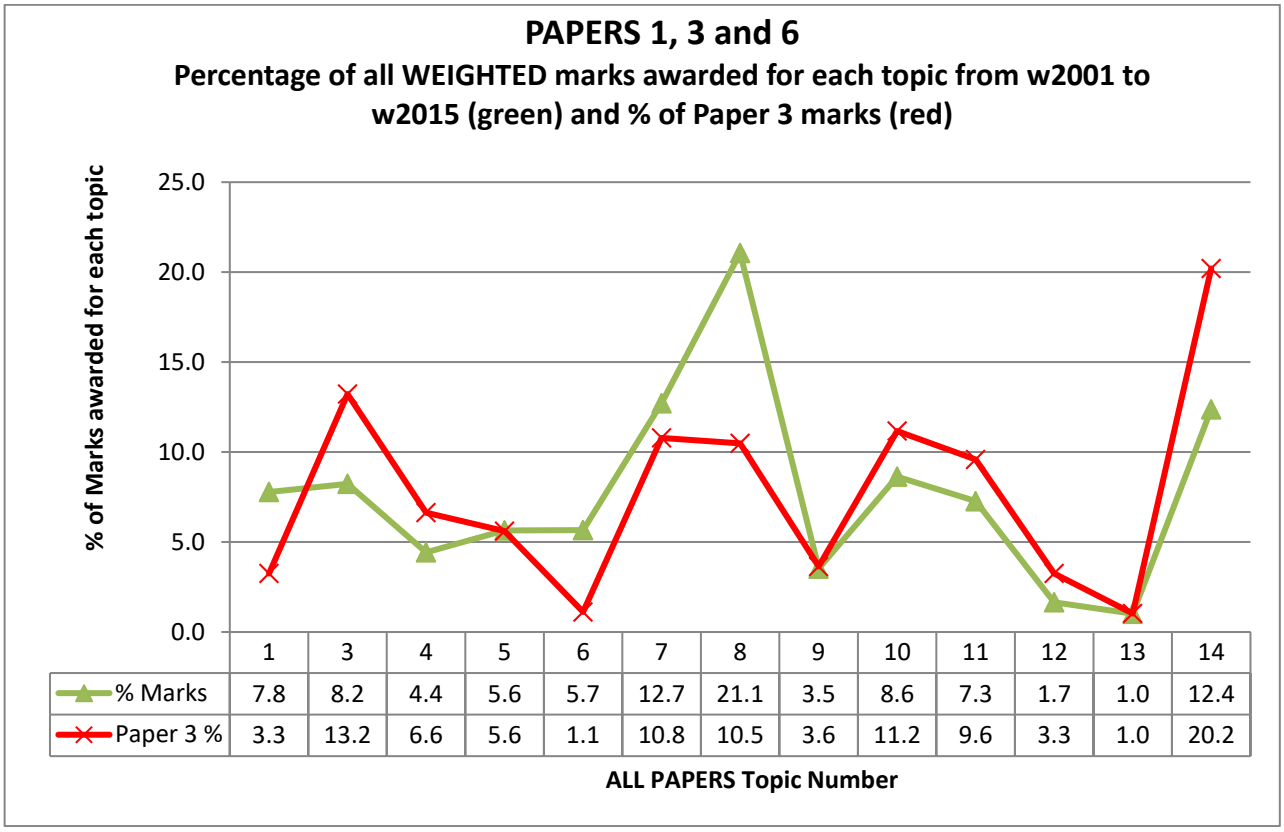
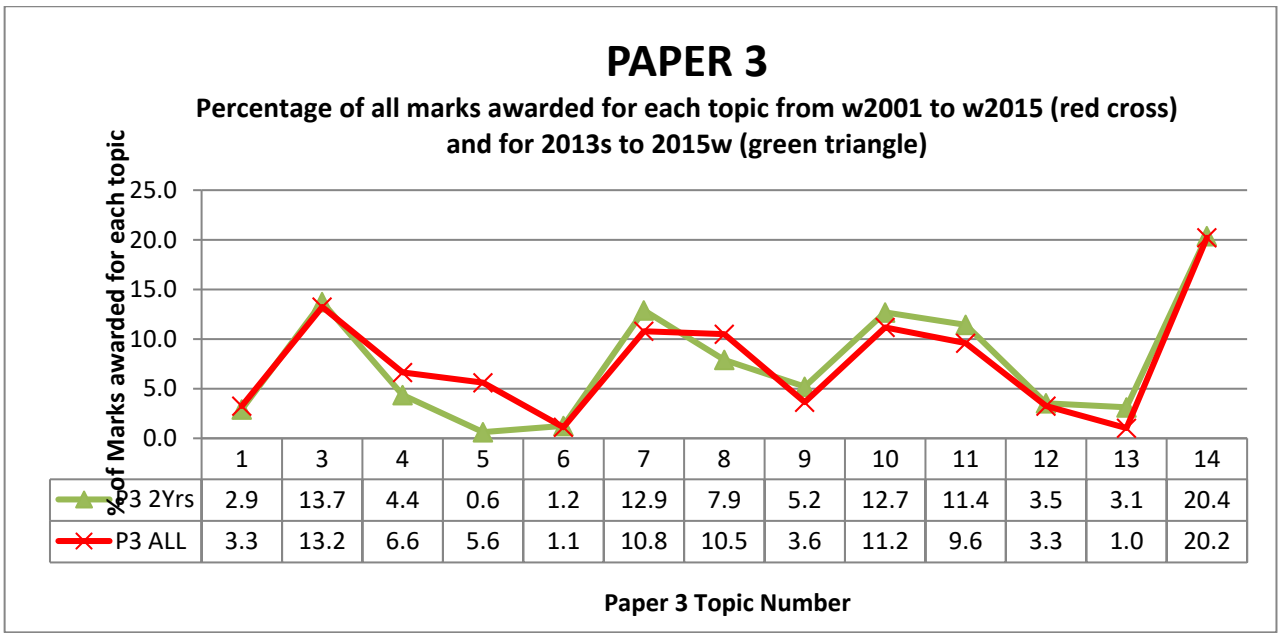
iG Chem EQ P3 15w to 10w Metals and Metal Extraction 280marks



	1	3	4	5	6	7	8	9	10	11	12	13	14
% Marks	7.8	8.2	4.4	5.6	5.7	12.7	21.1	3.5	8.6	7.3	1.7	1.0	12.4
Paper 3 %	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2



	1	3	4	5	6	7	8	9	10	11	12	13	14
P3 2Yrs	2.9	13.7	4.4	0.6	1.2	12.9	7.9	5.2	12.7	11.4	3.5	3.1	20.4
P3 ALL	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2

Topics ranked in order of average ratio of marks per topic from winter (w)2001 to w2015

Topic	14	3	10	7	8	11	4	5	9	1	12	6	13
Rank ALL Papers	2	4	5	3	1	6	9	8	11	7	12	10	13
Rank P3: A* Focus	1	2	3	4	5	6	7	8	9	10	10	12	13
All Syllabus Word Count RANK	1	2	5	3	6	4	9	7	10	8	12	11	13

Relative % frequency of topics being assessed in exams

	Topics:	1	3	4	5	6	7	8	9	10	11	12	13	14
Total Marks		255	273	146	155	187	421	694	116	306	244	54	34	409
% of Marks (Weighted)	3293	7.7	8.3	4.4	4.7	5.7	12.8	21.1	3.5	9.3	7.4	1.7	1.0	12.4

Details of papers used to calculate these frequencies and error

Paper (old syllabus)	1st Paper	Last Paper	Total # Papers	Marks/ paper	Theor. All Papers	Actual All Marks	Difference	Weight per paper	Weight per mark
Paper 1	2002s	2012w	22	40	880	869	-11	30	0.75
Paper 3	2001w	2015w	29	80	2320	2336	16	50	0.63
Paper 6	2001w	2015w	29	60	1740	1890	150	20	0.63

CIE iGCSE Chemistry Syllabus Details

(syllabus code 0620)

The core material is examined in all three exam papers (papers 1,3 and 6) and is intended to assess understanding up to a grade C level. From 2016, the Supplement material is **examined in all three papers**, however, before 2016 papers 1 and 6 did not contain any Supplement material.

10 Metals

10.1 Properties of metals

Core

- List the general physical properties of metals
- Describe the general chemical properties of metals, e.g. reaction with dilute acids and reaction with oxygen
- Explain in terms of their properties why alloys are used instead of pure metals
- Identify representations of alloys from diagrams of structure

10.2 Reactivity series

Core

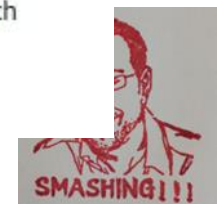
- Place in order of reactivity: potassium, sodium, calcium, magnesium, zinc, iron, (hydrogen) and copper, by reference to the reactions, if any, of the metals with:
  - water or steam
  - dilute hydrochloric acid

  and the reduction of their oxides with carbon
- Deduce an order of reactivity from a given set of experimental results

Supplement

- Describe the reactivity series as related to the tendency of a metal to form its positive ion, illustrated by its reaction, if any, with:
  - the aqueous ions
  - the oxides

  of the other listed metals
- Describe and explain the action of heat on the hydroxides, carbonates and nitrates of the listed metals
- Account for the apparent unreactivity of aluminium in terms of the oxide layer which adheres to the metal



Sub Topic: Chem 10.1 **Q# 1/** iGCSE Chemistry/2003/w/Paper 3/ Q2 (b)

(iii) Suggest why the introduction of a different metallic atom into the structure makes the alloy stronger than the pure metal.

.....

.....[2]

Sub Topic: Chem 10.1 **Q# 2/** iGCSE Chemistry/2002/w/Paper 3/

4 For over 5000 years copper has been obtained by the reduction of its ores. More recently the metal has been purified by electrolysis.

(ii) Alloys have similar structures to pure metals. Give a labelled diagram that shows the structure of a typical alloy, such as brass.

[3]

Sub Topic: Chem 10.2 **Q# 3/** iGCSE Chemistry/2015/w/Paper 31/

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(a) Copper powder from a mixture containing copper and zinc powders.

procedure .....

.....

explanation .....

.....

[3]

Sub Topic: Chem 10.2 **Q# 4/** iGCSE Chemistry/2014/s/Paper 31/

7 One way of establishing a reactivity series is by displacement reactions.

(a) A series of experiments was carried out using the metals lead, magnesium, zinc and silver. Each metal was added in turn to aqueous solutions of the metal nitrates.

The order of reactivity was found to be:

magnesium	most reactive
zinc	↓
lead	
silver	least reactive

(i) Complete the table.

