PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



MARK SCHEME

SECTION 2: INORGANIC CHEMISTRY (PACK 2)

SCORE	PERCENTAGE
/201	%

STEMUP

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Mark Scheme

Q1.

Question number	Answer	Additional guidance	Marks
(a)	**M1** acid - hydrochloric acid / HCl **M2** alkali – sodium hydroxide / NaOH A description that makes reference to the following four points.	**REJECT** hydrogen chloride /HCl(g) **ALLOW** sodium carbonate If both name and formula given mark name only **IGNORE** state symbols with NaOH even if incorrect	2
(b)	**M1** add water (tc dissolve the sodium chloride/salt) **M2** warm / stir (to dissolve the sodium chloride/salt more quickly) **M3** filter (to remove the glass / to separate the glass from the solution) **M4** (heat/leave to) evaporate the water	 **ALLOW** decant / sieve **ALLOW** heat/distil / boil to remove the water **M2** dep on **M1** but **M3** and **M4** can still be awarded if **M1** is missing **M4** dep on **M3**	4
		Total	**6**

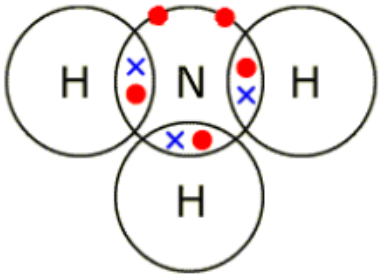
Q2.

Question number	Answer	Notes	Marks
(a)	**C** red is correct because litmus indicator in an acidic solution is red **A** is incorrect because litmus indicator in an acidic solution is not blue **B** is incorrect because litmus indicator in an acidic solution is not orange **D** is incorrect because litmus indicator in an acidic solution is not yellow		1
(b)	**C** 7 is correct because the pH value of a neutral solution is 7 **A** is incorrect because the pH value of a neutral solution is not 0 **B** is incorrect because the pH value of a neutral solution is not 4 **D** is incorrect because the pH value of a neutral solution is not 14		1

Question number	Answer	Notes	Marks
(c)	**D** is correct because a solution with a pH value of 9 is weakly alkaline **A** is incorrect because a solution with a pH value of 9 is not strongly acidic **B** is incorrect because a solution with a pH value of 9 is not strongly alkaline C is incorrect because a solution with a pH value of 9 is not weakly acidic		1
(d)	**A** is correct because HNO_3 is the chemical formula of an acid **B** is incorrect because H_2O is not the chemical formula of an acid **C** is incorrect because NaCl is not the chemical formula of an acid **D** is incorrect because NaOH is not the chemical formula of an acid		1

Question number	Answer	Notes	Marks
(e)	neutralisation	**ALLOW** exothermic	1
(f)	**M1** potassium chloride **M2** water	**ACCEPT** in either order **ALLOW** correct chemical formulae	2

Q3.

Question number	Answer	Notes	Marks
(a)	 **M1** 3 bonding pairs **M2** rest of molecule fully correct	**M2** dep on **M1** **ALLOW** any combination of dots and crosses	2
(b) (i)	<table><tr><td>**M1 ammonium chloride**</td><td>ammonium carbonate</td></tr><tr><td>NH_4Cl</td><td>**M2** $(NH_4)_2CO_3$</td></tr></table>		2
(ii)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	**ALLOW** multiples **IGNORE** state symbols even if incorrect	1
(iii)	**M1** add sodium hydroxide (solution) **M2** test (gas / ammonia) with (damp) red litmus paper / (damp) universal indicator paper **M3** (red litmus) turns blue / universal indicator) turns blue / purple	**REJECT** if solution / ammonium (sulfate) tested with litmus / universal indicator paper	3

