SOLUTION TO 5070/41/M/J/19

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Q1		
	ANSWER	**NOTES**
a	Letter: B Name: (Volumetric) Pipette	A pipette can measure the stated volume of solution most accurately.
b (i)	Burette	
(ii)	In aqueous Ammonia: Yellow /Orange In dilute Sulfuric acid: Red / Pink	
c	Add 50 cm^3 of 0.100 mol/dm^3 aqueous ammonia to a clean beaker using a burette / pipette. Add 25 cm^3 of 0.100 mol/dm^3 sulfuric acid to the same beaker from a burette. Stir well using a clean glass rod. Heat the beaker to evaporate the water from the solution till it becomes saturated (some solid appears on the inner sides of the beaker). Allow the beaker to cool for crystals to form. Dry crystals by pressing between (dry) filter papers.	Candidates can choose any other suitable volume of Ammonia. The volume of Sulfuric acid must always be half of that of Ammonia. $H_2SO_4(aq) + 2NH_3(aq) \rightarrow (NH_4)_2SO_4(aq)$

Q1		
	ANSWER	**NOTES**
d (i)	35 cm^3	
(ii)	• the damp blue litmus paper: no change in colour (stays blue) • the damp red litmus paper: changes to blue	Ammonia is a (weakly) basic gas. It therefore turns damp red litmus blue.

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Q2		
	ANSWER	**NOTES**
a (i)		
(ii)	450 s	
b (i)	Experiment 5 is repeated.	
(ii)	The point for 5 seems anomalous. It does not follow the general data trend. It is therefore repeated to increase the reliability of the data set.	
c	The more the mass of NaCl the faster the rate of rusting.	
d	**Effect:** The time for the blue colour to appear increases. **Explanation:** The paint excludes Oxygen / water. It acts as a barrier between the iron and Oxygen / Water.	
e (i)	Different students see the blue colour differently. As a result, they record different times. Different times could also result from use of stopwatch. Different students may use the stopwatch differently.	Perception of colour differs from one individual to another. Differences could also arise from the use of stopwatch. Some students are more accurate in timing the appearance of blue colour using the stopwatch than others. This gives rise to random errors.

Q2 continued from previous page		
	ANSWER	**NOTES**
e (ii)	The trend does not change as the same masses of NaCl are used by each student. The systematic errors that affect the masses remain the same.	

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Q3

	ANSWER	NOTES
a	A = ethanol B = hexene C = ethanoic acid	The mixture turns from orange to colourless with B → positive result for an unsaturated hydrocarbon / alkene. B is hexene. Solid Calcium carbonate can react with Ethanoic acid to form Calcium ethanoate and carbon dioxide gas. It does not react with Ethanol and hexene. Liquid C is therefore Ethanoic acid. Liquid A must be Ethanol.
b	↓	

Reagent	Observations		
	A	B	C
Add bromine solution	***The mixture remains orange / stays the same / has no visible change***	The mixture turns from orange to colourless	The mixture remains orange
Add solid calcium carbonate	No visible change	No visible change	***Effervescence / bubbles / fizzing / calcium carbonate dissolves / disappears***
Add dilute sulfuric acid and a few drops of potassium manganate (VII)	***The mixture turns (from purple) to colourless / decolourises***	The mixture turns from purple to colourless	The mixture remains purple

c (i)	The student mixes liquids A and C. (Ethanol and Ethanoic acid)	Ethanol + Ethanoic acid → Ethyl ethanoate + Water Ethyl ethanoate is an ester. Esters are sweet smelling liquids.

Q3 (continued from previous page)		
	ANSWER	**NOTES**
c (ii)	**Precaution:** The student should wear safety goggles, enclosed footwear, laboratory coat, and rubber gloves. **Reason:** Concentrated Sulfuric acid is corrosive and can cause severe skin burns / potential eye damage.	**Alternative answer:** The process required warming. Ethanol is a flammable liquid. The student should use a hotplate or water bath instead of warming directly using a Bunsen burner to prevent potential fire.