✓ = reacts
✗ = does not react

aqueous solution	metal: lead Pb	metal: magnesium Mg	metal: zinc Zn	metal: silver Ag
lead(II) nitrate		✓	✓	✗
magnesium nitrate				
zinc nitrate				
silver nitrate				

[3]

(ii) Displacement reactions are redox reactions.
On the following equation, draw a **ring** around the reducing agent and an **arrow** to show the change which is oxidation.

$$Zn + Pb^{2+} \rightarrow Zn^{2+} + Pb$$

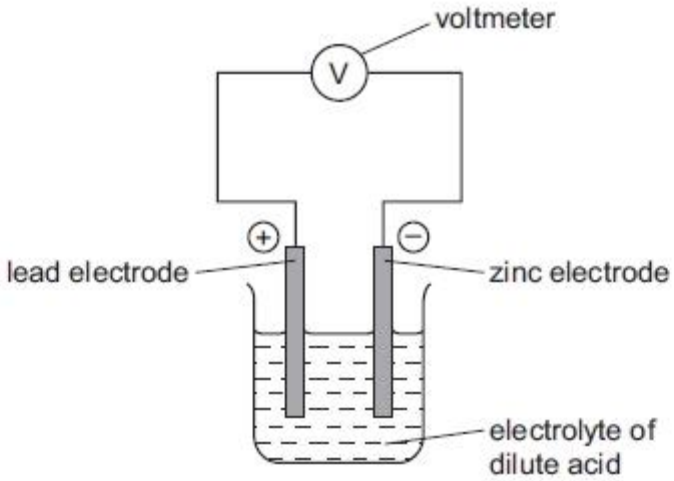
[2]

(iii) Complete the following ionic equation.

$$Zn + 2Ag^{+} \rightarrow \text{.....} + \text{.....}$$

[1]

(b) Another way of determining the order of reactivity of metals is by measuring the voltage and polarity of simple cells. The polarity of a cell is shown by which metal is the positive electrode and which metal is the negative electrode. An example of a simple cell is shown below.



(i) Mark on the above diagram the direction of the electron flow. [1]

(ii) Explain, in terms of electron transfer, why the more reactive metal is always the negative electrode.

.....

.....

..... [2]

(iii) The following table gives the polarity of cells using the metals zinc, lead, copper and manganese.

cell	electrode 1	polarity	electrode 2	polarity
A	zinc	–	lead	+
B	manganese	–	lead	+
C	copper	+	lead	–

What information about the order of reactivity of these four metals can be deduced from the table?

.....

.....

..... [2]

(iv) What additional information is needed to establish the order of reactivity of these four metals using cells?

..... [1]

Sub Topic: Chem 10.2 **Q# 5/** iGCSE Chemistry/2013/w/Paper 31/Q2

(b) The following metals are in order of reactivity.

potassium
zinc
copper

For those metals which react with water or steam, name the products of the reaction, otherwise write 'no reaction'.

potassium .....

.....

zinc .....

.....

copper .....

..... [5]

5 The reactivity series shows the metals in order of reactivity.

(a) The reactivity series can be established using displacement reactions. A piece of zinc is added to aqueous lead nitrate. The zinc becomes coated with a black deposit of lead.

$$Zn + Pb^{2+} \rightarrow Zn^{2+} + Pb$$

Zinc is more reactive than lead.

The reactivity series can be written as a list of ionic equations.

..... → ..... + ... most reactive metal : the best reductant (reducing agent)

$Zn \rightarrow Zn^{2+} + 2e^-$

$Fe \rightarrow Fe^{2+} + 2e^-$

$Pb \rightarrow Pb^{2+} + 2e^-$

$Cu \rightarrow Cu^{2+} + 2e^-$

$Ag \rightarrow Ag^{+} + e^-$

(i) In the space at the top of the list, write an ionic equation for a metal which is more reactive than zinc. [1]

(ii) Write an ionic equation for the reaction between aqueous silver(I) nitrate and zinc.

..... [2]

(iii) Explain why the positive ions are likely to be oxidants (oxidising agents).

..... [1]

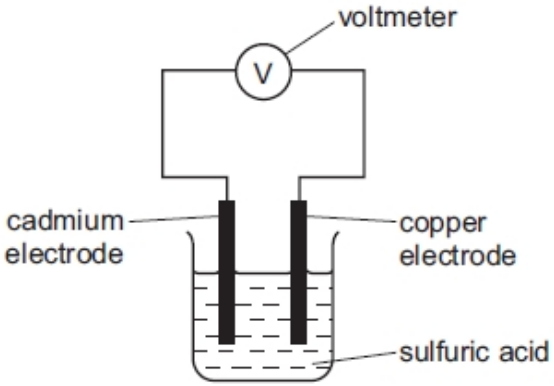
(iv) Deduce which ion is the best oxidant (oxidising agent).

..... [1]

(v) Which ion(s) in the list can oxidise lead metal?

..... [1]

(b) A reactivity series can also be established by measuring the voltage of simple cells. The diagram shows a simple cell.



Results from cells using the metals tin, cadmium, zinc and copper are given in the table below.

cell	electrode 1 positive electrode	electrode 2 negative electrode	voltage / volts
1	copper	cadmium	0.74
2	copper	tin	0.48
3	copper	zinc	1.10

Write the four metals in order of increasing reactivity and explain how you used the data in the table to determine this order.

.....

.....

..... [3]

Sub Topic: Chem 10.2 **Q# 8/** iGCSE Chemistry/2012/s/Paper 31/ Q5

(b) All nitrates decompose when heated.

(i) The equation for the thermal decomposition of silver(I) nitrate is given below.

$$2AgNO_3 \rightarrow 2Ag + 2NO_2 + O_2$$

What are the products formed when copper(II) nitrate is heated?

..... [1]

(ii) Complete the equation for the action of heat on sodium nitrate.

.....$NaNO_3$ → ..... + ...

[2]

Sub Topic: Chem 10.2 **Q# 9/** iGCSE Chemistry/2012/s/Paper 31/

5 Reactive metals tend to have unreactive compounds. The following is part of the reactivity series.

sodium — most reactive
calcium
zinc
copper
silver — least reactive

The table above is the one mentioned in question 5(c) and 5(d)

(c) Which of the metals in the list on page 5 have oxides which are not reduced by carbon?

..... [1]

(d) Choose from the list on page 5, metals whose ions would react with zinc.

..... [2]

Sub Topic: Chem 10.2 **Q# 10/** iGCSE Chemistry/2011/w/Paper 31/

7 Some hydroxides, nitrates and carbonates decompose when heated.

(a) (i) Name a metal hydroxide which does not decompose when heated.

..... [1]

(ii) Write the equation for the thermal decomposition of copper(II) hydroxide.

..... [2]

(iii) Suggest why these two hydroxides behave differently.

..... [1]

(b) (i) Metal nitrates, except those of the Group 1 metals, form three products when heated. Name the products formed when zinc nitrate is heated.

.....

..... [2]

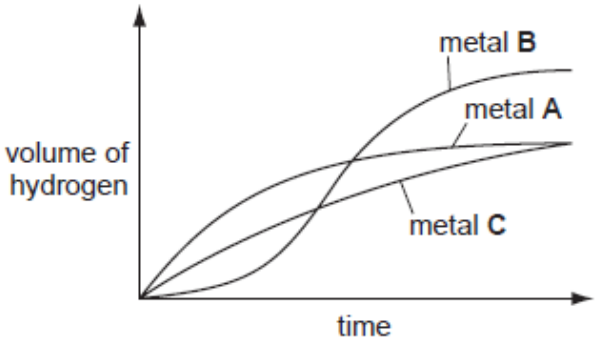
(ii) Write the equation for the thermal decomposition of potassium nitrate.

..... [2]

Sub Topic: Chem 10.2 **Q# 11/** iGCSE Chemistry/2011/s/Paper 31/

7 Excess hydrochloric acid was added to powdered zinc. The hydrogen evolved was collected and its volume measured every 20 seconds.

The experiments were repeated at the same temperature using the same number of moles of powdered magnesium and aluminium.



(a) Identify metals **A**, **B** and **C** by choosing from zinc, magnesium and aluminium. Give a reason for each choice.

metal **A** .....

.....

metal **B** .....

.....

metal **C** .....

..... [5]

(b) Using 'moles', explain why two of the metals form the same volume of hydrogen but the third metal forms a larger volume.

.....

.....

..... [3]

Sub Topic: Chem 10.2 **Q# 12/** iGCSE Chemistry/2010/w/Paper 31/ Q2

(c) The common ore of tin is tin(IV) oxide and an ore of copper is malachite, $CuCO_3.Cu(OH)_2$.

(ii) Malachite is heated to form copper oxide and two other chemicals.
Name these chemicals.

..... and ..... [2]

Sub Topic: Chem 10.2 **Q# 13/** iGCSE Chemistry/2010/s/Paper 31/b

8 Methanoic acid is the first member of the homologous series of carboxylic acids.

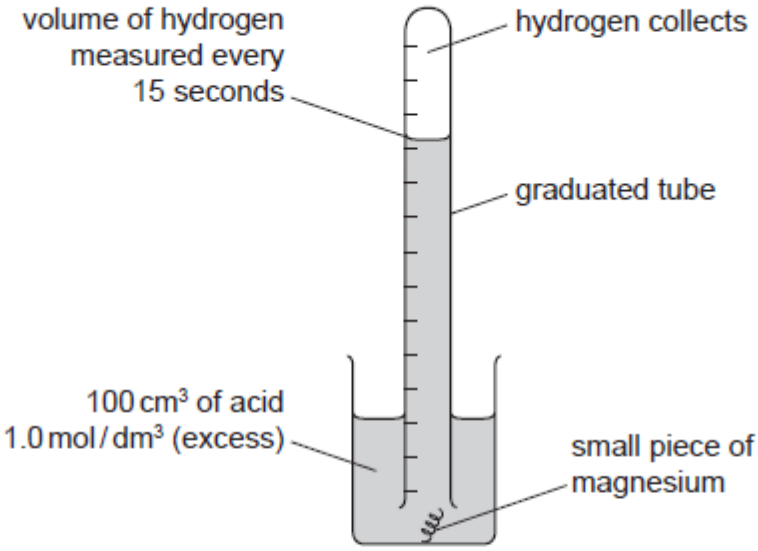
(iii) Aluminium is also above hydrogen in the reactivity series.
Why does methanoic acid not react with an aluminium kettle?

.....

..... [1]

Sub Topic: Chem 10.2 **Q# 14/** iGCSE Chemistry/2010/s/Paper 31/

3 A diagram of the apparatus which could be used to investigate the rate of reaction between magnesium and an excess of an acid is drawn below.



(a) The magnesium kept rising to the surface. In one experiment, this was prevented by twisting the magnesium around a piece of copper. In a second experiment, the magnesium was held down by a plastic net fastened to the beaker.

(i) Suggest a reason why magnesium, which is denser than water, floated to the surface.

.....

..... [1]

(ii) Iron, zinc and copper have similar densities. Why was copper a better choice than iron or zinc to weigh down the magnesium?

.....

..... [1]

Sub Topic: Chem 10.2 **Q# 15/** iGCSE Chemistry/2009/s/Paper 31/

4 The reactivity series of metals given below contains both familiar and unfamiliar elements. For most of the unfamiliar elements, which are marked *, their common oxidation states are given.

* barium	Ba
* lanthanum	La (+3)
magnesium	
zinc	
* chromium	Cr (+2), (+3), (+6)
iron	
copper	
* palladium	(+2)

Choose metal(s) from the above list to answer the following questions.

(i) Which **two** metals would not react with dilute hydrochloric acid?

..... [2]

(ii) Which **two** unfamiliar metals (*) would react with cold water?

..... [2]

(iii) What is the oxidation state of barium?

..... [1]

(iv) Name an unfamiliar metal (*) whose oxide cannot be reduced by carbon.

..... [1]

(v) Why should you be able to predict that metals such as iron and chromium have more than one oxidation state?

.....

