to loss of heat to the surroundings.	
(iii)	22.0°C	The lowest temperature reached would be the initial temperature of the solution before addition of Zinc.

Q6
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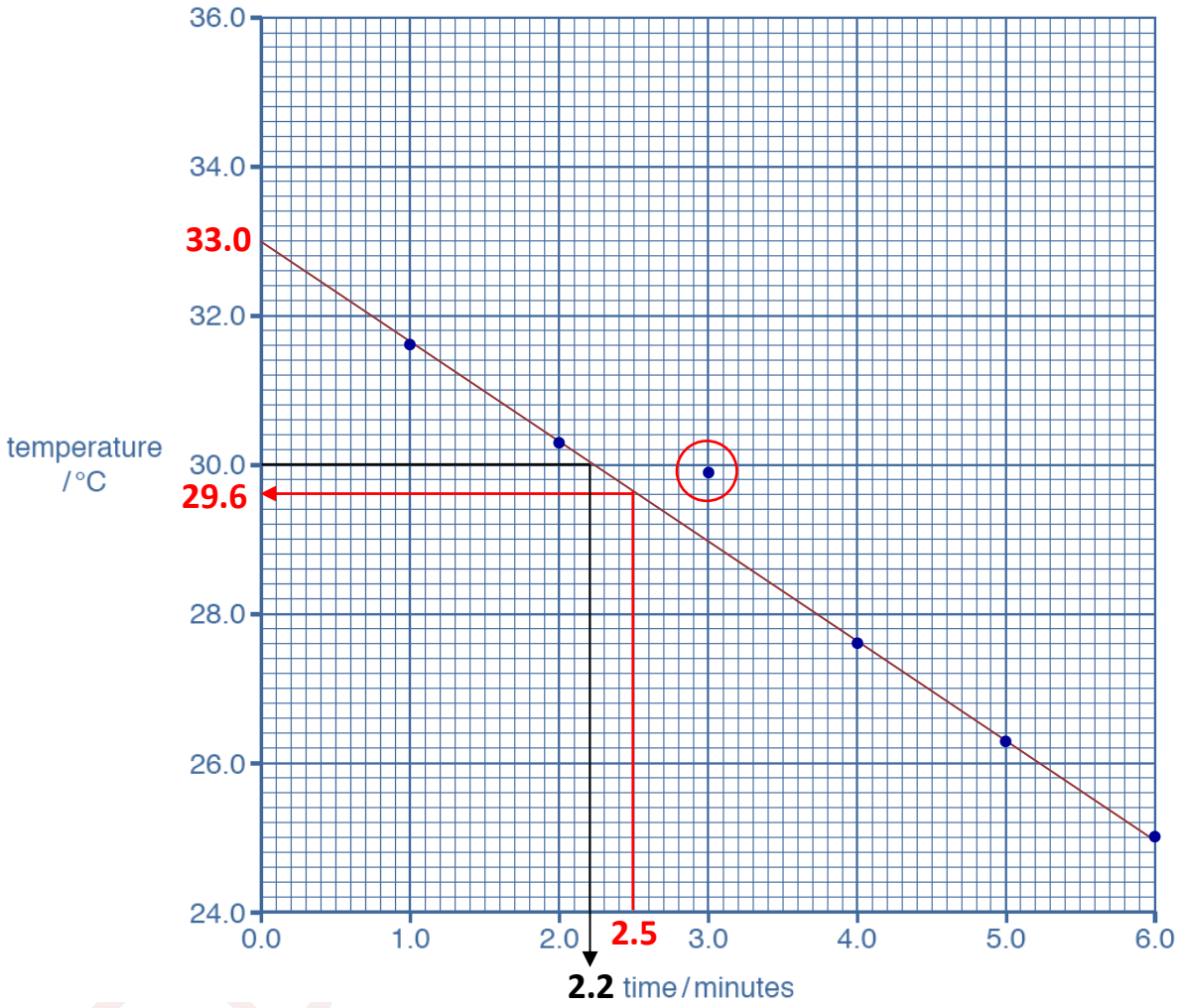
	ANSWER	NOTES
b (i)		
(ii)	shown on the graph	
c (i)	29.6°C	
(ii)	2.2 minutes	
d (i)	33.0°C	
(ii)	11°C	33.0 – 22.0 = 11°C

Q6 continued from previous page		
	ANSWER	**NOTES**
e (i)	Volume of Iron(II) sulfate = 25.0 cm^3 = 0.025 dm^3 n (Iron(II) sulfate) = 2.0 × 0.025 = 0.05	
(ii)	Maximum temperature rise = 11°C Moles of Iron(II) sulfate = 0.05 Heat produced $= \frac{25 \times 4.2 \times 11}{1000 \times 0.05}$ = 23.1 kJ / mol	

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