AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.7

Properties of metals and alloys

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**45**
Available paper years	**2007–2024**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.2.2.7 Properties of metals and alloys

Answer 01 · Mark scheme January 2007 | CHY1H | Original Q3 | Legacy

Question 3

	answers	extra information	mark
(a)(i)	contain enough metal to make it economical / worth while to extract		1
(ii)	reduction	accept displacement accept redox	1
(iii)	Fe + CO_2	do **not** accept Fe_2 / Fe_4	1
	correct balancing	accept multiples and halves	1
	2Fe_2O_3 + **3**C → **4**Fe + **3**CO_2	allow Fe_2 / Fe_4 as ecf	
(b)	**Pure Iron** (in pure metal all the atoms are the same size and) able to slip / slide over each other – (property soft)	OWTTE ignore references to molecules / particles. if they say 'move' both times, allow **one** mark but 'crack' or 'split' is wrong.	1
	Cast iron (in cast iron) different sized atoms / larger atoms **or** structure is distorted / disrupted	OWTTE	1
	so it is difficult for layers of atoms to slip / slide over each other	OWTTE	1
(c)	any **three** from: • conserves / saves resources / metal ores • saves energy resources (used for extraction / processing) • decreases waste materials • decreases a named pollution	accept cheaper / saves money do **not** accept acid rain	3
total			10

4.2.2.7 Properties of metals and alloys

Answer 02 · Mark scheme

March 2007 | CHY1A | Original Q5 | Legacy

Five	**A**	aluminium	**4**
	B	calcium	**2**
	C	sodium	**1**
	D	zinc	**3**

Answer 03 · Mark scheme

March 2007 | CHY1A | Original Q9 | Legacy

Nine	**2**	**3**	**4**	**2**

4.2.2.7 Properties of metals and alloys

Answer 03 · Mark scheme

March 2007 | CHY1A | Original Q9 | Legacy

CHY1A (Products from Rocks) Higher Tier

Question	Key		
One	**A**	calcium carbonate only	**1**
	B	calcium oxide only	**3**
	C	calcium carbonate and calcium oxide	**2**
	D	carbon dioxide only	**4**
Two	**A**	**2**	
	B	**1**	
	C	**4**	
	D	**3**	

	A	B	C	D
Three	**3**	**2**	**3**	**3**
Four	**2**	**3**	**4**	**2**
Five	**3**	**4**	**3**	**3**
Six	**2**	**3**	**3**	**2**
Seven	**3**	**2**	**3**	**3**
Eight	**3**	**1**	**1**	**3**
Nine	**1**	**4**	**2**	**1**

4.2.2.7 Properties of metals and alloys

Answer 04 · Mark scheme June 2007 | CHY1A | Original Q1 | Legacy

Question	Key		
One	**A**	hard	**3**
	B	resistant to corrosion	**4**
	C	easily shaped	**2**
	D	brittle	**1**

Answer 05 · Mark scheme June 2007 | CHY1A | Original Q2 | Legacy

Two	**A**	an alloy	**4**
	B	an element	**1**
	C	a hydrocarbon	**2**
	D	a mixture of compounds	**3**

	A	B	C	D

Answer 06 · Mark scheme June 2007 | CHY1A | Original Q5 | Legacy

Five	**3**	**2**	**1**	**1**

Answer 07 · Mark scheme June 2007 | CHY1H | Original Q1 | Legacy

The full source mark scheme begins on page 54. Follow original question 1 in that document.

Answer 08 · Mark scheme November 2007 | CHY1A | Original Q2 | Legacy

Two	**A**	pure iron	**3**
	B	an alloy	**1**
	C	a mixture of compounds	**2**
	D	a mixture of elements	**4**

	A	B	C	D

Answer 09 · Mark scheme January 2008 | CHY2H | Original Q2 | Legacy

The full source mark scheme begins on page 67. Follow original question 2 in that document.

4.2.2.7 Properties of metals and alloys

Answer 10 · Mark scheme March 2008 | CHY1AP | Original Q6 | Legacy

Six	**2**	**4**	**2**	**2**

Answer 11 · Mark scheme March 2008 | CHY1AP | Original Q7 | Legacy

Seven	**2**	**3**	**4**	**4**

Answer 12 · Mark scheme June 2008 | CHY1AP | Original Q7 | Legacy

Seven	**3**	**1**	**3**	**3**

4.2.2.7 Properties of metals and alloys

Answer 13 · Mark scheme

June 2008 | CHY1H | Original Q4 | Legacy

question	answers	extra information	mark
4(a)	any **one** from: • light(er) / less dense • resistant to acids / alkalis / chemical	 ignore stronger accept resistant to corrosion	1
4(b)	any **two** from: • magnesium is more reactive than titanium • titanium is more reactive than carbon • magnesium is more reactive than carbon • magnesium is most reactive • carbon is least reactive	it must be clear list principle applies allow reverse argument ignore reference to temperature magnesium is above titanium in the reactivity series	2

Question 4 continued on the next page...

COMPONENT NUMBER: CHY1H

COMPONENT NAME: Science B / Chemistry

STATUS: Final

DATE: June 2008

Question 4 continued...

question	answers	extra information	mark
4(c)	any **three** from: • 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 • more energy used (per tonne of titanium) • magnesium / chlorine is expensive • labour intensive	it = titanium ignore references to cost / easier / usefulness alone **or** references to incorrect processes allow ≥ 3 / many / several allow high energy requirement ignore references to temperature	3
Total			**6**

4.2.2.7 Properties of metals and alloys

Answer 13 · Mark scheme June 2008 | CHY1H | Original Q4 | Legacy

COMPONENT NUMBER: CHY1H

COMPONENT NAME: Science B / Chemistry

STATUS: Final

DATE: June 2008

Answer 14 · Mark scheme November 2008 | CHY1AP | Original Q2 | Legacy

Two	**A**	It is a pure metal.	**1**
	B	It is the alloy that contains only two metals.	**2**
	C	It is a low carbon steel alloy.	**3**
	D	It is the alloy that contains the most different elements.	**4**

	A	**B**	**C**	**D**

Answer 15 · Mark scheme November 2008 | CHY1AP | Original Q6 | Legacy

Six	**4**	**1**	**1**	**3**

Answer 16 · Mark scheme November 2008 | CHY1AP | Original Q8 | Legacy

Eight	**3**	**4**	**3**	**1**

Answer 17 · Mark scheme March 2009 | CHY1AP | Original Q4 | Legacy

Four	**3**	**2**	**3**	**4**

4.2.2.7 Properties of metals and alloys

Answer 18 · Mark scheme

June 2009 | CHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	reacts with carbon / C carbon dioxide / CO_2 / gas is formed / given off	accept burns / oxidises carbon accept carbon monoxide / CO accept correctly balanced equation for **2** marks ignore state symbols	1 1
4(a)(ii)	change / improve properties	accept any specific property accept to make alloys / special steels ignore brittle	1
4(b)	any **two** from: • to conserve ores / iron • to prevent the use of landfills • to conserve energy / fuel • to reduce carbon / carbon dioxide emissions • to meet EU / International targets	 accept ores / iron are non-renewable / non-sustainable allow less quarrying / mining allow reduce waste accept fossil fuels are non-renewable ignore costs / demand	2
Total			**5**

4.2.2.7 Properties of metals and alloys

Answer 18 · Mark scheme June 2009 | CHY1H | Original Q4 | Legacy

CHY1H

Answer 19 · Mark scheme November 2009 | CHY1AP | Original Q4 | Legacy

Four	**4**	**3**	**2**	**1**

4.2.2.7 Properties of metals and alloys

Answer 20 · Mark scheme

January 2010 | CHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	any **four** from: • giant structure / lattice • positive ions • sea of electrons **or** delocalised / free electrons • awareness of outer shell / highest energy level electrons are involved • (electrostatic) attractions / bonds between electrons and positive ions • bonds / attractions (between atoms/ ions) are strong • a lot of energy / heat is needed to break these bonds / attractions	max **3** marks if any reference made to covalent / ionic bonding / molecules **or** intermolecular forces **or** graphite / diamond **or** forces of attraction between electrons and then ignore throughout ignore layers ignore electrons can move allow hard to break for strong ignore forces unqualified ignore high temperature	4

Question 4 continues on next page

CHY2H

Question 4 continued

question	answers	extra information	mark
4(b)(i)	that they are very small **or** 1–100 nanometres **or** a few (hundred) atoms	accept tiny / really small / a lot smaller / any indication of very small eg microscopic, smaller than the eye can see ignore incorrect numerical values if very small is given	1
4(b)(ii)	any **2** from: • one (non-bonded) electron from each atom • delocalised / free electrons • electron carry / form / pass current / charge	 allow sea of electrons ignore electrons can move ignore carry electricity	2
Total			**7**

