

Question	Marking Guidance	Mark	Comments
8(a)	A ligand is an electron pair / lone pair donor	1	Allow uses lone / electron pair to form a co-ordinate bond
	A bidentate ligand donates two electron pairs (to a transition metal ion) from different atoms / two atoms (on the same molecule / ion)	1	QoL
8(b)	CoCl_4^{2-} diagram Tetrahedral shape $109^\circ 28'$	1	Four chlorines attached to Co with net 2- charge correct
		1	Charge can be placed anywhere, eg on separate formula
		1	Penalise excess charges
	$[\text{Co}(\text{NH}_3)_6]^{2+}$ diagram Octahedral shape 90°	1	Allow 109° to 109.5°
		1	Six ammonia / NH_3 molecules attached to Co with 2+ charge correct
		1	Allow 180° if shown clearly on diagram
8(c)	In different complexes the <u>d</u> orbitals / <u>d</u> electrons (of the cobalt) will have different energies / <u>d</u> orbital splitting will be different	1	
	Light / energy is absorbed causing an electron to be excited	1	
	Different frequency / wavelength / colour of light will be absorbed / transmitted / reflected	1	

8(d)	<p>1 mol of H_2O_2 oxidises 2 mol of Co^{2+}</p> <p>$M_r \text{ CoSO}_4 \cdot 7\text{H}_2\text{O} = 281$</p> <p>Moles $\text{Co}^{2+} = 9.87/281 = 0.03512$</p> <p>Moles $\text{H}_2\text{O}_2 = 0.03512/2 = 0.01756$</p> <p>Volume $\text{H}_2\text{O}_2 = (\text{moles} \times 1000)/\text{concentration}$ $= 0.01756 \times 1000/5.00$ $= 3.51 \text{ cm}^3 / (3.51 \times 10^{-3} \text{ dm}^3)$</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>Or $\text{H}_2\text{O}_2 + 2\text{Co}^{2+} \rightarrow 2\text{OH}^- + 2\text{Co}^{3+}$</p> <p>If M_r wrong, max 3 for M1, M4, M5</p> <p>M4 is method mark for (M3)/2 (also scores M1)</p> <p>Units essential for answer</p> <p>M5 is method mark for (M4) x 1000/5 Allow 3.4 to 3.6 cm^3</p> <p>If no 2:1 ratio or ratio incorrect Max 3 for M2, M3 & M5</p> <p>Note : Answer of 7 cm^3 scores 3 for M2, M3, M5 (and any other wrong ratio max 3)</p> <p>Answer of 16.8 cm^3 scores 3 for M1, M4, M5 (and any other wrong M_r max 3)</p> <p>Answer of 33.5 cm^3 scores 1 for M5 only (so wrong M_r AND wrong ratio max 1)</p>
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