AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.10.3 USING MATERIALS

SCORE	PERCENTAGE
/271	%

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Mark schemes

Q1.

(a)

property	J	K
density in g/cm^3		
melting point in °C		✓
flame resistance		✓
water absorption	✓	

*three correct = **2** marks*
*one or two correct = **1** mark*

2

(b) $\frac{1.4 \times 6.0}{0.90}$

1

= 9.3 (kg)

allow 9.3(333…)(kg)

1

*an answer of 9.3(333…)(kg) scores **2** marks*

(c) polymer **L** will not melt

1

(d) polymers are more hard-wearing

1

(e) any **two** from:

- (wool / sheep) renewable
  allow wool grows back, etc.
- (wool) will not run out
  ignore (wool is) readily available
- (crude oil) non-renewable
  allow finite
- (crude oil) will run out
  ignore references to cost
  ignore properties from tables 1 and 2

2

[8]

Q2.

(a) tin

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1

(b) 70 (%)

1

(c) $\frac{90}{100} \times 1100$

1

= 990 (g)

1

(d) mixture of metals

1

(e) (red brass) contains more copper
allow converse

1

(so) layers slide more easily
or
layers are less distorted

1

(f) 24

1

[8]

Q3.

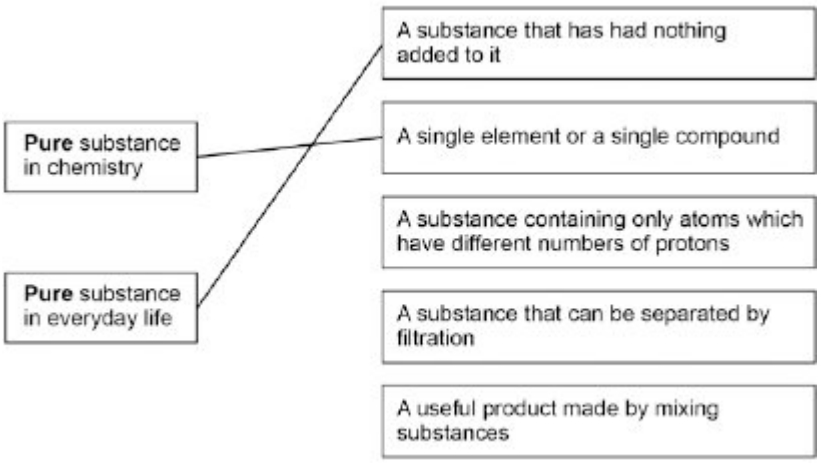
(a) Air

2

Steel

1

(b)



Allow **1** mark for the correct meanings linked to context but incorrect way around

1

(c) Damp litmus paper turns white

1

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(d) Iron(III)

1

[6]

Q4.

(a) 50

1

(b) 5%

1

(c) any **two** from:

- cost (9 carat is cheaper)
- pure gold is soft
  or
  24 carat gold is soft
  or
  9 carat gold is harder
  allow 9 carat gold is stronger
  allow gold is an alloy in 9 carat gold
- can change the colour

2

[4]

Q5.

(a) 1×10^{-2} g

1

(b) $\frac{0.46}{8.45} \times 100$

1

(test tube 1) 5.44 %
and
(test tube 2) 0.854 %

1

4.586

1

4.59

1

allow ecf answer correctly calculated to 3 significant figures
*allow 4.59 with no working for **4** marks*
*allow 4.586 with no working for **3** marks*

(c) **Level 3 (5–6 marks):**
Detailed and coherent conclusions based on the evidence together with an evaluation
are given in a response that is coherent and well-structured. A range of relevant points is made demonstrating a broad understanding of the key scientific ideas.

Level 2 (3–4 marks):

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An attempt to relate relevant points and draw conclusions or to make an evaluation. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Simple descriptive statements are made. The logic may be unclear and any conclusions,
if present, may not be consistent with the reasoning.

0 marks:
No relevant content.

Indicative content

Simple statements

- nail rusted in test tubes 1 and 5
- test tubes 1 and 4 contained air / oxygen and water
- nail did not rust in test tubes 2, 3 and 4
- test tube 2 no water present
- test tube 3 no air / oxygen present
- test tube 4 paint stopped rusting
- test tube 6 scratched galvanised iron did not rust
- test tube 6 galvanising stopped rusting

Conclusions

- both water and oxygen are required for rusting
- coatings that prevent water and oxygen reaching the metal prevent rusting
- when paint is scratched, iron comes into contact with water and oxygen and the iron rusts
- in test tube 5 less iron exposed so less rusting than in test tube 1
- galvanising is better at resisting rusting than paint when scratched
- zinc is more reactive than iron, so when galvanised metal is scratched, zinc reacts with water and oxygen first / sacrificially

Evaluation

- oil and paint are effective at preventing rusting when the coating is intact galvanising is the most effective coating because it prevents rusting even
when scratched.

