M1.(a) (i) Propanone evaporates (or similar)

1

Removes water (from the precipitate)

Accept 'removes impurities / excess reagents'.

Accept 'salt insoluble in propanone'.

1

(ii) Add NaOH / NH_3 / Na_2CO_3

1

No green ppt

Accept 'no visible change'.

Must have correct reagent to score this mark.

1

(iii) Some salt dissolves (in propanone) **or** some lost in filtration **or** some Fe^{2+} gets oxidised (to Fe^{3+} in air)

Do not accept 'reaction reversible' or 'incomplete reaction' or similar.

1

(iv) Moles $Fe^{2+} = 2.50 \times 10^{-2}$

Accept 2.5×10^{-2}

1

M_r of salt = 179.8

Allow 180

Allow if 179.8 or 180 appears in a calculation.

1

Mass of salt = $179.8 \times 2.5 \times 10^{-2} \times 0.95 = 4.27$ (g)

Correct answer with no working scores this mark only.

Allow range 4.2 to 4.3 (g)

1

(v) 1.67 mol or correct ratio of $5FeC_2O_4 : 3MnO_4^-$

1

(b) $Ca^{2+} + C_2O_4^{2-} \rightarrow CaC_2O_4$

Accept multiples.

1

(c) (Insoluble) calcium ethanedioate coats surface

Allow 'calcium ethanedioate is insoluble'.

Do not allow answers based on ethanedioic acid being a weak acid.

Do not accept 'acid used up' or 'reaction very fast'.

1

(d) Small amount of tea used **or** concentration of the acid in tea is low

Accept 'high temperature decomposes the acid'.

Accept 'calcium ions in milk form a precipitate with the acid'.

Do not accept 'do not drink tea often' or similar.

1

(e) Mass of acid = 180.0 and mass of reagents = 450.0

Accept 180 and 450.

1

(180 / 450 ×100 =) 40.0%

Do not penalise precision.

Correct answer without working scores this mark only.

1

[14]

M2. (a) Hydrogen/H_2 gas/bubbles

1

1.0 mol dm^{-3} HCl/H^+

1

At 298K and 100kPa

Allow 1 bar instead of 100 kPa
Do not allow 1 atm

1

Pt (electrode)

1

(b) $Li^+ + MnO_2 + e^- \rightarrow LiMnO_2$

Ignore state symbols

1

–0.13(V)

1

(c) Fe^{3+} ions reduced to Fe^{2+}

Can score from equation/scheme

1

Because $E(Fe^{3+}/Fe^{2+}) > E(H^+/H_2)$/*E*(hydrogen)

Allow emf/E_{cell} +ve/0.77V
Allow Fe^{3+} better oxidising agent than H^+
Allow H_2 better reducing agent than Fe^{2+}
Only award this explanation mark if previous mark given

1

(d) Moles $Cr_2O_7^{2-}$ = $\underline{23.7 \times 0.01/1000}$ = 2.37×10^{-4}

1

1 mol $Cr_2O_7^{2-}$ reacts with 6 mol Fe^{2+} so moles Fe^{2+} in 25 cm^3 = $6 \times 2.37 \times 10^{-4} = 1.422 \times 10^{-3}$

1

M1 × 6

Moles Fe^{2+} in 250 cm^3 = 1.422×10^{-2}

M2 × 10 or M4/10

1

Original moles Fe^{2+} = $\underline{10.00/277.9}$ = 0.0360

Independent mark

1

Moles Fe^{2+} oxidised = 0.0360 – 0.0142 = 0.0218

M4 – M3

1

% oxidised = (0.0218 × 100)/0.0360 = 60.5%

(M5 × 100)/M4
Allow 60 to 61
Note Max 3 if mol ratio for M2 wrong
eg 1:5 gives 67.1%
1:1 gives 93.4%
Note also, 39.5% (39-40) scores M1, M2, M3 and M4 (4 marks)

1

[14]

M3. (a) (i) 0.00301/ 3.01 × 10^{-3};

Penalise < 3sf in (a)(i);
Allow 3.01 × 10^{-3} – 3.05 × 10^{-3}.
(for candidates who have used Mg as 24)

1

(ii) 0.00602
Allow correct answer a(i) × 2.

1

(iii) 0.00965/ 9.65 × 10^{-3};
Allow 0.009646/ 0.0096-0.0097.

1

(iv) 0.00363 moles;
Allow range 0.0035 to 0.0037.
Allow (a)(iii) – 2 (a)(ii) (must be positive).

1

(b) PV = nRT;
Allow all capitals/ lower case.

1

$V = \frac{0.512 \times 8.31 \times 298}{96000}$;

M2 Mark is for <u>all numbers correct</u>.
If units in answer are in dm^3 allow this expression with 96 in denominator.

1

0.0132 m^3/ 13.2 dm^3;

M3 <u>Must have correct units</u>/
allow 13200 cm^3.
Allow min 2 sig figs in answer.

1

(c) O = 69.6 (%);

1

$\frac{30.4}{14}$ $\frac{69.6}{16}$ 2.17 : 4.35

Use of 7/8 CE then M1 only.

1

(1 : 2) <u>NO_2</u>

Mark for formula not ratio.
If NO_2 and no working shown then allow 1 mark.
If 69.6% + NO_2 only = 2.
Need to see evidence of M2 working.
Allow M2 conseq on the wrong M1 (ie max 1).

1

[10]

M4. (a) (i) M_r = 132.1

1

132

0.0238

Allow 0.024
Allow 0.0237
Penalise less than 2 sig fig once in (a)

1

(ii) 0.0476

1

0.0474-0.0476
Allow (a) (i) × 2

(iii) 1.21

Allow consequential from (a) (ii)
ie allow (a) (ii) × 1000/39.30
Ignore units even if wrong

1

(b) $\frac{34 \times 100}{212.1}$

Allow mass or Mr of desired product times one hundred divided by total mass or Mr of reactants/products
If 34/212.1 seen correctly award M1

1

= 16.0(3)%

Allow 16%
16 scores 2 marks

1

(c) 100(%)

Ignore all working

1

(d) PV = nRT or n = $\frac{PV}{RT}$

If rearranged incorrectly lose M1 and M3

1

n = $\frac{100000 \times 1.53 \times 10^{-2}}{8.31 \times 310}$

M2 for mark for converting P and T into correct units in any expression

1

= 0.59(4)

Allow 0.593
M3 consequential on transcription error only not on incorrect P and T

1

(e) (Na_2SO_4) H_2O
(44.1%) 55.9%

M1 is for 55.9

1

44.1/142.1 55.9/18
0.310 3.11
= 1 = 10

Alternative method gives180 for water part = 2 marks

1

x = 10

X = 10 = 3 marks
10.02 = 2 marks

1

[13]