..... [1]

(ii) Their hydroxides are heated.
If the compound decomposes, complete the word equation.
If it does not decompose, write "no reaction".

Potassium hydroxide → .....

Calcium hydroxide → ..... [2]

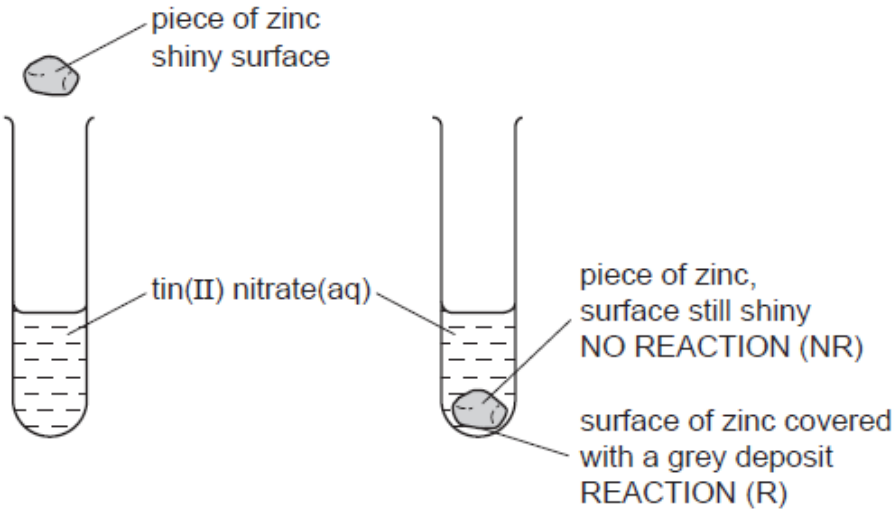
(iii) Complete the equations for the decomposition of their nitrates.

$2KNO_3$ → ..... + ...

$2Ca(NO_3)_2$ → ..... + ... + ... [4]

6 The reactivity series lists metals in order of reactivity.

(a) To find out which is the more reactive metal, zinc or tin, the following experiment could be carried out.



This experiment could be carried out with other metals and the results recorded in a table. Then the order of reactivity can be deduced.

(i) The order was found to be:

manganese	most reactive
zinc	
tin	
silver	least reactive

Complete the table of results from which this order was determined.

aqueous solution	tin Sn	manganese Mn	silver Ag	zinc Zn
tin(II) nitrate		R	NR	R
manganese(II) nitrate				
silver(I) nitrate				
zinc nitrate				

[3]

(ii) Write the ionic equation for the reaction between tin atoms and silver(I) ions.

.....

[2]

(iii) The following is a redox reaction.

$$Mn + Sn^{2+} \longrightarrow Mn^{2+} + Sn$$

Indicate on the equation the change which is oxidation.
Give a reason for your choice.

.....

[2]

(iv) Explain why experiments of this type cannot be used to find the position of aluminium in the reactivity series.

.....

.....

[2]

Sub Topic: Chem 10.2 **Q# 18/** iGCSE Chemistry/2007/s/Paper 3/

5 **(a)** Titanium is produced by the reduction of its chloride. This is heated with magnesium in an inert atmosphere of argon.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

(i) Explain why it is necessary to use argon rather than air.

.....

[1]

(ii) Name another metal that would reduce titanium chloride to titanium.

.....

[1]

Sub Topic: Chem 10.2 **Q# 19/** iGCSE Chemistry/2006/s/Paper 3/

2 Some reactions of metals **W**, **X**, **Y** and **Z** are given below.

metal	reaction with water	reaction with dilute hydrochloric acid
W	A few bubbles form slowly in cold water.	Vigorous reaction. Gas given off.
X	Vigorous reaction. Metal melts. Gas given off.	Explosive reaction. Should not be attempted.
Y	No reaction.	No reaction.
Z	Does not react with cold water. Hot metal reacts with steam.	Steady fizzing.

(a) Arrange these metals in order of reactivity.

most reactive .....

.....

.....

least reactive ..... [2]

(b) Which of these metals could be

(i) magnesium,

..... [1]

(ii) copper?

..... [1]

Sub Topic: Chem 10.2 **Q# 20/** iGCSE Chemistry/2005/w/Paper 3/Q5

The major ore of strontium is its carbonate, $SrCO_3$. Strontium is extracted by the electrolysis of its molten chloride.

(d) Both metals react with water.

(i) Write a word equation for the reaction of zinc and water and state the reaction conditions.

word equation ..... [1]

conditions ..... [2]

(ii) Write an equation for the reaction of strontium with water and give the reaction condition.

equation ..... [2]

condition ..... [1]

Sub Topic: Chem 10.2 **Q# 21/** iGCSE Chemistry/2005/s/Paper 3/ Q6

(d) Predict the equations for the decomposition of the following aluminium compounds.

(i) ..... $Al(OH)_3$ ⟶ ..... + ... [2]

(ii) aluminium nitrate ⟶ ..... + ... + ...

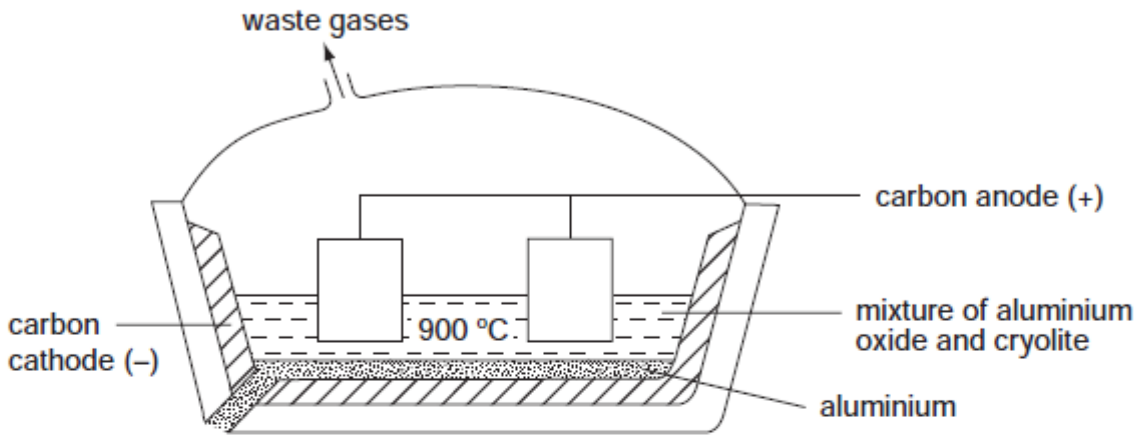
.... [2]

Sub Topic: Chem 10.2 **Q# 22/** iGCSE Chemistry/2005/s/Paper 3/

6 The position of aluminium in the reactivity series of metals is shown below.

magnesium
aluminium
zinc
copper

(a) Aluminium is extracted by the electrolysis of its molten oxide.



(b) Aluminium reacts very slowly with aqueous copper(II) sulphate.

$$2Al(s) + 3CuSO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + 3Cu(s)$$

(i) Which of the two metals has the greater tendency to form ions?

..... [1]

(ii) Describe what you would see when this reaction occurs.

..... [1]

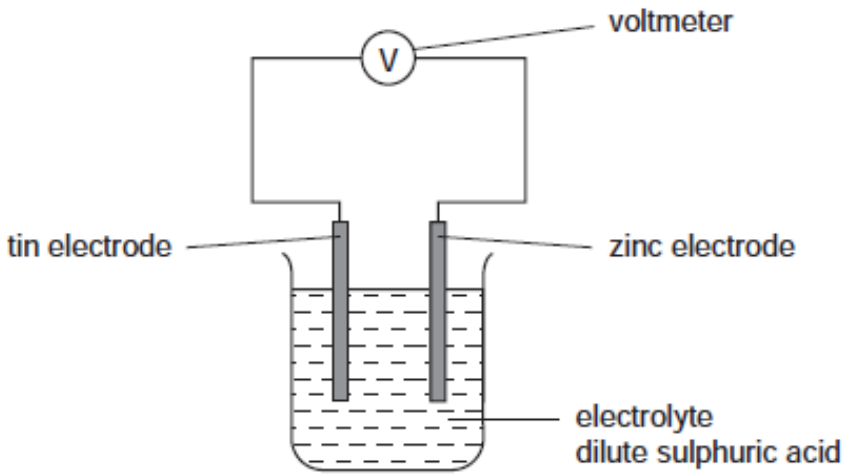
(iii) Explain why aluminium reacts so slowly.

.....

[1]

Sub Topic: Chem 10.2 **Q# 23/** iGCSE Chemistry/2004/w/Paper 3/ Q4

(b) The following diagram shows a simple cell.



(i) Predict how the voltage of the cell would change if the tin electrode was replaced with a silver one.

[1]

(ii) Which electrode would go into the solution as positive ions? Give a reason for your choice.

[1]

(iii) State how you can predict the direction of the electron flow in cells of this type.

[1]

Sub Topic: Chem 10.2 **Q# 24/** iGCSE Chemistry/2004/w/Paper 3/

7 (a) (i) Write a symbol equation for the action of heat on zinc hydroxide.

[2]

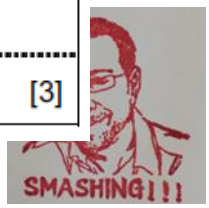
(ii) Describe what happens when solid **sodium** hydroxide is heated strongly.

[1]

(b) What would be **observed** when copper(II) nitrate is heated?

.....

[3]



Sub Topic: Chem 10.2 **Q# 25/** iGCSE Chemistry/2004/w/Paper 3/

4 In the following list of ionic equations, the metals are in order of reactivity.

$\square \rightarrow \square + \square$

$Zn \rightarrow Zn^{2+} + 2e^-$

$Sn \rightarrow Sn^{2+} + 2e^-$ ↑ reactivity of metals increases

$Hg \rightarrow Hg^{2+} + 2e^-$

$Ag \rightarrow Ag^{+} + e^-$

(a) (i) In the space at the top of the series, write an ionic equation that includes a more reactive metal. [1]

(ii) Define *oxidation* in terms of electron transfer.

.....

[1]

(iii) Explain why the positive ions are likely to be oxidising agents.

[1]

(iv) Which positive ion(s) can oxidise mercury metal (Hg)?

[1]

Sub Topic: Chem 10.2 **Q# 26/** iGCSE Chemistry/2003/s/Paper 3/

4 Nitrogen dioxide, NO_2, is a dark brown gas.

(a) Most metal nitrates decompose when heated to form the metal oxide, nitrogen dioxide and oxygen.

(i) Write a symbol equation for the decomposition of lead(II) nitrate.

$Pb(NO_3)_2 \rightarrow$ ..... + ... + ... [2]

(ii) Potassium nitrate does not form nitrogen dioxide on heating. Write the word equation for its decomposition.

.....[1]

Sub Topic: Chem 10.2 **Q# 27/** iGCSE Chemistry/2003/s/Paper 3/

5 The first three elements in Period 6 of the Periodic Table of the Elements are caesium, barium and lanthanum.

(c) All three metals react with cold water. Complete the word equation for these reactions.

metal + water → ..... + ... [2]

Sub Topic: Chem 10.2 **Q# 28/** iGCSE Chemistry/2002/w/Paper 3/ Q4

(d) Copper is an unreactive metal. Its compounds are easily reduced to the metal or decomposed to simpler compounds. Complete the following equations.