(c)	(i)	**M1** 2 x 14 ÷ 80 **OR** 0.35	correct answer without working scores 2	2
		M2 (0.35 x 100 =) 35 (%)	**ALLOW** 1 mark for 17 / 17.5 / 18 (%)	
	(ii)	An answer that links any 4 points:		4
		M1 (NH_3) higher % of N **OR** (($NH_4)_2SO_4$) lower % of N		
		M2 $(NH_4)_2SO_4$ easy to use (to soil) / easy for the plants to absorb / less wastage **OR** (NH_3) difficult to use (to soil) / difficult for the plants to absorb / more wastage / has to be dissolved (in water) first		
		M3 $(NH_4)_2SO_4$ pH close to that of (rain) water / will not alter the pH (of the soil/water)	**REJECT** NH_3 has a pH close to rainwater	
		M4 NH_3 will cause (the soil/water) to become alkaline / will raise the pH (of the soil/water) / neutralise (the water / soil) / may stunt growth of plants / may damage / kill plants	**REJECT** ammonia causes the soil / water to become acidic	
		M5 NH_3 and or $(NH_4)_2SO_4$ soluble so runoff / wastage of fertiliser / water pollution / eutrophication / leaching		
				Total 14

Q4.

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>(a)</td><td><table><tr><th>Apparatus</th><th>Unit</th></tr><tr><td>(gas) syringe</td><td>cm^3</td></tr><tr><td>(top pan) balance OR (weighing) scales</td><td>g OR mg</td></tr></table></td><td>ALLOW ml
ALLOW words e.g.grams
ALLOW weighing machine
ALLOW kg

1 mark each correct row/column
Mark horizontally or vertically (whichever benefits the candidate)</td><td>2</td></tr>
<tr><td>(b) (i)</td><td>M1 to cool (the water vapour/steam)

M2 so the water vapour/steam condenses</td><td>ALLOW to keep condenser cool

ALLOW so the water vapour/steam becomes liquid</td><td>2</td></tr>
<tr><td>(ii)</td><td>M1 add silver nitrate/$AgNO_3$ (solution)

M2 white precipitate</td><td>IGNORE addition of nitric acid but REJECT addition of hydrochloric/sulfuric acid for M1

M2 dep on use of silver nitrate</td><td>2</td></tr>
<tr><td>(iii)</td><td>M1 measure its boiling point

M2 (boiling point is) 100°C

OR

M1 measure its freezing point

M2 (freezing point is) 0°C</td><td>ALLOW boil it

ALLOW freeze it</td><td>2</td></tr>
<tr><td colspan="3">Total for question</td><td>= 8 marks</td></tr>
</table>

Q5.

Question number	Answer	Notes	Marks
a	**B** (Z X Y W) A is not correct as Z is the most reactive metal C is not correct as Z is the most reactive metal D is not correct as X is more reactive than Y		**1**
b i	W		**1**
ii	X		**1**
c	**M1** brown/pink/pink-brown solid forms	**ALLOW** red-brown /orange-brown **IGNORE** red or orange alone **ALLOW** precipitate for solid	**2**
	M2 solution turns colourless	**ALLOW** solution becomes paler **IGNORE** clear **IGNORE** incorrect initial colour of solution **IGNORE** references to magnesium disappearing **IGNORE** references to heat	

Q6.

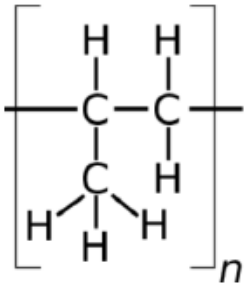
Question number	Answer	Notes	Marks
(a)	Any six from: M1 add barium carbonate (one spatula at a time) to the acid M2 until the barium carbonate is in excess M3 filter off the excess barium carbonate M4 heat solution to evaporate some of the water M5 cool or leave to crystallise	 ALLOW until some barium carbonate is left/no longer effervesces /fizzes/bubbles M3 dep on M2 ALLOW heat until crystals start to form ALLOW heat until solution is saturated ALLOW heat until crystals form on the end of a glass rod/heat to crystallisation point	6
	M6 filter the crystals (from the solution) M7 leave crystals in a warm place to dry	M6 dep on M5 IGNORE washing ALLOW leave to dry ALLOW dry on filter paper ALLOW dry in a desiccator ALLOW dry in a (warm) oven If solution is evaporated to dryness M5, M6 and M7 cannot be scored	
(b)	M1 add (dilute) acid before adding the barium chloride M2 white precipitate	ALLOW any named acid except sulfuric acid M2 is dependent on M1	2
			8

Q7.