4.2.2.7 Properties of metals and alloys

Answer 20 · Mark scheme January 2010 | CHY2H | Original Q4 | Legacy

CHY2H

Answer 21 · Mark scheme March 2010 | CHY1AP | Original Q2 | Legacy

Two	**A**	reduction	**4**	
	B	combustion	**2**	
	C	thermal decomposition	**1**	
	D	corrosion	**3**	

	A	**B**	**C**	**D**

Answer 22 · Mark scheme March 2010 | CHY1AP | Original Q3 | Legacy

Three	**2**	**3**	**2**	**2**

Answer 23 · Mark scheme June 2010 | CHY1AP | Original Q3 | Legacy

Three	**2**	**1**	**1**	**2**

4.2.2.7 Properties of metals and alloys

Answer 24 · Mark scheme

June 2010 | CHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	C	must be correct symbol do **not** accept carbon any balancing must be correct	1
3(a)(ii)	$Fe + CO_2$ 2…. + 3….	correct formulae correct balancing allow $Fe_2 + 3CO_2$ for this mark	1 1
3(a)(iii)	layers / atoms in pure iron are able to slide over each other **or** layers / atoms in cast iron are unable to slide over each other (easily)	it = pure iron accept ions for atoms ignore molecules / particles	1

Question 3 continues on the next page

CHY1H

Question 3 continued

question	answers	extra information	mark
3(b)	any **three** from: • less iron ore used • less other metals extracted / used to make different steels • less fuel used • less specified pollution • less / no landfill space needed • less / no mining needed **or** fewer specified effects of mining	mention of ozone = max **2** accept the idea that ores would be conserved but not unspecified conservation accept the idea that ores would be conserved but not unspecified conservation accept the idea that fuels would be conserved ignore reduces energy requirements accept global warming / greenhouse effect / CO_2 / CO / carbon emissions / acid rain / SO_2 / global dimming / do **not** accept ozone layer ignore reduces waste accept effect such as eyesore / loss of habitat eg 'less mining iron ore' = **2** marks	3
Total			**7**

4.2.2.7 Properties of metals and alloys

Answer 24 · Mark scheme June 2010 | CHY1H | Original Q3 | Legacy

CHY1H

Answer 25 · Mark scheme June 2011 | CHY1AP | Original Q3 | Legacy

Three	**3**	**2**	**4**	**1**

Answer 26 · Mark scheme June 2011 | CHY1AP | Original Q9 | Legacy

Nine	**1**	**2**	**2**	**3**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

4.2.2.7 Properties of metals and alloys

Answer 27 · Mark scheme

June 2011 | CHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)		any mention of molecules / compounds = max **1** allow ions for particles throughout it = brass	
	brass is an alloy **or** brass is a mixture (of metals) **or** brass has different sized / types of atoms / particles	accept brass does not have a regular structure **or** has a disrupted / irregular structure	1
	or in copper all the atoms / particles are the same **or** are the same size / type	accept copper has a regular structure	
	(so) in brass layers / atoms / particles cannot (easily) slide **or** in copper layers / atoms / particles can slide (more easily)	ignore moves easier	1
3(b)(i)	(thermal) decomposition	accept endothermic (reaction) do not accept combustion / burning	1
	by heating	accept in a furnace / kiln	1
3(b)(ii)		they = zinc or lead	
	carbon is more reactive than lead / zinc		1
	(so) lead / zinc oxide is reduced **or** oxygen is removed (by carbon)	accept so lead / zinc oxide reacts with carbon / carbon monoxide accept carbon displaces zinc / lead (from their oxide) allow carbon reacts with the oxygen accept word equation **or** balanced symbol equation	1

Question 3 continues on the next page . . .

4.2.2.7 Properties of metals and alloys

CHY1H

Question 3 continued . . .

question	answers	extra information	mark
3(b)(iii)	(zinc separates / escapes because) zinc boils / turns to a gas (at the temperature of the furnace) **or** the boiling point of zinc is below the temperature of the furnace	ignore density ignore evaporates	1
	lead separates because it melts but does not boil **or** the temperature of the furnace is above the melting point of lead but below its boiling point	ignore density accept lead is molten for lead melts if no other mark awarded allow **1** mark for they (zinc and lead) have different boiling points **or** zinc's boiling point is lower than lead's or vice versa	1
Total			**8**

4.2.2.7 Properties of metals and alloys

Answer 27 · Mark scheme

June 2011 | CHY1H | Original Q3 | Legacy

CHY1H

4.2.2.7 Properties of metals and alloys

Answer 28 · Mark scheme

June 2011 | CHY3H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	(copper) stops barnacles / seaweed (sticking)	it = copper accept lead doesn't stop barnacles / seaweed (sticking) ignore all other properties	1
2(a)(ii)	(Muntz Metal) is less expensive / cheaper / cheapest	it = Muntz Metal must be a comparison accept copper is more expensive ignore other properties	1
2(b)(i)	atomic absorption spec(troscopy) / spectrometry **or** mass spec(trometry) / spectroscopy	accept spectroscopy / spectrometry alone allow AAS / MS do **not** allow NMR spectroscopy **or** IR spectrometry **or** chromatography	1
2(b)(ii)	sensitive **or** detect (very) small amounts **or** only small sample needed	it = instrumental method allow (more) precise ignore accurate allow converse for chemical method ignore metal contains small amount / low concentration of iron	1
2(c)	any **two** from: • unreactive / not very reactive • strong / hard • malleable / easy to shape	transition elements (= they) allow does not corrode ignore reference to rust ignore tough / durable / hard wearing ignore ductile / density / melting point	2
Total			**6**

4.2.2.7 Properties of metals and alloys

Answer 28 · Mark scheme June 2011 | CHY3H | Original Q2 | Legacy

CHY3H

Answer 29 · Mark scheme November 2011 | CHY1AP | Original Q7 | Legacy

Seven	**1**	**2**	**2**	**3**

4.2.2.7 Properties of metals and alloys

Answer 30 · Mark scheme

January 2012 | CH1HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	reduction	accept redox / smelting	1
4(a)(ii)	3 4 3		1
4(b)(i)	55	ignore other units	1
4(b)(ii)	water	accept sodium hydroxide accept correct formulae H_2O or NaOH	1
4(b)(iii)	any **one** from: • save energy / fuel for transporting the ore • (old) quarries nearby for waste/red mud	accept less (cost of) transport allow transported quickly	1

Question 4 continues on the next page …….

CH1HP

Question 4 cont'd…

question	answers	extra information	mark
4(c)	**Environmental** any **one** from: • less mining / quarrying (of bauxite) • less landfill space needed / used • less use of fossil fuels / energy • less carbon dioxide produced **Ethical or social** any **one** from: • saves resources • creates (local) employment • more people aware of the need for recycling	 allow loss of habitat / less qualified noise pollution allow less red mud / waste allow using resources more than once if answers reversed and both correct award **1** mark allow less qualified noise pollution if not given in environmental	1 1
Total			**7**

4.2.2.7 Properties of metals and alloys

Answer 30 · Mark scheme

January 2012 | CH1HP | Original Q4 | Legacy

CH1HP

4.2.2.7 Properties of metals and alloys

Answer 31 · Mark scheme

question	answers	extra information	mark
7(a)	(because to produce low-carbon steel) oxygen is needed to react with / oxidise carbon	accept (to produce low-carbon steel) oxygen removes carbon as carbon dioxide	1
	(to produce titanium) an atmosphere of argon is used because it is unreactive		1
	any oxygen / air would react with / oxidise magnesium or titanium	ignore magnesium chloride / titanium chloride reacts with oxygen	1
7(b)		it = titanium ignore references to abundance / usefulness / temperature / amounts / relative reactivity / equipment	
	for titanium:	allow converse arguments for iron	
	• there are more stages in its manufacture	accept slower rate of production **or** is more labour intensive **or** a batch process is used or the process used is not continuous	1
	• larger amounts of energy are needed	accept the titanium chloride is cooled and reheated which is not energy efficient	1
	• magnesium / chlorine / argon have to be produced **or** are expensive **or** are used		1

4.2.2.7 Properties of metals and alloys

CH1HP

question	answers	extra information	mark
7(c)	titanium is below magnesium and above iron (in the reactivity series of metals)	allow similar position to aluminium **or** carbon **or** zinc	1
	because magnesium removes chlorine from titanium chloride **and** titanium removes oxygen from iron oxide **OR** magnesium more reactive than titanium because it removes chlorine from titanium chloride (1) titanium more reactive than iron because it removes oxygen from iron oxide (1)	allow magnesium displaces titanium **and** titanium displaces iron accept magnesium more reactive than titanium because it displaces titanium accept titanium more reactive than iron because it displaces iron	1
Total			**8**

