M1.(a)   Fe + H$_2$SO$_4$ → FeSO$_4$ + H$_2$

> *Accept multiples.*
> *Ignore state symbols, even if incorrect.*

1

   (b)   Hazard   acid corrosive **or**
                  hydrogen flammable / explosive

> *Accept 'iron(II) sulfate / sulfuric acid an irritant'.*

1

        Precaution   gloves or eye protection **or**
                    avoid naked flames / spark

> *Allow 'if reagent contacts skin wash off immediately' or*
> *answers to that effect instead of gloves.*
> *Do not allow 'wipe up spillages'.*
> *Ignore 'lab coat' or 'use of fume cupboard' or 'do not ingest*
> *chemicals'.*

1

[3]

M2.   (a)   (i) M_r MgO = 40.3

> *If used 40 then penalise this mark but allow consequential*
> *M2 (0.0185)*

1

              0.741/40.3 = 0.0184

> *0.018 with no M_r shown = 0*
> *Penalise if not 3 sig figs in this clip only*

1

        (ii)   0.0184 × 5/2 = 0.0460

> *Allow 0.0459 to 0.0463*
> *Allow their (a)(i) × 5/2 ie allow process mark of × 5/2 but*
> *insist on a correct answer being written down*
> *Ignore sig figs*

1

(b)   pV = nRT

$$(V = \frac{0.402 \times 8.31 \times 333)}{100\,000})$$

           If rearranged incorrectly then lose M1
           If this expression correct then candidate has scored first mark

    0.0111

           Ignore units

    11.1 (dm^3)

           3 marks for 11.1 (dm^3)
           However if 11.1 m^3 or cm^3 allow 2 (ie penalise wrong units in final answer)
           Ignore sig figs- but must be 2 sig figs or greater

(c)   (i)   0.0152 × 2 = 0.0304
                Allow 0.03

    (ii)   0.938 mol dm^{-3}
                Allow range 0.92 – 0.94
                Minimum 2 sig figs
                Allow consequential marking from (c)(i)
                Ignore units even if wrong

1

1

1

1

1

[8]

M3.(a)   Any **two** from:

    Weigh by difference or rinse weighing bottle <u>and</u> add to beaker

    Rinse beaker <u>and</u> add washings to graduated flask

    Invert flask several times to ensure uniform solution

    Use a funnel to transfer to the flask <u>and</u> rinse the funnel

Use a stirrer to prepare the solution <u>and</u> rinse the stirrer

If more than two answers apply the list rule.

<div align="right">**Max 2**</div>

(b) $K_a = [H^+]^2 / [HA]$

        Allow any correct expression relating K_a, [H^+] and [HA]

<div align="right">**1**</div>

    [HA] = $(10^{-2.50})^2 / 1.07 \times 10^{-3}$

        M2 also scores M1

<div align="right">**1**</div>

    = 9.35×10^{-3} (mol dm^{-3})

        Do not allow 9.4 (answer is 9.346).

        Correct answer only scores 1 mark.

        Do not penalise precision but must be to at least two significant figures.

<div align="right">**1**</div>

(c)   (b) × 138.0 / 4

<div align="right">**1**</div>

    = 0.322

        Using 8.50×10^{-3} gives 0.293

        Correct answer scores M1 and M2.

        Do not penalise precision but must be to at least two significant figures.

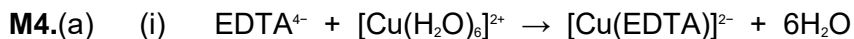<div align="right">**1**</div>

(d)   (c) × 100 / 0.500 = 64.5%

        Using 0.293 from (c) gives 58.7%

        Using 0.347 gives 69.4%

        Do not penalise precision.

<div align="right">**1**</div>

<div align="right">**[8]**</div>

M4.(a) (i) $EDTA^{4-} + [Cu(H_2O)_6]^{2+} \rightarrow [Cu(EDTA)]^{2-} + 6H_2O$

1

(ii) (Mol EDTA = (6.45/1000) ×0.015 =)9.68×10^{-5} mol Cu(II)

1

Conc. Cu(II) = ((9.68×10^{-5}) / 0.025 =) 0.00387 mol dm^{-3}
Correct answer without working gains M2 only.