(i) ...CuO + ... → ...Cu + ...

(ii) Copper(II) hydroxide $\xrightarrow[\text{(heat)}]{}$ ..... + ...

.....

(iii) $Cu(NO_3)_2 \xrightarrow[\text{(heat)}]{}$ ..... + ... + ...

[4]

Sub Topic: Chem 10.2 **Q# 29/** iGCSE Chemistry/2002/w/Paper 3/ Q1

(c) The results of an investigation into the action of heat on copper(II) sulphate-5-water, a blue crystalline solid, are given below.

The formula is $CuSO_4.5H_2O$ and the mass of one mole is 250 g

A 5.0 g sample of the blue crystals is heated to form 3.2 g of a white powder. With further heating this decomposes into a black powder and sulphur trioxide.

(i) Name the white powder.

.....[1]

(ii) What is observed when water is added to the white powder?

.....[1]

(iii) Name the black powder.

.....[1]

(iv) Calculate the mass of the black powder. Show your working.

.....

.....

.....[3]

Sub Topic: Chem 10.2 **Q# 30/** iGCSE Chemistry/2002/s/Paper 3/

1 In 1886, the modern electrolytic process for the extraction of aluminium was discovered in the USA by C. Hall.

(a) Before this discovery, the only method of extracting the metal was by displacement.

(i) Name a metal that can displace aluminium from aluminium chloride.

.....[1]

(ii) Write a word equation for this displacement reaction.

.....[1]

(iii) Complete the equation for the reaction.

$AlCl_3$ + ... ⟶ ..... + ...[2]

Sub Topic: Chem 10.3 **Q# 31/** iGCSE Chemistry/2015/s/Paper 31/

2 Iron from the Blast Furnace is impure. It contains about 5% of impurities, mainly carbon, sulfur, silicon and phosphorus, which have to be removed when this iron is converted into steel.

(a) Explain how the addition of oxygen and calcium oxide removes these impurities. Include an equation for a reaction of oxygen and a word equation for a reaction of calcium oxide in this process.

.....

.....

.....

.....

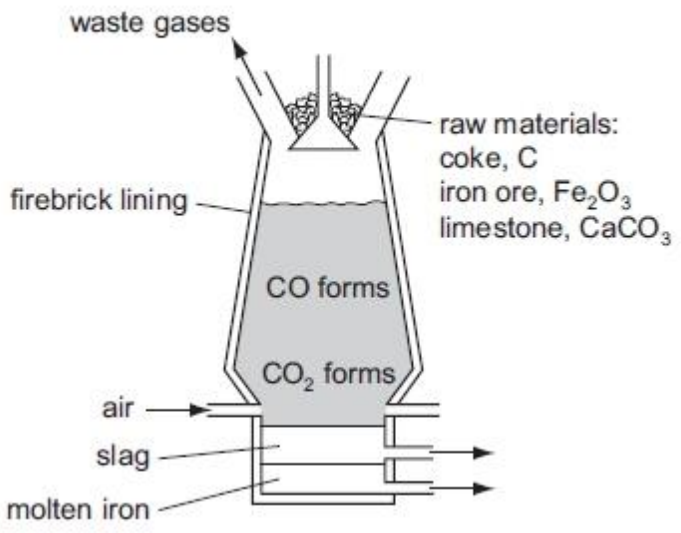
.....

.....

[5]

Sub Topic: Chem 10.3 **Q# 32/** iGCSE Chemistry/2014/w/Paper 31/

4 Iron is extracted from the ore hematite in the Blast Furnace.



(a) The coke reacts with the oxygen in the air to form carbon dioxide.

$$C + O_2 \rightarrow CO_2$$

(i) Explain why carbon monoxide is formed higher in the Blast Furnace.

.....

..... [2]

(ii) Write an equation for the reduction of hematite, Fe_2O_3, by carbon monoxide.

..... [2]

(b) **(i)** Limestone decomposes to form two products, one of which is calcium oxide. Name the other product.

..... [1]

(ii) Calcium oxide reacts with silicon(IV) oxide, an acidic impurity in the iron ore, to form slag. Write an equation for this reaction.

..... [2]

(iii) Explain why the molten iron and the molten slag form two layers and why molten iron is the lower layer.

.....

..... [2]

(iv) Suggest why the molten iron does **not** react with the air.

..... [1]

Sub Topic: Chem 10.3 **Q# 33/** iGCSE Chemistry/2014/s/Paper 31/

5 Zinc is obtained from the ore, zinc blende, ZnS.

(a) Describe the extraction of zinc from its ore, zinc blende. Include at least one balanced equation in your description.

.....

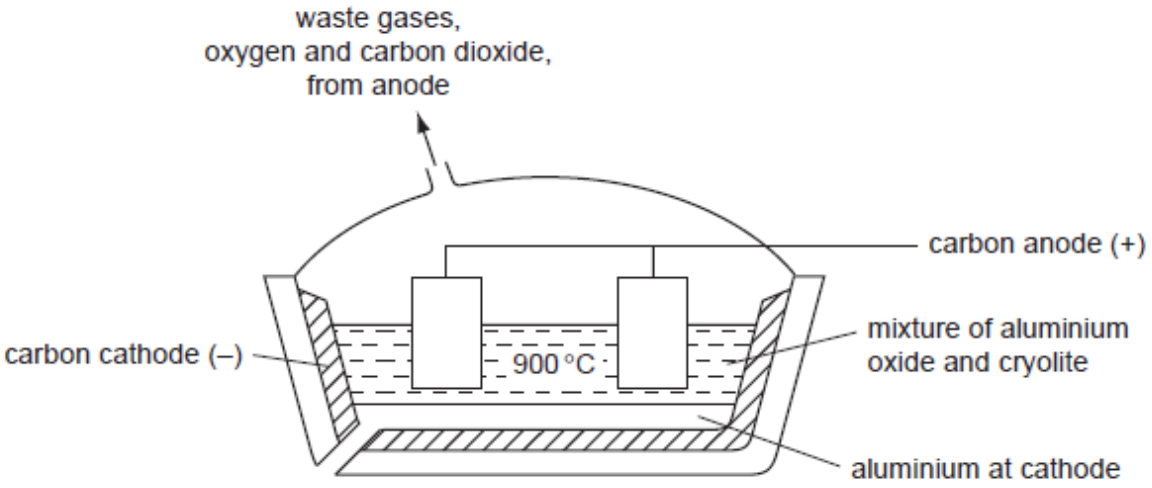
.....

.....

.....

..... [5]

3 Aluminium is extracted by the electrolysis of a molten mixture of alumina, which is aluminium oxide, and cryolite.



(a) (i) Alumina is obtained from the main ore of aluminium.
Name this ore.

..... [1]

(ii) Explain why it is necessary to use a mixture, alumina and cryolite, rather than just alumina.

.....

..... [2]

(iii) Copper can be extracted by the electrolysis of an aqueous solution.
Suggest why the electrolysis of an aqueous solution cannot be used to extract aluminium.

.....

.....

..... [2]

(b) The ions which are involved in the electrolysis are Al^{3+} and O^{2-}. The products of this electrolysis are given on the diagram.
Explain how they are formed. Use equations where appropriate.

.....

.....

.....

..... [4]

Sub Topic: Chem 10.3 **Q# 35/** iGCSE Chemistry/2011/s/Paper 31/

3 Iron from the blast furnace is impure. It contains about 4 % carbon and 0.5 % silicon. Most of this impure iron is used to make mild steel, an alloy of iron containing less then 0.25 % carbon.

(a) A jet of oxygen is blown through the molten iron in the presence of a base, usually calcium oxide. Explain how the percentage of carbon is reduced and how the silicon is removed.

.....

.....

.....

..... [4]

Sub Topic: Chem 10.3 **Q# 36/** iGCSE Chemistry/2011/s/Paper 31/

4 A major ore of zinc is zinc blende, ZnS. A by-product of the extraction of zinc from this ore is sulfur dioxide which is used to make sulfuric acid.

(a) **(i)** Zinc blende is heated in air. Zinc oxide and sulfur dioxide are formed. Write the balanced equation for this reaction.

..... [2]

(ii) Zinc oxide is reduced to zinc by heating with carbon. Name **two** other reagents which could reduce zinc oxide.

..... [2]

(iii) The zinc obtained is impure. It is a mixture of metals. Explain **how** fractional distillation could separate this mixture.
zinc bp = 908 °C, cadmium bp = 765 °C, lead bp = 1751 °C

.....

..... [2]

Sub Topic: Chem 10.3 **Q# 37/** iGCSE Chemistry/2010/w/Paper 31/ Q2

(c) The common ore of tin is tin(IV) oxide and an ore of copper is malachite, $CuCO_3.Cu(OH)_2$.

(i) Write a word equation for the reduction of tin(IV) oxide by carbon.

..... [1]

Sub Topic: Chem 10.3 **Q# 38/** iGCSE Chemistry/2010/s/Paper 31/

7 Titanium is a transition element. It is isolated by the following reactions.

titanium ore → titanium(IV) oxide → titanium(IV) chloride → titanium

TiO_2 $TiCl_4$ Ti

(a) Why is it usually necessary to include a number in the name of the compounds of transition elements?

..... [1]

(b) Titanium(IV) chloride is made by heating the oxide with coke and chlorine.

$$TiO_2 + 2Cl_2 \rightleftharpoons TiCl_4 + O_2$$

$$2C + O_2 \rightleftharpoons 2CO$$

Explain why the presence of coke ensures the maximum yield of the metal chloride.

.....

.....

..... [2]

(c) Explain why the change, titanium(IV) chloride to titanium, is reduction.

.....

..... [1]

Sub Topic: Chem 10.3 **Q# 39/** iGCSE Chemistry/2009/w/Paper 3/

3 **(a)** An important ore of zinc is zinc blende, ZnS.

(i) How is zinc blende changed into zinc oxide?

..... [1]

(ii) Write a balanced equation for the reduction of zinc oxide to zinc by carbon.

..... [2]

Sub Topic: Chem 10.3 **Q# 40/** iGCSE Chemistry/2008/w/Paper 31/ Q3

(b) **(i)** Name a reagent that can reduce iron(III) oxide to iron.

..... [1]

(ii) Write a symbol equation for the reduction of iron(III) oxide, Fe_2O_3, to iron.

..... [2]

Sub Topic: Chem 10.3 **Q# 41/** iGCSE Chemistry/2008/w/Paper 31/ Q3

(d) Iron from the blast furnace is impure. Two of the impurities are carbon and silicon. These are removed by blowing oxygen through the molten iron and adding calcium oxide.

(i) Explain how the addition of oxygen removes carbon.

.....

..... [1]

(ii) Explain how the addition of oxygen and calcium oxide removes silicon.

.....

..... [2]

Sub Topic: Chem 10.3 **Q# 42/** iGCSE Chemistry/2007/w/Paper 3/ Q4

(b) Some of the zinc oxide was mixed with an excess of carbon and heated to 1000 °C Zinc distils out of the furnace.

$$2ZnO + C \rightleftharpoons 2Zn + CO_2$$
$$C + CO_2 \rightarrow 2CO$$

(ii) Why is it necessary to use an excess of carbon?

.....

