COMPONENT 1 - Concepts 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.

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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 level. 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

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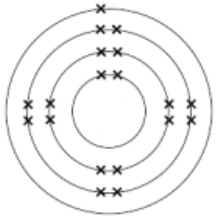
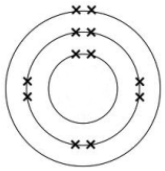
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			$^{40}_{20}Ca$ (1) 10 (1) 9 (1) 20 (1) 18 (1)		5		5		
	(b)	(i)				1		1		
		(ii)				1		1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		Atomic weights (1) Patterns of reactivity (1)	2			2		
		(ii)		Any **three** of the following Must have explanation as well as observation K and Cu occupy their own spaces – have different properties (1) Gaps filled – new elements discovered (1) Additional group – noble gases discovered (1) Transition metals placed together – have similar properties (1)	3			3		
				Question 1 total	**5**	**7**	**0**	**12**	**0**	**0**

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Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
2	(a)	(i)		Scales: Both axes (1) Plotting: All correct (2) Any 8 correct (1) Line: Smooth curve through all points (1) Judgement by eye		4		4	4	
		(ii)		Graph rises as acid and alkali react in a neutralisation reaction (1) Which is exothermic reaction (1) Temperature falls after alkali used up and exothermic reaction no longer occuring (1)			3	3		3
	(b)	(i)		pH / universal indicator	1			1		1
		(ii)		Colour change as acid added (1) Description of colour change (1) e.g. purple to green to red	2			2		2
				Question 2 total	**3**	**4**	**3**	**10**	**4**	**6**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		11.1 (2) 4/36 x 100 Award (1) for 4/36 Allow ecf		2		2	2	
		(ii)		Low atom economy (1) and any one form: (1) Not efficient process/ Not economic process/ Not a 'green' process / O_2 is a waste product			2	2		
	(b)			Straight line from (0,0) of lower gradient (1) Line to 0.2 g after 10 minutes (1)			2	2	2	2
	(c)			Raw material is water …renewable natural resource (1) Combustion product is water ….does not contribute to global warming (1)		2		2		
				Question 3 total	**0**	**4**	**4**	**8**	**4**	**2**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Increase in demand for copper for relevant use with brief explanation e.g. more copper wire required as more electrical appliances built, more copper for pipes as central heating installed in more homes		1		1		
	(b)			Any **two** of the following High grade copper ore reserves being used up (1) Lower supply leads to increasing costs (1) Negative effect on landscape / habitat (1)	2			2		
	(c)	(i)		Plants absorb copper compounds through their roots	1			1		
		(ii)		copper(II) oxide	1			1		
		(iii)		Any three: Large scale harvesting of plants required Only small amounts of copper are obtained from plant Huge areas for plant growth Supply limited by plant growth cycle /Slow process	3			3		
		(iv)		Add iron to copper(II) sulfate (1) Iron is a more reactive metal than copper (1) Iron displaces copper / iron reduces copper(II) ions (1) $CuSO_4 + Fe \rightarrow FeSO_4 + Cu$ (1)	1 1 1	 1		4		3
				Question 4 total	**10**	**2**	**0**	**12**	**0**	**3**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Al^{3+} (1) $4e^-$ (1)	2			2		
		(ii)		Up to two methods for one mark each with second mark available for development of point, e.g. Cryolite added to lower melting point of aluminium oxide (1) Process can operate at a lower temperature (1) Cheaper source of electricity (1) Locate in countries with plentiful energy / fossil fuel reserves or nuclear power (1)	4			4		
		(iii)	I	M_r Al_2O_3 = 102 (1) Mass ratio 204 : 108 (1) Answer = 1080 (1) Accept calculation by alternative method using mole ratios		3		3	3	

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
			II	Mass ratio 2040 : 960 (1) Number of moles oxygen = $\frac{960 \times 10^6}{32}$ (1) Volume = $3 \times 10^7 \times 0.024 = 7.2 \times 10^5$ (1)		3		3	3	
	(b)	(i)		mobile sea of electrons	1			1		
		(ii)		layers of atoms/ions slide over one another	1			1		
				Question 5 total	**8**	**6**	**0**	**14**	**6**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**A** sodium iodide (1) **B** ammonium carbonate (1) **C** calcium chloride (1) **D** iron(II) bromide (1)	2		2	4		4
	(b)	(i)		$Cu^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cu(OH)_2(s)$ (2) Must include correct state symbols for full marks to be awarded If equation not correct award (1) for correct ions LHS and compound RHS correct balancing		2		2		
		(ii)		$FeBr_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaBr$ (3) Ignore state symbols If equation not correct award (1) for each of the following $Fe(OH)_3$ on product side NaBr on product side		3		3		
				Question 6 total	**2**	**5**	**2**	**9**	**0**	**4**

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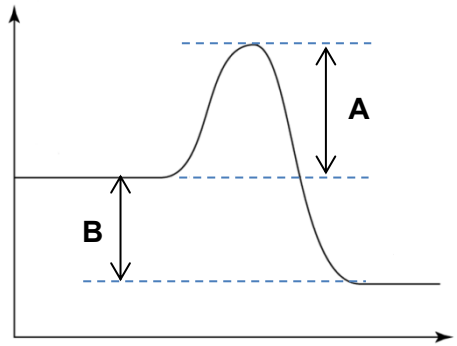
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Energy released in forming bonds = (4 × 523) + (4 × 463) (1) 3944 (1) Total energy needed to break bonds = 3944 – 1103 = 2841 (1) 2841 = (4 × 339) + (3 × O=O) (1) (O=O) = 495 (1) Error carried forward (ecf) possible	1 1	1 1	 1 	 5	 5	
	(b)			(1) for each of **A** and **B** as shown  		2		2		
	(c)			Products have less energy than the reactants	1			1		
				Question 7 total	**3**	**4**	**1**	**8**	**5**	**0**