6

(d) iron + oxygen + water

*all three needed for **2** marks*

*2 correct = **1** mark*

ignore air

2

[13]

Q6.

(a) all points correct

±1 small square

allow 1 mark for 6 or 7 plots

2

Year	Percentage (%) of bottles made from

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	other materials
1975	5
1980	10
1985	22
1990	42
1995	70
2000	72
2005	90
2010	95

1

(b) **Level 3 (5–6 marks):**
A detailed and coherent argument is provided which considers a range of issues and comes to a conclusion consistent with the reasoning.

Level 2 (3–4 marks):
An attempt to describe the advantages and disadvantages of the production and uses is made, which comes to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Simple statements made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

0 marks:
No relevant content.

Indicative content

- glass – 2 stages in production of soda-lime glass
- glass – second stage, heating sand, limestone and sodium carbonate
- HDPE – 3 stages in production
- HDPE – second stage, cracking of naphtha to obtain ethene
- HDPE – third stage, polymerisation of ethene
- fewer stages in glass production, may be quicker
- higher temperature in glass manufacture, therefore maybe higher energy requirement
- glass bottle can be reused
- consideration of collection / cleaning costs to reuse glass bottles
- other glass products can be made from recycled glass
- plastic has greater range of sizes
- both produced from limited raw materials
- higher percentage recycled materials in glass conserves raw materials

This indicative content is not exhaustive, other creditworthy responses should be awarded marks as appropriate.

6

[9]

Q7.

(a) (i) hard

ignore strong

1

(ii) hundred

1

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(b) (i) Covalent

1

(ii) 3

1

(iii) Soft and slippery

1

(c) (i) cross-links

allow bonds

ignore links

*do **not** accept intermolecular*

1

(ii) melt

1

(iii) any **two** from:

- temperature

  allow heat(ing)
- pressure
- catalyst

2

(d) (i) CH_4

1

(ii) Small molecules

1

[11]

Q8.

(a) has delocalised electrons

accept free (moving) electrons

1

(so electrons) can move through the structure/metal

accept (so electrons) can carry charge through the structure/metal

accept (so electrons) can form a current

1

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 1***

(b) giant structure

accept lattice

accept each atom forms four bonds (with other carbon atoms)

ignore macromolecular

1

strong bonds

accept covalent

*do **not** accept ionic*

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1

*reference to intermolecular forces/bonds **or** incorrect particles = **max 1***

(c) thermosetting polymers do not melt (when heated)

accept thermosetting polymers do not change shape (when heated)

accept thermosetting polymers have high(er) melting points

ignore thermosetting polymers do not soften (when heated)

1

due to cross-links (between chains)

accept due to bonds between chains

1

*reference to smart polymers = **max 1***

accept converse argument

[6]

Q9.

(a) The ore is not pure or contains impurities or the ore does not contain 100% of the metal compound

allow to concentrate the metal or metal compound

1

rock / other compounds need to be removed / separated

1

(b) (i) (cast iron is) brittle

allow not strong

ignore weak

1

(ii) the oxygen reacts with carbon

allow carbon burns in oxygen or is oxidised

1

reducing the percentage of carbon in the mixture
or producing carbon dioxide

1

(c) (i) aluminium has a low density

1

(ii) (because copper) is in the central / middle (block of the periodic table)

1

whereas aluminium is in Group 3 (of the periodic table)

1

(iii) iron is more reactive (than copper)

ignore cost

1

so copper is displaced / reduced

1

[10]

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Q10.

(a) sodium loses (electron)

sharing / covalent / metallic = max 2

1

chlorine gains (electron)

1

1 **or** an (electron)

1

(b) (i) Have no overall electric charge

1

(ii) Should iodine be added to salt?

1

reason
any **one** from:

- cannot be done by experiment
  accept difficult to get / not enough evidence
- based on opinion / view
  allow must be done by survey
- ethical **or** economic issue.