..... [2]

Sub Topic: Chem 10.3 **Q# 43/** iGCSE Chemistry/2007/s/Paper 3/

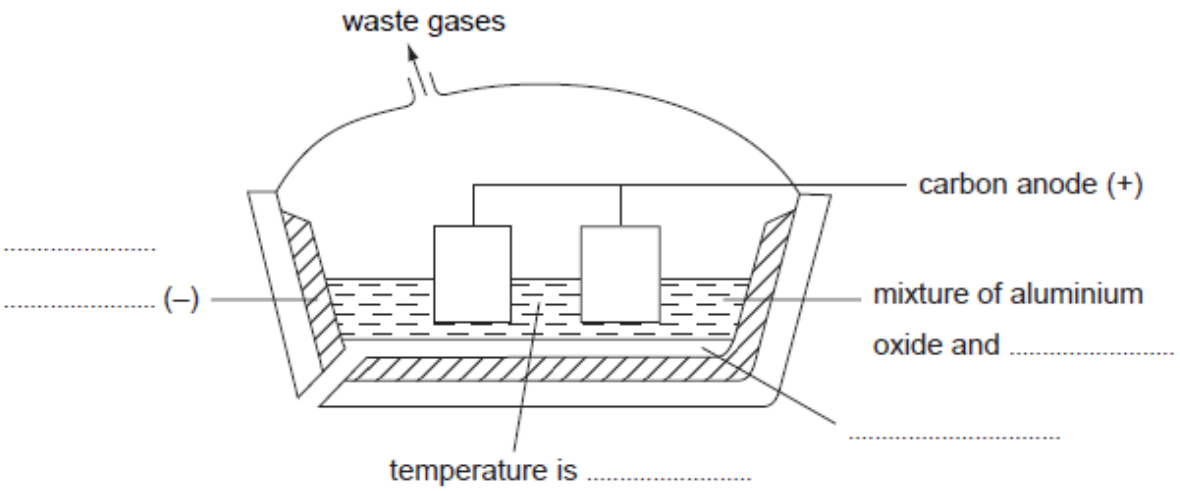
6 Aluminium is extracted by the electrolysis of a molten mixture that contains alumina, which is aluminium oxide, Al_2O_3.

(a) The ore of aluminium is bauxite. This contains alumina, which is amphoteric, and iron(III) oxide, which is basic. The ore is heated with aqueous sodium hydroxide. Complete the following sentences.

The ..... dissolves to give a solution of .....

The ..... does not dissolve and can be removed by ..... [4]

(b) Complete the labelling of the diagram.



[4]

(c) The ions that are involved in the electrolysis are Al^{3+} and O^{2-}.

(i) Write an equation for the reaction at the cathode.

..... [2]

(ii) Explain how carbon dioxide is formed at the anode.

.....

..... [2]

Sub Topic: Chem 10.3 **Q# 44/** iGCSE Chemistry/2006/s/Paper 3/ Q1

(c) Iron is extracted in a blast furnace. The list below gives some of the substances used or formed in the extraction.

carbon monoxide **coke** **iron ore** **limestone** **slag**

(i) Which substance is a mineral containing largely calcium carbonate?

..... [1]

(ii) Which substance is formed when impurities in the ore react with calcium oxide?

..... [1]

(iii) Which substance is also called hematite?

..... [1]

Sub Topic: Chem 10.3 **Q# 45/** iGCSE Chemistry/2006/s/Paper 3/ Q1

(d) State **two** functions of the coke used in the blast furnace.

.....

..... [2]

Sub Topic: Chem 10.3 **Q# 46/** iGCSE Chemistry/2005/w/Paper 3/ Q5

(b) The major ore of zinc is zinc blende, ZnS.

(i) Describe how zinc is extracted from zinc blende.

.....

.....

..... [2]

(ii) Give a use of zinc.

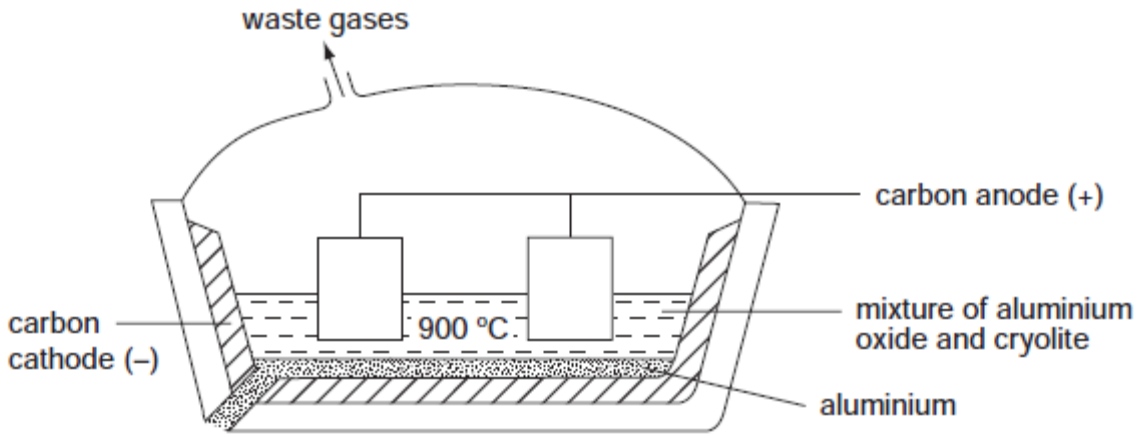
..... [1]

Sub Topic: Chem 10.3 **Q# 47/** iGCSE Chemistry/2005/s/Paper 3/

6 The position of aluminium in the reactivity series of metals is shown below.

magnesium
aluminium
zinc
copper

(a) Aluminium is extracted by the electrolysis of its molten oxide.



(i) Name the main ore of aluminium.

..... [1]

(ii) Why does the molten electrolyte contain cryolite?

..... [1]

(iii) Oxygen is produced at the positive electrode (anode). Name another gas which is given off at this electrode.

..... [1]

3 Zinc blende is the common ore of zinc. It is usually found mixed with an ore of lead and traces of silver.

(a) (i) Describe how zinc blende is changed into zinc oxide.

.....

.....[2]

(ii) Write an equation for the reduction of zinc oxide by carbon.

.....[2]

(iii) The boiling point of lead is 1740 °C and that of zinc is 907 °C. Explain why, when both oxides are reduced by heating with carbon at 1400 °C, only lead remains in the furnace.

.....

.....[2]

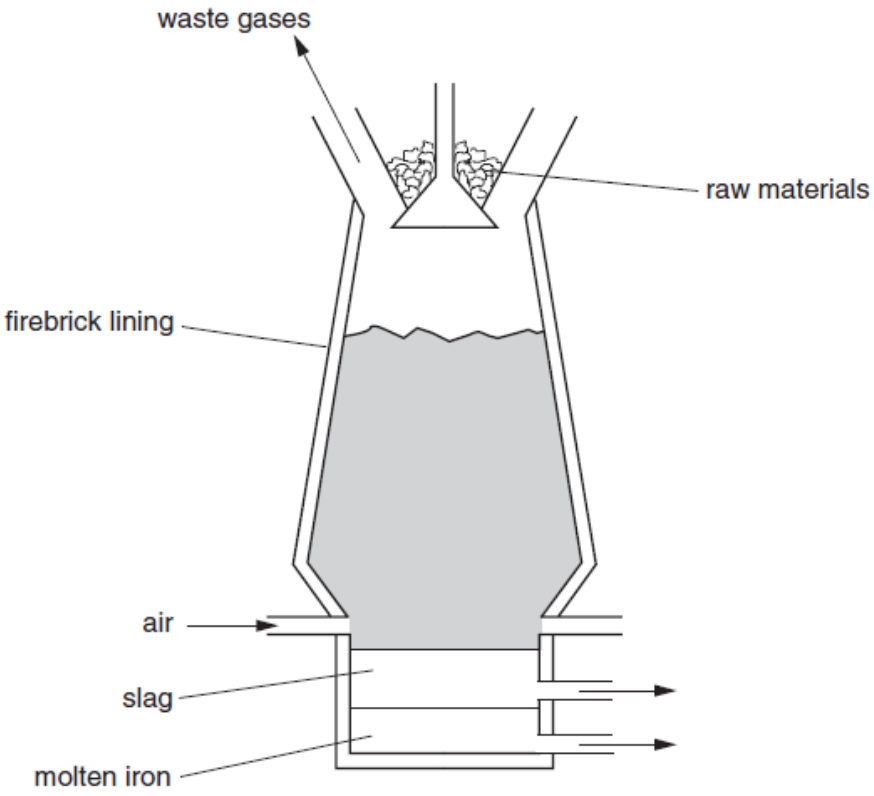
1 No one knows where iron was first isolated. It appeared in China, the Middle East and in Africa. It was obtained by reducing iron ore with charcoal.

(a) Complete the following equation.

Fe_2O_3 + C → ..... + ...
iron ore charcoal

[2]

(b) In 1705 Abraham Darby showed that iron ore could be reduced using coke in a blast furnace.



(i) The temperature in the furnace rises to 2000 °C. Write an equation for the exothermic reaction that causes this high temperature.

.....

(ii) In the furnace, the ore is reduced by carbon monoxide. Explain how this is formed.

.....

.....[3]

(c) The formation of slag removes an impurity in the ore. Write a word equation for the formation of the slag.

.....[2]

Sub Topic: Chem 10.3 **Q# 50/** iGCSE Chemistry/2003/s/Paper 3/

1 No one knows where iron was first isolated. It appeared in China, the Middle East and in Africa. It was obtained by reducing iron ore with charcoal.

(iii) The iron from the blast furnace is impure. It contains about 5% of carbon and other impurities, such as silicon and phosphorus. Describe how the percentage of carbon is reduced and the other impurities are removed.

.....

.....

.....

[4]

Sub Topic: Chem 10.3 **Q# 51/** iGCSE Chemistry/2002/s/Paper 3/ QiGCSE Chemistry/Q1

(b) Aluminium is produced by the electrolysis of an electrolyte that contains aluminium oxide.

(i) Write an ionic equation for the reduction of the aluminium ion at the cathode.

.....[2]

(ii) Name the main ore of aluminium.

.....[1]

(iii) Complete the following description of the electrolyte by filling the spaces.

The electrolyte is a ..... mixture of aluminium oxide and ..... which is maintained at 900 °C. [2]

(iv) Explain why the gas given off at the anode is a mixture of oxygen and carbon dioxide.

.....

.....[2]

Sub Topic: Chem 10.3 **Q# 52/** iGCSE Chemistry/2001/w/Paper 3/Q4 (a)

(ii) Describe how zinc is extracted from zinc blende.

.....

.....

.....[3]

Sub Topic: Chem 10.3 **Q# 53/** iGCSE Chemistry/2001/w/Paper 3/

4 **(a)** Zinc is made by reducing zinc oxide. In 1695 Homberg obtained zinc from calamine, zinc carbonate. At present zinc is extracted from the ore, zinc blende.

(i) Suggest a way of changing calamine into zinc oxide.

.....[1]

Sub Topic: Chem 10.4 **Q# 54/** iGCSE Chemistry/2015/s/Paper 31/

2 Iron from the Blast Furnace is impure. It contains about 5% of impurities, mainly carbon, sulfur, silicon and phosphorus, which have to be removed when this iron is converted into steel.

(b) Mild steel is the most common form of steel. Mild steel contains a maximum of 0.3% of carbon.