1

(b) Samples may not be consistent throughout the river
OR
Concentration may vary over time
Ignore comments on technique.

1

(c) $[Ag(NH_3)_2]^+$
Accept name eg diamminesilver(I) ion.

1

aldehyde
Allow CHO.

1

[6]

M5.(a) Theoretical mass produced = 180 × 2 / 138 = 2.61 g
Using 1.76 × 100 / 2 is a chemical error (CE), scores 0 / 2

1

Percentage yield = 1.76 × 100 / 2.61 = 67.5%
Correct answer scores M1 and M2.
Accept 67.4%
Do not penalise precision but answers must be to at least two significant figures.

1

(b)   Crystals lost when filtering or washing / some aspirin stays in solution / other reactions occurring

Ignore references to impurities.

                                                                        1
                                                                        [3]

M6.   (a)   (i)   <u>0.0212</u>

Need 3 sig figs

Allow correct answer to 3 sig figs eg 2.12 x 10^{-2}

                                                                        1

(ii)   0.0106

Mark is for (a)(i) divided by 2 leading to correct answer 2 sig figs

                                                                        1

(iii) M_r = <u>100.1</u>

1.06 g

Allow 100.1 as 'string'

Need 3 sig figs or more

Consequential on (a)(ii) x 100(.1)

                                                                        2

(iv)   Neutralisation or acid / base reaction

Allow acid / alkali reaction

Apply list principle

                                                                        1

(b)   (i)   T = 304(K) and P = 100 000 (Pa)

Only T and P correctly converted

                                                                        1

$$\frac{100\,000 \times 3.50 \times 10^{-3}}{8.31 \times 304} \quad OR \quad n = \frac{PV}{RT}$$

                                                                        1

0.139 (mol)

Allow <u>0.138 – 0.139</u>

                                                                        1

(ii)   0.0276 – 0.0278(mol)

Allow answer to (b)(i) divided by 5 leading to a correct answer

Allow 0.028

1

(c)   4.20 g $Ca(NO_3)_2$

1

$Ca(NO_3)_2$ H_2O

$$\frac{4.20}{164(.1)} \qquad \frac{1.84}{18}$$

Mark is for dividing by the correct Mr values
M2 and M3 dependent on correct M1

0.0256   0.102

M2 can be awarded here instead

1   :   3.98

$x = 4$

If $Ca(NO_3)_2.4H_2O$ seen with working then award 3 marks
Credit alternative method which gives $x = 4$

1

[12]

M7.(a)   Mol Pb = 8.14 / 207(.2) (= 0.0393 mol)

M1 and M2 are process marks

1

Mol HNO_3 = 0.0393 × 8 / 3 = 0.105 mol

Allow mark for M1 × 8/3 or M1 × 2.67

1

Vol HNO_3 = 0.105 / 2 = 0.0524 (dm^3)

Accept range 0.0520 to 0.0530

No consequential marking for M3
Answer to 3 sig figs required

1

(b)　101000 (Pa) and 638 × 10⁻⁶ (m³)

1

n = pV/RT　　(= $\underline{101000 × 638 × 10^{-6}}$)　　(　8.31 ×
298　　　　　　)

Can score M2 with incorrect conversion of p and V
If T incorrect lose M1 and M3

1

<u>0.026</u>(0) (mol)

If answer correct then award 3 marks
Allow answers to 2 sig figs or more
26.02 = 1
If transcription error lose M3 only

1

(c)　(i)　$2Pb(NO_3)_2(s) \rightarrow 2\ PbO(s)+ 4NO_2(g) + (1)O_2(g)$
Allow multiples
Allow fractions

1

　　(ii)　Decomposition not complete / side reactions / by-products / some (NO_2)
escapes / not all reacts / impure $Pb(NO_3)_2$
Ignore reversible / not heated enough / slow

1

　　(iii)　Hard to separate O_2 from NO_2 / hard to separate the 2 gases
Allow mixture of gases
Not 'all products are gases'

1

[9]