

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	dilution by a factor of 100	an answer of (pH=) 5 gains 2 marks	1	AO1 5.4.2.5
	(pH=) 5	allow pH changes by 1 when solution is diluted by factor of 10 or allow pH changes by 2	1	AO3 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	any one from: - metal (metal) hydroxide (metal) carbonate - alkali	allow named example allow correct formula ignore base allow ammonium hydroxide allow ammonium carbonate allow soluble base allow ammonia	1	AO1 4.4.2.1 4.4.2.2 4.4.2.3

2.2	$\text{Ca}(\text{NO}_3)_2$	allow $\text{Ca}^{2+}(\text{NO}_3^-)_2$	1	AO2 4.4.2.2
-----	----------------------------	---	---	----------------

Question	Answers	Mark	AO / Spec. Ref.
2.3	Level 3: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.4.2.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use magnesium oxide and sulfuric acid • add sulfuric acid to a beaker • warm sulfuric acid • add magnesium oxide • stir • continue adding until magnesium oxide is in excess • filter • using a filter paper and funnel • to remove excess magnesium oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	(strong because) completely ionised (in aqueous solution)	ignore pH allow dissociated for ionised do not accept hydrogen is ionising do not accept H ⁺ are ionised	1	AO1 4.3.4 4.4.2.6
	(dilute because) small amount of acid per unit volume	ignore low concentration	1	AO1 4.3.4 4.4.2.6

3.2	5.0	allow 5	1	AO2 4.4.2.6
-----	-----	---------	---	----------------

4.1	HNO_3		1	AO1 5.1.1.1 5.4.2.2
-----	----------------	--	---	---------------------------

4.2	red	allow orange or yellow do not accept green	1	AO1 5.4.2.4
	purple or blue	allow shades of purple eg violet	1	

4.3	D		1	AO3 5.4.2.4
-----	---	--	---	----------------

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	$\text{Mg} + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2$		1	AO2 5.6.1.2 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	H ⁺		1	AO1 4.4.2.4

6.2	hydrochloric (acid)	allow HCl	1	AO2 4.4.2.2
	water	allow H ₂ O	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	$\text{ZnO(s)} + \text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$	allow 1 mark for 2/3 correct state symbols	2	AO2 5.2.2.2 5.4.2.3 RPA8

7.2	zinc oxide remains or solid remains	ignore colour allow zinc oxide is added until in excess	1	AO1 5.3.2.4 5.4.2.2 5.4.2.3 RPA8
-----	--	---	---	--

7.3	filtration / filter		1	AO1 5.4.2.2 5.4.2.3 RPA8
-----	---------------------	--	---	-----------------------------------

7.4	heat	do not accept heat to dryness	1	AO1 5.4.2.2 5.4.2.3 RPA8
	leave to crystallise / cool	allow leave to evaporate some water	1	

7.5	(at start) value in range 12–14 (at end) value in range 0–3	must be in this order	1 1	AO1 AO2.2 5.4.2.2 5.4.2.4
-----	--	-----------------------	------------	------------------------------------

7.6	$2 \text{ NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{ H}_2\text{O}$	allow 1 mark for Na_2SO_4 and H_2O	2	AO2 5.1.1.1 5.4.2.2
-----	---	--	---	---------------------------

8.1	incomplete / partial ionisation	allow incomplete / partial dissociation	1	AO3 4.7.2.4
	(because) reaction is reversible	allow (because) reaction is in equilibrium	1	

8.2	mass (of flask and contents) decreases		1	AO1
	(because) carbon dioxide is produced	}	1	AO2
	(and) carbon dioxide escapes (from the flask)		1	AO2
				4.3.1.3 4.7.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	green to red		1	AO1 5.4.2.4

9.2	decreases		1	AO1 5.4.2.4
-----	-----------	--	---	----------------

9.3	(aq)	allow aq ignore aqueous ignore HNO ₃	1	AO1 5.2.2.2
-----	------	---	---	----------------

9.4	any two from: • (white) solid disappears • fizzing / bubbles / effervescence • (then) stops fizzing • (white) solid left at the end / bottom	allow a gas is produced ignore colourless solution	2	AO3 5.4.2.2 5.4.2.3
-----	---	--	---	--

9.5	$\text{Zn}(\text{NO}_3)_2$		1	AO2 5.1.1.1 5.4.2.2
-----	----------------------------	--	---	---------------------------

