

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	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 60 minutes

Score: /57

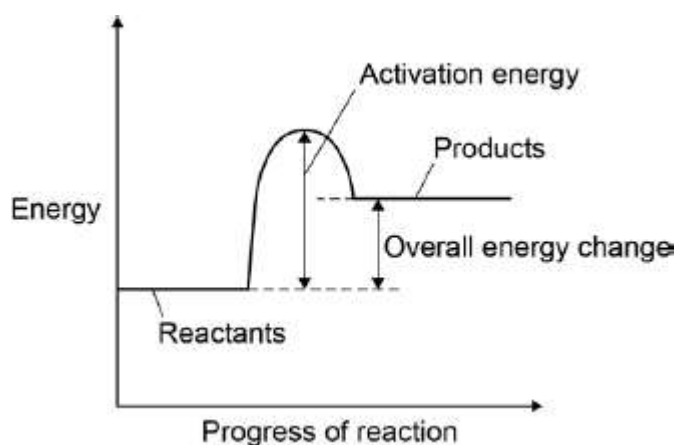
Percentage: /100

Grade Boundaries:

M1.(a) the relative energies of the reactants, products and the overall energy change

1

the activation energy



1

(b) $(4 \times 413) + (2 \times 498) = 2\,648$

1

$$(2 \times 805) + (4 \times 464) = 3\,466$$

1

$$(3466 - 2648 =) 818 \text{ (kJ / mol)}$$

1

allow max 2 marks for one ecf

(c) **Level 3 (5–6 marks):**

A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered with the dependent and control variables correctly identified. The method would lead to the production of valid results.

Level 2 (3–4 marks):

The bulk of a method is described with mostly relevant detail, which demonstrates a

reasonable understanding of the relevant scientific techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):

Simple statements are made which demonstrate some understanding of some of the relevant scientific techniques and procedures. The response may lack a logical structure and would not lead to the production of valid results.

0 marks:

No relevant content

Indicative content

Named apparatus

- thermometer
- measuring cylinder
- stirring rod
- spatula
- plastic cup (with lid) or beaker
- stopwatch
- filter paper or watch glass
- balance

Method

- weigh the same mass of each metal in each same state of division eg powder
- measure a set volume of sulfuric acid into a plastic cup or beaker
- measure and record the temperature of the sulfuric acid
- add metal W into the plastic cup or beaker
- stir and record the highest temperature or record the temperature after a set time
- calculate the increase in temperature
- repeat the method for metals X, Y and Z
- repeat for each metal at least three times to calculate a mean

Safe use

- comment on safe use should include wearing safety glasses

6

(d) **W>Y>X>Z**

1

reason for position of **W** and **Z**

***W** reacts with most solutions whereas **Z** reacts with none of the solutions*

1

reason for position of **X** and **Y**

Y is more reactive than X because Y reacts more with sulfuric acid

1

(e) magnesium is most reactive because not displaced by any metal

1

zinc is second most reactive because displaced by only one metal

1

copper and hydrogen cannot be placed in order of reactivity or are least reactive because

1

they both are displaced by the most / three metals

1

experiment – add sulfuric acid to copper because copper is less reactive than hydrogen
then copper would not react with sulfuric acid to displace hydrogen

1

[19]



1

correct formulae of products

1

correct balancing

1

(b) iron loses oxygen – reduction

1

carbon gains oxygen – oxidation

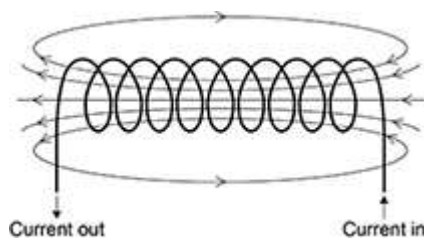
1

(c) any **four** from:

- resources for manufacture are limited
- recycling reduces the use of resources
- reduces energy consumption in extraction / manufacture
- reduces waste from processing and extraction
- reduces environmental impact of extraction

4

(d)



field lines going through and around coil

1

correct directional arrows

1

(e) any **two** from:

1 mark for suggestion, 1 mark for correctly linked explanation

- use many coils **or** tight coils **or** long wire (1)
- to give a strong magnetic field for lifting heavy objects (1)
explanation must be correctly linked to the suggestion to gain the mark

or

- add an iron core
- to increase field circuit for lifting

or

- include a switch in circuit
- so can drop / pick up cars

max. 4

[15]

M3.(a) did not appear because they had not been discovered or they are unreactive or they did not form compounds

1

(b) arranged in order of atomic / proton number

1

elements in the same group have the same number of electrons in the outer shell

1

(c) chlorine>bromine>iodine

table shows that chlorine displaces bromine and iodine

1

and bromine displaces iodine

1

(d) $\text{Cl}_2(\text{aq}) + 2 \text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2 \text{Cl}^-(\text{aq})$
correct formulae

1

correct balancing

1

correct state symbol

1

- (e) the further down the group, the halogen becomes less reactive because outer electrons are further from the nucleus

1

so less attractive force on an incoming electron

1

[10]

- M4.** (a) unreactive / near bottom of reactivity series

1

- (b) carbon more reactive / higher up reactivity series

1

- (c) very reactive / near top of reactivity series

1

cannot use displacement methods / can only be extracted by electrolysis / had to wait discovery of electricity

1

[4]

- M5.** (a) react with oxygen / oxidise / burn in oxygen / burning / combustion **or** tungsten to tungsten oxide **or** makes an oxide

key idea is oxidation

ignore breaking ignore fire / flames / exothermic

ignore react with air

1

- (b) it is (very) unreactive / not reactive / inert / does not react with tungsten **or** it is a noble gas **or** it is in group 0 or 8 or 18

*do **not** accept unreactive / inert metal **or** argon is not very reactive*

1

full outer shell (of electrons) / 8 electrons in outer shell

1

does not need to gain / lose / swap / transfer / share electrons **or** does not need to form bonds

does not bond ionically / covalently

1

[4]

M6. (a) any **one** from:

- light(er) / less dense
ignore stronger
- resistant to acids / alkalis / chemical
accept resistant to corrosion

1

(b) any **two** from:

*it must be clear
list principle applies
allow reverse argument
ignore reference to temperature*

- magnesium is more reactive than titanium
magnesium is above titanium in the reactivity series
- titanium is more reactive than carbon
- magnesium is more reactive than carbon
- magnesium is most reactive
- carbon is least reactive

2

(c) any **three** from:

*it = titanium
ignore references to cost / easier / usefulness alone **or**
references to incorrect processes*

- takes a long time to process
- low abundance (of ore)

- small amount produced
- batch process used **or** blast furnace is continuous
- more stages used to manufacture titanium
allow ≥ 3 / many / several
- more energy used (per tonne of titanium)
allow high energy requirement
ignore references to temperature
- magnesium / chlorine is expensive
- labour intensive

3

[6]