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 mol/dm^3 solution of hydrochloric acid		1	AO2 4.4.2.4
01.3	hydrogen H^+	'+' must be superscript and on the right of the 'H' symbol	1 1	AO1 4.4.2.4
01.4	water		1	AO1 4.4.2.4
02.1	the H^+ ion concentration in solution A is 10 times the H^+ ion 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	pipette		1	AO1 4.4.2.5

Question	Answers	Extra information	Mark	AO / Specification reference
03.2	**two** from: • swirl the conical flask to ensure good mixing • put it on a white tile so that you can see the colour • add the solution slowly so that you know exactly when the end point has been reached	one mark for each correct answer	2	AO3 4.4.2.5
03.3	when she has obtained three concordant readings	'concordant' must be present for the mark to be awarded	1	AO1 4.4.2.5
03.4	$\frac{(21.20 + 21.30 + 21.25)}{3} = 21.25$		1	AO2 4.4.2.5
03.5	number of moles of acid = concentration × volume in dm^3 = 0.00 425 mol one mole of NaOH reacts with one mole of HCl, so moles of NaOH = 0.00 425 concentration of NaOH = $\frac{\text{number of moles}}{\text{volume}}$ $= \frac{0.00425}{0.0250} = 0.170\ mol/dm^3$	allow error carried forward throughout	1 1 1 1	AO2 4.4.2.5
04.1	**two** from: • stir/swirl the conical flask to ensure good mixing • warm • use (finer) powder of zinc oxide	one mark for each correct answer	2	AO3 4.4.2.3
04.2	stop when they see unreacted zinc oxide		1	AO1 4.4.2.3
04.3	to remove unreacted solid/zinc oxide		1	AO1 4.4.2.3

Question	Answers	Extra information	Mark	AO / Specification reference
04.4	water bath and Bunsen burner **or** electric heater		1	AO1 4.4.2.3
04.5	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
04.6	$ZnO(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2O(g)$	1 mark for formulae and state symbols of reactants 1 mark for formulae and state symbols of products **or** 1 mark for correct formulae 1 mark for correct state symbols 1 mark for balancing	3	AO2 4.4.2.2 4.3.1.1
04.7	number of moles of HCl = $\frac{25.0}{1000}$ × 0.5 = 0.0125 mol from balanced equation, two moles of acid make one mole of zinc chloride 0.0 125 mol of acid makes 0.5 × 0.0 125 mol = 0.00 625 mole of zinc chloride mass of one mole of zinc chloride = 65 + (35.5 × 2) = 136 g maximum mass of zinc chloride = number of moles × mass of one mole = 0.00 625 × 136 g = 0.85 g	1 mark for correct answer, 1 mark for correct number of significant figures	1 1 1 1 2	AO2 4.3.2.2 4.3.4

Question	Answers	Extra information	Mark	AO / Specification reference
05.1	magnesium because it loses electrons $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$	1 mark for formulae and state symbols of reactants 1 mark for formulae and state symbols of reactants **or** 1 mark for correct formulae 1 mark for correct state symbols 1 mark for balancing	1 1 3	AO2 4.4.2.1
05.2	$MgCl_2$ H_2		1 1	AO2 4.4.2.1
06.1	weak – **one** from citric/ethanoic/carbonic strong – **one** from hydrochloric/sulfuric/nitric	accept any correct acids	1 1	AO1 4.4.2.6
06.2	5 as pH decreases by one unit, H^+ increases by a factor of 10 Here, H^+ has decreased by a factor of 100, so pH increases by two units			AO1 × 1 AO2 × 2 4.4.2.6
06.3	H^+ concentration in A = $\frac{20}{100} \times 5\ mol/dm^3 = 1\ mol/dm^3$ H^+ concentration in B = $\frac{100}{100} \times 2\ mol/dm^3 = 2\ mol / dm^3$ H^+ concentration in B is higher B has the lower pH		1 1 1 1	AO2 4.4.2.6

Question	Answers	Extra information	Mark	AO / Specification reference
07.1	2-		1	AO2 4.4.2.1
07.2	$MgSO_4$		1	AO2 4.4.2.1
07.3	$MnCl_2$		1	AO2 4.4.2.1
07.4	hydrogen		1	AO1 4.4.2.1
08.1	sulfuric acid		1	AO1 4.4.2.2
08.2	**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	
	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.		1-2	
	No relevant content		0	