Question number	Answer	Notes	Marks
(a) (i)	(hydrated) iron(III) oxide	REJECT incorrect oxidation states	1
(ii)	M1 (barrier method involves) coating iron in paint/oil/grease/plastic M2 stops oxygen/air/water getting to the iron	ALLOW coating in named metal below iron in reactivity series eg tin ALLOW stops iron reacting with oxygen/air/water	2
(b) (i)	reading at start: 20.5 reading at end: 33.5 (1) volume of oxygen used in cm^3: 13.0 (1)	CSQ on reading	2
(ii)	not all oxygen had reacted / not enough iron (wool)	ALLOW not left for long enough/ OWTTE	1
(c)	M1 calculation of volume oxygen used M2 correct expression for percentage of oxygen M3 correct evaluation Example calculation: M1 (35.5 – 20.0 =) 15.5 M2 (15.5 ÷ 80.0) x 100 M3 19.4(%)	ALLOW ECF from M1 ACCEPT 19.375/19.38 correct answer with no working scores 3	3
		(Total for Question = 9)	

Q8.

Question number	Answer	Notes	Marks
(a) (i)	M1 alkanes M2 because fits general formula C_nH_{2n+2}	 M2 not dep on M1	2 Grad
(ii)	D	ALLOW C_3H_8	1 cler
(iii)	M1 (compounds of F with same molecular formula /C_4H_{10}) but different structural/displayed formulae M2 structural/displayed formula of butane M3 structural/displayed formulae of methylpropane		3 Exp
(b)	a description including the following points M1 heat/vapourise crude oil M2 pass into (fractionating) column/tower M3 fractions/compounds/molecules/hydrocarbons separate because of different boiling points M4 compound D collected at top of column/in refinery gas fraction	 ALLOW boil ALLOW idea of temperature gradient All marks could be scored from a suitably labelled diagram MAX 3 if description of lab process If confusion with cracking only M1 can be awarded	4 Exp

Question number	Answer	Notes	Marks
(c) (i)	addition (polymer)	REJECT additional	1 Cler
(ii)	poly(propene) / polypropene	ALLOW polypropylene	1 grad
(iii)	 M1 correct repeat unit M2 brackets and n and extension bonds	Ignore bond angles ALLOW use of CH_3 M2 DEP M1	2 Exp
		Total for Q = 14	

Q9.

Question number	Answer	Mark
(a)	Any two of: • concentration of copper(II) sulfate solution (1) • volume of copper(II) sulfate solution (1) • particle size of metal (1)	2

Question number	Answer	Additional guidance	Mark
(b)(i)	• (G) 5.5 (°C) (1) • (H) 11.5 (°C) (1)	accept 5.47	2

Question number	Answer	Mark
(b)(ii)	An explanation that makes reference to the following two points: • H (1) • because of the biggest temperature increase (1)	2

Question number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that makes reference to the following two points: • F (1) • because there is no temperature increase (1)	accept there is no reaction	2

(Total for question = 8 marks)

Q10.

Question number	Answer	Notes	Marks
a	**2** C_2H_4 + **4** HCl + **(1)** O_2 → **2** $C_2H_4Cl_2$ + **2** H_2O	**ACCEPT** multiples and fractions	**1**
b	breaking down by heating OWTTE		**1**
c i	(it) contains a (carbon to carbon) double bond		**1**
ii	**M1** add bromine water/solution **M2** (bromine water/solution) is decolourised/ turns (from orange to) colourless	**ACCEPT** Br_2(aq) as long as the state symbol is present **IGNORE** clear **REJECT** discoloured If initial colour of bromine water given it must be correct- **ALLOW** any combination of orange/yellow/brown **M2** dep on **M1** or near miss **ALLOW** **M1** add acidified potassium manganate(VII) **M2** potassium manganate(VII) is decolourised/turns (from purple) to colourless **REJECT** any other initial colour	**2**
d	poly(chloroethene) /polychloroethene	**ACCEPT** polyvinyl chloride **ALLOW** PVC	**1**

Q11.