1

(c) (i) nitric (acid)

1

(ii) an alkali

1

(iii) indicator

accept any named acid base indicator

1

(d) (i) Crystallisation

1

(ii) fertiliser

allow to help crops grow

1

(iii) any **one** from:

- pressure
  allow concentration
- temperature
  ignore heat
- catalyst.

1

[12]

Q11.

(a) giant structure / lattice / layers / close packed

first 3 marks can be obtained from a suitably labelled diagram

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incorrect structure or bonding or particle = max 3

1

made up of atoms / <u>positive</u> ions

1

with delocalized / free electrons

1

so electrons can move / flow through the metal

accept so electrons can carry charge through the metal
accept so electrons can form a current

1

(b) an alloy (is a metal which) has different types / sizes of atoms

accept converse for pure metal throughout
both marks can be obtained from suitable diagrams
allow made of different metals
allow mixture of metals / atoms / elements
ignore particles
ignore properties
*do **not** accept compound*

1

alloy has distorted layers

allow layers are unable to slide

1

(c) (i) can return to its original shape

accept shape memory alloy
accept smart alloy
ignore other properties

1

(ii) (pure copper is too) soft

accept converse
accept malleable or bends
accept copper is running out
ignore references to strength and weakness

1

(iii) aluminium oxide

accept alumina
accept Al_2O_3
ignore bauxite / aluminium ore

1

(iv) any **one** from:

- different conditions
- different catalyst
- different pressure

allow different concentration

- different temperature.

*do **not** accept different monomers*

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1

(d) any **two** from:
- accurate
- sensitive
- rapid
- small sample.

both needed for 1 mark

1

[11]

Q12.

(a) (i) brown

1

(ii) oxygen + iron + water ⟶ hydrated iron oxide / rust

allow correct symbol equation

ignore oxidation numbers for product

1

(b) (i) 32.3

1

(ii) 7.6

ecf from (b)(i)

1

(iii) do not know start volume of air

1

because the burette not graduated to the end

allow iron wool takes up some of the space

*if no other marks awarded accept all iron may have rusted (**1**) **or** still some oxygen left / not all used up (**1**)*

1

(c) (i) gains oxygen and water **or** oxygen and water are added

allow reacts with or gains oxygen

allow reacts with or gains water

allow reacts with or gains elements which add to mass

ignore iron oxide forms

1

(ii) as temperature increases (from 10 °C to 42 °C or to 50 °C) the increase in mass of nail increases

accept positive correlation

accept mass increases

1

rate of increase gets faster as temperature goes up

accept exponential

ignore non linear

1

no further increase at temperatures over 42 °C

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accept no further increase at high temperatures

*exponential increase scores **2** marks*

1

(iii) use a (bigger) flask **or** let air into the tube **or** leave for less time **or**

ignore more water

1

to make sure sufficient oxygen / air **or** not all oxygen used up

accept converse

*if no other marks awarded allow change in surface area for rusting **or** change in number of nails for **1** mark*

1

[12]

Q13.

(a) alloy

1

(b) in mixture:

different sized / bigger atoms

1

so there are no layers / rows / lines (to slide)

accept converse

1

(c) any **two** from:

ignore references to bend and mould

- cost
- toxicity
- strength
- *appearance of brace*
- *unreactive **or** resistant to corrosion / saliva*

allow rusting as alternative to corrosion

2

(d) crosslinks

allow lines / bonds between the rows / chains

1

[6]

Q14.

(a) (i) an alloy

1

(ii) harder

1

(b) (i) 162.5

*correct answer with or without working gains **2** marks*

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*if no answer or incorrect answer then evidence of correct working [56 + (3x35.5)] gains **1** mark*

2

(ii) 34.46

accept rounding from 34 - 34.5

*correct answer with or without working gains **2** marks*

*accept ecf from (b)(i) correctly calculated for **2** marks*

*if no answer or incorrect answer then evidence of 56 / 162.5 **or** 56 / answer to (b)(i) gains **1** mark*

2

[6]

Q15.

(a) (Chromium =) 20

in correct order

1

(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

*allow too soft **or** too 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) 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]

Q16.

