5(a)

species	number of **unpaired** electrons	
	3d	4s
Cu	0	1
Cu^{2+}	1	0

5(b)

- five 3d orbitals (lines, boxes) in the isolated Cu^{2+} ion of the same energy
- splitting: three higher and two lower d orbitals
- energy of all five d orbitals in complex higher than all d orbitals in isolated ion

any two [1], all three [2]

5(c)

M1: more than one (stable) oxidation state / exist in variable oxidation states

M2: vacant / empty (d) orbitals are energetically accessible
OR vacant / empty (d) orbitals can form dative bonds with ligands

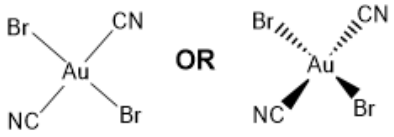
5(d)

metal ion	coordination number	formula of complex ion	charge of complex ion
Ag^{+}	2	$Ag(CN)_2$	1–
Fe^{2+}	6	$Fe(CN)_6$	4–

each row [1]

5(e)

M1:



M2: (shape) square planar **AND** (bond angle) 180°

5(f)(i)

M1: moles MnO_4^- = 0.075 × 0.0225 = 1.6875 × 10^{-3}

M2: moles V^{2+} = 5 / 3 × 1.6875 × 10^{-3} = 2.8125 × 10^{-3}

M3: mass V = 50.9 × 2.8125 × 10^{-3} = 0.143 g
% of V = 0.143 / 0.250 × 100 = 57.3 min 2sf

5(f)(ii)

$2VO_3^- + 3Zn + 12H^+ \rightarrow 2V^{2+} + 3Zn^{2+} + 6H_2O$

M1: 2 : 3 ratio on both sides

M2: rest of the equation correct