COMPONENT 2 - Applications in Chemistry

HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

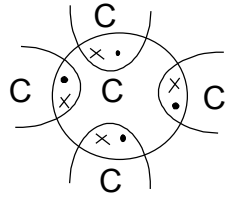
Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the levels. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

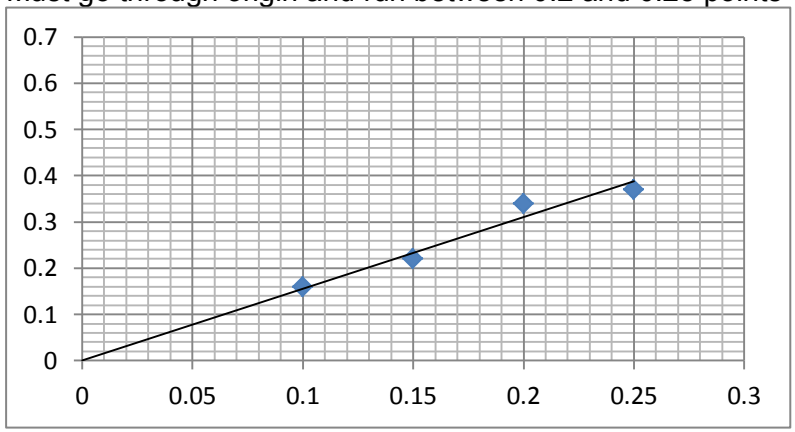
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Covalent bonding Each carbon atom shares electron pairs with four other carbon atoms  (1)	1 1	 1		3		
	(b)	(i)		Three valence electrons of carbon are used up in forming the covalent bonds (1) The fourth electron is delocalized and able to move (1)	2			2		
		(ii)		In graphite, the carbon atoms are arranged in flat parallel layers attracted to adjacent layers by <u>weak</u> forces (1) This allows each layer to slide over the other easily (1)	2			2		
		(iii)		0.047 nm^3 Both answer and unit required		1		1	1	

