

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	1 – strong acid 5 – weak acid 9 – weak alkali		1 1 1	AO1 4.4.2.4
01.2	1 g/dm ³ solution of hydrochloric acid		1	AO2 4.4.2.4
01.3	hydrogen H ⁺	+ must be a superscript and on the right of the H	2	AO1 4.4.2.4
01.4	water	accept correct formula (H ₂ O)	1	AO1 4.4.2.4
02.1	the H ⁺ concentration in solution A is ten times the H ⁺ concentration in solution B		1	AO2 4.4.2.6
02.2	copper chloride, carbon dioxide and water		1	AO2 4.4.2.2
02.3	CuCl ₂		1	AO2 4.4.2.2
03.1	two from: <ul style="list-style-type: none"> ● stir/swirl ● warm ● use (finer) powder of zinc oxide 	one mark for each correct answer up to two marks	2	AO3 4.4.2.3
03.2	stop when they see unreacted zinc oxide		1	AO1 4.4.2.3

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03.3	to remove unreacted solid/zinc oxide		1	AO1 4.4.2.3
03.4	water bath and Bunsen burner or electric heater		1	AO1 4.4.2.3
03.5	evaporate only some of the water (until crystals start to form) then remove the heat source and allow to crystallise from the solution at room temperature		1 1	AO3 4.4.2.3
03.6	$\text{ZnO(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{O(g)}$	one mark for formulae and state symbols of reactants one mark for formulae and state symbols of reactants or one mark for correct formulae one mark for correct state symbols one mark for balancing	3	AO2 4.4.2.2 4.3.1.1
03.7	two moles of acid make one mole of zinc chloride so 0.0125 mol makes $\frac{0.0125}{2} = 0.00625$ moles of zinc chloride mass of one mole of zinc chloride = $65 + (35.5 \times 2) = 136$ g maximum mass of zinc chloride = number of moles \times mass of one mole = 0.00625×136 g = 0.85 g		1 1 1 1 1	AO2 4.3.2.2 4.3.4

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04.1	magnesium because it loses electrons $\text{Mg(s)} + 2\text{H}^+(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$	one mark for formulae and state symbols of reactants one mark for formulae and state symbols of reactants or one mark for correct formulae one mark for correct state symbols one mark for balancing	1 1 3	AO2 4.4.2.1
04.2	MgCl_2 H_2		1 1	AO2 4.4.2.1
05.1	weak – one from citric/ethanoic/carbonic strong – one from hydrochloric/sulfuric/nitric	accept any correct acids	1 1	
05.2	five as pH decreases by one unit, H^+ increases by a factor of ten here, H^+ has decreased by a factor of 100, so pH increases by a factor of two units		1 1 1	AO1 AO2 4.4.2.6

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05.3	$\text{H}^+ \text{ concentration in A} = \frac{20}{100} \times 5 \text{ g/dm}^3$ $= 1 \text{ g/dm}^3$ $\text{H}^+ \text{ concentration in B} = \frac{100}{100} \times 2$ $= 2 \text{ g/dm}^3$ <p>the H^+ concentration in B is higher, so B has the lower pH</p>		1 1 1 1	AO2 4.4.2.6
06.1	2-		1	AO2 4.4.2.1
06.2	MgSO_4		1	AO2 4.4.2.1
06.3	MnCl_2		1	AO2 4.4.2.1
06.4	hydrogen		1	AO1 4.4.2.1
07.1	sulfuric acid		1	AO1 4.4.2.2
07.2	Level 3: The description of the method is detailed and accurate. Apparatus is named correctly, and the reasons given are clear and coherent.		5-6	AO1 4.4.2.3
	Level 2: The descriptions of the method is correct, although lacks detail. Apparatus is named correctly, and reasons are given for some steps, although these may not be clearly explained.		3-4	

