M1.(a) $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

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 × <u>5/2</u> = 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

1

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

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

0.0111

1

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

1

(c) (i) 0.0152 × 2 = 0.0304

Allow 0.03

1

(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

[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.

Max 2

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

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

1

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

M2 also scores M1

1

$= 9.35 \times 10^{-3}$ (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.

1

(c) (b) × 138.0 / 4

1

= 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.

1

(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.

1

[8]

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

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

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

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

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} (m^3)

1

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

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]