(a) (i) many ethene / molecules / monomers

accept double bonds open / break

accept addition polymerisation

1

join to form a long hydrocarbon / chain / large molecule

ignore references to ethane

*correct equation gains **2** marks*

1

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(ii) (can be deformed but) return to their original shape (when heated or cooled)

ignore 'it remembers its shape'

1

(iii) cross links / extra bonds in PEX

it = PEX throughout

accept inter-molecular bonds
ignore inter-molecular forces

1

molecules / chains in PEX are held in position

accept rigid structure

1

molecules / chains in PEX unable to slide past each other / move

1

(b) any **four** from:

ignore costs / sustainability / non-renewable

- less (hydrocarbon) fuels used

  allow less energy

- less / no electrical energy used

  allow no electrolysis

- reduce carbon / carbon dioxide emissions

  allow less global warming

- reduce / no pollution by sulfur dioxide / acid rain

  allow less / no transportation

- continuous process

- conserve copper which is running out or only low-grade ores available

  allow less waste

- reduce the amount of solid waste rock that needs to be disposed

  allow less mining

- reduce the need to dig large holes (to extract copper ores)

4

[10]

Q17.

(a) any **one** from:

- disposal / lack of space / does not decompose in landfill sites

  ignore non-biodegradable alone

- other specified problems with waste (e.g. litter **or** eyesore **or** harm to animals **or** destroys habitats)

  ignore pollution unqualified

1

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(b) (i) (from) orange

allow red / brick red / brown / yellow

1

(to) colourless

allow decolourised

*do **not** allow discoloured*

ignore clear

1

(ii) one carbon−carbon bond and four carbon−hydrogen bonds correctly drawn

*do **not** accept h*

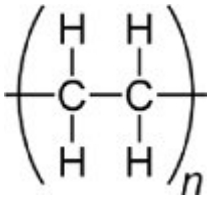
1

two trailing / connecting bonds extending beyond brackets

1

structure in bracket and n at the bottom right corner only

*do **not** accept N*



*would score **3** marks*

1

(c) there are (covalent) bonds / links <u>between chains</u> **or** crosslinks

*any mention of <u>ionic</u> bonds or strong intermolecular <u>forces</u> scores a maximum of **2** marks*

allow intermolecular bonds

1

which are strong

1

so the bonds between chains cannot be (easily) overcome / broken (by heating)

allow bonds between chains require a lot of energy to be broken

allow so molecules cannot move past each other / separate

ignore converse for thermosoftening

1

[9]

Q18.

(a) (alloy) atoms / ions / particles not in layers

accept layers are distorted

accept different (size) particles / atoms

1

so, (alloy) layers / atoms / ions / particles can't slide

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*if no other mark awarded allow (an alloy) is a mixture of metals for **1** mark*

1

(b) diamonds have a giant covalent structure

1

diamonds have strong bonds between carbon atoms

1

(c) (i) a compound

1

(ii) CH_4

1

(iii) covalent

1

(d) methane has a low boiling point
or boiling point less than 20°C molecules

1

because it has small molecules

accept it has forces between molecules

*accept weak forces between molecules for **2** marks*

1

[9]

Q19.

(a) because atoms / ions / particles in alloy are different (sizes)

*do **not** allow reference to molecules*

ignore reference to compounds

1

so layers distorted

(and layers / atoms / ions / particles) don't slide **or** slide less easily

accept all marking points in a suitably labelled or annotated diagram

1

*if no other mark awarded accept an alloy is a mixture **or** contains different metals / elements for **1** mark*

1

(b) giant structure **or** lattice **or** macromolecule

*max **3** marks if incorrect bonding*

1

strong bonds (between carbon / atoms)

1

covalent (bonds)

1

each carbon / atom forms 4 bonds

accept tetrahedral

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*if no other marks awarded, allow carbon (atoms) for **1** mark*

1

(c) *reference to incorrect bonding = max **3***
*reference to 'weak covalent bonds' = max **2***
allow correctly drawn diagram for first two marking points eg. (tangled) lines with no cross-links

chains **or** large molecules

ignore layers

1

with intermolecular forces **or** forces between chains

allow bonds for forces accept no cross-links

1

that are weak

must relate to 2 nd marking point

1

and are easily overcome/ broken (when heated)

accept molecules / chains can flow / move

1

[11]

Q20.

(a) +1/+

*do **not** accept 1 without the +*

1

electron

allow phonetic spelling

1

(b) (i) elements

1

(ii) non-metal

1

(c) soft

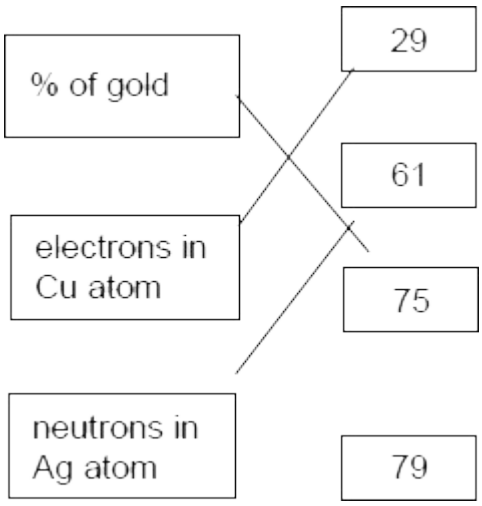
1

an alloy

1

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(d)



one *mark for each correct link*
extra lines lose the mark

3

[9]

Q21.

