

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 / NH₃ / Na₂CO₃

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 Fe²⁺ gets oxidised (to Fe³⁺ in air)

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

1

(iv) Moles Fe²⁺ = 2.50×10^{-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 $5\text{FeC}_2\text{O}_4 : 3\text{MnO}_4^-$

1

(b) $\text{Ca}^{2+} + \text{C}_2\text{O}_4^{2-} \rightarrow \text{CaC}_2\text{O}_4$

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

$(180 / 450 \times 100 =) 40.0\%$

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

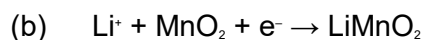
Allow 1 bar instead of 100 kPa

Do not allow 1 atm

1

Pt (electrode)

1

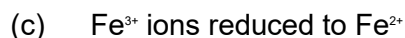


Ignore state symbols

1

-0.13(V)

1



Can score from equation/scheme

1

Because $E(\text{Fe}^{3+}/\text{Fe}^{2+}) > E(\text{H}^+/\text{H}_2)/E(\text{hydrogen})$

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 $\text{Cr}_2\text{O}_7^{2-} = \underline{23.7 \times 0.01/1000} = 2.37 \times 10^{-4}$

1

1 mol $\text{Cr}_2\text{O}_7^{2-}$ reacts with 6 mol Fe^{2+} so moles
 Fe^{2+} in 25 $\text{cm}^3 = 6 \times 2.37 \times 10^{-4} = 1.422 \times 10^{-3}$

1

M1 × 6

Moles Fe^{2+} in 250 $\text{cm}^3 = 1.422 \times 10^{-2}$

M2 × 10 or M4/10

1

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

Independent mark

1

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

M4 – M3

1

% oxidised = $(0.0218 \times 100)/0.0360 = 60.5\%$

$(M5 \times 100)/M4$
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) $0.00301/ 3.01 \times 10^{-3}$;

Penalise < 3sf in (a)(i);

Allow $3.01 \times 10^{-3} - 3.05 \times 10^{-3}$.

(for candidates who have used Mg as 24)

1

(ii) 0.00602

Allow correct answer $a(i) \times 2$.

1

(iii) $0.00965/ 9.65 \times 10^{-3}$;

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 all numbers correct.

If units in answer are in dm³ allow this expression with 96 in denominator.

1

0.0132 m³/ 13.2 dm³;

*M3 Must have correct units/
allow 13200 cm³.*

Allow min 2 sig figs in answer.

1

(c) O = 69.6 (%);

1

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

Use of 7/8 CE then M1 only.

1

(1 : 2) NO₂

Mark for formula not ratio.

If NO₂ and no working shown then allow 1 mark.

If 69.6% + NO₂ 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) (Na₂SO₄) H₂O
(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 gives 180 for water part = 2 marks

1

x = 10

X = 10 = 3 marks
10.02 = 2 marks

1

[13]