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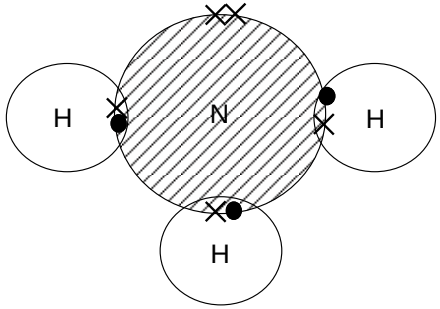
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		Nitrogen atom shares electrons with three hydrogen atoms  		1 1		2		
		(ii)		Weak forces between ammonia molecules (1) Molecules have sufficient energy at room temperature to overcome these forces (1)	2			2		
	(b)	(i)		Equilibrium position moves to oppose any change (1) Decreasing pressure moves equilibrium position towards the side with more gas molecules in order to oppose change (1) Left hand side has more gas molecules therefore yield of ammonia decreases (1)	1	 1 1		3		
		(ii)		Increasing temperature moves equilibrium position in the endothermic direction (1) This is the right to left reaction therefore yield of ammonia decreases (1) A catalyst increases rate without affecting the yield (1)	3			3		

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	(c)	(i)		$HNO_3 + NH_3 \rightarrow NH_4NO_3$ (2) If equation not correct award (1) for correct reactants or correct products Accept alternative equation $HNO_3 + NH_4OH \rightarrow NH_4NO_3 + H_2O$ (2)		2		2		
		(ii)		React equal volumes of HNO_3 and NH_3 to get neutral solution (1) Heat/boil solution to remove/evaporate some of the water (1) Leave to cool and crystallise (1)	 1 1	1		 3		3
	(d)	(i)		Mr $(NH_4)_3PO_4$ = 149 (1) 42/149 x100 = 28.2 (1) Award 42/149 (1) if answer is incorrect		2		2	2	
		(ii)		Dissolve pellets in water / add pellets to water to make solution (1) Add dilute barium chloride solution to each solution (1) Fertiliser **A** – no change observed, fertiliser **B** white precipitate (of barium sulfate / barium sulfate & barium phosphate) (1) Accept alternate test to verify Mg^{2+} ions e.g. Add dilute sodium hydroxide to each solution (1) Fertiliser **A** - no change observed, fertiliser **B** white precipitate (of magnesium hydroxide) (1)	2	1		3		3
				Question 8 total	**10**	**10**	**0**	**20**	**2**	**6**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			17143 (1) Accept anything up to full calculator reading 17.1 (1) Must be given to 3 significant figures	1	1		2	2	2
	(b)			First reading / 1.46 (1) Any of the following for (1) Heat loss here was greater than for other measurements e.g. bigger gap between flame and beaker More than 100 g of water measured into beaker Credit other sensible suggestions			2	2		2
	(c)			Experimental values **much** lower than / around half the theoretical values (1) Same trend in results i.e. amount of energy released increases from ethanol to propanol to butanol (1)			2	2		2
	(d)			Any two **pairs** with 1 mark for improvement and 1 mark for explanation in each case Improvement Enclose apparatus / reduce drafts (1) Explanation Less heat lost between flame and beaker (1) Improvement Copper can instead of glass beaker / better conductor (1) Explanation More heat transferred to water (1) Improvement Improve insulation / lag beaker / lid on beaker (1) Explanation Less heat lost after transfer to water (1) Credit other sensible improvement (1) and explanation (1)			4	4		4
				Question 9 total	**1**	**1**	**8**	**10**	**2**	**10**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)	I	24.0 – do not accept 24	1			1		1
			II	Moles NaOH = 0.0216 (1) 1 mol NaOH : 1 mol CH_3COOH (1) Conc^n CH_3COOH = 0.864 (1) Award full marks for correct answer with no working Error carried forward possible (ecf)		3		3	3	3
		(ii)	I	60	1			1		
			II	Moles CH_3COOH in 100 cm^3 vinegar = 0.0833 (1) Conc CH_3COOH is 0.833 therefore label information is correct (1)			2	2	2	2
	(b)			Jo is incorrect to say that the concentration of the ethanoic acid is 0.0010 mol/dm^3. – Marks given for logical reasoning: pH is a measure of conc of H^+ ions in solution (1) There is a difference of 100x in H+ concentration because the pH changes 10 times with each pH unit/ Two unit changes in pH means a 10 x 10 =100 change in H^+ conc (1) But ethanoic acid is a weak acid and does not completely ionise (1) so concentration of the acid is not same as/ is higher than the H+ ion conc (1)			4	4	1	
				Question 10 total	**2**	**3**	**6**	**11**	**6**	**6**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
11				**Indicative content:** **AO1 allocation** - Addition polymers e.g. polyethene, polychloroethene etc. One type of monomer, unsaturated therefore reactive, C=C double bond opens, monomers join to form saturated polymer chain Condensation polymers e.g. nylon May have one or two different monomers, must have reactive functional groups at both ends, functional groups react to produce polymer chain, small molecule produced at each bond new bond location **AO2 allocation** - Representation of reactions using appropriate equations/block diagrams **5 – 6 marks**: Comparison of monomer type/number, functional groups and reaction products; illustrated with reference to one named example for both and good attempt at one equation. *There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.* **3 – 4 marks**: Comparison of at least one of monomer type/number, functional groups and reaction products; one named example for both *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.* **1 – 2 marks**: Description of at least one characteristic of any monomer linked to the correct type of polymerisation. *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.*	4	2		6		
				Question 11 total	**4**	**2**	**0**	**6**	**0**	**0**

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