Question number	Answer	Notes	Marks
(a) (i)	M1 <u>atoms</u> of the same element / <u>atoms</u> with the same number of protons /<u>atoms</u> with the same atomic number	**REJECT** different number of electrons **IGNORE** same number of electrons	2
	M2 (with a) different number of neutrons / different mass number		
(ii)		correct answer without working scores 3	3
	M1 (63 x 69.5) + (65 x 30.5) **OR** 6361		
	M2 their M1 ÷ 100 **OR** 63.61		
	M3 63.6	**ALLOW** answer to **M2** to 3 sig figs 63.61 without working scores 2	
(b) (i)	**A** decomposition		1
	B is incorrect as it is not a neutralisation reaction C is incorrect as it is not an oxidation reaction D is incorrect as it is not a reduction reaction		
(ii)	**C** green to black		1
	A is incorrect as copper(II) carbonate is not blue B is incorrect as copper(II) carbonate is not blue and copper(II) oxide is not white D is incorrect as copper(II) oxide is not orange		

(c)	(i)	(28.20 – 20.52 =) 7.68		1
	(ii)	(31.77 – 28.20 =) 3.57		1
	(iii)	**M1** 7.68 ÷ 159.5 **OR** 0.04815 **M2** 3.57 ÷ 18 **OR** 0.1983 **M3** 0.1983 ÷ 0.04815 **OR** 4.12	correct answer without working scores 3 **ALLOW** ecf from (i) and/or (ii) for **M1** and **M2**; and **M3** provided the answer rounds to 4 **REJECT** incorrect rounding in **M1** or **M2** **ALLOW** any number of sig figs in **M1** and **M2** except 1 Penalise 1 sig fig once only	3
	(iv)	not all the water was removed (from the hydrated copper(II) sulfate)	**ALLOW** the (hydrated copper(II) sulfate) was not heated for long enough **ALLOW** not all the water left the tube (that was being heated) **ALLOW** not all the (hydrated copper sulfate) reacts	1 **Total 13**

Q12.

Question number	Answer	Notes	Marks
(a) (i)	M1 add anhydrous copper sulfate M2 turns (from white) to blue	ALLOW add white copper sulfate M2 dep on copper sulfate in M1 ALLOW M1 add anhydrous / blue cobalt chloride M2 turns (from blue) to pink M2 dep on cobalt chloride in M1	2
(ii)	M1 measure the boiling point / freezing point M2 100 °C / 0°C	ALLOW boil it or freeze it Value must match property	2
(b)	M1 mass of hydrated zinc sulfate = 54.46-41.64 **OR** 12.82 g M2 Moles of hydrated zinc sulfate = 12.82÷287 **OR** 0.0447 M3 Moles H_2O = 0.0447×7 **OR** 0.313 M4 Mass H_2O = 5.63 g M5 Volume H_2O 5.6 cm^3	 ALLOW M1÷287 ALLOW M2×7 ALLOW M3×18 Must be 1dp ALLOW M4 to 1dp Correct answer of 5.6 cm^3 to 1dp with or without working scores 5 marks	5
(c) (i)	1.7	ALLOW 2 or more significant figures REJECT incorrect rounding	1
(ii)	M1 stand the measuring cylinder in a beaker of ice OR M1 replace the delivery tube with a (Liebig) condenser M2 less water / water vapour / steam lost	ALLOW any way of cooling the measuring cylinder or delivery tube ALLOW add a condenser IGNORE add a stopper / bung ALLOW more water (vapour) / steam condenses ALLOW less water evaporates	2
			Total for question = 12

Q13.