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Q4

	ANSWER	NOTES
	↓	White ppt. = Aluminium hydroxide $Al(OH)_3$ dissolves in excess of aq. NaOH but remains insoluble in excess of aq. NH_3. Chloride ions react with Silver ions to form a white ppt. of Silver chloride. The formation of a light blue ppt. which dissolves in excess of aq. NH_3 is a positive result for Copper(II) ions. Sulfate ions react with Barium ions to form a white ppt. of Barium sulfate.

Test	Observation	Pollutant ions present in sample
M1 ***Add aqueous sodium hydroxide / NaOH(aq) / aqueous NaOH***	white ppt., soluble in excess giving a colourless solution	Al^{3+}
Acidify with dilute nitric acid, then add aqueous silver nitrate	***M2 white ppt***	Cl^-
Add aqueous ammonia	Light blue ppt., soluble in excess, giving a dark blue solution	***M3*** Cu^{2+}
M4 Aqueous barium chloride / aqueous $BaCl_2$ / aqueous barium nitrate / aqueous $Ba(NO_3)_2$ (1) **AND** Acid / Dilute nitric acid / aqueous HNO_3 or Dilute hydrochloric acid / aqueous HCl (1)	***M5 white ppt***	SO_4^{2-}

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Q5

	ANSWER	NOTES
a	**Test:** The colourless liquid can be tested with anhydrous Copper(II) sulfate or with anhydrous Cobalt (II) chloride paper. **Result:** Anhydrous Copper(II) sulfate changes colour from white to blue. Anhydrous Cobalt(II) chloride paper changes colour from blue to pink.	
b	The ice cools the vapour and condenses it (to water).	
c	Carbon dioxide turns limewater milky.	Limewater is weakly alkaline while Carbon dioxide is an acidic gas. It reacts with limewater to form Calcium carbonate as a precipitate.
d (i)	↓	

titration number	1	2	3
final reading	24.9	29.5	38.8
initial reading	0.0	5.2	14.3
volume of 1.00 mol / dm^3 HCl / cm^3	24.9	24.3	24.5
best titration results (✓)		✓	✓

Q5 (continued from previous page)		
	ANSWER	**NOTES**
d (ii)	average volume = (24.3 + 24.5) ÷ 2 = 24.4 cm^3	
(iii)	average volume = 24.4 cm^3 = 0.0244 dm^3 n (HCl) = 1.00 × 0.0244 = 0.0244	Number of moles, n = Volume × Concentration
(iv)	0.0244 × 4 = 0.0976	
(v)	Volume of NaOH = 100 cm^3 = 0.100 dm^3 n (NaOH) = 0.100 × 2 = 0.200	
(vi)	0.200 – 0.0976 = 0.1024 moles	
(vii)	**mole ratio** 1 CO_2 : 2 NaOH ½ CO_2 : 1 NaOH n (CO_2) = 0.1024 ÷ 2 = 0.0512	
(viii)	n (hydrocarbon burnt) = 0.73 ÷ 86 = 0.00849 moles	n = mass ÷ molar mass (M_r)

Q5

(continued from previous page)

	ANSWER	NOTES
(ix)	$\frac{0.00849}{0.0512} = 6.03 \approx 6$ n = 6	n = number of moles of Carbon atoms in 1 mole of the alkane 0.00849 moles of Hydrocarbon burn to produce 0.0512 moles of CO_2. 1 mole of Hydrocarbon burns to produce $\frac{0.00849}{0.0512}$ moles of CO_2. $\frac{0.00849}{0.0512} = 6.03 \approx 6$ Number of moles of CO_2 formed = number of moles of C present in 1 mol of the hydrocarbon n = 6 The hydrocarbon is C_6H_{14} – hexane.