High carbon steel contains 2% of carbon. It is less malleable and much harder than mild steel.

(i) Give a use of mild steel.

..... [1]

(ii) Suggest a use of high carbon steel.

..... [1]

(iii) Explain why metals are malleable.

.....

.....

.....

..... [3]

(iv) Suggest an explanation why high carbon steel is less malleable and harder than mild steel.

.....

.....

..... [2]

Sub Topic: Chem 10.4 **Q# 55/** iGCSE Chemistry/2014/s/Paper 31/Q5

(b) State **two** major uses of zinc.

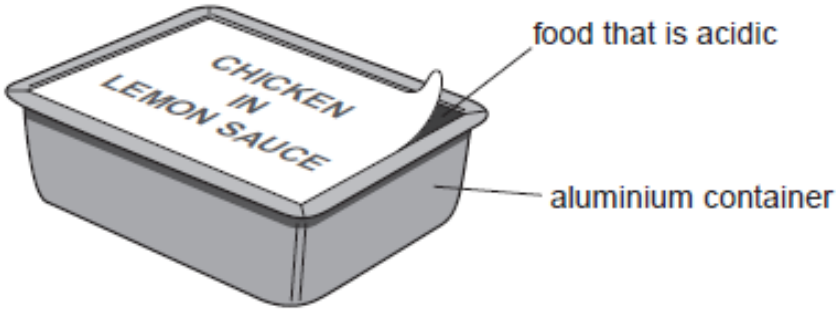
.....

..... [2]

Sub Topic: Chem 10.4 **Q# 56/** iGCSE Chemistry/2011/w/Paper 31/ Q3

(c) The uses of a metal are determined by its properties.

(i) Foods which are acidic can be supplied in aluminium containers.



Explain why the acid in the food does not react with the aluminium.

.....

..... [1]

Sub Topic: Chem 10.4 **Q# 57/** iGCSE Chemistry/2011/s/Paper 31/Q3

(b) (i) Why are steel alloys used in preference to iron?

..... [1]

(ii) State a use of the following alloys.

mild steel .....

stainless steel ..... [2]

Sub Topic: Chem 10.4 **Q# 58/** iGCSE Chemistry/2010/w/Paper 31/ Q2c

(iv) Give **one** use of copper, other than making alloys.

..... [1]

Sub Topic: Chem 10.4 **Q# 59/** iGCSE Chemistry/2010/s/Paper 31/

7 Titanium is a transition element. It is isolated by the following reactions.

titanium ore → titanium(IV) oxide → titanium(IV) chloride → titanium

TiO_2 $TiCl_4$ Ti

(d) Complete the table which shows some of the properties of titanium and its uses. The first line has been completed as an example.

property	related use
soluble in molten steel	making steel titanium alloys
.....	making aircraft and space vehicles
resistant to corrosion, especially in sea water	.....

[2]

Sub Topic: Chem 10.4 **Q# 60/** iGCSE Chemistry/2008/s/Paper 31/ Q3

(c) (i) Give **two** reasons why copper is used,

in electric wiring, ...

..... [2]

in cooking utensils. .....

..... [2]

(ii) Give another use of copper.

..... [1]

Sub Topic: Chem 10.4 **Q# 61/** iGCSE Chemistry/2007/w/Paper 3/ Q4

(d) Give two uses of zinc.

1. .....

2. ..... [2]

Sub Topic: Chem 10.4 **Q# 62/** iGCSE Chemistry/2007/s/Paper 3/Q6

(d) Give an explanation for each of the following.

(i) Aluminium is used extensively in the manufacture of aircraft.

..... [1]

(ii) Aluminium is used to make food containers.

..... [2]

(iii) Aluminium electricity cables have a steel core.

..... [1]

Sub Topic: Chem 10.4 **Q# 63/** iGCSE Chemistry/2006/w/Paper 3/ Q6

(b) Impure copper is extracted from the ore. This copper is refined by electrolysis.

(iii) One use of this pure copper is electrical conductors, another is to make alloys. Name the metal that is alloyed with copper to make brass.

..... [1]

Sub Topic: Chem 10.4 **Q# 64/** iGCSE Chemistry/2006/s/Paper 3/ Q1

(e) Most of the iron is converted into mild steel or stainless steel. Give **one** use for each.

mild steel .....

stainless steel ..... [2]

Sub Topic: Chem 10.4 **Q# 65/** iGCSE Chemistry/2003/w/Paper 3/Q3

(b) A major use of zinc is to make diecasting alloys. These contain about 4% of aluminium and they are stronger and less malleable than pure zinc.

(i) Give one other large scale use of zinc.

.....[1]

Sub Topic: Chem 10.4 **Q# 66/** iGCSE Chemistry/2003/s/Paper 3/

1 No one knows where iron was first isolated. It appeared in China, the Middle East and in Africa. It was obtained by reducing iron ore with charcoal.

(d) Stainless steel is an alloy of iron. It contains iron, other metals and about 0.5% of carbon.

(i) State a use of stainless steel.

.....

(ii) Name a metal, other than iron, in stainless steel.

..... {2}

Sub Topic: Chem 10.4 **Q# 67/** iGCSE Chemistry/2002/w/Paper 3/

4 For over 5000 years copper has been obtained by the reduction of its ores. More recently the metal has been purified by electrolysis.

(a) Copper is used to make alloys.

(i) Give **two** other uses of copper.

.....[2]

Sub Topic: Chem 10.4 **Q# 68/** iGCSE Chemistry/2002/s/Paper 3/Q1

(c) One property of aluminium is that it resists corrosion because it is covered with a layer of its oxide.

(i) Give **one** use of the metal that depends on this property.

.....[1]

(ii) Give another use of the metal that depends on a different property.

use .....

property.....[2]

Sub Topic: Chem 10.4 **Q# 69/** iGCSE Chemistry/2001/w/Paper 3/Q4

(c) Zinc is used to make alloys.

(i) Name an alloy that contains zinc.

.....[1]

(ii) What is the other metal in this alloy?

.....[1]

Q# 1/ iGCSE Chemistry/2003/w/Paper 3/ Q3 (b)

(iii) different size atom **NOT** shape [1]

prevents layers from moving [1]

Q# 2/ iGCSE Chemistry/2002/w/Paper 3/Q4a

(ii) **regular array** [1]

different sizes [1]

delocalised or mobile or free electrons [1]

Q# 3/ iGCSE Chemistry/2015/w/Paper 31/

Question	Answer	Marks
2(a)	add a (dilute) acid; filter; copper does not react or dissolve/zinc reacts or dissolves or forms a salt;	1 1 1

Q# 4/ iGCSE Chemistry/2014/s/Paper 31/

7 (a) (i)

aqueous solution	lead Pb	magnesium Mg	zinc Zn	silver Ag
lead (II) nitrate		✓	✓	✓
magnesium nitrate	✗		✗	✗
zinc nitrate	✗	✓		✗
silver(I) nitrate	✓	✓	✓	

each horizontal line correct (1) [3]

(ii) Zn (1)

An arrow **from** Zn **to** Zn^{2+} (1) [2]

(iii) $Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag$ (1) [1]

(b) (i) correct direction from zinc to lead (1) [1]

(ii) metals react by **losing electrons** (1)

the more reactive metal/zinc will lose electrons more readily (making the electrode negatively charged). (1) [2]

(iii) manganese **and** zinc are more reactive than lead (and/or copper) (1)

lead is more reactive than copper (1) [2]

(iv) the **polarity** of a Mn/Zn (cell)
or the **voltages** of Zn/Pb **and** Mn/Pb (cells) (1) [1]

Q# 5/ iGCSE Chemistry/2013/w/Paper 31/

(b) potassium hydrogen (1) and potassium hydroxide (1)
zinc hydrogen (1) and zinc oxide (1)
copper no reaction (1) [5]

Q# 6/ iGCSE Chemistry/2013/s/Paper 31/

5 (a) (i) any metal above zinc
$Mg \rightarrow Mg^{2+} + 2e^-$ [1]

(ii) $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$ [2]
Note: not balanced only [1]

(iii) because they can accept or gain electrons / change into atoms or can be reduced [1]

(iv) Ag^+ or silver [1]
charge not essential but if given must be correct

(v) Ag^+ and Cu^{2+} **or** silver and copper [1]
charge not essential but if given must be correct

Q# 7/ iGCSE Chemistry/2013/s/Paper 31/

(b) Cu Sn Cd Zn *(i.e. all **4** in correct order)* [1]
relates order to voltage [1]

one relevant comment from: [1]

higher reactivity metals are the negative electrode / copper is least reactive because it is the positive electrode because copper would have the lowest voltage / copper cell V = 0 / the bigger the difference in reactivity, the bigger the voltage / zinc has highest voltage because it is most reactive / more reactive metals have higher voltage

Q# 8/ iGCSE Chemistry/2012/s/Paper 31/

(b) (i) CuO **and** NO_2 **and** O_2; [1]
accept: names or correct formulae

(ii) $2NaNO_3 \rightarrow 2NaNO_2 + O_2$ [2]
accept: $NaNO_3 \rightarrow NaNO_2 + 1/2\ O_2$
not balanced = [1]

Q# 9/ iGCSE Chemistry/2012/s/Paper 31/ Q5

(c) Na / Ca; [1]

(d) Cu; Ag; [2]
accept: *ions* Cu^{2+} *and* Ag^+

Q# 10/ iGCSE Chemistry/2011/w/Paper 31/

7 (a) (i) any Group 1 metal [1]
accept: LiOH

(ii) $Cu(OH)_2 \rightarrow CuO + H_2O$ [2]
note: products only = 1

(iii) reactivity of metals / metals have different reactivities [1]

(b) (i) zinc oxide, nitrogen dioxide, oxygen [2]
note: two correct = 1

(ii) $2KNO_3 \rightarrow 2KNO_2 + O_2$ [2]
note: unbalanced = 1, correct word equation = 1

Q# 11/ iGCSE Chemistry/2011/s/Paper 31/

7 **(a)** metal A is magnesium [1]
cond most reactive or fastest reaction [1]

metal B is aluminium [1]
cond faster reaction after removal of oxide layer / it would give more hydrogen / aluminium more reactive than zinc [1]

metal C is zinc [1]
zinc least reactive [1]
NOTE MAX [5]
If you encounter different reasoning which is correct, please award the appropriate marks.