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	<p>Level 1: The method is outlined correctly. The names of one or two pieces of apparatus are given, as well as reasons for one or two steps only. The description overall lacks clarity and coherence.</p> <p>No relevant comment.</p>		1-2	
	<p>Indicative content:</p> <ul style="list-style-type: none"> • use a spatula to add excess copper hydroxide to the acid in a conical flask/beaker • excess copper hydroxide is used so that all the acid reacts • filter using filter paper and funnel to remove excess/unreacted copper hydroxide • heat the filtrate in an evaporating basin over a water bath/with an electric heater until crystals begin to appear • Remove the heat and allow the rest of the water to evaporate slowly, to allow big crystals to form 	allow correct diagram, showing standard representations of equipment, to aid description	0	
07.3	$\text{Cu}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + 2\text{H}_2\text{O}$		3	AO2 4.4.2.2
07.4	$32.5 \times \frac{30}{1000}$ $= 0.975\text{g}$ $\frac{0.975}{97.5}$ $= 0.01 \text{ moles Cu}(\text{OH})_2$		1 1 1 1	AO2 4.3.2.1

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07.5	0.01 moles $\text{Cu}(\text{OH})_2 = 0.01$ moles CuSO_4 M_r of $\text{CuSO}_4 = 63.5 + 32 + (16 \times 4) = 159.5$ 0.01×159.5 $= 1.595 \text{ g}$ $= 1.6 \text{ g}$		1 1 1 1	AO2 4.3.2.1
08.1	pH probe universal/broad range indicator		1 1	AO1 4.4.2.4
08.2	A		1	AO1 4.4.2.4
08.3	E		1	AO1 4.4.2.4
08.4	B		1	AO2 4.4.2.4
08.5	increases		1	AO2 4.4.2.4
09.1	Ca^{2+}		1	AO2 4.2.1.2
09.2	O^{2-}	one mark for charge one mark for formula written correctly	2	AO2 4.2.1.2
09.3	Level 3: The properties are clearly described, and correct reasons are given for each of these properties. The descriptions and reasons are coherently written.		5-6	AO1 4.2.2.3

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	<p>Level 2: All the properties are clearly described, but reasons are not given for them or some of the properties are clearly described and reasons are given for each of them.</p> <p>Level 1: Some correct points are made. The answer lacks coherence and explanations are not clearly linked to descriptions of properties.</p> <p>No relevant content</p> <p>Indicative content:</p> <ul style="list-style-type: none"> • high melting point – large amounts of energy needed to break the many strong bonds/strong electrostatic forces of attraction • high boiling point – large amounts of energy needed to break the many strong bonds/strong electrostatic forces of attraction • conducts electricity in liquid state or in solution – has charged particles/ions that are then free to move (so that charge can flow) • does not conduct electricity in solid state – its charged particles/ions are not free to move (so charge cannot flow) 		3-4	
			1-2	
			0	
10.1	Z		1	AO3 4.4.2.6

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10.2	W and Y for a given concentration of solution, citric acid has the lower hydrogen ion concentration and higher pH for the two solutions of concentration 0.1 mol / dm^3 W has the higher pH for the two solutions of concentration 1 mol / dm^3 Y has the higher pH		1 1 1 1	AO3 4.4.2.6
10.3	a weak acid is partially dissociates in aqueous solution/a strong acid is fully dissociates in aqueous solution		1	AO1 4.1.2.6
10.4	weak – one from ethanoic / carbonic strong – one from sulfuric/nitric	accept any correct acids	1 1	AO1 4.1.2.6
10.5	Level 3: Points that support and do not support the statement are made in detail, and a judgement made and justified. The answer is clearly and coherently written.		5-6	AO3 4.1.2.6
	Level 2: Points that support and do not support the statement are made, but a judgement is not be included. The answer is reasonably clear, but not organised in a logical way.		3-4	
	Level 1: One or two relevant points are made. The answer is not clearly written nor is it logically organised.		1-2	
	No relevant content		0	