(a) 2,4

allow electrons in any position on correct shells

1

(b) (electron) 79

1

neutron

allow phonetic spelling

1

118

1

(c) (i) 16 **and** 9

in this order

1

(ii) any **two** from:

ignore reasons about colour / lustre / corrosion / rarity

- (100% / pure) gold is soft
  allow layers can slide in pure gold
- (alloyed) to make the metal hard(er)
  ignore just 'the ring is an alloy'
  allow (alloyed) to stop the layers sliding
  allow (alloyed) to make the metal strong
- gold is expensive **or** alloy is less expensive

2

[7]

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Q22.

(a) (i) 2.5(kg)

ignore units

1

(ii) 40% (cement) **and** Test 3

ignore units

1

because it is anomalous or because it is much lower than the other two readings

accept value not used to calculate mean

ignore outlier

1

(iii) as the percentage of cement increases the mass needed to break the sleeper increases

allow 'strength' for 'mass needed'

allow correct relationship using percentage of sand

1

(iv) volume/percentage / amount of water

accept temperature

1

(b) any **two** from:

- availability (of the raw materials)
- cost of the raw materials
- purity (of the raw materials)

2

[7]

Q23.

(a) 2.5

*correct answer with or without working gains **2** marks*

if answer incorrect

2.6 / 2.625 / 2.62 / 2.63

***or** recognise 3.0 as anomalous gains **1** mark*

accept answer in table

ignore units

2

(b) as the percentage of cement increases the mass needed to break the sleeper increases

*allow 50% cement is the strongest **or** 30% sand is the strongest **or** the highest amount of cement is the strongest*

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or

as the percentage of sand increases the mass needed to break the sleeper decreases

1

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

- availability of materials
- cost (of materials)
- time needed (for the concrete mixture) to set/harden
- compression strength (of the concrete)
  accept weight of the train
- testing full size (concrete railway sleepers)
  accept any test on full size sleepers
  accept 'how well it would last / weather'

2

(ii) any **four** from:

*maximum of **3** marks if no comparison made*
ignore yes or no

negative concrete:

allow converse statements for wood

- more fossil fuel / energy / heat (needed to produce cement / concrete)
- cement / concrete resources / limestone not renewable whereas wood is renewable
- quarrying limestone destroys landscapes / habitats whereas growing wood improves landscapes / habitats
  allow quarrying causes noise pollution / dust / etc.
- making cement / concrete releases carbon dioxide / greenhouse gases whereas growing wood absorbs carbon dioxide / greenhouse gases / is carbon neutral
  allow making cement / concrete
  causes global warming / climate
  change whereas growing wood
  reduces global warming / climate change
  ignore loss of trees / deforestation (and resultant effects such as an increase in CO_2)

positive concrete:

- (less resources are needed because) cement / concrete sleepers last longer **or** wood rots / needs replacing
  ignore strength / ease of breaking
  ignore weathering / effects of acid rain

4

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[9]

Q24.

(a) 79

1

79

1

(b) hundred

1

(c) (i) electron(s)

1

(ii) three

1

(d) changes rate of reaction

accept lowers activation energy

or

speeds up / slows down reaction

accept reduces costs

1

(e) (i) melt

1

(ii) crosslinking

allow answers on diagram

or

(covalent) bonds between polymers / chains

allow bonds between layers
*do **not** allow intermolecular*

1

[8]

Q25.

(a) (i) cryolite

1

(ii) lower the melting point of the aluminium oxide

1

(b) (i) opposite charges **or** oxide ions are negative

1

attract

1

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(ii) carbon

1

(iii) reacts with oxygen **or** forms carbon dioxide

accept burns

1

(c) **Structure mark:**

either Al (atoms) in layers / rows

accept Al (atoms) all the same size
allow Al (atoms) in lines

or alloy (atoms) not in layers / rows

accept different sizes of atoms in alloy
allow alloy (atoms) not in lines

1

Sliding mark:

either so (Al layers) can slide

or so (alloy) layers cannot slide

1

[8]

Q26.