4.2.2.7 Properties of metals and alloys

Answer 31 · Mark scheme

January 2013 | CH1HP | Original Q7 | Legacy

CH1HP

4.2.2.7 Properties of metals and alloys

Answer 32 · Mark scheme

June 2013 | CH1HP | Original Q1 | Legacy

Question 1

question	answers	extra information	Mark
1(a)(i)	2.8.3	any sensible symbol can be used to represent an electron	1
1(a)(ii)	proton(s) **and** neutron(s)	both needed for the mark	1
1(a)(iii)	number of protons is equal to number of electrons	allow positive and negative charges cancel out allow same amount of protons and electrons	1
1(b)(i)	**2** Al + Fe_2O_3 → **2** Fe + Al_2O_3	equation must be balanced	1
1(b)(ii)	aluminium is more reactive (than iron)	it = aluminium accept converse accept aluminium displaces iron accept aluminium is higher in the reactivity series (than iron)	1
Total			**5**

4.2.2.7 Properties of metals and alloys

Answer 33 · Mark scheme

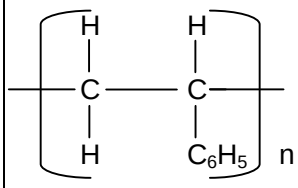
June 2013 | CH1HP | Original Q4 | Legacy

Question 4

question	Answers	extra information	Mark
4(a)	any **one** advantage from:	ignore can be made into other items	1
	• conserves resources (of crude oil / metal ores)	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	
	any **one** disadvantage from:		1
	• made of different polymers / alloys / materials		
	• difficulty / cost of separating the different materials	allow not all the materials can be recycled	
4(b)	hard / strong / durable		1
	resistant to corrosion **or** unreactive	allow do not rust do **not** allow corrosive	1
4(c)(i)		ignore pressure / hot / heat	
	vapours (of decane)	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	

Question 4 continues on the next page

Question 4 continued

question	Answers	extra information	Mark
4(c)(ii)	many monomers **or** many ethene molecules join / bond **OR** monomers / ethene molecules (1) form chains **or** very large molecules (1)	 allow addition polymerisation for second mark if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for **1** mark	1 1
4(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
Total			**10**

4.2.2.7 Properties of metals and alloys

Answer 34 · Mark scheme

June 2013 | CH2HP | Original Q5 | Legacy

Question 5

question	Answers	extra information	Mark
5(a)	because atoms / ions / particles in alloy are different (sizes)	do **not** allow reference to molecules ignore reference to compounds	1
	so layers distorted		1
	(and layers / atoms / ions / particles) don't slide **or** slide less easily	accept all marking points in a suitably labelled or annotated diagram if no other mark awarded accept an alloy is a mixture **or** contains different metals / elements for **1** mark	1
5(b)		max **3** marks if incorrect bonding	
	giant structure **or** lattice **or** macromolecule		1
	strong bonds (between carbon / atoms)		1
	covalent (bonds)		1
	each carbon / atom forms 4 bonds	accept tetrahedral if no other marks awarded, allow carbon (atoms) for **1** mark	1
5(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 2nd marking point	1
	and are easily overcome/ broken (when heated)	accept molecules / chains can flow / move	1
Total			**11**

4.2.2.7 Properties of metals and alloys

Answer 35 · Mark scheme June 2015 | CH1HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	The ore is not pure or contains impurities or the ore does not contain 100% of the metal compound rock / other compounds need to be removed / separated	allow to concentrate the metal or metal compound	1 1	2+3 / 1.3.1b
4(b)(i)	(cast iron is) brittle	allow not strong ignore weak	1	1 / 1.3.2a
4(b)(ii)	the oxygen reacts with carbon reducing the percentage of carbon in the mixture **or** producing carbon dioxide	allow carbon burns in oxygen or is oxidised	1 1	2 / 1.3.2b
4(c)(i)	aluminium has a low density		1	2 / 1.3.3c
4(c)(ii)	(because copper) is in the central/middle (block of the periodic table) whereas aluminium is in Group 3 (of the periodic table)		1 1	1 / 1.3.3a
4(c)(iii)	iron is more reactive (than copper) so copper is displaced/reduced	ignore cost	1 1	1+2 / 1.3.1h/i
Total			10	

4.2.2.7 Properties of metals and alloys

Answer 35 · Mark scheme

June 2015 | CH1HP | Original Q4 | Legacy



4.2.2.7 Properties of metals and alloys

Answer 36 · Mark scheme

June 2015 | CH2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)		first 3 marks can be obtained from a suitably labelled diagram incorrect structure or bonding or particle = max 3		AO1 2.1.h,i 2.2.4a
	giant structure / lattice / layers / close packed		1	
	made up of atoms / positive 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	
3(b)		accept converse for pure metal throughout both marks can be obtained from suitable diagrams		AO1 2,2,4c
	an alloy (is a metal which) has different types / sizes of atoms	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	
3(c)(i)	can return to its original shape	accept shape memory alloy accept smart alloy ignore other properties	1	AO1 2.2.4d

Question 3 continues on the next page

4.2.2.7 Properties of metals and alloys

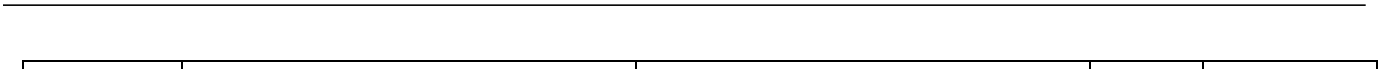
Question 3 continued

3(c)(ii)	(pure copper is too) soft	accept converse accept malleable or bends accept copper is running out ignore references to strength and weakness	1	**AO2** 2.2.4c 2.7.1d
3(c)(iii)	aluminium oxide	accept alumina accept Al_2O_3 ignore bauxite / aluminium ore	1	**AO1** 2.7.1h
3(c)(iv)	any **one** from: • different conditions • different catalyst • different pressure • different temperature	allow different concentration do **not** accept different monomers	1	**AO1** 2.2.5a
3(d)	any **two** from: • accurate • sensitive • rapid • small sample	both needed for 1 mark	1	**AO1** 2.3.2a
Total			**11**	

4.2.2.7 Properties of metals and alloys

Answer 36 · Mark scheme

June 2015 | CH2HP | Original Q3 | Legacy



4.2.2.7 Properties of metals and alloys

Answer 37 · Mark scheme

June 2016 | CH1HP | Original Q3 | Legacy

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	(thermal) decomposition	allow decomposes or endothermic	1	AO1 1.2.1b/c
3(a)(ii)	copper oxide		1	AO2 1.2.1b/c
3(b)(i)	the (potassium) carbonate did not decompose/change/react (when heated) the mass did not change or the limewater did not go cloudy because no carbon dioxide produced	allow temperature not high enough do **not** allow potassium did not decompose ignore references to reactivity	1 1 1	AO1+AO2 +AO3 1.2.1c/e; 4.5.4a
3(b)(ii)	the less reactive the metal the more (easily) its carbonate will decompose/react or vice versa	needs to be a relative comparison allow max **1** mark where the distinction between a metal and its carbonate is not clear allow **1** mark for carbonates of reactive metals do not decompose or vice versa	2	AO3 1.2.1 c; 1.3
3(c)(i)	make it economical (to extract the metal/iron)	allow make it worth extracting allow so they can make money/profit	1	AO1 1.3.1a
3(c)(ii)	Fe balanced correctly (2,3,4,3)	not ecf allow correct balanced equation but with $2Fe_2$ on right for one mark	1 1	AO2 1.1.3b; 1.3.2c

4.2.2.7 Properties of metals and alloys

Answer 37 · Mark scheme

June 2016 | CH1HP | Original Q3 | Legacy

3(c)(iii)	**iron** from the blast furnace is brittle **steel** produced is strong / flexible	"it" = iron allow steel has more/specific uses allow steel is rust-resistant	1 1	AO1 1.3.2a/b/c
3(c)(iv)	(recycling) is used to conserve iron (ore) **or** energy **or** resources **or** minimise pollution **or** reduce the need to quarry (not reuse) because of damage, paint removal, rusting/corrosion, metal fatigue/weaker (not landfill) because sites have limited space **or** loss of habitats	allow reverse arguments. allow to reduce the use of landfill	1 1 1	AO1+AO2 1.3.1j
Total			**15**	

4.2.2.7 Properties of metals and alloys

Answer 38 · Mark scheme June 2017 | CH1HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	any **one** from: • all these gases / hydrogen / methane / water vapour / ammonia may not have been in the Earth's early atmosphere • the conditions of the reaction were not like those on early Earth • many different amino acids are needed for life processes	ignore no proof / evidence **or** no one was there **or** references to religion **or** meteorites / comets. allow nobody knows what was in the Earth's early atmosphere allow very little (0.5%) in the Earth's early atmosphere allow nobody knows what the conditions were on early Earth allow only simple amino acids **/** glycine were produced	1	**AO3** 1.7.2d;e
5(a)(ii)	any **three** from: • used by plants / algae **or** for photosynthesis • absorbed / dissolved by oceans • locked up in sedimentary rocks / carbonates / limestone • locked up in fossil fuels	ignore volcanoes allow stored in for locked up allow stored in for locked up mention of respiration: maximum two marks	3	**AO1** 1.7.2f;g;h
5(b)(i)	helium / He **and** neon / Ne	both needed	1	**AO2** 1.7.2j