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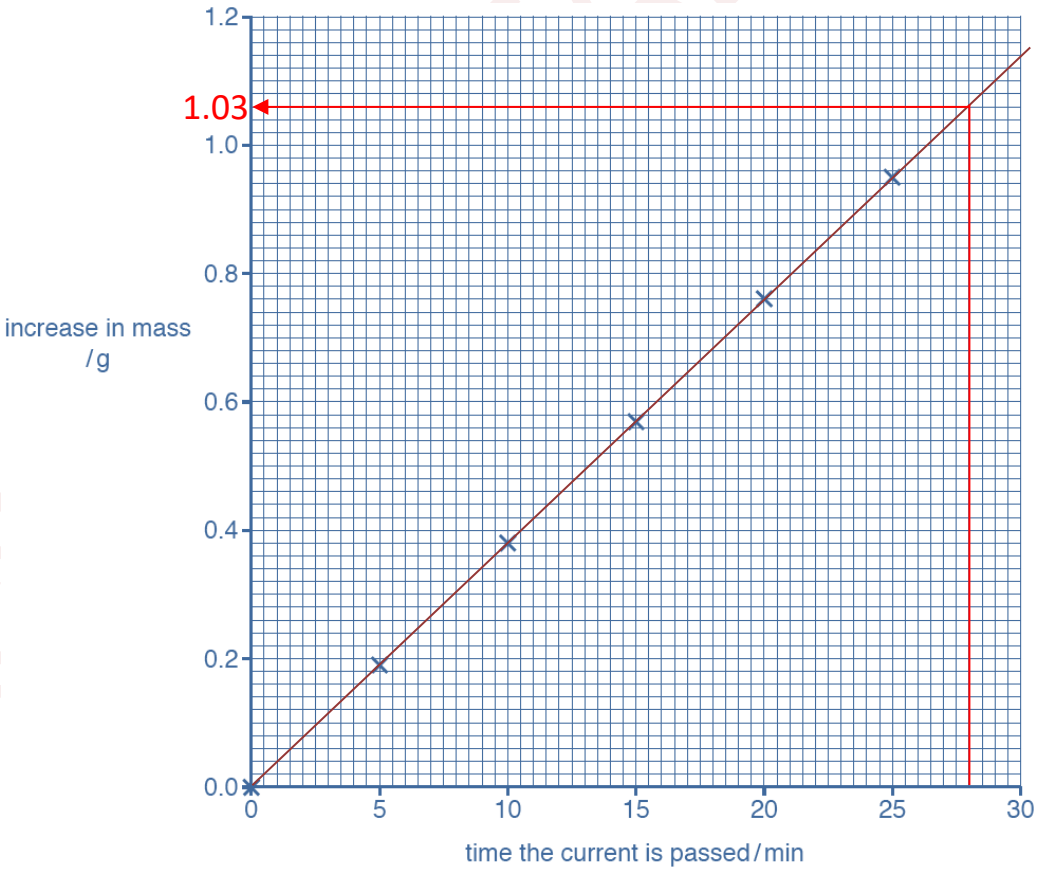
Q6		
	ANSWER	**NOTES**
a	0.38 0.76	The mass increases by 0.19 g for every 5 min increase in the time the current is passed.
b (i)	Pink-brown solid deposits on the cathode. The cathode appears bigger in size.	
(ii)	Copper ions from the electrolyte get discharged on the cathode forming metallic Copper.	
c	1.03 g	



Q6 (continued from previous page)		
	ANSWER	**NOTES**
d	Some of the Copper may not adhere to the cathode. It may fall off causing a decrease in mass.	
e (i)	The mass of anode decreases.	The Copper anode itself gets oxidised forming Cu^{2+} ions which enter the solution.
(ii)	Initial mass of Anode = 4.00 g Decrease in mass of Anode after 15 minutes = 0.57 g Mass of Anode after 15 minutes = 4.00 – 0.57 = 3.43 g	After 15 minutes: Increase in mass of cathode = decrease in mass of anode

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