Q	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)		W is $CuCl_4^{2-}$	1	
			Yellow-green/yellow/green	1	Not necessary to indicate solution Do not allow precipitate/solid
			$[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow CuCl_4^{2-} + 6H_2O$	1	Allow $+ 4HCl \rightarrow 4H^+$
5	(b)		X is $Cu(H_2O)_4(OH)_2$	1	Allow $Cu(OH)_2$/copper hydroxide
			Blue precipitate/solid	1	Ignore shades
			$[Cu(H_2O)_6]^{2+} + 2NH_3 \rightarrow Cu(H_2O)_4(OH)_2 + 2NH_4^+$	1	Allow any balanced equation/equations leading to this hydroxide or $Cu(OH)_2$ But must use ammonia
5	(c)		Y is $[Cu(NH_3)_4(H_2O)_2]^{2+}$	1	
			Deep/dark/royal blue solution	1	QoL
			$Cu(H_2O)_4(OH)_2 + 4NH_3 \rightarrow [Cu(NH_3)_4(H_2O)_2]^{2+} + 2H_2O + 2OH^-$	1	Accept equation for formation from $Cu(OH)_2$
5	(d)		Z is $CuCO_3$	1	Allow copper carbonate
			Green solid/precipitate	1	Allow blue-green precipitate
			$[Cu(H_2O)_6]^{2+} + CO_3^{2-} \rightarrow CuCO_3 + 6H_2O$	1	
5	(e)	(i)	$Cu^{2+}(aq) + Fe(s) \rightarrow Cu(s) + Fe^{2+}(aq)$	1	Allow hydrated ions State symbols not essential but penalise if wrong
			Blue	1	Do not allow description of solids
			Green	1	Allow yellow/(red-)brown/orange

5	(e)	(ii)	Any two correct points about copper extraction from two of these three categories: Any relevant mention of lower energy consumption Any relevant mention of benefits of less mining (of copper ore) Less release of CO_2 (or CO) into the atmosphere	Max 2	 Do not allow reference to electricity alone or to temperature alone. Allow avoids depletion of (copper ore) resources Not just greenhouse gases. Must mention CO_2 or CO