SOLUTION TO 5070/42/O/N/19

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Q1		
	ANSWER	**NOTES**
a	Gas jar	
b	Y and Z	Gas A is less dense than air, hence can be collected using set Y by downward displacement of air. Gas A is insoluble in water, hence can be collected using set Z by downward displacement of water.
c	X	Gas C is denser than air, hence can be collected using set X by upward displacement of air. Gas C is soluble in water, hence cannot be collected by bubbling through water.
d (i)	Gas B is denser than air.	Gas B is denser than air, hence can be collected using set X by upward displacement of air. Apparatus Y is more suitable for gases that are less dense than air.
(ii)	Gas B is colourless therefore it is not possible to know when D is full. It will be easier to make out the water being displaced completely from D in apparatus Z.	

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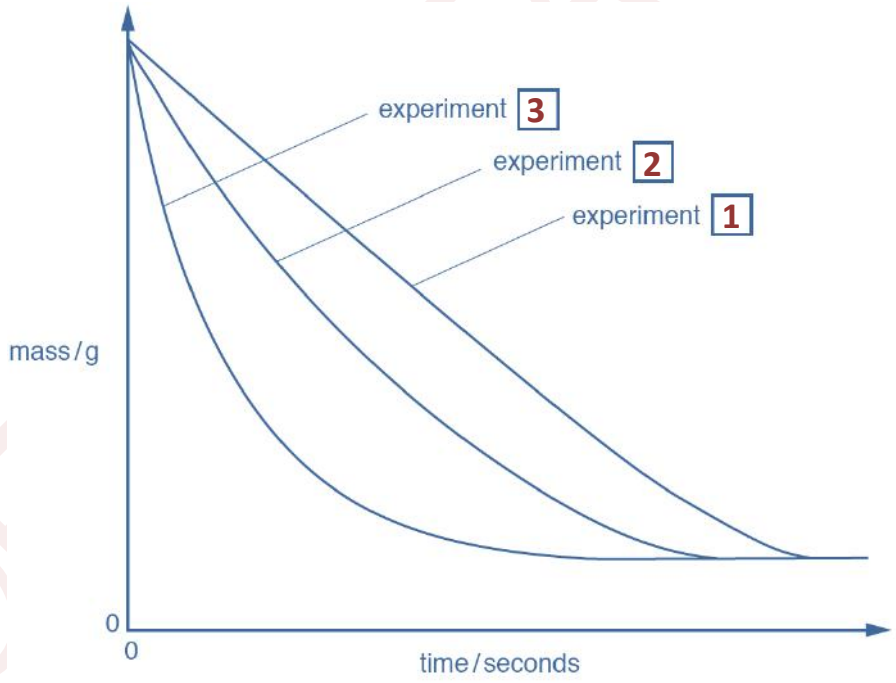
Q2		
	ANSWER	**NOTES**
a	Conical flask	
b	Variable: time Apparatus: timer / clock / stopwatch	
c	Carbon dioxide gas formed in the reaction escapes through the cotton plug.	
d	• Concentration of dilute Hydrochloric acid • Temperature	
e		
(i)	The gradient of the graph indicates the reaction rate. The 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 further change in mass).	
(iv)	The reaction stops when all of the dilute hydrochloric acid has reacted.	Calcium carbonate is in excess, hence won't react completely.

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Q3

ANSWER

A known excess of dilute Hydrochloric acid of a given concentration is measured out in a beaker using a measuring cylinder.

The initial temperature of the acid is measured using a thermometer and recorded.

A known mass of one of the solids (weighed using an electronic balance) is added to the acid.

If the temperature increases in course of the reaction, then the solid is Sodium carbonate.
If the temperature decreases, then the solid is Sodium hydrogencarbonate.

Accordingly, the highest / lowest temperature attained by the reaction mixture is measured and recorded.

The energy change per gram of the solid is calculated using the equation:

$$q = \frac{mc\Delta T}{\text{mass of solid}}$$

q = heat energy change
m = mass of the dilute HCl
c = specific heat capacity of water
ΔT = change in temperature

The process is repeated with the other solid, all other factors being the same.
The
In this case, the lowest temperature attained by the reaction mixture is measured and recorded.

The energy change per gram is calculated and compared with the previous calculated value to determine the reaction which produces the larger energy change per gram of solid.