Question number		Answer	Notes	Marks
(a)		$2\ H_2O_2 \rightarrow 2\ H_2O + (1)\ O_2$	**ALLOW** multiples and fractions	1
(b)		Relights a glowing splint/spill		1
(c)		Speeds up/increases rate of the reaction	**IGNORE** references to lowering activation energy	1
(d)	(i)	All points plotted correctly	**ALLOW** ± half a square	1
	(ii)	Point at 8 minutes circled		1
	(iii)	Smooth curve of best fit		1
	(iv)	took the reading too soon/before 8 minutes	**ACCEPT** misread the volume (of oxygen)	1
	(v)	**M1** vertical line on graph drawn to curve from 3 mins		2
		M2 value obtained from candidate's graph	Expected value 29 or 30 cm^3 **ALLOW** ± half a square	

Question number	Answer	Notes	Marks
(e) (i)	**M1** curve drawn on graph that is less steep than curve of student's results. **M2** curve levels off at 40 cm^3	 **ALLOW** ± half a square	2
(ii)	An explanation that links the following three points **M1** reaction is slower **M2** fewer particles/molecules (in the same volume) **M3** fewer collisions per unit time	 **ACCEPT** particles are further apart / less crowded **ACCEPT** less frequent collisions **IGNORE** less chance of a collision	3
			Total 14

Q14.

Question number	Answer	Notes	Marks
(a)	Any one from: M1 add more limewater (to cover tube on left) M2 the glass tube on the left should be longer/in the limewater		1

(b)	(i)	M1 volume of carbon dioxide = 10 (cm^3) M2 10÷76 × 100 = 13.2 (%)	correct answer with or without working scores 2 marks. **ACCEPT** any number of significant figures except 1 **REJECT** incorrect rounding **ALLOW** ecf on incorrect volume of carbon dioxide **ALLOW** 66/76 x 100 = 86.8 for 1 mark	2
	(ii)	limewater turns (from colourless to) cloudy or milky	**ALLOW** white precipitate	1
	(iii)	M1 the percentage/amount of carbon dioxide in the air is too small M2 therefore the reading on the syringe would change by less than 1 cm^3	**ALLOW** there is 0.04% of carbon dioxide in the air **ALLOW** the change on the gas syringe would be too small **ALLOW** syringe not precise/accurate enough to measure small volume changes	2

(c)	(i)	copper(II) oxide	**ALLOW** copper oxide /CuO **REJECT** copper (I) oxide	1
	(ii)	the powder has a greater surface area (than larger pieces of copper)	**ALLOW** the powder reacts more quickly (than larger pieces of copper)	1
	(iii)	M1 argon/it has a full outer shell of electrons M2 therefore does not lose or gain (or share) electrons	**ALLOW** has eight outer shell electrons	2
				10

Q15.

Question number	Answer	Notes	Marks
(a)	galvanising	**ACCEPT** galvanisation	1
(b) (i)	rust		1
(ii)	**M1** oxygen / air	**ACCEPT** O_2 **IGNORE** O	2
	M2 water	**ACCEPT** H_2O/moisture **ACCEPT** in either order	
(c) (i)	(a reaction which) gives out / produces / releases heat (energy) / thermal energy	**IGNORE** energy without mention of heat or thermal	1
(ii)	An explanation that links the following two points		2
	M1 aluminium/Al is more reactive than iron/Fe	**ACCEPT** aluminium/Al is higher in reactivity series than iron/Fe **ACCEPT** reverse argument	
	M2 (because) aluminium/Al displaces iron/Fe (from its oxide)	**ALLOW** replaces/takes place of	
(iii)	An explanation that links the following three points		3
	M1 aluminium is oxidised and iron/iron oxide is reduced	**ALLOW** both oxidation and reduction occur	
	M2 aluminium gains oxygen	**ALLOW** aluminium/Al loses electrons	
	M3 iron oxide/iron loses oxygen	**ALLOW** iron ions /Fe^{3+} gains electrons **ALLOW** correct references to changes in oxidation number for **M2** and **M3**	
			Total 10

Q16.