(a) causes dust pollution

1

increases traffic

1

(b) (i) it is soft

accept the layers of atoms can slide over each other
ignore other properties

1

(ii) contains chromium / nickel

allow contains other metals

1

(c) (i) an element

1

(ii) hard

1

(iii) is resistant to corrosion

1

[7]

Q27.

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(a) (i) contains enough metal to <u>make it economical</u> to extract

1

(ii) Fe (+) CO_2

formula of both products must be correct

1

(Fe_2O_3) (+) ....3....(CO)

→

.....2.....(Fe) (+) .....3...(CO_2)

balancing correct

allow correct balancing using Fe_2

1

(iii) reduction

accept redox

1

(b) (i) oxygen <u>reacts</u> with the carbon to produce carbon dioxide

allow carbon monoxide for carbon dioxide

1

OR

carbon dioxide is produced (1)

which escapes as a gas (1)

1

(ii) to give steels with <u>different</u> / particular properties or for <u>different</u> / <u>particular</u> uses

ignore to make different alloys

1

(c) copper is very expensive

accept the metal (iron / steel) costs less than copper

ignore energy

1

because copper ores are 'low grade' / running out

allow copper is rare

ignore nickel

1

[9]

Q28.

(a) alloys

1

(b) bar drawn correctly up to 4%

ignore width of bar

1

(c) (contains) <u>more</u> carbon

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ignore contains 4% carbon
accept higher level responses related to structure / arrangement of atoms

1

(d) (i) 73.8

1

(ii) mild (steel)

1

(iii) corrosion

1

[6]

Q29.

(a) atoms

1

(b) mixture

1

metal

1

structure

1

smart

1

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

- saves raw materials / iron ore
- saves energy / fuels
  accept cheaper / saves money
- make new / useful items
- make money / it is economic
- <u>reduces</u> pollution
  allow less harmful for the environment
- decreases cost of steel cans
- reduces carbon dioxide emissions
- decreases waste materials / use of landfill

2

(ii) any **one** from:

- provide information / education of the need to recycle
- legislate against / charge for waste

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- reward / pay people to recycle
  accept fine people for not recycling
- put labels on the cans
- provide recycling bags / bins / areas

1

[8]

Q30.

(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]

Q31.

(a) (i) reacts with carbon / C

accept burns / oxidises carbon

1

carbon dioxide / CO_2 / gas is formed / given off

accept carbon monoxide / CO
accept correctly balanced equation for ***2*** *marks*
ignore state symbols

1

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(ii) change / improve properties

accept any specific property

accept to make alloys / special steels

ignore brittle

1

(b) any **two** from:

- to conserve ores / iron

  accept ores / iron are non-renewable / non-sustainable
  allow less quarrying / mining

- to prevent the use of landfills

  allow reduce waste

- to conserve energy / fuel

  accept fossil fuels are non-renewable

- to reduce carbon / carbon dioxide emissions

- to meet EU / International targets

  ignore costs / demand

2

[5]

Q32.

(a) (i) many ethene / molecules / monomers

accept double bonds open / break

1

join to form a long hydrocarbon / chain / large molecule

accept addition polymerisation

ignore references to ethane

*correct equation gains **2** marks*

1

(ii) (can be deformed but) return to their original shape (when heated or cooled)

ignore 'it remembers its shape'

1

(iii) cross links / extra bonds in PEX

accept inter-molecular bonds
ignore inter-molecular forces

1

molecules / chains in PEX are held in position

accept rigid structure

1

molecules / chains in PEX unable to slide past each other / move

it = PEX throughout

1

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(b) any **four** from:

- less (hydrocarbon) fuels used
  allow less energy
- less / no electrical energy used
  allow no electrolysis
- reduce carbon / carbon dioxide emissions
  allow less global warming
- reduce / no pollution by sulfur dioxide / acid rain
- continuous process
  allow less / no transportation
- conserve copper which is running out or only low-grade ores available
- reduce the amount of solid waste rock that needs to be disposed
  allow less waste
- reduce the need to dig large holes (to extract copper ores)
  allow less mining
  ignore costs / sustainability / non-renewable

4

[10]

Q33.

(i) zinc

accept Zn

1

iron only

accept Fe

1

copper

accept Cu
do not credit iron

1

(ii) iron

1

(iii) copper **or** iron or manganese

*accept Cu **or** Fe **or** Mn*

1

[5]

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