4.2.2.7 Properties of metals and alloys

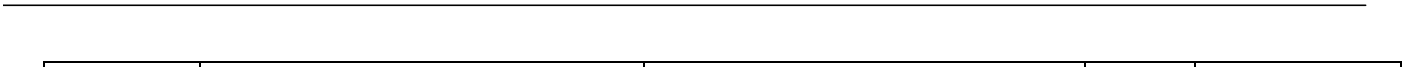
Answer 38 · Mark scheme June 2017 | CH1HP | Original Q5 | Legacy

5(b)(ii)	carbon dioxide would be solid **or** would block pipes	ignore freezes allow forms dry ice	1	**AO3** 1.7.2j
5(b)(iii)	 the other gas is argon / Ar because they have similar boiling points **or** there is only 3 °C difference in boiling points	mark independently	 1 1	**AO2** 1.7.2j
5(c)	 **stage 1:** oxygen reacts with carbon so carbon content decreases **or** carbon forms carbon dioxide **stage 2:** (other metals added) to form an alloy so the steel has a specific property / specific use	mark independently allow because cast iron is (too) brittle allow to stop layers sliding allow because pure iron is (too) soft	 1 1 1 1	**AO1** **AO2** 1.3.2a;b;c
Total			**12**	

4.2.2.7 Properties of metals and alloys

Answer 38 · Mark scheme

June 2017 | CH1HP | Original Q5 | Legacy



Answer 39 · Mark scheme

June 2017 | CH2HP | Original Q2 | Legacy

The full source mark scheme begins on page 82. Follow original question 2 in that document.

4.2.2.7 Properties of metals and alloys

Answer 40 · Mark scheme

June 2019 | 8462/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	Tube 1: (nail) rusts because air / oxygen **and** water present		1	AO1
	Tube 2: (nail) does not rust because no water	allow Tube 2: (nail) does not rust because only air / oxygen	1	AO1
	Tube 3: (nail) does not rust because no air / oxygen	allow Tube 3: (nail) does not rust because only water	1	AO1
	Tube 4: (nail) does not rust because paint is a barrier (to water / air / oxygen)	allow Tube 4: (nail) does not rust because paint is a protective layer / coating (against water / air / oxygen) **or** allow Tube 4: (nail) does not rust because paint protects it from water / air / oxygen	1	AO1 AO2 4.10.3.1 4.10.3.2
	Tube 5: (nail) does not rust because stainless steel resistant to corrosion	allow Tube 5: (nail) does not rust because stainless steel does not corrode allow Tube 5: (nail) does not rust because stainless steel contains nickel / chromium If no other mark awarded allow **1** mark for correct rusting pattern in all 5 tubes	1	

4.2.2.7 Properties of metals and alloys

Answer 40 · Mark scheme

June 2019 | 8462/2H | Original Q4

04.2	magnesium is more reactive (than iron) (so magnesium) provides sacrificial protection	allow converse allow magnesium is more reactive (than steel) allow (so magnesium) corrodes / reacts instead of iron / steel allow (so magnesium) corrodes / reacts before iron / steel ignore references to protective layers ignore references to magnesium rusting	1 1	AO2 4.10.3.1
04.3	(aluminium has a coating of) aluminium oxide (so the aluminium oxide) protects the metal (from further corrosion)	 allow (so aluminium oxide) prevents water / air / oxygen from reaching the metal	1 1	AO1 4.10.3.1
Total			**9**	

4.2.2.7 Properties of metals and alloys

Answer 41 · Mark scheme

November 2021 | 8462/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	C		1	AO3 4.2.2.7 4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(in an alloy) the atoms are of different sizes		1	AO1 4.2.2.7
	(so) the layers (of atoms in an alloy) are distorted		1	
	(so in an alloy) the layers slide over each other less easily (than in a pure metal)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	measure temperature change	allow measure the temperature before **and** after the reaction	1	AO1
	when each metal is added to silver nitrate solution		1	AO1
	same concentration / volume of solution **or** same mass / moles of metal	allow same initial temperature (of silver nitrate solution)	1	AO2
	the greater the temperature change the more reactive		1	AO3 4.4.1.2 4.5.1.1 RPA4

Total			8

4.2.2.7 Properties of metals and alloys

Answer 42 · Mark scheme

November 2021 | 8462/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	(lead is) toxic / poisonous	allow (lead is) harmful ignore (lead is) dangerous / deadly / lethal	1	AO3 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	the proportions (of metals) are different		1	AO3 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	any **three** from: • recycling conserves copper ores • recycling uses less energy • recycling reduces waste • mining / quarrying cause environmental impacts	ignore references to cost allow copper ores are finite allow recycling reduces use of landfill allow description of environmental impact caused by mining / quarrying	3	AO1 AO2 AO3 4.10.1.1 4.10.1.4 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	grow plants (on land containing copper ores) plants are burnt (to produce ash) ash dissolved in acid (to produce a solution of a copper compound) electrolysis of solution (containing a copper compound) **or** displacement (of copper) from solution (containing a copper compound)	allow named plant allow addition of scrap iron to the solution (of a copper compound)	1 1 1 1	AO1 4.10.1.4

4.2.2.7 Properties of metals and alloys

Question 8 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	any **two** from: • high grade ores still available • land not available • phytomining takes a long time • new technology	allow demand not high enough	2	AO3 4.10.1.4

Total			**11**

4.2.2.7 Properties of metals and alloys

Answer 43 · Mark scheme

June 2023 | 8462/1H | Original Q6

Question 6

Question	Answers	Mark	AO/ Spec. Ref
06.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3 4.2.2.7 4.2.2.8 4.4.1.2
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content **relevant points** • silver is the best electrical conductor • aluminium is the least dense • aluminium is the least expensive • copper is a better conductor than aluminium **or** copper is almost as good a conductor as silver • copper is much less expensive than silver • overhead power cables need a low density metal • wiring in homes needs to be affordable • printed circuit boards only require small amounts of material **judgements** • use aluminium for overhead wires because of aluminium's low density and/or lower cost • use copper for domestic wiring because copper is a very good conductor and not too expensive • use silver only for small uses such as circuit boards due to high cost • copper is a good compromise between electrical conductivity and cost		

4.2.2.7 Properties of metals and alloys

Answer 43 · Mark scheme

June 2023 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(metals have) delocalised electrons		1	AO1 4.2.1.5 4.2.2.8
	the electrons carry (electrical) charge	ignore current / electricity for charge	1	
	the electrons move through the structure / metal	ignore throughout for through	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	in alloys different sized atoms distort the layers / structure		1	AO3 4.2.2.7 4.2.2.8
	(so) the movement of (delocalised) electrons is restricted		1	

Total Question 6	9

4.2.2.7 Properties of metals and alloys

Answer 44 · Mark scheme

June 2024 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(thermal) energy is transferred by delocalised electrons	allow heat is transferred	1 1	AO1 4.2.1.5 4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2		allow (positive / metal) ions for atoms throughout		AO1 4.2.2.7
	(the alloy / mixture has) different sized atoms		1	
	(so the) layers are distorted		1	
	(so the) layers cannot easily slide	allow (so the) atoms cannot slide over each other	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$		1	AO2 4.3.1.1 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	$1\ Fe^{2+} : 2\ Fe^{3+} : 4\ O^{2-}$		1	AO2 4.4.2.2

4.2.2.7 Properties of metals and alloys

Answer 44 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(M_r Fe_3O_4 =) 232		1	AO2 4.3.1.2
	(% Fe =) $\frac{3 \times 56}{232} \times 100$	allow $\frac{168}{232} \times 100$ allow correct use of an incorrectly determined M_r using the values of A_r given in the question	1	
	= 72.4 (%)	allow 72.41379 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6		a maximum of **4** marks can be awarded for a method which determines and uses the volume of iron oxide as a gas		AO2 4.3.2.1 4.3.2.2
	(40.0 kg =) 40 000 (g)		1	
	(moles Fe_2O_3 = $\frac{40\,000}{160}$ =) 250	allow correct use of an incorrectly converted or unconverted mass	1	
	(moles CO_2 = 250 × $\frac{3}{2}$ =) 375	allow correct use of an incorrectly determined number of moles of Fe_2O_3	1	
	(volume of CO_2 =) 375 × 24	allow correct use of an incorrectly determined number of moles of CO_2	1	
	= 9000 (dm^3)		1	

