

M1.(a) any **one** from:

- solution becomes colourless or colour fades
- zinc becomes bronze / copper coloured
allow copper (forms) or a solid (forms)
- zinc gets smaller
allow zinc dissolves
- bubbles or fizzing.
ignore precipitate

1

(b) improvement:

use a plastic / polystyrene cup or add a lid

accept use lagging / insulation

1

reason - must be linked

reduce / stop heat loss

OR

improvement:

use a digital thermometer

allow use a data logger

reason - must be linked

more accurate or easy to read or stores data

allow more precise or more sensitive

ignore more reliable

ignore improvements to method, eg take more readings

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There is a statement about the results.

Level 2 (3–4 marks)

There are statements about the results. These statements may be linked or may include data.

Level 3 (5–6 marks)

There are statements about the results with at least one link and an attempt at an explanation.

Examples of chemistry points made in the response:

Description:**Statements**

Concentration of copper sulfate increases

Temperature change increases

There is an anomalous result

The temperature change levels off

Reaction is exothermic

Linked Statements

Temperature change increases as concentration of copper sulfate increases

The temperature change increases, and then remains constant

After experiment 7 the temperature change remains constant

Statements including data

The trend changes at experiment 7

Experiment 3 is anomalous

Attempted Explanation

Temperature change increases because rate increases

Temperature change levels off because the reaction is complete

Explanation

As more copper sulfate reacts, more heat energy is given off

Once copper sulfate is in excess, no further heat energy produced

6

[9]

M2.(a) any **three** from:

- concentration of (salt) solution
- volume of (salt) solution
ignore amount of solution
- **initial** temperature (of the solution)
ignore room temperature
- surface area / form of metal
- moles of metal
allow mass / amount
ignore time
ignore size of tube

3

(b) 20

1

32

1

12

allow ecf

1

- (c) (i) four bars of correct height
tolerance is + / - half square
3 correct for 1 mark

2

bars labelled

1

- (ii) *one variable* is non-continuous / categoric
accept qualitative or discrete

accept no values between the metals

1

(iii) magnesium

1

because biggest temperature change

accept gives out most energy

ignore rate of reaction

dependent on first mark

1

(iv) does not react / silver cannot displace copper

1

because silver not more reactive (than copper) **or** silver below copper in reactivity series

*do **not** accept silver is less reactive than copper sulfate*

1

(v) replace the copper sulfate

could be implied

1

with any compound of a named metal less reactive than copper

allow students to score even if use an insoluble salt

1

[16]

- M3.(a)** eg plastic (beaker) / insulation / lid / cover **or** any mention of enclosed
any sensible modification to reduce heat loss
ignore prevent draughts
ignore references to gas loss
ignore bomb calorimeter 1
- (b) all the substances react **or** all (the substances) react fully / completely **or** heat evolved quickly **or** distribute heat
'so they react' is insufficient for the mark
accept increase chances of (successful) collisions / collision rate increase
*do **not** accept rate of reaction increase / make reaction faster* 1
- (c) experiment 2 **and**
 different / higher / initial / starting temperature
*accept experiment 2 **and** the room is hotter / at higher temperature*
*do **not** accept temperature change / results higher* 1
- (d) temperature change does not fit pattern
*accept anomalous / odd **or** it is the lowest **or** it is lower than the others **or** it is different to the others*
'results are different' is insufficient 1
- (e) 7 / 7.0 1
- (f) $(100 \times 4.2 \times 7) = 2940$
ecf from (e) 1

- (g) diagram A **and**
reaction exothermic / heat evolved / ΔH is negative / temperature rises
accept energy is lost (to the surroundings)
accept energy of products lower than reactants
allow arrow goes downwards

1

[7]

M4. (a) any **one** from:

- no method / electrolysis / equipment / technology
allow 'didn't know how to' or 'no knowledge'
- aluminium is a very reactive metal
- high melting point
allow 'couldn't heat it enough'
- potassium had not been discovered

1

(b) because others / scientists / they could not repeat the experiment

ignore he could not repeat the experiment

or

others / they could not obtain the same results

1

(c) reaction is endothermic **or**
reaction takes in heat / energy

accept activation energy

ignore rate / high temperature

ignore bonds broken

1

(d) (aluminium chloride + potassium) → aluminium + potassium chloride

in either order

accept correct formulae

ignore metal

ignore balancing

1

(e) when tested it had the properties of a metal

accept a test for a metal property eg conductivity / reaction with acid

1

properties were different (from other known metals)
accept properties compared with other metals

1

[6]

M5. (a) gives out energy **or** heat 1

(b) (i) *accept qualified answers in terms of volume of gas related to time*
fast initially 1

slows down 1

reaction stops
accept reaction is now very slow 1

(b) (ii) 21 1

(iii) 84
correct answer with or without working = 2 marks
allow ecf from (b)(ii) correctly calculated for 2 marks
*allow evidence of 21/25 **or** (b)(ii)/25 for 1 mark* 2

(c) because they / particles have more energy / move faster
ignore particles move more / vibrate 1

(and so) particles collide more often / more frequently **or** particles more likely to collide
ignore collide faster
ignore more collisions 1

(and) more of the collisions are successful **or** particles collide with more energy / harder **or** more of the particles have the activation energy
accept more successful collisions

1

[10]

M6. (a) gives out heat / energy
allow release / loses
allow the products have less energy

or

energy / heat transferred to the surroundings
ignore temperature rises
allow more energy given out in forming bonds than taken in to break bonds

1

(b) (i) speed up the reaction (owtte)
accept changes the rate
accept lowers activation energy
accept increases successful collisions
accept allows reaction to take place at a lower temperature

1

(ii) nitrogen (N₂) / oxygen (O₂) / products are safe **or** not harmful / pollutant / toxic / dangerous / damaging
ignore releases nitrogen / oxygen unless qualified

or

(harmful) nitrogen monoxide / NO is not released into the air.
accept prevents / less acid rain
ignore greenhouse gas / ozone layer

1

(iii) 2 and 2
accept correct multiples or fractions

1

(iv) idea of catalyst not being used up
allow not changed by reaction
ignore catalyst does not take part

ignore catalyst not used in the reaction

1

(v) idea of different reactions (require different catalysts)

accept catalysts work for specific reactions

allow different gases

1

(c) • smaller / very small / or any indication of very small / 1–100 nanometres /
a few (hundred) atoms

ignore just small

ignore size of the converter

1

• big(ger) surface area

1

• less (catalyst) needed / small amount of catalyst needed

1

[9]