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	<p>Indicative content:</p> <ul style="list-style-type: none"> • pH is a measure of the hydrogen ion concentration • the greater the hydrogen ion concentration, the lower the pH • for weak and strong acids of the same concentration, the hydrogen ion concentration is always smaller in the weak acid so the pH is always higher • so the statement is true for solutions of the same concentration • but a dilute solution of a strong acid could have a smaller hydrogen ion concentration than a more concentrated solution of a weak acid • so the statement is not always true for solutions of different concentrations. 			
11.1	noble gases		1	AO1 4.1.2.4
11.2	2,8,8		1	AO2 4.1.1.7
11.3	they have stable arrangements of electrons/full outer shell		1	AO1 4.1.2.4
11.4	increases		1	AO1 4.1.2.4

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12.1	31		1	AO2 4.1.1.5
12.2	(69 - 31 =) 38		1	AO2 4.1.1.5
12.3	31 - 3 = 28		1	AO2 4.1.1.5
12.4	one from: <ul style="list-style-type: none"> • boron • aluminium • indium • thallium 		1	AO2 4.1.2.1
13.1	$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$	one mark for formulae and state symbols of reactants one mark for formulae and state symbols of products or one mark for correct formulae one mark for correct state symbols one mark for balancing	3	AO2 4.4.2.2

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13.2	M_r of $\text{CaCO}_3 = 100 \text{ g}$ number of moles of $\text{CaCO}_3 = \frac{\text{mass}}{\text{molarmass}} = \frac{10}{100} = 0.10 \text{ mol}$ 1 mole of CaCO_3 reacts with 2 moles of HCl so number of moles of HCl that reacts with 10 g of calcium carbonate is $0.10 \times 2 = 0.20 \text{ mol}$ M_r of HCl = 36.5 g number of moles of HCl = $\frac{\text{mass}}{\text{molarmass}} = \frac{5}{36.5} = 0.137 \text{ g}$ the number of moles of HCl present is less than that required to react with 10.0 g of calcium carbonate, so calcium carbonate is present in excess and hydrochloric acid is the limiting reactant		1 1 1 1 1	AO2 4.3.2.4
13.3	from the equation, two moles of hydrochloric acid make one mole of calcium chloride so 0.137 mole of acid makes $\frac{0.137}{2} = 0.0685$ moles of calcium chloride mass of calcium chloride = number of moles \times molar mass $= 0.0685 \times 111 \text{ g} = 7.60 \text{ g}$	allow error carried forward if student using CaCO_3 as the limiting reagent	1 1 1	AO2 4.3.2.2
13.4	some of the solution will remain in the filter paper when the mixture is filtered	allow other valid reasons	1	AO3 4.4.2.3

Question	Answers	Extra information	Mark	AO / Specification reference
14.1	only partially ionised in aqueous solution		1	AO1 4.4.2.6
14.2	$3\text{Mg(s)} + 2\text{H}_3\text{PO}_4\text{(aq)} \rightarrow \text{Mg}_3\text{(PO}_4\text{)}_2\text{(aq)} + 3\text{H}_2\text{(g)}$		1	AO2 4.3.1.1
14.3	oxidised: magnesium reduced: hydrogen		1 1	AO2 4.4.2.1
14.4	Na_3PO_4 $3\text{NaOH(aq)} + \text{H}_3\text{PO}_4\text{(aq)} \rightarrow \text{Na}_3\text{PO}_4\text{(aq)} + 3\text{H}_2\text{O(l)}$	one mark for Na, one mark for PO_4 accept a balanced equation for the salt provided	2 1	AO3 4.4.2.2
14.5	moles of $\text{H}_3\text{PO}_4 = 0.5 \times \frac{25}{1000}$ = 0.0125 moles of NaOH = $0.0125 \times 3 = 0.0375$ $\frac{0.0375}{0.15}$ = $0.25 \text{ dm}^3 / 250 \text{ cm}^3$		1 1 1 1	AO2 4.3.4