Question number	Answer	Notes	Marks
(a)	Any two from M1 all in Group 7/same group M2 because all have 7/same number of electrons in outer shell M3 the number of shells determines the Period they are in		2 Grad

(b)	(i)	Ultraviolet radiation	ALLOW UV radiation ALLOW ultraviolet light /UV light/ultraviolet rays/UV rays	1 cler
	(ii)	$Cl_2 + CH_4 \rightarrow CH_3Cl + HCl$	ALLOW multiples	1 Grad
	(iii)	M1 attraction between shared pair of electrons M2 and nuclei of the two/both atoms (in the bond) **OR** M1 bonding/shared pair of electrons M2 attracted to (both) nuclei of atoms (in the bond)	ALLOW M1 attraction of (two) nuclei M2 for shared/bonded pair of electrons (between them)	2 Exp
	(iv)	M1 the four shared pairs of electrons between carbon and the other four atoms M2 rest of molecule correct including the three lone pairs of electrons around chlorine atom	M2 DEP M1 ALLOW any combination of dots and crosses	2 Grad
	(v)	M1 weak forces of attraction between molecules/weak intermolecular forces M2 little (heat) energy needed to overcome them	ALLOW weak bonds between molecules /weak intermolecular bonds IGNORE less energy 0 marks if implication is that covalent bonds are weak/broken	2 Exp

(c)	Explanation including M1 (one) electron (per carbon atom) delocalised M2 (so) free to move (between layers)	IGNORE sea of electrons /free electrons M2 DEP on mention of electrons 0 marks if mention of ions in graphite	2 Exp
		Total Q	= 12

Q17.

Question number	Answer	Notes	Marks
(a)	Any three from: M1 sodium (atom) loses electron(s) M2 oxygen (atom) gains electron(s) M3 sodium loses 1 electron AND oxygen gains 2 electrons OR M3 (both atoms become ions with configuration) 2.8	any mention of sharing of electrons scores 0	3
(b)	62		1
(c)	Any two from: M1 (sodium oxide has) ions / (giant) ionic structure M2 ions / electrons cannot flow / move M3 no delocalised electrons		2
(d)	M1 flame test M2 yellow colour	ALLOW any description of a flame test ALLOW orange or yellow-orange M2 dep on M1 or mention of flame	2
(e)	$2Na_2O \rightarrow 2Na + Na_2O_2$		1
			Total for question = 9 marks

Q18.

Question number	Answer	Notes	Marks
(a) (i)	Any one from: Na K Al In	**ALLOW** names of elements Apply list principle	1
(ii)	Any one from S Cl	**ALLOW** names of elements	1
(b)	same number / three electrons in the outer shell	**ALLOW** valence shell	1
(c)	M1 Xe or xenon M2 as it has a full outer shell (of electrons)	 ALLOW has eight electrons in outer shell ACCEPT does not (easily) gain/lose/share electrons M2 dep on M1	2
(d) (i)	M1 (universal indicator turns) blue or purple M2 because an alkali is produced	 **ACCEPT** OH^- / hydroxide ions are produced **ALLOW** sodium hydroxide is a base / a base is produced	2
(ii)	(similarity) any one from: (both) effervesce melt / turn into a sphere move on surface universal indicator turns the same colour (difference) any one from: potassium gives a lilac flame potassium moves faster potassium effervesces faster	 **ALLOW** fizzes/bubbles **ALLOW** float **ALLOW** both disappear/get smaller/dissolve **ALLOW** faster/more vigorous reaction for potassium **ALLOW** reverse arguments for sodium	2
(iii)	Example calculation M1 (moles of hydrogen) $0.036 \div 2$ **OR** 0.018 mol M2 $0.018 \times 6.0 \times 10^{23}$ **OR** 1.08×10^{22} molecules M3 1.1×10^{22}	correct answer with no working scores 3 marks **ALLOW** ECF M1 $\times 6.0 \times 10^{23}$ **ALLOW** ECF M2 but must be to 2 sig figs 2.16×10^{22} scores 1 2.2×10^{22} scores 2	3
		Total for question = 12 marks	

Q19.

