

1(a)(i)	24 protons 28 neutrons 24 electrons
1(a)(ii)	(⁵⁴ Cr has two) more neutrons (than ⁵² Cr)
1(a)(iii)	(relative) abundance (of each isotope)
1(a)(iv)	The fourth isotope has any value of RIM less than 51.996
1(b)(i)	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ (3d ⁵ 4s ¹)
1(b)(ii)	6
1(c)(i)	Cr / Cr ₂ O ₇ ²⁻ AND it gains electrons
1(c)(ii)	(+) ⁴
1(c)(iii)	<i>Due to an issue with question 1(c)(iii), the question has been removed from the question paper.</i>
1(c)(iv)	M1 CO ₂ has only instantaneous / temporary dipole–induced dipole forces AND methanal has permanent dipole–permanent dipole (and id-id) forces M2 IMF's in methanal are stronger than IMF's in CO ₂
1(d)(i)	rate of forward and backward (reaction) are the same / equal OR concentrations of reactants and products are constant
1(d)(ii)	closed system
1(d)(iii)	M1 (mixture becomes more) orange M2 forward reaction is endothermic M3 (mixture becomes more) orange M4 equilibrium moves (forwards/right) to compensate for extra acid / H ⁺
1(e)	M1 hydrolysis M2 CrF ₄ + 2H ₂ O → CrO ₂ + 4HF

1(a)(i)	25 protons 30 neutrons 25 electrons
1(a)(ii)	(atoms of an element) with the same number of protons and different number of neutrons
1(a)(iii)	M1 (relative) isotopic mass. OR (relative isotopic) mass of Mn-55 and Mn-53 M2 (relative) abundance of each isotope
1(b)(i)	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ (3d ⁵ 4s ²)
1(b)(ii)	5
1(c)(i)	Mn / MnO ₂ AND it gains electrons
1(c)(ii)	(+) ⁴
1(c)(iii)	<i>Due to an issue with question 1(c)(iii), the question has been removed from the question paper.</i>