Transition Metals and Chemistry - Mark Scheme

Q1.

Question number	Answer		Additional guidance	Marks
(a)	• copper is **oxidised** from 0 to +2	(1)	Look at the equation in the question for the correct oxidation number changes if not given on the answer lines	2
	• nitrogen is **reduced** from (+)5 to (+)4	(1)		
			Award maximum of one mark if the terms oxidised and reduced are not used or used the wrong way round	

Question number	Answer		Additional guidance	Mark
(b)	An answer which makes reference to the following points:		Accept the points in either order	2
	• (precaution) carry out in a fume cupboard	(1)	Do not award 'well-ventilated laboratory/ face masks'	
	• (hazard) toxic nitrogen dioxide/NO_2 gas.	(1)	Allow poisonous	

Question number	Answer		Additional guidance	Marks
(c)			Example of calculation:	6
	• calculation of the number of moles of thiosulfate	(1)	$n(S_2O_3^{2-})$ = (22.65 × 0.100 ÷ 10000=) = 2.265 × 10⁻³ /0.002265 (mol)	
	• evaluation of the number of moles of iodine	(1)	$n(I_2)$ = (2.265 × 10⁻³ ÷ 2=) = 1.1325 × 10⁻³ / 0.0011325 (mol)	
	• evaluation of the number of moles of copper ions in the 10.0 cm³ aliquot	(1)	$n(Cu^{2+})$ = (1.1325 × 10⁻³ × 2=) = 2.265 × 10⁻³ / 0.002265 (mol)	
	• evaluation of the number of moles of copper ions in 250 cm³	(1)	$n(Cu^{2+})$ = (2.265 × 10⁻³ × 25) = 5.6625 × 10⁻² / 0.056625 (mol)	
	• evaluation of mass of copper ions in sample	(1)	$m(Cu^{2+})$ = (5.6625 × 10⁻² × 63.5=) = 3.5956875 (g)	
	• evaluation of percentage of copper in sample to 2/3 SF	(1)	% = (3.5956875 ÷ 5.0000 × 100= 71.91375=) = 72/71.9 %	
			Penalise inappropriate rounding once only	
			Correct answer with no working scores 6 marks	

Question number	Answer	Additional guidance	Marks
(d)	An answer that makes reference to the following points: • colours of the precipitates formed (1) • addition of excess sodium hydroxide has no effect on copper precipitate (1) • but the zinc precipitate dissolves to form colourless solution (1) • equation for the formation of a precipitate for either copper(II) or zinc ions (1) • equation for the dissolving of the zinc precipitate (1) • all state symbols correct. (1)	Blue precipitate with copper(II) ions **and** white precipitate with zinc ions Do not award 'clear' Example of equations: $[Cu(H_2O)_6]^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(H_2O)_4OH)_2(s) + 2H_2O(l)$ or $[Zn(H_2O)_6]^{2+}(aq) + 2OH^-(aq) \rightarrow Zn(OH)_2(s) + 6H_2O(l)$ or $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ or $Zn^{2+}(aq) + 2OH^-(aq) \rightarrow Zn(OH)_2(s)$ $Zn(OH)_2(s) + 2OH^-(aq) \rightarrow [Zn(OH)_4]^{2-}(aq)$	6
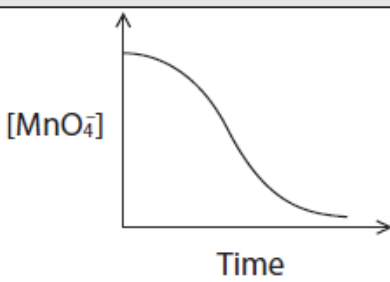
Question number	Answer	Additional guidance	Marks
(e)	An explanation that makes reference to: • copper forms an ion with an incomplete d subshell (1) • but the only ion that zinc forms has a completely filled d subshell. (1)		2

Question number	Answer	Additional guidance	Marks
(f)	A explanation that makes reference to: • the atoms/cations are of different size (in brass) (1) • therefore the layers do not slide over one another so easily. (1)	Ignore movement of the electrons Accept a labelled diagram	2

Q2.

Question number	Answer	Mark
	B ethanoate ion, CH_3COO^-	1

Q3.

Question number	Answer	Mark
	C	1

Q4.

Question number	Answer	Mark
(a)	C $[Pt(NH_3)_2Cl_2]$	1

Question number	Answer	Mark
(b)	A $[CuCl_2]^-$	1

Question number	Answer	Mark
(c)	D $[Cr(H_2O)_6]^{2+}$	1

Q5.

Question number	Answer	Mark
(a)	C this label indicates the intermediate species	1

Question number	Answer	Mark
(b)	B they can gain and then lose electrons	1

Q6.

Question number	Answer	Mark
	C sodium hydroxide	1

Q7.

Question number	Answer	Mark
	B VO_2^+	1