Question number	Answer	Notes	Marks
(a) (i)	zinc + copper(II) sulfate → **zinc sulfate + copper**	**REJECT** copper(II) as a product **ACCEPT** zinc(II) sulfate	1
(ii)	polystyrene is an insulator / prevents heat loss	**ALLOW** to prevent the cup falling over	1
(iii)	zinc is more reactive / higher in the reactivity series than copper	**ALLOW** reverse argument	1
(iv)	M1 temperature rise = 28.6 °C M2 (75 × 4.2 × 28.6 =) 9009	correct answer without working scores 2 ALLOW 9010/9000 **IGNORE** any sign **ALLOW** ECF from M1	2
(b) (i)	M1 800÷1000 OR 0.8 (kJ) M2 0.65÷65 OR 0.01 (mol) M3 0.8÷0.01 = −80 (kJ/mol) OR M1 0.65÷65 OR 0.01 (mol) M2 800÷0.01 OR 80 000 (J/mol) M3 −80 (kJ/mol)	correct answer without working scores 3 **ALLOW** ECF but answer must have a − sign 80/+80 scores 2	3
(ii)	M1 zinc/Zn is oxidised because loses electrons M2 silver ion(s)/Ag^+ reduced because gain electrons OR M1 zinc/Zn is oxidised **and** silver ion(s)/Ag^+ reduced M2 zinc/Zn loses electrons **and** silver ion(s)/Ag^+ gain electrons		2
		Total for question = 10 marks	

Q20.

Question number	Answer	Notes	Marks
a	to increase the rate of reaction	**ACCEPT** to make the reaction faster/ to speed up the reaction **REJECT** any reference to increasing the solubility of copper(II) oxide	**1**
b	(the copper(II) oxide/it) stops disappearing **OR** mixture turns cloudy (black) **OR** (black) solid settles (at the bottom of the beaker)	**ALLOW** stops dissolving **REJECT** any other colour **REJECT** any other colour **ALLOW** copper(II) oxide/ it settles (at the bottom of the beaker) **IGNORE** precipitate	**1**
c	to remove excess/unreacted copper(II) oxide/solid/base (from the mixture)	**ACCEPT** to separate the copper(II) sulfate solution (from the copper(II) oxide/unreacted solid/excess solid)	**1**
d	blue		**1**

Question number	Answer	Notes	Marks
e	**M1** heat/boil the filtrate	**NOTE:** If the solution is heated to remove all the water then only **M1** can be awarded **NOTE** If the solution is left to evaporate all the water without heating only 1 mark can be awarded	**5**
	M2 until crystals form in a cooled sample/ on a glass rod	**ACCEPT** to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water **M2** dep on **M1**	
	M3 leave the solution to cool/crystallise	**NOTE:** If the solution is left to completely evaporate after heating then award MAX 3	
	M4 filter (to remove the crystals)	**ACCEPT** decant the (excess) solution **IGNORE** references to washing the crystals	
	M5 dry the crystals on filter paper/on paper towel/in a warm oven /in a desiccator /leave to dry	**REJECT** hot oven or any method of direct heating e.g. Bunsen burner No **M5** if crystals washed after drying	

Question number	Answer	Notes	Marks
f i	• calculate the moles of CuO • calculate the mass of $CuSO_4.5H_2O$ • give the answer to an appropriate number of significant figures Example calculation **M1** *n*[CuO] = 9.54 ÷ 79.5 OR 0.120 (mol) **M2** mass of $CuSO_4.5H_2O$ = 0.120 × 249.5 **OR** 29.94 (g) **M3** = 29.9 **OR** **M1** 79.5 (g) → 249.5 (g) **M2** 9.94 (g) → (249.5 ÷ 79.5) × 9.54 (g) **OR** 29.94 (g) **M3** = 29.9	Final answer must be to 3 sig figs Final answer must be to 3 sig figs 29.94 with no working scores 2 29.9 with no working scores 3	**3**

ii	**M1** (23.92 ÷ 29.9) × 100 OR (23.92 ÷ **M3** from (i)) × 100 **M2** = 80(%)	**ALLOW** use of **M2** from (i) 29.94 gives 79.89% **ALLOW** any number of sig figs **ACCEPT** answer of 79.7(3)% using 30g Correct answer without working scores 2	**2**