Question	Answers	Mark	AO / Spec. Ref.
9.6	Level 3: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 5.4.2.2 5.4.2.3 RPA8
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative Content: • react hydrochloric acid • (with) copper oxide • in a suitable container • warm (hydrochloric) acid • add copper oxide • until is in excess or until solid remains • stir • filter excess copper oxide • pour solution / filtrate into evaporating basin • use of water bath or use of electric heater • to heat gently or partially evaporate • leave to cool / crystallise For level 3 the correct chemicals must have been selected.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	potassium chloride	allow KCl	1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	$\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$	ignore state symbols	1	AO1 4.1.1.1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	copper carbonate and copper oxide only		1	AO1 4.4.1.2 4.4.2.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	a dilute solution of a strong acid		1	AO2 4.3.2.5 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.2	1.0 mol/dm ³ hydrogen chloride solution		1	AO2 4.4.2.4 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.1	(nitric acid) calcium nitrate		1	AO1 4.10.4.2
	(phosphoric acid) (calcium) triple superphosphate or calcium dihydrogenphosphate		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.2	(industrial process) (is) large(er) scale (is) quicker (is a) continuous process reasoned judgement	allow converse for laboratory process ignore references to cost / energy ignore large mass produced allow does not need to be repeated	 1 1 1 1	AO3 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13.1	completely ionises in aqueous solution	allow completely dissociates in aqueous solution	1	AO1 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13.2	fizzing / effervescence or magnesium disappears		1	AO3 5.4.2.5
	at a greater rate with a strong acid	allow converse with weak acid allow for 2 marks strong acid has a greater temperature increase	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13.3	(pH) decreases by (a unit of) 2	allow pH is lower	1 1	AO1 AO2 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14.1	(zinc oxide) solid remaining	allow (zinc oxide) solid no longer disappears ignore references to colour / effervescence	1	AO1 4.2.2.2 4.4.2.2 4.4.2.3 RPA 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14.2	(excess) zinc oxide can be filtered off	allow converse statements for hydrochloric acid allow separation / removal of (excess) zinc oxide is easier ignore to ensure all the (hydrochloric) acid is used up	1	AO1 4.4.2.2 4.4.2.3 RPA 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14.3	any one from: • zinc hydroxide • zinc carbonate	allow $\text{Zn}(\text{OH})_2$ allow ZnCO_3	1	AO1 4.4.2.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14.4	heat (the solution) until crystallisation point is reached	allow heat (the solution) until crystals start to form allow heat (the solution) to reduce the volume allow heat (the solution) to evaporate (some of the water)	1	AO1 4.4.2.3 RPA 1
	leave the solution (to cool / crystallise)	if no other mark is awarded allow 1 mark for heat the solution to dryness	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14.5	$\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$	ignore state symbols	1	AO2 4.4.1.2 4.4.1.4

Question	Answers	Mark	AO/ Spec. Ref
15.1	Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3-4	AO1 4.3.2.5 4.4.2.4 4.4.2.6
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1-2	
	No relevant content	0	
	Indicative content <u>General principle</u> - pH depends on H^+ ion concentration - the higher the concentration of H^+ ions the lower the pH <u>Strength</u> - the stronger an acid the greater the ionisation / dissociation (in aqueous solution) (so) the stronger the acid the lower the pH <u>Concentration</u> - the higher the concentration of an acid the more acid / solute in the same volume (of solution) (so) the higher the concentration of the acid the lower the pH		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
15.2	there are no ions that are free to move	allow there are no ions in solution allow there are no ions free to carry the charge	1	AO3 4.2.2.3 4.4.2.2 4.4.2.4 4.4.2.5
	(because) barium sulfate is solid / insoluble		1	
	(and) hydrogen ions have reacted with hydroxide ions to produce water	allow (and) water is a covalent / molecular substance	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
16.1	hydrogen / H ⁺		1	AO1 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
16.2	(indicator) universal (result) (green to) red / orange / yellow OR (indicator) (blue) litmus (1) (result) (turns) red (1) OR (indicator) methyl orange (1) (result) (turns) red (1)	MP2 is dependent upon MP1 being awarded ignore pH meter	1 1	AO1 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
16.3	pH of the solution increases		1	AO3 5.3.2.5 5.4.2.4

Question	Answers	Mark	AO/ Spec. Ref
17.1	Level 3: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.4.2.2 4.4.2.3 RPA1
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use zinc carbonate and hydrochloric acid • add zinc carbonate to the (hydrochloric) acid • in a beaker • stir • continue adding until the zinc carbonate is in excess • shown by excess solid • and no more effervescence • filter (the reaction mixture) • to remove the excess zinc carbonate • heat the solution • using a water bath or electric heater • to crystallisation point • leave the solution to crystallise • pat crystals dry with filter paper		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
17.2	any two from: • zinc • zinc oxide • zinc hydroxide	allow Zn allow ZnO allow Zn(OH) ₂	2	AO2 4.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.1	(the acid is only) partially ionised (in aqueous solution)		1	AO1 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.2	the mass of acid dissolved is doubled and the volume of the solution is halved		1	AO2 4.3.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.3	methyl orange from yellow to red / orange / pink OR phenolphthalein (1) from pink to colourless (1) OR litmus (1) from blue to red (1)	MP2 is dependent on the award of MP1 if no other marks awarded, allow 1 mark for universal indicator turns from purple / blue to green / yellow / orange / red	1 1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.4	OH^-		1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.5	3.16×10^{-3} (mol/dm ³)		1	AO2 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
19.1	any two from: • effervescence / fizzing / bubbles • barium disappears • forms a colourless solution • temperature increases	ignore references to floating / flames ignore produces a gas allow barium gets smaller allow barium moves around	2	AO3 4.1.2.1 4.4.1.2 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
19.2	$\text{Ba} + 2 \text{HCl} \rightarrow \text{BaCl}_2 + \text{H}_2$	allow multiples allow 1 mark for BaCl_2 allow 1 mark for H_2 ignore state symbols	3	AO2 4.1.1.1 4.4.1.2 4.4.2.1