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Q4

ANSWER	NOTES

	sodium hydroxide	excess sodium hydroxide	silver nitrate and nitric acid	aluminium and sodium hydroxide + heat
aqueous chromium nitrate	green ppt (1)	soluble (1)	no reaction (1)	ammonia (1) litmus blue (1)
aqueous iron(II) chloride	green ppt (1)	insoluble	white ppt	no reaction
aqueous iron(III) chloride	brown ppt (1)	insoluble (1)	white ppt (1)	no reaction (1)

	reagents			
solutions	**Test for metal ions**		**test for halide ions**	**test for Nitrate ions**
	aqueous sodium hydroxide	aqueous sodium hydroxide in excess	aqueous Silver nitrate and dilute nitric acid	Aluminium and aqueous sodium hydroxide + heat
aqueous Chromium (III) nitrate	✓	✓	✗	**positive result:** (Ammonia) gas produced upon warming, turns damp red litmus blue
aqueous Iron (II) chloride	✓	✓	✓	✗
aqueous Iron (III) chloride	✓	✓	✓	✗

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Q5

	ANSWER	NOTES
a	8.20 – 5.28 = 2.92 g	
b	to make sure the remaining solution that may have been left behind is transferred from the beaker to the container	
c	500.0 cm^3 Volumetric flask	
d	Solution G	Washing with (distilled) water will leave traces of water in the pipette which will dilute solution G and alter its concentration. This will introduce errors in the titre values.
e	Excess of aqueous potassium iodide and dilute sulfuric acid are used.	
f	average volume of **L** = 22.6 cm^3	The best titration results are the ones that are closest to each other or identical.

1	2	3
22.6	46.8	32.8
0.0	23.6	10.2
22.6	23.2	22.6
✓		✓

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Q5
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	ANSWER	NOTES
g	Average volume of L = 22.6 cm^3 = 0.0226 dm^3 n ($Na_2S_2O_3$) = 0.100 × 0.0226 = 0.00226	
h	**mole ratio** 2 $Na_2S_2O_3$: 1 I_2 n (I_2) = 0.00226 ÷ 2 = 0.00113	
i	**mole ratio** 1 KIO_3 : 3 I_2 x KIO_3 : 0.00113 I_2 x = 0.00113 ÷ 3 = 0.000377 moles of KIO_3 in 25.0 cm^3 of G = 0.000377	
j	moles of KIO_3 in 500.0 cm^3 of G $= \frac{0.000377}{25} \times 500$ = 0.00753	
k	M_r of KIO_3 = 39 + 127 + 16 × 3 = 214	

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Q5
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	ANSWER	NOTES
l	Mass of KIO_3 = number of moles of KIO_3 × 214 = 0.00753 × 214 = 1.61 g	
m	percentage by mass of KIO_3 in the sample of impure potassium iodate(V) $= \frac{1.61}{2.92} \times 100$ = 55.1 %	

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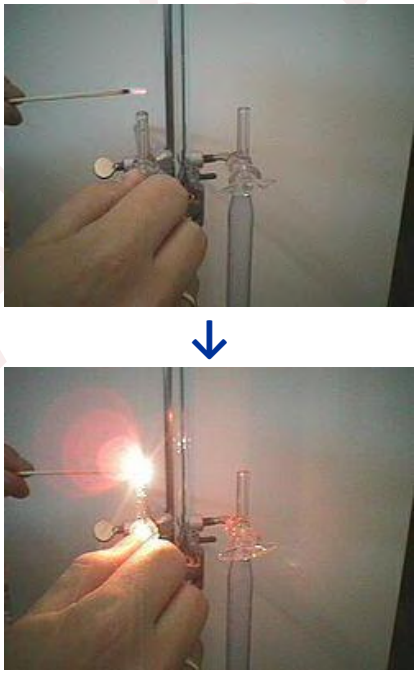
Q6		
	ANSWER	**NOTES**
a	**Name:** Oxygen **Test:** bring a glowing splint close to the gas **Result:** the splint relights	Hydroxide ions get discharged at the anode in preference to sulfate ions to form Oxygen gas. $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ Oxygen supports combustion. The glowing splint therefore relights in Oxygen. 
b (i)	The student should wash the cathode with distilled water to remove traces of the electrolytic solution and dry it completely before weighing.	
(ii)	Initial mass of cathode (before the electrolysis)	

