M1. (a) (i) <u>4.98 × 10^{-3}</u>

Only

1

(ii) 2.49 × 10^{-3}
Allow answer to (a)(i) ÷ 2
Allow answers to 2 or more significant figures

1

(iii) 2.49 × 10^{-2}
Allow (a)(ii) × 10
Allow answers to 2 or more significant figures

1

(iv) 138.2
3.44 divided by the candidate.s answer to (a)(iii)
138.2 or 138.1 (i.e. to 1 d.p.)

1

(v) (138 – 60) ÷ 2 = 39.1
Allow 39 – 39.1
Allow ((a)(iv) – 60) ÷ 2

1

K/potassium
Allow consequential on candidate's answer to (a)(iv) and (a)(v) if a group 1 metal
Ignore + sign

1

(b) PV = n RT or rearranged
If incorrectly rearranged CE = 0

1

$$T = \frac{0.022 \times 100000}{0.658 \times 8.31}$$

Correct M2 also scores M1

Page 2

402(.3) K (or 129 °C)

> *allow 402-403K*
> *or 129-130 °C*
> *do not penalise °K*
> *M3 must include units for mark*

(c)   Pressure build up from gas/may explode/stopper fly out/glass shatters/breaks

> *Penalise incorrect gas*

(d)   (i) M_r = 84.3

> *If 84 used, max 1*

$\dfrac{6.27}{84.3}$ = 0.074(4)

> *CE if not 84 or 84.3*
> *Allow answers to 2 or more significant figures*
> *M2 = 0.074-0.075*

(ii)   M1 M_r MgSO$_4$ = 120(.4)

> *allow 120.3 and 120.1*
> *CE if wrong Mr*

M2   Expected mass MgSO$_4$ = 0.074(4) × 120(.4) = 8.96 g

> *Allow 8.8 – 9.0 or candidate's answer to (d)(i) × 120(.4)*

M3   95% yield = $\dfrac{8.96 \times 95}{100}$ = 8.51 g

> *Allow 8.3 – 8.6*
> *M3 dependent on M2*

Alternative method

M2   0.074(4) × 95/100 = 0.0707

M3   0.0707 × 120(.4) = 8.51 g

> *Allow (d)(i) × 95/100*

Page 3

Allow 8.3 – 8.6
M3 dependent on M2

1

[15]

M2.(a)   2-6 drops / 0.1-0.3 cm^3
Accept 'a few drops'

1

(b)   Incorrect volume recorded / space will fill during titration / produces larger titre value
Do not accept 'to give an accurate result' without further qualification
Do not accept references to contamination

1

[2]

M3.(a)   34.0
Penalise precision once

1

(b)   1.76 mol dm^{-3}

1

(c)   answer to (b) divided by 0.05
35(.3) on correct figures

1

Shows working
Correct answer only scores this mark
Lose this mark if any units are given for the factor

Page 4

M4.   (a)   (i)   Ammonia

If reagent is missing or incorrect cannot score M3

1

Starts as a pink (solution)

1

Changes to a yellow/straw (solution)
Allow pale brown
Do not allow reference to a precipitate

1

        (ii)   (dark) brown

Do not allow pale/straw/yellow-brown (i.e. these and other shades except for dark brown)

1

    (b)   (i)   Ruby/red-blue/purple/violet/green

Do not allow red or blue
If ppt mentioned contradiction/CE =0

1

Green

If ppt mentioned contradiction/CE =0

1

$[Cr(H_2O)_6]^{3+} + 6OH^- \rightarrow [Cr(OH)_6]^{3-} + 6H_2O$

1

Formula of product
Can score this mark in (b) (ii)

1

        (ii) $H_2O_2 + 2e^- \rightarrow 2OH^-$

1

$2[Cr(OH)_6]^{3-} + 3H_2O_2 \rightarrow 2CrO_4^{2-} + 8H_2O + 2OH^-$

Allow 1 mark out of 2 for a balanced half-equation such as
$Cr(III) \rightarrow Cr(VI) + 3e^-$
or $Cr^{3+} + 4H_2O \rightarrow CrO_4^{2-} + 8H^+ + 3e^-$ etc

Page 5

also for 2Cr(III) + 3H$_2$O$_2$ → 2CrO$_4^{2-}$ (unbalanced)

2

Yellow

Do not allow orange

1

(c)   2MnO$_4^-$ + 6H$^+$ + 5H$_2$O$_2$ → 2Mn^{2+} + 8H$_2$O + 5O$_2$
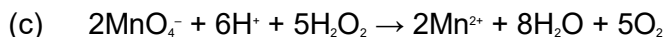
if no equation and uses given ratio can score M2, M3, M4 & M5

1

Moles MnO$_4^-$ = (24.35/1000) × 0.0187 = <u>4.55 × 10^{-4}</u>

Note value must be quoted to at least 3 sig. figs.

M2 is for 4.55 × 10^{-4}

1

Moles H$_2$O$_2$ = (4.55 × 10^{-4}) <u>× 5/2</u> = 1.138 × 10^{-3}

M3 is for × 5/2 (or 7/3)

Mark consequential on molar ratio from candidate's equation

1

Moles H$_2$O$_2$ in 5 cm^3 original

M4 is for × 10

1

= (1.138 × 10^{-3}) <u>× 10</u> = 0.01138

Original [H$_2$O$_2$] = 0.01138 <u>× (1000/5)</u> = 2.28 mol dm^{-3}

(allow 2.25-2.30)

M5 is for consequentially correct answer from (answer to mark 4) × (1000/5)

Note an answer of between 2.25 and 2.30 is worth 4 marks)

If candidate uses given ratio 3/7 max 4 marks:

M1: Moles of MnO$_4^-$ = <u>4.55 × 10^{-4}</u>

M2: Moles H$_2$O$_2$ = (4.55 × 10^{-4}) <u>× 7/3</u> = 1.0617 × 10^{-3}

M3: Moles H$_2$O$_2$ in 5 cm^3 original

= (1.0617 × 10^{-3}) × 10 = 0.01062

M4: Original [H$_2$O$_2$] = 0.01062 × (1000/5) = 2.12 mol dm^{-3}

(allow 2.10 to 2.15)

1

[17]

M5.(a)   pV = nRT

> *Do not penalise incorrect use of capitals / lower case letters.*
> *Accept correct rearrangement of equation.*

1

   (b) $2C_4H_{10} + 5O_2 \rightarrow 4CH_3COOH + 2H_2O$

> *Accept any correct combination of multiples, including fractions.*

1

   (c)   23.0 g ethanol produces 30.0 g ethanoic acid

1

   15.1% (4.54 ×100 / 30)

> *Do not penalise precision.*
> *15.1% scores 2 marks.*
> *Accept consequential answer on wrong mass of ethanoic acid for second mark only.*

1

[4]

M6.(a)   (i)   0.150

> *Accept 0.15*

1

   (ii)   0.0750

> *Accept 0.75*
> *Accept consequential answer from (i)*

1

   (iii)   106.0

> *Must have M_r to 1 d.p. to score mark.*
> *Only penalise once in paper*
> *Do not penalise correct answer in g.*

Ignore wrong units.

1

     (iv)   7.95

           Accept consequential answer from (ii) and (iii).

1

  (b)   Hazard: (acid) corrosive
       Precaution: eye protection / gloves

           Both hazard and appropriate precaution needed for 1 mark.

           Do not accept 'toxic' as hazard.

           Accept 'irritant <u>vapour</u>' and 'fume cupboard'.

           Do not accept 'ingest'.

1

[5]