Total Question 7	15

4.2.2.7 Properties of metals and alloys

Answer 45 · Mark scheme

June 2024 | 8462/2H | Original Q6

Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.10.2.1 4.10.3.2
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • bamboo is renewable • aluminium is a finite resource • growing bamboo uses up agricultural land • mining aluminium ore is a polluting activity • cost of aluminium alloy is lower • (so) can be replaced more frequently • aluminium alloy is stronger • (so) can withstand larger forces • aluminium alloy has lower mass • (so) bicycle is faster • (so) is easier to carry / transport • the aluminium alloy frame lasts less long • (so) bicycle must be replaced more frequently • aluminium alloy is recyclable (so) aluminium ores are conserved • bamboo can provide renewable heat energy • (so) less overall contribution to global warming • (and) is carbon neutral • neither material may reach landfill • both materials have a sustainable disposal method **Reasoned judgment**		

4.2.2.7 Properties of metals and alloys

Answer 45 · Mark scheme

June 2024 | 8462/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	aluminium (alloy) has an oxide coating (so) contact between aluminium (alloy) and water / air / oxygen is prevented	 do **not** accept sacrificial protection	1 1	AO1 4.10.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(coating with) grease	allow (coating with) oil allow galvanise allow use stainless steel as the alloy	1	AO2 4.10.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(carbon fibre) reinforcement (polymer resin) matrix / binder	allow reinforces the polymer / resin ignore (carbon) fibres allow binds the fibres / fragments ignore (polymer) resin	1 1	AO2 4.10.3.3

Total Question 6	11

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Chemistry 4421

CHY1H Unit Chemistry 1

Mark Scheme

2007 examination - June series

4.2.2.7 Properties of metals and alloys

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Dr Michael Cresswell, Director General.

4.2.2.7 Properties of metals and alloys

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.2.2.7 Properties of metals and alloys

CHY1H Question 1

	answers	extra information	mark
(a)	any **two** from: • nitrogen • carbon dioxide • water (vapour) / steam	 accept formulae N / N_2 accept formula CO_2 ignore CO accept formula H_2O	2
(b)	any **three** from: <u>limestone</u> • abundant / local • natural material **or** no 'processing' needed • relatively easy to cut • appearance better <u>concrete</u> • <u>raw materials</u> are abundant • can be reinforced (by steel rods) / strong(er) / supported (by steel rods) • concrete mixture can be poured / moulded / constructed on site • less reactive with acid rain / weathering / erosion	no mark for 'limestone' or 'concrete' on first line – mark advantages only ignore ideas of speed of production or easier to use accept 'can build higher' ignore density / extraction / quarrying / pollution / cost	3
total			5

4.2.2.7 Properties of metals and alloys

CHY1H Question 2

	answers	extra information	mark
(a)(i)	$Cu_2S + 2O_2 \rightarrow 2CuO + SO_2$	accept fractions and multiples	1
(ii)	any **two** from: • sulfur dioxide • causes acid rain • consequence of acid rain eg kills fish / plants	 accept sulphur dioxide / sulphur oxide / SO_2 ignore other comments eg global warming / ozone / global dimming / greenhouse effect	2
(b)	any **two** from: • heat (copper oxide with carbon) • oxygen is removed by carbon **or** carbon monoxide / carbon dioxide is produced **or** carbon displaces copper • because carbon is more reactive than copper	 accept copper (oxide) loses oxygen **or** carbon gains oxygen accept carbon oxide accept a correct word or balanced symbol equation allow a correct comparison of reactivity	2
(c)(i)	electrolysis	accept electroplating	1
(ii)	(electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys **or** named alloys		1

Continued on next page

4.2.2.7 Properties of metals and alloys

Question 2 continued

	answers	extra information	mark
(d)	any **three** explanations from: <u>for recycling</u> • less acid rain (pollution) • copper reserves last longer / conserved **or** do not run out • energy for extraction (saved) **or** less energy required • less mining / quarrying • less waste (copper) / electrical appliances dumped **or** less landfill <u>against recycling</u> • collection problems • transport problems • difficult to separate copper from appliances • energy used to melt the collected copper	ignore electrolysis / pollution ignore ideas about less machinery / plant ignore idea of cost	3
total			10

4.2.2.7 Properties of metals and alloys

CHY1H Question 3

	answers	extra information	mark
(a)(i)	core		1
(ii)	plate (boundaries)	accept parts of the crust ignore crust alone	1
	sudden movement / colliding **or** normally move a few centimetres per year	accept movement but ignore movement apart accept continental drift	1
	convection currents / driven by heat from radioactive processes / decay	idea of source of energy for the movement	1
	the idea of uncertainty with an explanation eg scientists do not know (with any certainty) • what happens under the crust • where the forces / pressure are building up • we cannot measure the forces • when the forces reach their limit	ignore references to volcanoes	1
(b)(i)	78		1

Continued on next page

4.2.2.7 Properties of metals and alloys

Question 3 continued

	answers	extra information	mark
(ii)	marks awarded for any 2 gases from the following 3 gases	max **3** marks from CO_2	
	any **four** from: carbon dioxide has decreased: • used by plants / bacteria (stromatolites) • during photosynthesis (must be linked to CO_2 decrease) • 'locked up' in (sedimentary) rocks / carbonates / fossil fuels • dissolved in oceans **and / or** oxygen has increased because: • released by plants / bacteria (stromatolites) • during photosynthesis (must be linked to O_2 increase) **and / or** nitrogen has increased because • ammonia reacted with oxygen (to release nitrogen) • nitrogen is released by bacteria	ignore references to respiration	4
total			10

4.2.2.7 Properties of metals and alloys

CHY1H Question 4

	answers	extra information	mark
(a)	permitted additive / (added) chemicals **or** names / types of additives	accept the chemical name ignore food additive alone	1
(b)(i)	water and oil do not mix / are immiscible **or** don't dissolve each other	ignore density ignore emulsifier alone	1
(ii)	any **two** from: • emulsifier • forms an emulsion • holds the two components together • by lowering the surface tension	 accept description of an emulsion accept stops them separating / they mix allow bonds / binds for holds accept a description of how an emulsifier works for **two** marks eg 'tadpole' diagram or dispersal of oil drops	2
(c)(i)	(because they contain) a double (carbon carbon) bond	accept unsaturated ignore poly or mono	1
(ii)	results suggest sunflower oil is best **or** 'the one that took the least time' because (sunflower oil) has the highest amount of unsaturation / most double bonds / least saturated	 ignore uses up I_2 most quickly second mark is dependent on first	1 1

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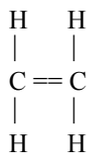
4.2.2.7 Properties of metals and alloys

Question 4 continued

	answers	extra information	mark
(d)(i)	any **one** from: • have a higher melting point than (vegetable) oil • are solid at (room temperature) / hardened / harder	 accept useful as spreads **or** doesn't soak into bread ignore hard / soft(er)	1
(ii)	any **two** from: • hydrogen added • to carbon carbon double bond / to saturate • (nickel) catalyst / temperature 60 - 150°C	 do **not** accept 'water' wrong catalyst doesn't get this mark ignore high / warm temperature	2
total			10

4.2.2.7 Properties of metals and alloys

CHY1H Question 5

	answers	extra information	mark
(a)(i)	by (fractional) distillation **or** fractionation	accept a description of the distillation process (heat and how separation works) eg heat **and** condense accept boil / vapourise etc for heat	1
(ii)	CO_2 H_2O	note the order of these products must be correct wrong way round = **1** mark	1 1
(b)(i)	(hexane) has been broken down (into smaller hydrocarbons / molecules)	accept (thermal) decomposition / cracked / split / broken up owtte	1
(ii)		accept $CH_2=CH_2$	1
(iii)	water / hydrogen oxide / steam	accept H_2O	1

Continued on next page

4.2.2.7 Properties of metals and alloys

Question 5 continued

	answers	extra information	mark
(c)	candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks. if they do not then the maximum mark is three any **four** from: <u>advantages of using sugar</u> • country has no wealth to buy (large quantities of) crude oil • country has limited technological development **or** underdeveloped / third world country • able / suitable climate to grow sugar cane • enough land to grow sugar cane / land cannot be used to grow food / deforestation • sugar is a renewable source **or** crude oil is a non-renewable resource / finite resource / limited resources • CO_2 / carbon neutral <u>advantages of using alkanes:</u> • economic costs are low • continuous process • country has large oil resources • country has oil refineries / cracking plants • very pure product • faster process	not 'expensive' alone	4
total			10

Version 1.0: 0108

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit 2 Chemistry

Mark Scheme

2008 examination – January series

4.2.2.7 Properties of metals and alloys

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4.2.2.7 Properties of metals and alloys

MARK SCHEME

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- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.2.2.7 Properties of metals and alloys