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Q6
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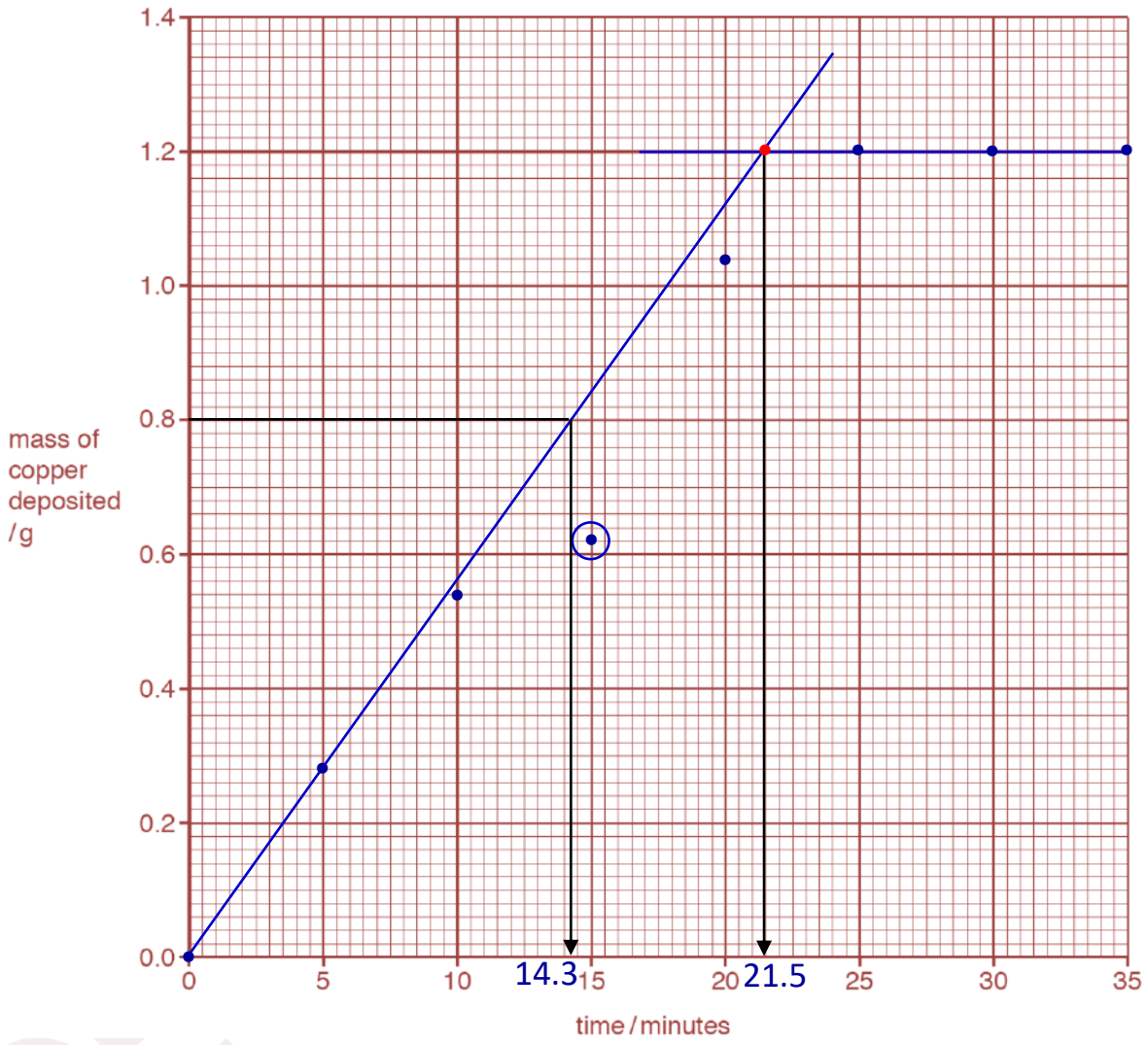
	ANSWER	NOTES
c (i)		
(ii)	shown on grid	
d (i)	14.3 minutes	
(ii)	21.5 minutes	

Q6 continued from previous page		
	ANSWER	**NOTES**
e	• Blue • Colourless	Electrolyte at the start of the experiment: aqueous Copper(II) sulfate Copper(II) ions are blue. Once all the Copper has been deposited at the cathode, no more Copper(II) ions are left in the electrolyte, hence it turns colourless. The electrolyte changes to Sulfuric acid which is colourless.

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