Question	Marking Guidance	Mark	Comments
8(a)	$2Fe^{2+} + S_2O_8^{2-} \rightarrow 2Fe^{3+} + 2SO_4^{2-}$	1	
	$2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$	1	
	two negative ions repel / lead to reaction that is slow / lead to reaction that has high E_a	1	
	iron able to act because changes its oxidation state	1	allow iron has variable oxidation state
	With iron ions have alternative route / route with lower activation energy	1	
8(b)(i)	$[Fe(H_2O)_6]^{3+} \rightarrow [Fe(H_2O)_5OH]^{2+} + H^+$	1	can have H_2O on LHS and H_3O^+ on R do not penalise further hydrolysis equations allow high charge density
	Fe^{3+} ion has higher charge (to size ratio) (than Fe^{2+})	1	
	increases polarisation of co-ordinated water / attracts O releasing an H^+ ion / weakens O—H bond	1	

8(b)(ii)	$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$	1	or 6 mol Fe(II) react with 1 mol dichromate If factor of 6 not used max =3 for M2, M4 and M5 e.g. 1:1 gives ans= 8.93 to 8.98% (scores 3)
	moles dichromate = $23.6 \times 0.218/1000 = 5.14 \times 10^{-4}$	1	
	moles iron = $5.14 \times 10^{-4} \times 6 = 0.00309$	1	M3 also scores M1
	mass iron = $0.00309 \times 55.8 = 0.172$	1	Mark is for moles of iron $\times$ 55.8 conseq Allow use of 56 for iron
	% by mass of iron = $0.172 \times 100/0.321 = 53.7\%$	1	Answer must be to at least 3 sig figures allow 53.6 to 53.9 Mark is for mass of iron $\times$ 100/0.321 conseq

8(c)	brown precipitate / solid	1	Allow red-brown / orange solid Not red or yellow solid
	bubbles (of gas) / effervescence/ fizz	1	Allow gas evolved / given off Do not allow just gas or CO_2 or CO_2 gas
	$2[Fe(H_2O)_6]^{3+} + 3CO_3^{2-} \rightarrow 2Fe(H_2O)_3(OH)_3 + 3CO_2 + 3H_2O$	1	Allow $2[Fe(H_2O)_6]^{3+} + 3CO_3^{2-} \rightarrow 2Fe(OH)_3 + 3CO_2 + 9H_2O$ Use of Na_2CO_3 e.g. …+ $3Na_2CO_3 \rightarrow$ .. + .. + .. + $6Na^+$

UMS conversion calculator www.aqa.org.uk/umsconversion