

Reactivity of Metals

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.4 Chemical Changes
Sub-Topic	Reactivity of Metals
Difficulty Level	Silver Level
Booklet	Mark Scheme 1

Time Allowed: 59 minutes

Score: /58

Percentage: /100

Grade Boundaries:

M1.(a)	408 kg	1
(b)	all points correct $\pm \frac{1}{2}$ small square <i>allow 1 mark if 5 points correct</i> best fit line	2 1
(c)	$\frac{1989}{36} \times 100$	1
	5525 dm ³	1
(d)	relative formula mass of TiCl ₄ is 190	1
	25.26 %	1
	Answer given to 3 significant figures = 25.3 %	1
	<i>25.23% with or without working gains 3 marks</i>	
(e)	argon is unreactive	1

water (vapour) would react with sodium

allow water (vapour) would react with titanium(IV) chloride

1

and air contains oxygen that would react with reactants

allow and air contains oxygen that would react with products

1

- (f) (titanium conducts electricity) because electrons in the outer shell of the metal atoms are delocalised

1

and so electrons are free to move

allow the delocalised electrons in the metal carry electrical charge through the metal

1

through the whole structure

1

[15]

M2.(a) Ionic

1

- (b) electrolyte

1

- (c) because the ions are free to flow

1

- (d) because potassium is higher in the reactivity series than hydrogen

1

so it is less easily discharged than hydrogen

1

(e) because water is covalent / molecular / contains molecules

1

so there are no free electrons to move **or** does not have an overall electrical charge

1

(f) conductivity of the solution increases with concentration

1

in a linear relationship **or** directly proportional

1

[9]

M3.(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]

M4.(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]

M5.(a) any **two** from:

- copper / ores are running out / harder to find
- there are no / very small amounts of high-grade copper ores left
- copper metal is in demand
- copper is expensive

- now economical to extract copper from low-grade ores
it = copper
allow new methods of extraction e.g. bioleaching and phytomining
allow high-grade ores are running out for 2 marks

2

- (b) (i) large amounts / 98% of rock to dispose of as waste
accept contains toxic (metal) compounds / bioleacher

or waste rock takes up a lot of space

1

- (ii) (copper sulfide reacts with oxygen to) produce sulfur dioxide / SO_2
allow (sulfur reacts with oxygen to) produce sulfur dioxide / SO_2

1

that causes acid rain

*allow description of effects of acid rain **or** sulfur dioxide*
*if no other mark awarded allow CO_2 produced which causes global warming **or** CO_2 produced by burning fuel or heating the furnace for 1 mark*

1

- (iii) any **one** from:

- large amounts of fuels / energy used (for the furnace and electrolysis)
allow large amounts of electricity needed
ignore high temperature / electrolysis unqualified
- (the extraction has) many steps / stages / processes
allow (extraction) is a long process / takes a lot of time
- large amounts of ore / material have to be mined
allow ores contain a low percentage of copper

1

- (iv) (copper ions move towards) the negative electrode / *cathode*

1

because copper ions / Cu^{2+} are positively charged **or** are oppositely charged **or** copper ions need to gain electrons

*allow because metal ions are positive **or** opposites attract*

1

(v) (growing) plants

1

[9]