

GCSE CHEMISTRY

Topic Paper: 4.1, 4.3 and 10.1 Extraction of metals
Part 1 & 2 Mark Scheme

MARK SCHEME



53 Marks



M1. (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]

M2.

(a) (i) reduction

accept redox / smelting

1

(ii) 3 4 3

1

(b) (i) 55

ignore other units

(ii) Water

accept sodium hydroxide

accept correct formulae H_2O or $NaOH$

1

(iii) any **one** from:

save energy / fuel for transporting the ore

accept less (cost of) transport allow transported quickly

(old) quarries nearby for waste/red mud

1

(c) **Environmental**

any **one** from:

less mining / quarrying (of bauxite)

allow loss of habitat / less qualified noise pollution

less landfill space needed / used

allow less red mud / waste

less use of fossil fuels / energy

less carbon dioxide produced

1

Ethical or social

any **one** from:

saves resources

allow using resources more than once

creates (local) employment

if answers reversed and both correct award 1 mark

more people aware of the need for recycling

allow less qualified noise pollution if not given in environmental

1



- M3.** (a) any **one** from:
ignore references to cost / mining / availability
there are many stages needed (to extract titanium)
allow longer / slower / more complicated process / batch process
more energy / materials are needed (to extract titanium)
ignore higher temperature ignore reference to electrolysis
titanium cannot be extracted by using carbon
*do **not** accept titanium extracted by electrolysis* 1
- (b) carbon dioxide
allow CO₂ 1
- (c) magnesium chloride is electrolysed / used / decomposed 1

magnesium and / or chlorine are recycled / reused
allow the products of electrolysis are recycled
word / symbol equation = 1 mark 1
- (d) *accept titanium for magnesium*

because oxygen / nitrogen (in air) would react with the magnesium
or
would produce magnesium oxide / nitride 1

whereas argon is inert / unreactive **or** argon does not react with magnesium
ignore argon is in Group 0 / noble gas 1
- (e) 240 1
- (f) 250
allow range 245 to 250 1



- M4.** (a) (very) small percentage / amount (in the Earth's crust)
any indication that there is a small amount, eg not much (left)
accept rare (elements) / rarer
accept not commonly found
ignore cannot find easily
ignore hard to extract 1
- (b) (i) oxygen / O₂ / O
do not accept O² 1
- (ii) any **one** from:
potassium / K
sodium / Na
calcium / Ca
magnesium / Mg
symbols must be correct
write name and incorrect symbol,
ignore symbol 1
- (c) (i) heating (with) **or** hot air blown into furnace
accept high temperatures or (very) hot 1
- carbon / carbon monoxide / coke / coking coal
do not accept coal / charcoal accept balanced equation only
- or**
carbon reacts with O₂ **or** carbon / coke burning (1)
accept balanced equation only CO / CO₂
- CO reacts with the ore (1)
for naming the reducing agent 1
- (ii) cost of melting ore / electricity
makes aluminium expensive (owtte)
or (large amount of) electricity used
or because you have to use electrolysis
or aluminium is higher in the reactivity series
or aluminium is harder to reduce
or unable to reduce with carbon
or the cost of purifying the bauxite
do not accept harder to extract / produce more energy is not enough 1

[6]



- M5.** (a) (Chromium =) 20 1
- in correct order
- (Nickel =) 8
accept Chromium = 8 and Nickel = 20 for 1 mark 1
- (b) (i) (because iron is made up of only) one type of atom 1
- (ii) not strong
ignore soft / corrosive / flexible
accept it rusts / corrodes or that it could wear away
accept could change shape / bend
accept layers / atoms could slide (over each other) 1
- (iii) has different sized atoms / particles
or
structure is different/distorted / disrupted
accept not in layers or not regular 1
- so it is difficult for layers / atoms / particles to slip / slide (over each other)
accept layers cannot slip / slide 1
- [6]**
-
- M6.** (a) (i) because large amounts of energy would be needed to extract the copper
accept because it is labour-intensive to extract copper from this land
accept because copper would have to be extracted from a large area of land (owtte) 1
- (ii) any **one** from:
produces large amounts of solid waste
atmospheric pollution from carbon dioxide / sulfur dioxide
more lorries / traffic 1
- (b) (i) iron is cheap
accept iron is much more abundant than copper 1
- (ii) iron displaces copper from solutions of its salts
accept iron is more reactive than copper 1



(c) (i) any **two** from:

less expensive / energy to extract the small amounts of copper

plants will remove carbon dioxide from the atmosphere as they grow

can release energy when plants are burned

2

(ii) not continuous as it takes a long time for plants to grow

accept supply not continuous as plants only harvested once / twice a year

1

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M7. (a) any **one** advantage from:

conserves resources (of crude oil / metal ores)

ignore can be made into other items

allow the materials (in the pen) are non-renewable

allow less expensive than producing from the raw material

reduces use of landfill

ignore less waste

less use of fuels/energy

less carbon dioxide produced

ignore global warming unqualified

1

any **one** disadvantage from:

made of different polymers / alloys / materials

difficulty / cost of separating the different materials

allow not all the materials can be recycled

1

(b) hard / strong / durable

1

resistant to corrosion **or** unreactive

allow do not rust

*do **not** allow corrosive*

1

(c) (i) vapours (of decane)

ignore pressure / hot / heat

allow high temperature (≥ 150 °C)

1



passed over a catalyst **or** porous pot **or** aluminium oxide

allow catalyst even if incorrectly named

1

or

mixed with steam (1)

at a (very) high temperature (1)

if temperature quoted, must be ≥ 500 °C

(ii) many monomers **or** many ethene molecules

1

join / bond

allow addition polymerisation for second mark

1

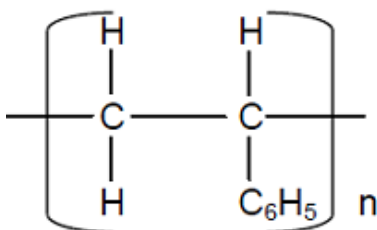
OR

monomers / ethene molecules (1)

form chains **or** very large molecules (1)

*if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for 1 mark*

(d)



allow bonds that do not extend through brackets

7 single bonds are used and are in the correct places with no additional atoms (1)

the brackets and the n are in the correct place (1)

2

[10]