CHY2H

Question 1

question	answers	extra information	mark
(a)	sensible line of best fit which goes through or close to all the points **except** the anomalous point	allow wobbly / short double lines ± ½ square	1
(b)	loss of gas / loss of CO_2	idea of gas produced / formed	1
(c)	7		1
(d)(i)	steeper line from around the same starting point and left of the points levelling off at 99	allow crosses if they are fully correct for **1** mark accept short level line at 99 ± ½ square	1 1
(d)(ii)	any **three** from: • particles / molecules / atoms/ ions have more energy • move faster • collide <u>more</u> often **or** <u>more</u> chance of collisions **or** bump into each other <u>more</u> • collide with <u>more</u> force / energy **or** <u>more</u> particles have the activation energy **or** <u>more</u> collisions result in reaction **or** <u>more</u> collisions are successful	 allow given / gain / get energy ignore move about more ignore vibrate more / faster ignore collide quicker / faster	3
total			8

4.2.2.7 Properties of metals and alloys

CHY2H

Question 2

question	answers	extra information	mark
(a)	any **one** from: • they are made of layers • atoms / ions / particles / layers (of atoms) can slide over each other	 do **not** accept line / rows / lattice	1
(b)	any **one** from: • smaller / tiny **or** very small • correct size range 1 to 100 nanometres • a few hundred atoms in size	 do **not** allow small alone if they state smaller and give a size outside range ignore size if it is less than 20,000	1
(c)	harder plus **one** from: • so does not wear as quickly / erode as quickly • less vulnerable to damage owtte • because they have a high surface area to volume ratio **or** stronger (1) plus **one** from: (1) • less likely to break / do not break • not as vulnerable to damage owtte • do not bend out of shape • because they have a high surface area to volume ratio	 ignore corrode harder to wear down = **1** mark accept withstand pressure harder and stronger alone gains **1** mark	1 1
total			4

4.2.2.7 Properties of metals and alloys

CHY2H

Question 3

question	answers	extra information	mark
(a)	N_2O		1
(b)	13.8 to 14	gains full marks without working if answer incorrect 13 gains **1** mark **or** 14/101 × 100 gains **1** mark	2
total			3

4.2.2.7 Properties of metals and alloys

CHY2H

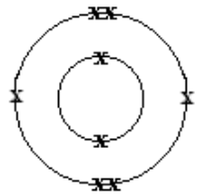
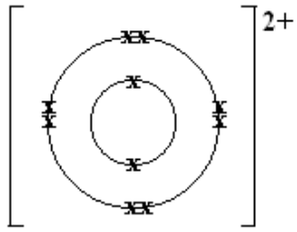
Question 4

question	answers	extra information	mark
(a)	electric current / electricity		1
	plus **one** from:		1
	• is passed through ionic compound / substance / electrolyte • passed through molten/aqueous compound / substance	must be linked to electricity allow liquid compound / substance do **not** allow solution / liquid alone	
	• causing decomposition	accept split up / breakdown / breaking up owtte ignore separated accept elements are formed ignore new substances form	
(b)	hydrogen	accept H_2 do **not** accept H / H^2	1
(c)	one electron from each atom	accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte	1
	is delocalised / free (to move)	must be linked to electrons answers of delocalised / free electrons only, gains **1** mark accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks **maximum 1** mark if graphite described as a metal / giant ionic lattice	1
total			5

4.2.2.7 Properties of metals and alloys

CHY2H

Question 5

question	answers	extra information	mark
(a)	any **one** from: • gives out heat / energy • transfers energy from a substance to the surroundings • ΔH / energy change / enthalpy change is negative	accept releases / gives off owtte ignore references to light	1
(b)	$2Mg + O_2 \rightarrow 2MgO$	accept correct multiples / fractions	1
(c)		electrons do not need to be paired accept dots / circles / e instead of crosses do **not** allow 2.6 without diagram	1
(d)		electrons do not need to be paired allow without brackets must have the charge accept dots / circles / e instead of crosses ignore extra empty outer shells ignore nucleus do **not** allow $[2.8]^{2+}$ without diagram	1

continued…

4.2.2.7 Properties of metals and alloys

CHY2H

Question 5 continued…

question	answers	extra information	mark
(e)	oppositely charged (ions / atoms)	allow positive and negative(ions / atoms)	1
	(they) attract	must be in correct context accept held by electrostatic forces ignore ionic bonding **maximum 1** if they refer to intermolecular forces / attractions / covalent bonds	1
(f)	magnesium chloride	accept $MgCl_2$ (if correctly written)	1
total			7

4.2.2.7 Properties of metals and alloys

CHY2H

Question 6

question	answers	extra information	mark
(a)	**Compound A** any **one** from: • sodium bromide • potassium bromide • ammonium bromide • hydrogen bromide • any metal bromide except silver and lead. **Compound B** silver nitrate	accept correct formulae accept silver sulfate	1 1
(b)	the silver compound will decompose / silver ions be reduced to silver (owtte)	accept film would darken owtte accept any idea of light changing silver bromide / silver ions / silver nitrate / silver sulfate allow ‘forms a black solid’ / it would turn black	1
(c)	precipitation	accept descriptions of precipitation reactions accept double decomposition accept precipitate do **not** allow displacement	1
(d)	electrons are gained	 the second mark **must** be linked to electrons accept it / silver / silver ions gains electrons for **both** marks ignore references to oxygen	1 1
total			6

4.2.2.7 Properties of metals and alloys

CHY2H

Question 7

question	answers	extra information	mark
(a)	1213.8 to 1214.3 correct answer not given then check working 1) moles of N_2 = $\frac{1000}{28}$ = 35.7 mol 2) moles of NH_3 = 2 × (answer from (1)) = 71.4 mol 3) mass of NH_3 = (answer from 2) × 17 = 71.4 × 17 = 1214 g **or** • 28g of N_2 → 34g of NH_3 • 1g of N_2 → $\frac{34}{28}$ = 1.214g NH_3 • 1000 g of N_2 → 1000 × 1.214 = 1214g **or** • $1000 \times \frac{34}{28}$ **or** **other correct methods**	gains **3** marks without working **1** mark for each correct step do **not** penalise rounding errors in this part **1** mark for each correct step do **not** penalise rounding errors in this part allow error carried forward eg gains **2** marks if correct answer not given $1000 \times \frac{28}{34}$ gains **1** mark, **2** marks if correctly calculated (823.5g) $1000 \times \frac{28}{17}$ gains **1** mark if calculated correctly (1647.05g) look for the key ideas in the methods above	3

continued…

4.2.2.7 Properties of metals and alloys

CHY2H

Question 7 continued…

question	answers	extra information	mark
(b)	25 / 25.035 **or** ecf from (a)	gains **2** marks even when there is no working incorrect answer then 304/(their answer from (a)) × 100 gains **1** mark	2
	or using figures from part (b)		
	27.6 / 28	gains **2** marks even when there is no working accept 27 for **1** mark if answers incorrect then304/1100 × 100 gains **1** mark	
(c)(i)	increase yield		1
	reaction is exothermic		1
	or		
	allow decreased yield because rate of reaction is slower / fewer collisions for **2** marks	**must** get both points for **2** marks	
(c)(ii)	increase yield		1
	plus **one** from: • more (gaseous) reactant molecules than (gaseous) product molecules (owtte) • increased rate of reaction / more collisions	accept greater volume on the left than the right owtte	1

continued…

4.2.2.7 Properties of metals and alloys

CHY2H

Question 7 continued…

question	answers	extra information	mark
(d)	any **one** from: **economic** • large town provides workforce • workers do not have to travel far to the factory. (owtte) • transport infrastructure already in place for large town. (owtte) • factory brings prosperity to town (owtte) • factory provides employment • reduced tourism • reduction in local house prices • any other sensible economic factor linked to town		1
	any **one** from: **safety** • escape of dangerous / harmful chemicals / gases (owtte) • danger of increased traffic • risk of explosion.(owtte) /danger of high pressure • consequences of an accident could be severe if the town is close • any other sensible safety idea	do **not** allow polluting gases unqualified	1

continued…

4.2.2.7 Properties of metals and alloys

CHY2H

Question 7(d) continued…

question	answers	extra information	mark
	any **one** from: **environmental** • factory might be unsightly (owtte) • screening of factory (owtte) • loss of habitats (owtte) • plant trees/ hedges etc on and around plant site • pollution of water / air / soil could harm plants / animals **or** noise pollution • CO_2 is produced by burning fuels / heating • CO_2 causes global warming / any effect of global warming • eye sore • any other sensible environmental factor	must be explained	1
total			12

4.2.2.7 Properties of metals and alloys

GCSE

Additional Science / Chemistry

CH2HP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

4.2.2.7 Properties of metals and alloys

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.
At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.
In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Different terms in the mark scheme are shown by a / ; eg allow smooth/free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only. Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept/allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore/Insufficient/Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4 Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information.
- Simple understanding.
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail.
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information.
- Clear understanding.
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given.
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised.
- Detailed understanding, supported by relevant evidence and examples.
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.2.2.7 Properties of metals and alloys

