InkChemistry

ANSWER BOOK

Redox titrations: manganate(VII) and thiosulfate

Redox · Unit C07

AQA 3.2.5.5 · OCR A 5.2.3

16 questions · 46 marks

NAVY EDITION

Every question in this book has a code beside its number.
Type inklearning.co.uk/q/ followed by the code to open that question online.
© 2026 Ink Learning Ltd. All rights reserved.
inklearning.co.uk/chemistry/

SECTION A · Short, 1 to 2 marks

A1 RTM-Q1

B1 manganate(VII) is purple and its reduction product Mn^{2+} is almost colourless, so the reagent is self-indicating. **B1** the solution in the flask turns from colourless, or very pale green, to the first permanent pale pink. [2]

A2 RTM-Q13

B1 $I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$. **B1** one mole of iodine reacts with two moles of thiosulfate. [2]

A3 RTM-Q16

B1 the precipitate is copper(I) iodide, CuI. [1]

SECTION B · Standard, 3 to 5 marks

B1 RTM-Q8

B1 rinse and fill the burette with the manganate(VII) solution and read the top of the meniscus. **B1** pipette 25.0 cm^3 of the iron(II) solution into a conical flask and add an excess of dilute sulfuric acid. **B1** run in the manganate with swirling, dropwise near the end, until the first permanent pale pink, with the flask on a white tile. **B1** repeat until titres are concordant, within 0.10 cm^3, and take the mean of the concordant titres. [4]

B2 RTM-Q11

B1 manganate(VII) is in the burette and measures a reducing agent directly; thiosulfate is in the burette and measures iodine liberated by an oxidising agent. **B1** manganate(VII) is self-indicating, whereas the iodine–thiosulfate titration uses starch as an indicator. **B1** the manganate end point is colourless to pale pink; the thiosulfate end point is blue-black to colourless. **B1** manganate needs excess dilute sulfuric acid; the iodine method needs excess potassium iodide in the flask. [4]

B3 RTM-Q2

B1 manganate(VII) oxidises chloride ions from hydrochloric acid to chlorine. **B1** some manganate is used up reacting with chloride as well as with the substance being analysed, so the titre is too large. **B1** sulfate ions are not oxidised by manganate(VII), so all the manganate reacts with the analyte and the ratio in the equation holds. [3]

B4 RTM-Q3

B1 the iodine colour fades from brown to pale straw, and the last trace of yellow is hard to see, so starch is used to make the end point sharp. **B1** starch forms a blue-black complex with iodine, and the end point is when that colour disappears. **B1** at high iodine concentration the starch holds iodine and releases it only slowly, so the colour would persist past the end point and the titre would be too large. [3]

B5 RTM-Q4

M1 moles of MnO_4^- = 0.0200 × 18.75/1000 = 3.75×10^{-4} mol. **M1** moles of Fe^{2+} = 5 × 3.75×10^{-4} = 1.875×10^{-3} mol, from the 1 : 5 ratio. **A1** concentration = $1.875 \times 10^{-3} \div 0.0250$ = 0.0750 mol dm^{-3}, to three significant figures. [3]

© 2026 Ink Learning Ltd. All rights reserved.

B6 RTM-Q9 — **B1** the reaction is slow at first because it involves two negative ions, MnO_4^- and $C_2O_4^{2-}$, which repel each other, giving a high activation energy. **B1** the Mn^{2+} ions produced act as a catalyst for the reaction. **B1** as Mn^{2+} builds up the rate increases, so the reaction is autocatalysed. [3]

B7 RTM-Q10 — **B1** the precipitate is manganese(IV) oxide, MnO_2. **B1** without enough H^+, manganate(VII) is reduced only to +4, gaining three electrons instead of five. **B1** the 1 : 5 ratio no longer applies, and the brown solid masks the pale pink end point. [3]

B8 RTM-Q12 — **B1** iron(II) in solution is oxidised to iron(III) by oxygen from the air when left standing. **B1** manganate(VII) reacts only with iron(II), so iron already oxidised is not counted and the titre is too small. **B1** the low result is explained by the method, so it does not show the label is wrong; a freshly made solution should be titrated straight away. [3]

B9 RTM-Q14 — **B1** $2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2(aq)$, so two moles of Cu^{2+} liberate one mole of I_2. **B1** $I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$, so one mole of I_2 reacts with two moles of $S_2O_3^{2-}$. **B1** two moles of Cu^{2+} therefore match two moles of $S_2O_3^{2-}$, a 1 : 1 ratio. [3]

B10 RTM-Q17 — **M1** moles of $Fe^{2+} = 0.0750 \times 25.0/1000 = 1.875 \times 10^{-3}$ mol. **M1** each Fe^{2+} gives one electron, so moles of $Cr_2O_7^{2-} = 1.875 \times 10^{-3} \div 6 = 3.125 \times 10^{-4}$ mol. **A1** volume $= 3.125 \times 10^{-4} \div 0.0200 = 0.015625$ dm³, so 15.6 cm³ to three significant figures. [3]

B11 RTM-Q19 — **B1** manganate(VII) is a strong enough oxidising agent to oxidise chloride ions to chlorine, which uses up extra manganate and makes the titre too large. **B1** dichromate(VI) is a weaker oxidising agent than manganate(VII). **B1** it does not oxidise chloride ions under titration conditions, so all the dichromate reacts with iron(II) and the 1 : 6 ratio holds. [3]

B12 RTM-Q20 — **B1** $HCOOH(aq) \rightarrow CO_2(g) + 2H^+(aq) + 2e^-$. **B1** carbon rises from +2 to +4, giving two electrons per molecule, while each MnO_4^- reduced to Mn^{2+} takes five. **B1** the electrons match at ten, so the ratio of MnO_4^- to HCOOH is 2 : 5. [3]

B13 RTM-Q22 — **B1** nitric acid is an oxidising agent, so it would oxidise some of the Fe^{2+} to Fe^{3+} before the titration began. **B1** less Fe^{2+} would be left to react with the manganate(VII), so the titre would be too small and the calculated concentration too low. **B1** sulfate ions are not oxidised by manganate(VII) and sulfuric acid does not oxidise Fe^{2+}, so it supplies the H^+ the half-equation needs without taking part in any other reaction. [3]

© 2026 Ink Learning Ltd. All rights reserved.

THIS BOOK ONLINE



Scan the code, or type the address, to open the questions in this book online:

inklearning.co.uk/chemistry/practise/questions/redox-titrations/

© 2026 Ink Learning Ltd. All rights reserved.