Question	Answers	Extra information	Mark	AO / Specification reference
	Indicative content • 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 diagrams, which should use standard representations of equipment, to aid description		
08.3	$Cu(OH)_2 + H_2SO_4 \rightarrow CuSO_4 + 2H_2O$		3	AO2 4.4.2.2
08.4	$32.5 \times \frac{30}{1000}$ = 0.975 g $\frac{75}{97.5}$ = 0.01 moles $Cu(OH)_2$		1 1 1 1	AO2 4.3.2.1
08.5	0.01 moles $Cu(OH)_2$ = 0.01 moles $CuSO_4$ M_r of $CuSO_4$ = 63.5 + 32 + (16 x 4) = 159.5 0.01 x 159.5 = 1.595g = 1.6g		1 1 1 1 1	AO2 4.3.2.1

Question	Answers	Extra information	Mark	AO / Specification reference
09.1	M_r of zinc nitrate = 189 g number of moles of zinc nitrate = $\frac{\text{mass}}{M_r} = \frac{9.4}{189}$ = 0.05 mol from equation, one mol of zinc carbonate makes one mole of zinc nitrate M_r of zinc carbonate = 125 g mass = number of moles × M_r of $ZnCO_3$ = 0.05 × 125 g = 6.25 g		1 1 1 1 1	AO2 4.3.2.2
09.2	pH at start between one and three pH increases as zinc carbonate added because zinc carbonate neutralises the acid		1 1 1	AO1 × 1 AO2 × 2 4.4.2.4
10.1	pH probe universal/broad range indicator		1 1	AO1 4.4.2.4
10.2	A		1	AO1 4.4.2.4
10.3	E		1	AO1 4.4.2.4
10.4	B		1	AO2 4.4.2.4
10.5	increases		1	AO2 4.4.2.4
11.1	$2NaOH(aq) + H_2SO_4(aq) \longrightarrow Na_2SO_4 + 2H_2O$	if $NaSO_4$ is used, but equation is still balanced, then maximum of 2 marks can be awarded	3	AO2 4.4.2.2

Question	Answers	Extra information	Mark	AO / Specification reference
11.2	• measure set volume/named volume of sulfuric acid and place in conical flask • using pipette • add a suitable indicator to the conical flask • put conical flask on a white tile • fill burette with sodium hydroxide • add sodium hydroxide 1cm^3 at a time to the conical flask • swirl after each addition • when indicator changes colour, record the volume of sodium hydroxide (this is a rough titre) • refill burette with sodium hydroxide solution • set up new conical flask with same volume of sulfuric acid and indicator • run sodium hydroxide into conical flask until near the end point • swirling continuously • add sodium hydroxide dropwise swirling after each addition • until indicator changes colour • record volume of sodium hydroxide added • repeat until at least 3 concordant results are obtained		6	AO1 4.4.2.5

Question	Answers	Extra information	Mark	AO / Specification reference
11.3	M_r of H_2SO_4 = 98 $\frac{29.4}{98}$ = 0.3 mol/dm^3 0.3 x $\frac{25}{100}$ = 7.5 x 10^{-3} mol of H_2SO_4 7.5 x 10^{-3} x 2 = 0.015 mol of NaOH		1 1 1 1 1 1	AO2 4.4.2.5
11.4	M_r of NaOH = 40 $\frac{20}{40}$ = 0.5 mol/dm^3 $\frac{0.015}{0.5}$ = 0.03 dm^3 = 30 cm^3		1 1 1 1 1 1	AO2 4.4.2.5
12.1	Z		1	AO3 4.4.2.6
12.2	W and Y for a given concentration of solution, citric acid has the lower hydrogen ion, H^+, 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

Question	Answers	Extra information	Mark	AO / Specification reference
12.3	a weak acid is partially dissociated in aqueous solution/a strong acid is fully dissociated in aqueous solution		1	AO1 4.1.2.6
12.4	strong - **one** from: • sulfuric • nitric weak - **one** from: • ethanoic • carbonic	accept any correct acids	1 1	AO1 4.1.2.6
12.5	**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	

Question	Answers	Extra information	Mark	AO / Specification reference
	Indicative content • 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			
13.1	Noble Gases		1	AO1 4.1.2.4
13.2	2,8,8		1	AO2 4.1.1.7
13.3	they have stable arrangements of electrons/full outer shell		1	AO1 4.1.2.4
13.4	increases		1	AO2 4.1.1.5
14.1	31		1	AO2 4.1.1.5
14.2	69 - 31 = 38		1	AO2 4.1.1.5

Question	Answers	Extra information	Mark	AO / Specification reference
14.3	31 - 3 = 28		1	AO2 4.1.1.5
14.4	**one** from: • boron • aluminium • indium • thallium		1	AO2 4.1.2.1