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	a smooth curve through or close to all points except (30,12)		1	**AO2** 2.4
1(a)(ii)	correct reading from the curve in 1(a)(i) (cm^3)	allow a tolerance of +/- 0.5 cm^3	1	**AO2** 2.4
1(a)(iii)	45-50 (seconds)		1	**AO3** 2.4
1(a)(iv)	line becomes less steep because gas is produced more slowly	ignore line levels out or plateaus allow examples with figures, eg 12 cm^3 gas from 0 to 20s but 1.5 cm^3 gas in last 20s ignore reaction has stopped or no more gas produced	1 1	**AO3** 2.4
1(a)(v)	0.6 (cm^3 per second)	allow 0.55 to 0.65	1	**AO2** 2.4
1(b)(i)	 temperature volume (of hydrogen peroxide)	concentration of hydrogen peroxide = max **1** ignore amount (of hydrogen peroxide)	 1 1	**AO3** 2.4
1(b)(ii)	 rate increases because more particles (in the same volume) so frequency of collisions increases	incorrect reference to energy = max **2** accept particles closer together allow greater chance of collisions ignore more collisions	 1 1 1	**AO1** 2.4.1e

4.2.2.7 Properties of metals and alloys

1(c)	(increasing the amount of catalyst) increases rate same final volume of gas	accept steeper graph or graph levels off earlier	1 1	**AO2** 2.4.1g
Total			**13**	

4.2.2.7 Properties of metals and alloys

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>2</td><td></td><td></td><td>6</td><td rowspan="6">AO1
2.1.1h
2.2.4b,c
2.2.5a,b</td></tr>
<tr><td colspan="4">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 on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td colspan="4"><table>
<tr><th>0 marks</th><th>Level 1
(1–2 marks)</th><th>Level 2
(3–4 marks)</th><th>Level 3
(5–6 marks)</th></tr>
<tr><td>no relevant information given</td><td>a statement about the structure or a property of a metal
or
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer
and
at least one statement linking structure and property</td></tr>
</table></td></tr>
<tr><td colspan="4">Statements shown as HT only are credited on both FT and HT.
However, HT only means that these statements are not expected in a FT answer.</td></tr>
<tr><td colspan="4">Examples of chemistry points made in response

Metal:

Properties
shiny
hardness
(tensile) strength
melting point/boiling point
density
malleable/flexible
ductile
conduct electricity or thermal energy</td></tr>
</table>

4.2.2.7 Properties of metals and alloys

Structure • metals contain atoms /((positive) ions HT only) • (the atoms/(positive) ions/particles are) closely packed / in a regular pattern / in a giant structure/in layers / in a lattice • strong bonds/(electrostatic attractions HT only) • (metal has delocalised electrons HT only) **Polymer:** **Properties** • flexible • melting/boiling point • density • can be shaped/moulded • poor conductor of electricity or thermal energy **Structure** • polymer consists of chains • polymer chains may be tangled • polymer has no cross links. • (polymer has weak intermolecular forces HT only) **Level 3:** **Examples of linked statements:** • metal can be bent and shaped because the layers can slide • some metals are soft because layers can slide • some metals are hard because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure/ in a lattice • metal has high melting/boiling point because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal is strong because of strong bonds • some metals are dense because the atoms are closely packed • (metal can conduct thermal energy and electricity because metal has delocalised electrons HT only) • thermosoftening polymer melts when heated because it has no cross-links (or has weak intermolecular forces HT only) • thermosoftening polymer is flexible because the chains can move over each other	

Total			**6**

4.2.2.7 Properties of metals and alloys

Question	Answers	Extra Information	Mark	AO / Spec. Ref
3(a)(i)	2 bonding pairs 4 unbonded electrons on each atom	accept dots, crosses, e, - or any combination ignore any electrons on any inner shells if no other mark awarded allow **1** mark for 1 bonding pair and 6 unbonded electrons on each atom	1 1	**AO2** 2.1.1g
3(a)(ii)	covalent	allow convalent and covelant ignore single or double ignore shared, shared bond or sharing	1	**AO1** 2.1.1g
3(a)(iii)	weak intermolecular forces require little energy to overcome	reference to weak covalent or weak ionic bonds = **0** accept weak intermolecular bonds MP2 dependent on MP1 if no other mark awarded allow 1 mark for simple/small molecules	1 1	**AO1** **AO2** 2.2.1a,b

4.2.2.7 Properties of metals and alloys

3(b)(i)	**2** Mg + O_2 → **2** MgO	accept multiples	1	**AO2** 2.2.2
3(b)(ii)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2**		**AO1** **AO2** 2.1.1a,b,c,f
	magnesium loses (electrons) **and** oxygen gains (electrons)		1	
	two (electrons transferred)		1	
	noble gas structure **or** 8 electrons in outer shells **or** (electrostatic) attraction between ions **or** forms ionic bonds	accept full outer shell (of electrons)	1	
3(b)(iii)	particles 1-100 nm in size	accept contain a few hundred atoms/ions accept have a high surface area to volume ratio ignore reference to (very) small particles do **not** accept smaller than an atom/ion	1	**AO1** 2.2.6a

4.2.2.7 Properties of metals and alloys

3(c)	has a high melting point	allow will not melt allow a lot of energy needed to melt ignore boiling point reference to incorrect particles or incorrect bonding or incorrect structure = max **1** from MP2 and MP3	1	**AO1** **AO2** 2.2.3a
	because all atoms linked to other atoms	allow giant structure/lattice ignore many bonds	1	
	by covalent bonds	allow strong bonds allow a lot of energy needed to break bonds accept giant covalent structure for MP2 and MP3	1	
Total			**13**	

4.2.2.7 Properties of metals and alloys

Question	Answers	Extra Information	Mark	AO / Spec. Ref
4(a)	add copper oxide and (sulfuric) acid		1	**AO1** **AO2** 2.6.1b,c
	excess (copper oxide)		1	
	filter (to remove excess)	ignore impurities	1	
	heat /boil / evaporate / leave (to crystallise)	do **not** accept to dryness	1	
4(b)	(M_r CuO =) 79.5		1	**AO2** 2.3.3c
	24.95/249.5 **or** 0.1 **OR** 79.5/249.5 **or** 0.3186…	allow ecf for M_r CuO from step 1 allow correct rounding to min 2SF	1	
	(24.95/249.5 x 79.5=) 7.95	allow ecf for M_r CuO from step 1 allow ecf from step 2 of incorrect calculation/ rounding of correct ratio allow correct rounding to min 2SF correct answer with or without working gains 3 marks	1	
4(c)(i)	as wealth decreases, ethene production decreases (with the exception of country C or D)	accept converse	1	**AO2** **AO3** 2.6
	sulfuric acid production is not linked to wealth		1	

4.2.2.7 Properties of metals and alloys

4(c)(ii)	use of products of ethene has increased	allow use of polymers / plastics / ethanol / poly(ethene) has increased ignore use of ethene as a (bio)fuel ignore cost	1	**AO3** 2.2.5
Total			**10**	

4.2.2.7 Properties of metals and alloys

Question	Answers	Extra Information	Mark	AO / Spec. Ref
5(a)(i)	draw line on paper put (dots of) inks on line place (bottom of) paper in solvent / water any **one** from: line drawn in pencil allow dots of ink to dry line above solvent lid		1 1 1 1	**AO1** 2.3.2b
5(a)(ii)	any **two** from: • A has 3 colours **and** B has 4 colours • 2 colours are the same • **A** has 1 colour not in **B and B** has 2 colours not in **A**	accept 3 colours are different if no other mark awarded allow **one** more colour in ink **B** than in ink **A** (or converse)	2	**AO3** 2.3.2b
5(b)(i)	substances carried by gas through column / tube / coil (packed with solid) (different substances move through the column) at different speeds	 accept (different) substances come out at different times or have different retention times	1 1 1	**AO1** 2.3.2c
5(b)(ii)	(relative) molecular mass	allow (relative) formula mass allow RFM, RMM, M_r	1	**AO1** 2.3.2c
Total			**10**	

4.2.2.7 Properties of metals and alloys

Question	Answers	Extra Information	Mark	AO / Spec. Ref
6(a)(i)	tick (✓) by: the initial temperature reading was too low		1	**AO3** 2.5
6(a)(ii)	the reaction is exothermic	allow energy is given out	1	**AO3** 2.5.1b
6(b)(i)	(positive/hydrogen) ions gain electrons hydrogen is below sodium in the reactivity series so hydrogen / H_2 is produced	accept (positive/hydrogen) ions are reduced accept reference to high reactivity of sodium If no other mark awarded allow hydrogen (and sodium) ions **or** positive ions are attracted to negative electrode for **1** mark	1 1 1	**AO1** **AO2** 2.7.1c,f,i
6(b)(ii)	**2** (Cl^-) → **Cl_2 + 2e^-**	must be completely correct allow multiples	1	**AO1** 2.7.1g
6(b)(iii)	solution is alkaline because sodium hydroxide / NaOH is produced **or** sodium hydroxide / NaOH is left over	accept hydroxide (ions) / OH^- is produced **or** hydroxide (ions) / OH^- is left over	1 1	**AO1** **AO2** 2.7.1i; 2.6.2d
Total			**8**	

4.2.2.7 Properties of metals and alloys

Answer 41 · Examiner comments November 2021 | 8462/1H | Original Q6

Question 6 (standard and standard / high demand)

06.2 This was poorly answered, with many instances of incorrect use of scientific terms. Some referred to molecules instead of atoms, different shapes instead of different sizes, and rows instead of layers. Many did not refer to the layers in a metal at all, merely referring to atoms, or a vague 'they' not being able to slide. Even those who did refer to layers rarely said those layers were distorted. There were many incorrect answers in terms of an incorrect type of bonding, and many thought that alloys are compounds.