(b) for magnesium and zinc same volume of hydrogen [1]

because both have valency of 2 / 1 mole of metal gives 1 mole of hydrogen / 1 mole of metal reacts with 2 moles of acid [1]

bigger volume for aluminium because its valency is 3 / 1 mole of metal gives 1.5 moles of hydrogen / 1 mole of metal reacts with 3 moles of acid [1]

If you encounter different reasoning which is correct, please award the appropriate marks.

accept balanced equations
accept ionic charges as alternative to valency

Q# 12/ iGCSE Chemistry/2010/w/Paper 31/ Q2

(ii) water [1]
carbon dioxide [1]

Q# 13/ iGCSE Chemistry/2010/s/Paper 31/Q8b

(iii) protected by oxide layer [1]

Q# 14/ iGCSE Chemistry/2010/s/Paper 31/

3 **(a)** **(i)** bubbles / effervescence / hydrogen / gas pushes up / lifts metal [1]

(ii) does not react with acid / zinc and iron react with acid [1]
not just unreactive

Q# 15/ iGCSE Chemistry/2009/s/Paper 31/

4 **(i)** Cu and Pd [2]

(ii) Ba and La [2]

(iii) +2 **or** 2+ **or** Ba^{2+} [1]

(iv) Ba **or** La [1]

(v) it is a transition metal **or** a d block element [1]

[Total: 7]

Q# 16/ iGCSE Chemistry/2008/w/Paper 31/ 6 (b)

(ii) potassium hydroxide → no reaction [1]
calcium hydroxide → calcium oxide and water [1]
ACCEPT metal oxide

(iii) $2KNO_3 \rightarrow 2KNO_2 + O_2$ [2]
[1] for **formula** of either product

$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$ [2]
[1] for **formulae** of any **TWO** products

Q# 17/ iGCSE Chemistry/2008/w/Paper 31/

6 (a) (i)

aqueous solution	tin Sn	manganese Mn	silver Ag	zinc Zn
tin(II) nitrate		R	NR	R
manganese(II) nitrate	NR		NR	NR
silver(I) nitrate	R	R		R
zinc nitrate	NR	R	NR	

[1] for each row [3]
ignore anything written in blank space

(ii) $Sn + 2Ag^+ \rightarrow Sn^{2+} + 2Ag$ [2]
all species correct [1]
accept equation with Sn^{4+}

(iii) Mn to Mn^{2+} need both species [1]
electron loss **or** oxidation number increases [1]

(iv) covered with oxide layer [1]
makes it unreactive **or** protects **or** aluminium oxide unreactive [1]

Q# 18/ iGCSE Chemistry/2008/s/Paper 31/

5 (a) (i) air would react (with the magnesium **or** titanium)
OR argon would not react (with the metals) [1]
NOT argon is inert

(ii) any metal higher than magnesium in reactivity series [1]

Q# 19/ iGCSE Chemistry/2006/s/Paper 3/

2 (a) X
W
Z
Y [2]
For most reactive X and least Y [1] **ONLY**
All other responses [0]

(b) magnesium W [1]
copper Y [1]

Q# 20/ iGCSE Chemistry/2005/w/Paper 3/Q5

(d)(i) zinc + water = zinc oxide + hydrogen [1]
heat **[1]** steam **[1]** [2]

(ii) $Sr + 2H_2O = Sr(OH)_2 + H_2$ [2]
Not balanced **[1]**
cold water [1]

Q# 21/ iGCSE Chemistry/2005/s/Paper 3/ Q6

(d) (i) $2Al(OH)_3 = Al_2O_3 + 3H_2O$ [2]
Not balanced [1]

(ii) Aluminium nitrate = aluminium oxide + nitrogen dioxide + oxygen [2]
only TWO correct products [1]

Q# 22/ iGCSE Chemistry/2005/s/Paper 3/ Q6

(b) (i) aluminium **[1]**

(ii) solution goes colourless **or** copper formed **[1]**
or a brown solid forms **or** blue colour disappears
or bubbles
NOT goes clear **or** copper formed

(iii) covered with an oxide layer **[1]**

Q# 23/ iGCSE Chemistry/2004/w/Paper 3/ Q4

(b) (i) increase **[1]**

(ii) zinc
COND and a correct reason - such as it loses electrons more easily **or**
it is more reactive **[1]**
Need both zinc and reason for the mark.

(iii) from the more reactive to the less reactive **NOT** just from zinc to lead **[1]**

Q# 24/ iGCSE Chemistry/2004/w/Paper 3/

7 (a) (i) $Zn(OH)_2 = ZnO + H_2O$ **[2]**
reactant [1] products [1]

(ii) it would melt **or** it does not decompose **or** it does not react **[1]**
NOT no change

(iii) blue (solid) **[1]**
to black (solid) **[1]**
brown gas **[1]**

Q# 25/ iGCSE Chemistry/2004/w/Paper 3/

4 (a) (i) Correct equation with a more reactive metal **[1]**

(ii) Electron loss **[1]**

(iii) Because they can accept electrons or take electrons away
from..... **[1]**

(iv) Silver or silver(I) **[1]**

Q# 26/ iGCSE Chemistry/2003/s/Paper 3/

4 (a) (i) Correct equation **[2]**
not balanced [1] ONLY
$2Pb(NO_3)_2 = 2PbO + 4NO_2 + O_2$

$Pb(NO_3)_2 = PO + 2\ NO_2 + \frac{1}{2}\ O_2$

(ii) potassium nitrate → potassium nitrite + oxygen **[1]**

Q# 27/ iGCSE Chemistry/2003/s/Paper 3/Q5

(c) metal hydroxide or hydroxide ions **[1]**
hydrogen **[1]**

Q# 28/ iGCSE Chemistry/2002/w/Paper 3/ Q4

(d) (i) $CuO + C \Longrightarrow Cu + CO$
or $2CuO + C \Longrightarrow 2\,Cu + CO_2$
or any other correct reductant – hydrogen or metal [1]

(ii) Copper(II) hydroxide = copper oxide + water [1]
accept symbols

(iii) $2Cu(NO_3)_2 \Longrightarrow 2CuO + 4NO_2 + O_2$ [2]
unbalanced ONLY [1]
NOT word equation

Q# 29/ iGCSE Chemistry/2002/w/Paper 3/ Q1

(c) (i) copper sulphate **or** anhydrous copper sulphate [1]
accept "unhydrated"
NOT formula

(ii) goes blue **or** becomes hot **or** steam [1]

(iii) copper oxide [1]

(iv) 5/250 = 0.02 moles [1]
Mr = 80 [1]
80 x 0.02 = 1.6 g [1]
NB (iv) to be marked **conseq** to (iii)
Correct answer no working **ONLY** [1]

Q# 30/ iGCSE Chemistry/2002/s/Paper 3/Q1

1 (a) (i) Any metal above aluminium Na, K, Ca, Mg etc [1]

(ii) If (i) is correct then word equation [1]

(iii) **conseq** to (i) symbol equation [2]
If not balanced ONLY [1]

Q# 31/ iGCSE Chemistry/2015/s/Paper 31/

2(a)	M1 *Forming an oxide* (all) elements or (all) impurities become oxides;		(All) elements or (all) impurities react with oxygen **A** M1 for any one element becoming an oxide
	M2 *Gaseous oxides* carbon dioxide or sulfur (di)oxide escape/are removed as gases;		**A** formulae/carbon monoxide **A** oxides of sulfur/carbon **I** sulfur trioxide
	M3 *Acidic oxides* silicon(IV) oxide or phosphorus(III/V) oxide react/are neutralised by calcium oxide/lime;		**A** silicon (di)oxide for silicon(IV) oxide **A** phosphorus (tri/pent)oxide for phosphorus(III/V) oxide
	M4 *Equation mark* any one of the following equations $S + O_2 \rightarrow SO_2$; $C + O_2 \rightarrow CO_2$ or $2C + O_2 \rightarrow 2CO$; $Si + O_2 \rightarrow SiO_2$; $4P + 5O_2 \rightarrow 2P_2O_5$ or $P_4 + 5O_2 \rightarrow 2P_2O_5$; $4P + 3O_2 \rightarrow 2P_2O_3$ or $P_4 + 3O_2 \rightarrow 2P_2O_3$;		**A** multiples **I** state symbols **I** unbalanced equations **R** other combustion equations with incorrect species
	M5 *Word equation mark* any one of the following word equations calcium oxide + silicon(IV) oxide → calcium silicate; calcium oxide + phosphorus(III/V) oxide → calcium phosphate;	5	**A** calcium oxide + silicon(IV) oxide → slag **A** correct symbol equation for M5 but **R** other equations with incorrect species used as M5

Q# 32/ iGCSE Chemistry/2014/w/Paper 31/

4 (a) (i) insufficient/limited oxygen [1]
or $2C + O_2 \rightarrow 2CO$

coke/carbon reacts with carbon dioxide [1]
or $C + CO_2 \rightarrow 2CO$

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
species (1) balancing (1) [2]

(b) (i) carbon dioxide [1]

(ii) $CaO + SiO_2 \rightarrow CaSiO_3$ [2]
[1] each side correct

(iii) (molten) iron higher density (than slag) [2]

(iv) No oxygen in contact with iron **or** layer of slag prevents hot iron reacting with oxygen/air **or** (all) oxygen reacts with carbon (so no oxygen left to react with iron) [1]

Q# 33/ iGCSE Chemistry/2014/s/Paper 31/

5 (a) M1: (zinc sulfide) heated / roasted / burnt in **air** (1)

M2: zinc oxide formed (1)

M3: zinc oxide **reduced** (1)

M4: (by adding) coke or carbon (1)

M5: Balanced equation (any one of) (1) [5]

$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
$2ZnO + C \rightarrow 2Zn + CO_2$
$ZnO + C \rightarrow Zn + CO$
$ZnO + CO \rightarrow Zn + CO_2$

Q# 34/ iGCSE Chemistry/2011/w/Paper 31/

3 (a) (i) bauxite [1]

(ii) lowers melting point [1]
better conductor / reduces amount of energy needed / reduces cost / more economic / makes process viable / conserves energy [1]

(iii) aluminium more reactive than copper / aluminium higher in reactivity series [1]
hydrogen not aluminium formed at cathode [1]

(b) $Al^{3+} + 3e \rightarrow Al$ [1]
$2O^{2-} \rightarrow O_2 + 4e$ [2]
note: not balanced = 1
oxygen reacts with carbon (anode) to form carbon dioxide / $C + O_2 \rightarrow CO_2$ [1]
note: if mark(s) for an electrode reaction are not awarded then allow aluminium ions accept electrons / are reduced [1]
oxide ion loses electrons / is oxidised [1]
max 4

Q# 35/ iGCSE Chemistry/2011/s/Paper 31/

3 (a) any four max 4
carbon forms carbon dioxide / carbon monoxide [1]
this is a gas it escapes / blown out / diffuses [1]
silicon forms silicon(IV) oxide / silica [1]
/ silicon(IV) oxide present in impure iron
silicon(IV) oxide reacts with calcium oxide to form slag **or** calcium silicate [1]
slag removed from surface [1]
accept skimmed, syphoned, poured off
not tapped max [4]
accept correct formula or equations
not calcium oxide reacts with silicon

Q# 36/ iGCSE Chemistry/2011/s/Paper 31/

4 (a) (i) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ [2]
not balanced only [1]

(ii) **two** reagents from named metal(s) more reactive than zinc/carbon monoxide [2]
not hydrogen

(iii) they have different boiling points [1]
cadmium will distil first then zinc leaving lead/lead distilled last [1]

Q# 37/ iGCSE Chemistry/2010/w/Paper 31/ Q2

(c) (i) tin(IV) oxide + carbon → tin + carbon dioxide [1]
not carbon monoxide as a reductant
accept carbon monoxide as a product
not tin(IV)
accept correct symbol equation

Q# 38/ iGCSE Chemistry/2010/s/Paper 31/

7 (a) a transition element has more than one oxidation state or valency [1]
accept different oxidation states

(b) by removing oxygen concentration of O_2 decreases [1]
prevents the back reaction / equilibrium shifts to right [1]

(c) oxidation number reduced (from (+) 4 to 0) [1]
accept accepts electrons **or** accepts four electrons
if number given must be 4