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
	(c)			No carbon atoms = 720/12 (1) Molecular formula C_{60} (1) (allow error carried forward)		1	1	2		
	(d)	(i)		3 620/1.44 = 2 514 Estimate of approx. 251/252 (also allow error carried forward - accept value if it is clearly 10:1 ratio of specific strength)		3		3	3	
		(ii)		Carbon nanotubes have a much higher strength-to-weight ratio (1) So will be stronger and lighter (1)			2	2		
				Question 1 total	**6**	**6**	**3**	**15**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Separation occurs because the two liquids have different boiling points (1) Ethanol boils at a lower temperature than water (1) At 78 °C ethanol vapour enters the condenser and becomes liquid as it is cooled (1) Ethanol is collected in the beaker and water is left in the flask (1)	1 1	 1 1 		 4		 4
	(b)	(i)		Only a small difference between boiling points (1) A large amount of ethanol vapour would also reach the condenser at the boiling point of compound **X** / 75 °C (1)		 1	1	 2		 2
		(ii)		Add fractionating column/ use fractional distillation		1		1		1
				Question 2 total	**2**	**4**	**1**	**7**	**0**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Reduction since the ions gain electrons	1			1		
	(b)	(i)		Filtration / filter	1			1		1
		(ii)	I	All points plotted correctly (1) Straight line of best fit– drawn with ruler (1) Must go through origin and run between 0.2 and 0.25 points  		2		2	2	2
			II	Allow ecf Use candidate's extrapolated straight line to award a mark for the value (Allow rounding up or down if value falls between minor gridlines) If answer is given to 1 or 3 decimal places do not award mark Unit must be included to obtain the mark *Expected value 0.46 g (allow 0.47 g)*		1		1	1	1
		(iii)		Experimental results below expected results / less copper formed than expected		1		1		1
		(iv)		Any **two** of following for (1) each Not all the zinc added had reacted Zinc contains an impurity / is oxidised Not all copper transferred from beaker to filter			2	2		2
				Question 3 total	**2**	**4**	**2**	**8**	**3**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Electrode	1			1		1
	(b)			Any of following for (1) Higher the concentration of sodium chloride, the higher the current Doubling the concentration doubles the current Current is proportional to concentration			1	1		
	(c)			Evidence is strong **because** Results are reproducible / each group has similar results / each 0.1 M increase in concentration leads to a similar increase in current			1	1		1
	(d)	(i)		0.34		1		1		
		(ii)		3.0 / 3		1		1	1	
	(e)			Calculation showing ratio required for **any** of 0.1, 0.2, 0.3 or 0.4 M solutions e.g. $\frac{0.1}{0.5} \times 50$ (1) 150 (1)	1	1		2	2	2
				Question 4 total	**2**	**3**	**2**	**7**	**3**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Methane is the reducing agent / reacts with the oxide	1			1		1
	(b)			To ensure that the reaction was complete	1			1		1
	(c)	(i)		1.2	1			1		
		(ii)		Mass of copper = 4.7 (1) Cu $\frac{4.7}{64}$ O $\frac{1.2}{16}$ (1) Cu : O ratio is 0.73 : 0.75 Therefore empirical formula is CuO (1) Working must be shown	1	1 1 1		4	4	
				Question 5 total	**4**	**3**	**0**	**7**	**4**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Flame test (1) NaBr & NaCl give yellow orange flame - KCl gives lilac flame. (Both observations for 1 mark).The KCl solution is identified Add dilute silver nitrate solution to the remaining solutions (1) NaBr gives cream precipitate (1) NaCl gives white precipitate (1) Award full marks for above. If candidate has added extra unnecessary test (i.e. test for KCl twice) then maximum mark possible is 4. **Alternative approach involves reversing testing sequence:** Add dilute silver nitrate solution to the solutions (1) NaCl and KCl give a white precipitate (1) NaBr gives cream precipitate (1) NaBr identified Flame test (1) NaCl gives orange flame & KCl a lilac flame (1) Award full marks for above. If candidate has added extra unnecessary test (i.e. test for NaBr twice) then maximum mark possible is 4.	1 2	1 1		5		5
	(b)			The first step is to remove barium ions from the solution so that we can test for Mg^{2+} without Ba^{2+} ions interfering (1) 1. Add sodium sulfate solution to the test solution (1) Precipitate of barium sulfate formed which can be removed by filtration (1) 2. Add sodium carbonate to the solution from step 2 to test for magnesium ions (1) 3. White precipitate of magnesium carbonate seen if magnesium ions are present (1)	1		4	5		5
				Question 6 total	**4**	**2**	**4**	**10**	**0**	**10**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7				**Indicative content:** **AO1 allocation -** Reagents: nitric acid and potassium hydroxide (or potassium carbonate) **Description** Use titration Measure known volume of one reagent into conical flask using pipette, add indicator solution Add other reagent steadily from burette whilst swirling flask, add dropwise near to end-point, record volume of reagent needed for colour change Repeat reaction using identical volumes of both solutions but without indicator Heat solution to reduce volume/evaporate, leave to crystallise **AO2 allocation -** **Explanation** Titration used since both reagents are soluble in water so need to use titration to exactly neutralise acid and alkali. This way the solution will not contain unreacted acid or alkali which otherwise cannot be easily separated. Equation $HNO_3 + KOH \rightarrow KNO_3 + H_2O$ (AO2) ($2\ HNO + K_2CO_3 \rightarrow 2KNO_3 + H_2O + CO_2$) **5 - 6 marks**: Correct apparatus named, suitable volume of first reagent given, indicator and colour change specified, good detail for evaporation stage. *There is a sustained line of reasoning which is coherent, substantiated and logically structure. The information included in the response is relevant to the argument.* **3 - 4 marks**: At least one piece of apparatus named, reaction repeated without indicator, reference to evaporation stage. *There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument*	4	2		6		6

				1 - 2 marks: Reagents named, reference to use of indicator and crystallisation. *There is a basic line of reasoning which is not coherent,supported by limited evidence and with very little structure*. There may be significant errors or the inclusion of information not relevant to the argument. **0 marks**: *No attempt made or no response worthy of credit.*						
				Question 7 total	**4**	**2**	**0**	**6**	**0**	**6**