06.3 Students were expected to do a simple comparison of the temperature change when each metal was added separately to silver nitrate solution. A control variable was needed for full marks to be awarded, as well as how the results would show which metal was the more reactive. Some students did not appear to know how to progress, with some trying to measure a temperature change while heating with a Bunsen burner, and some appearing to confuse reactivity with melting or boiling point. Of those students who did realise what was required, many spoiled their control variable by referring to the same 'amount' of a substance instead of volume, or concentration, or mass, as appropriate to the substance. Many students referred to temperature rather than temperature change. A few students tried to get round the fact that no other chemicals were available by making zinc nitrate and then seeing if Q would react with it. This approach could have worked but only if they had taken steps to ensure that all the silver nitrate had reacted before adding Q.

Answer 42 · Examiner comments November 2021 | 8462/2H | Original Q8

Question 8 (standard, standard / high and high demand)

08.1 The likely toxicity of lead was identified by approximately half of the students.

08.2 Nearly half of the students gained this mark.

08.3 A good spread of marks were seen here, with around 70% giving at least one creditworthy response, usually linked to energy or waste. However very few were able to gain all 3 marks.

08.4 Approximately one-third of students were able to gain the first two marking points. However, very few scored beyond marking point 2 as the need to add the resulting ash to acid was almost never given.

08.5 Under half of students gave one reason, usually that phytomining is slow. Very few were able to give a second reason.

Answer 43 · Examiner comments June 2023 | 8462/1H | Original Q6

Question 6 (standard, standard/high and high demand)

06.1 Nearly a half of students gave Level 3 answers, nearly all of the others giving Level 1 responses. However, fewer than one in six students reached the top of Level 3.

4.2.2.7 Properties of metals and alloys

Answer 43 · Examiner comments

June 2023 | 8462/1H | Original Q6

In order to reach Level 3, at least one judgement was necessary. Many students misinterpreted the question and thought that just one metal should be used for all three uses, instead of selecting the best metal for each individual use. These students usually chose copper on the basis of its high electrical conductivity and low cost; these students were able to score 3 marks. The best answers gave reasoned judgements for all three uses, based on a consideration of cost and/or density for overhead cables, conductivity and cost for wiring in homes, and tiny amounts of material required for printed circuit boards. Many students did not realise the significance of the density in the selection of a metal for overhead power cables, and its lack of importance for the other uses. Some incorrectly related density to strength, malleability or other properties. Others stated that because 'the government' pays for overhead cabling, cost is not an issue.

Many students wasted time and space quoting actual figures from the table, which is unnecessary. 'Copper is nearly as conductive as silver but far cheaper' conveys the essential points without any actual figures. Examiners expect the students to analyse the figures and add value to the data given in a table.

06.2 Nearly a quarter of students gave fully correct answers, with most able to score at least one mark. The majority of students knew that electrical conductivity is due to delocalised electrons, and most referred to electrons as charge carriers. However, many merely referred to the movement of electrons as being 'throughout' the structure, meaning everywhere within it, rather than 'through' the structure, meaning a unidirectional movement (when a pd is applied) rather than random movement. Some students referred to electrons transferring charge from one to another; this is not correct.

06.3 Nearly a third of students scored at least one mark on this high demand question, which required the linking of two different areas of the specification. Students needed to link what they knew about alloys (distorted layers due to different sized atoms) to electrical conductivity, to suggest that the distorted layers would impede the flow of electrons. Some students seem to think that the atoms in an alloy have different shapes.

Answer 44 · Examiner comments — June 2024 | 8462/1H | Original Q7

Question 7 (standard, standard/high and high demand)

07.1 Only a quarter of students gained both marks, and a third did not score. Many students described how solids in general conduct thermal energy, rather than answering the question which is specifically about conduction in a metal. Many students realised that the process has something to do with delocalised electrons. However, many described how electricity is conducted, rather than thermal energy. The idea of the delocalised electrons transferring thermal energy through the metal was not at all well known. As the question asked how thermal energy is conducted, repetition of the word 'conduct' did not help to explain the meaning of that word.

07.2 This question discriminated well, with over a half of students scoring 2 or 3 marks. There were many well-expressed, complete answers. Common errors often involved an attempt to describe some sort of stronger bonding (sometimes covalent or ionic) in the alloy. Some lost credit because of poor use of language; it is not 'metals' which are different sizes, but their atoms (or positive ions). A common error was to refer to different shapes of atoms. 'Particles' is also insufficient as it could refer to other types of particle than atoms. 'Intermolecular forces' were often referred to, although they are not present in either a pure metal or an alloy.

07.3 Just over a half of students identified the correct equation, spotting that the mole ratio of Fe:Cl_2 was 2:3. The most popular distractor was Fe + Cl_2 → $FeCl_2$, where the student had ignored the information provided about the reacting number of moles.

07.4 Only two fifths of students identified the correct response by working out the total charge of the various combinations and choosing the one with a net zero charge. $3Fe^{2+}$:$4O^{2-}$ was a very popular distractor, with $3Fe^{3+}$:$4O^{2-}$ not far behind.

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Answer 44 · Examiner comments — June 2024 | 8462/1H | Original Q7

07.5 Over three quarters of students obtained full marks on this question. For those who did not, it was sometimes difficult to award any credit because the M_r had not been evaluated. Common errors were $56/M_r$ x 100 or $64/M_r$ x 100. Some students attempted to bring in the 0.12 and 0.18 from question **07.3**, which was about a different compound.

07.6 Those students who understand moles had little difficulty with this question; almost a half scored at least 4 marks. The most common error was a failure to convert the mass of Fe_2O_3 to grams. Some students attempted to calculate a volume of Fe_2O_3, not appreciating that it is a solid as shown by the state symbols in the equation. Some students unnecessarily calculated the mass of carbon dioxide before converting this to a volume. The mole ratio was sometimes applied incorrectly to the mass of Fe_2O_3. Despite being given the M_r of Fe_2O_3 as 160, many students used 320 instead. Whilst this sometimes led mathematically to the 'correct' answer, it is incorrect chemistry and full credit was therefore not awarded.

4.2.2.7 Properties of metals and alloys

Answer 45 · Examiner comments

June 2024 | 8462/2H | Original Q6

Question 6 (standard and standard / high demand)

06.1 Most students were able to compare the given data with mathematical processing commonly seen and where the majority of the credit for linked reasons was awarded. Most of the explicitly linked reasons in the indicative content were rarely seen.

Many students thought that burning bamboo to produce heat energy as a method of disposal was a negative point, commonly referring to the release of carbon dioxide as problematic. This was invalid given that bamboo can be seen as a carbon neutral material.

A significant number of students gave comprehensive responses in terms of logically linked reasons but were unable to reach Level 3 because they did not give a reasoned judgement as to which material is better. It is essential that students understand what is required when a particular command word is used, in this case 'evaluate'.

Around one-fifth of students gained a Level 3 mark, with roughly a further 55% achieving Level 2.

06.2 The idea of a protective oxide coating was scored much more often than the idea of contact between aluminium and water or air or oxygen being prevented.

Common misconceptions were that aluminium has too low a reactivity to react with water or oxygen, that the presence of other metals means that aluminium cannot react with water or oxygen - quite often the idea of sacrificial protection was included – or that iron is the only metal that can corrode. Less than 5% of students gained both marks.

06.3 Greasing, oiling and the use of a sacrificial metal, eg galvanising, were commonly seen. Around three-quarters of students gained this mark.

06.4 A significant number of students gave properties of the components, eg strong, flexible, light. The term 'matrix' was seen much more often than 'binder'. The components of a composite were often reversed. Around 15% of students were awarded both marks.