Q# 39/ iGCSE Chemistry/2009/w/Paper 3/

3 (a) (i) heat **or** roast **or** burn <u>in air</u> [1]
need both points for mark

(ii) $ZnO + C \rightarrow Zn + CO$ [2]
or $2ZnO + C \rightarrow 2Zn + CO_2$
unbalanced **ONLY** [1]

Q# 40/ iGCSE Chemistry/2008/w/Paper 31/ Q3

(b) (i) hydrogen **or** carbon **or** carbon monoxide **or** methane
or more reactive metal **NOT** Group I [1]

(ii) any correct equation [2]
only error not balanced [1]

Q# 41/ iGCSE Chemistry/2008/w/Paper 31/ Q3

(d) **(i)** forms carbon dioxide/carbon monoxide (which escapes) [1]

(ii) forms silicon(IV) oxide **or** silicon oxide **or** silica [1]
OR CaO reacts with SiO_2
to form slag **or** calcium silicate [1]
ignore an incorrect formula if a correct name "slag" given
NOT Si + O_2 + CaO form slag, this gains mark for slag only

Q# 42/ iGCSE Chemistry/2007/w/Paper 3/ Q4 (b)

(ii) to get maximum yield of zinc **or** reduce all zinc oxide [1]
NOTE the above mark is awarded for why add excess carbon moves equilibrium to right **or** to favours the products **or** removes CO_2 from equilibrium [1]
NOTE this mark is awarded for how does the addition of excess carbon give max yield of zinc
NOTE Allow any coherent explanation flexibly based on the above ideas
EXAMPLES:
moves equilibrium to right [1] because carbon dioxide removed [1]
to get maximum yield of zinc [1] as equilibrium moves to right [1]
NOT just to make CO from CO_2

Q# 43/ iGCSE Chemistry/2008/s/Paper 31/

6 **(a)** alumina **or** aluminium oxide [1]
sodium aluminate [1]
iron(III) oxide [1]
filtration **or** centrifuge NOT conditional [1]

(b) from left to right:
carbon cathode **or** carbon negative electrode [1]
900 to 1000°C [1]
aluminium [1]
cryolite [1]

(c) **(i)** Al^{3+} + 3e = Al [2]
not balanced [1]
$Al^{3+}(aq)$ = 0

(ii) oxygen is formed **NOT** oxide [1]
reacts with carbon anode [1]

Q# 44/ iGCSE Chemistry/2006/s/Paper 3/ Q1

(c) **(i)** limestone **[1]**

(ii) slag **[1]**

(iii) iron ore **[1]**

Q# 45/ iGCSE Chemistry/2006/s/Paper 3/ Q1

(d) to burn **or** provide heat **[1]**
to make carbon monoxide **[1]**

Q# 46/ iGCSE Chemistry/2005/w/Paper 3/ Q5

(b)(i) heat zinc blende in air to form oxide **[1]**
reduce oxide with carbon **[1]**

(ii) galvanising
sacrificial protection
alloys
batteries
roofing
Any **ONE** **[1]**

Q# 47/ iGCSE Chemistry/2005/s/Paper 3/

6 (a) (i) bauxite **[1]**

(ii) to reduce melting point **or** improve conductivity **[1]**
or as a solvent **or** reduce the working temperature

(iii) carbon dioxide **or** monoxide **or** fluorine **[1]**

Q# 48/ iGCSE Chemistry/2003/w/Paper 3/

3 (a) (i) heat **or** roast [1]
in air [1]

(ii) Either correct equation [2]
$ZnO + C = Zn + CO$
$2ZnO + C = 2Zn + CO_2$
Not balanced **ONLY** [1]
NOT carbon monoxide as a reductant

(iii) bp of lead above 1400 ^{0}C it remains
bp of zinc below 1400 ^{0}C
boils away **or** forms vapour
Any TWO [2]

OR lead does not boil [1]
zinc boils [1]

Q# 49/ iGCSE Chemistry/2003/s/Paper 3/

1 (a) A correct equation either CO or CO_2 as product
If not balanced but otherwise correct [1] ONLY [2]

(b) (i) $C + O_2 \rightarrow CO_2$ NOT word equation [1]
(ii) (higher in furnace) no oxygen left [1]
carbon dioxide reacts with carbon (to give carbon monoxide) [1]

OR incomplete combustion of carbon [2]

OR either equation gains both marks
$CO_2 + C = 2CO$ or $2C + O_2 = 2CO$

OR carbon dioxide reacts [1]
with carbon [1]

(c) limestone + sand → slag [2]
OR calcium carbonate + silicon (IV) oxide → calcium silicate (+ carbon dioxide)

For knowing that impurity is sand [1] ONLY

Accept calcium oxide and silicon oxide
Accept lime

Q# 50/ iGCSE Chemistry/2003/s/Paper 3/ Q1

(iii) blow air/oxygen through
carbon becomes carbon dioxide
carbon dioxide escapes as gas
silicon and phosphorus become oxides
calcium oxide or calcium carbonate
forms slag
Any FOUR NOT blast furnace [4]

Q# 51/ iGCSE Chemistry/2002/s/Paper 3/ QiGCSE Chemistry/Q1

(b) (i) $Al^{3+} + 3e \Longrightarrow Al$ [2]
For Al^{3+} **ONLY [1]** anywhere in equation

(ii) bauxite [1]

(iii) molten or liquid or fused or homogeneous [1]
cryolite [1]

(iv) oxygen from oxide or formed at anode or implied it is formed [1]
carbon (anode) to form carbon dioxide [1]

Q# 52/ iGCSE Chemistry/2001/w/Paper 3/Q4 (a)

(ii) zinc sulphide or roast or burn or sulphur dioxide formed [1]
zinc oxide [1]
reduce with carbon or dissolve zinc oxide in sulphuric acid and electrolyse [1]
NOT electrolysis of blende or oxide

Q# 53/ iGCSE Chemistry/2001/w/Paper 3/

4 (a) (i) heat (ignore air) or roast NOT burn [1]

Q# 54/ iGCSE Chemistry/2015/s/Paper 31/

2(b)(i)	*Any **one** from:* (making) car (bodies); machinery; chains; pylons; white goods; nails; screws; as a building material; sheds / roofs; reinforcing concrete;	1	**A** bridges **A** tools **I** cutlery
2(b)(ii)	*Any **one** from:* knives; drills; railway tracks; machine/ cutting tools / hammers; razor blades; chisels;	1	**I** cutlery items **I** bridges
2(b)(iii)	M1 atoms or cations or (positive) ions or metal ions; M2 arranged in a lattice or in layers or in rows or in a regular structure; M3 rows or layers slide over one another;	3	**I** (sea of) electrons **R** protons or nuclei for M1 **A** M2 non-directional forces **A** ECF on particle named in M1 for M3 **I** 'atoms' slide over one another
2(b)(iv)	M1 carbon **atoms** or **particles** in structure different size (to cations); M2 so reduce moving or interrupt movement;	2	**R** ions and molecules for M1 **A** M2 for prevents sliding **A** M2 for 'stops' sliding

Q# 55/ iGCSE Chemistry/2014/s/Paper 31/

(b) Any **two** from: [2]

- (making) brass **or** alloys (1)
- galvanising (1)
- sacrificial protection (1)
- batteries (1)

Q# 56/ iGCSE Chemistry/2011/w/Paper 31/ Q3

(c) (i) protective oxide layer [1]

Q# 57/ iGCSE Chemistry/2011/s/Paper 31/Q3

(b) (i) any sensible suggestion – harder/stronger/can be tailored for a specific use/more resistant to corrosion [1]
not steel does not rust

(ii) mild steel – cars or any vehicle/bicycles/white goods/screws or nails/roof/bridges/tools/ buildings/ships/pipes/machinery etc. [1]

stainless steel – chemical plants/cooking utensils/jewellery/cutlery/surgical equipment/ kitchen sinks/pipes/etc. [1]

Q# 58/ iGCSE Chemistry/2010/w/Paper 31/ Q2

(iv) wires / pipes / jewellery / nails / roofing / ammunition / coins / cookware / catalyst / sculpture [1]

Q# 59/ iGCSE Chemistry/2010/s/Paper 31/

(d) low density / lightweight / light [1]
propellers / fittings on ships / inert anodes in electrolysis / hip replacements / ship building / chemical plants / cathodic protection / diving equipment [1]

Q# 60/ iGCSE Chemistry/2008/s/Paper 31/ Q3

(c) (i) good conductor [1]
malleable **or** ductile [1]

good conductor of heat
high melting point (and high boiling point)
unreactive **or** resists corrosion
appearance
any **TWO** [2]
do not accept malleable **or** ductile if either is given for wiring

(ii) alloys **or** named alloy **or** pipes **or** ornaments **or** jewellery **or** integrated circuit boards **or** electroplating **or** roofs, etc. [1]

Q# 61/ iGCSE Chemistry/2007/w/Paper 3/ Q4

(d) prevent iron from rusting **NOT** with galvanising **or** sacrificial protection
making brass **or** making alloys **NOT** bronze
electroplating **or** as an electrode in electrolysis
cells
roofing
sacrificial protection
coinage
TWO uses [2]

Q# 62/ iGCSE Chemistry/2008/s/Paper 31/Q6

(d) (i) low density **or** light or resistant to corrosion
accept strength/weight ratio **or** alloys are strong [1]
strong on its own is neutral

(ii) not attacked **or** corroded **or** unreactive
oxide layer
easily shaped **or** malleable **or** ductile
any **TWO** [2]

(iii) for strength **or** so it does not break **or** does not sag **or** can have pylons further apart [1]

NOT steel is a better conductor
NOT aluminium protects steel from rusting

Q# 63/ iGCSE Chemistry/2006/w/Paper 3/ Q6 (b)

(iii) Zinc [1]

Q# 64/ iGCSE Chemistry/2006/s/Paper 3/ Q1

(e) mild steel cars **or** machinery **or** fridges etc. **[1]**
stainless steel cutlery **or** chemical plants etc. **[1]**

Q# 65/ iGCSE Chemistry/2003/w/Paper 3/

(b) (i) making brass **or** any zinc containing alloy **or** galvanising [1]
or sacrificial protection **or** batteries **or** roofs

Q# 66/ iGCSE Chemistry/2003/s/Paper 3/ Q1

(d) **(i)** Cutlery **or** chemical plant **or** watches **or** utensils **or** surgical instruments **or** cars **or** sinks **or** aircraft **or** garden tools [1]
(ii) nickel **or** chromium **or** molybdenum **or** niobium **or** titanium [1]

Q# 67/ iGCSE Chemistry/2002/w/Paper 3/Q4a

4 **(a)** **(i)** wiring **NOT** good conductor
pipes
utensils
roofs
electroplating
lightning conductor
bi-metallic strips
NOT coinage metal or any other use than involves an alloy
TWO from above [2]

Q# 68/ iGCSE Chemistry/2002/s/Paper 3/Q1

(c) **(i)** packaging of food **or** window frames **or** roofs [1]
accept "cans"
NOT aircraft cars etc

(ii) low density [1]
light alloys for aircraft [1]
or electrical cables
good conductor
or foil
malleable
good conductor of heat
If use repeated with different properties then 2/3

Q# 69/ iGCSE Chemistry/2001/w/Paper 3/Q4

(c) (i)	brass	bronze (2% zinc)	diecast alloy	[1]
(ii)	copper	copper	aluminium	[1]