

**O Level Combined Chemistry Structured**

**Metals Test 2.0**

Q1

- (a) The ease of obtaining a metal from its ore is related to the metal's position in the reactivity series.

Using suitable examples, explain why this is true.

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

- (b) Explain why environmentalist are advocating for the recycling of metals.

.....  
.....[1]

[Total: 3]

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Q2

5 The list below shows how long ago some metals were discovered.

calcium	206 years ago
copper	7000 years ago
iron	3000 years ago
lead	7000 years ago
magnesium	259 years ago
sodium	207 years ago
zinc	2000 years ago

(a) With reference to their reactivity, explain why metals such as copper and lead were discovered much earlier than others. [1]

.....  
.....

(b) Recycling metals helps to conserve metal ores which are non-renewable. However in some countries, metals are not recycled. [2]

Suggest two reasons why metals are **not** recycled.

reason 1 .....

.....

reason 2 .....

.....

(c) When iron is extracted from its ore in the blast furnace, molten slag is also produced.

(i) Describe how slag is formed. Include a suitable chemical equation in your answer. [2]

.....  
.....  
.....  
.....

- (ii) Explain why sodium cannot be extracted in the same way as iron in the blast furnace. [1]

.....  
.....  
.....

- (d) Metals can form either *basic oxides* or *amphoteric oxides* when they react with oxygen.

- (i) Explain what is meant by a *basic oxide*. [1]

.....  
.....

- (ii) Describe a chemical test that can be used to determine if a metal oxide is basic or amphoteric in nature. [2]

.....  
.....  
.....  
.....

- (iii) Unlike metals, non-metals form oxides with relatively low boiling points. Explain why. [2]

.....  
.....  
.....

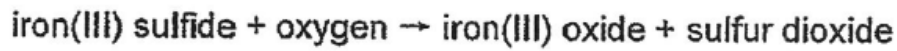
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Q3

- (a) When miners mine for gold, they often mistakenly find another metallic-yellow coloured material called pyrite. Pyrite is made up of iron(III) sulfide, sometimes also known as "fool's gold".

The iron can be extracted from pyrite by first passing oxygen gas across heated pyrite:



- (i) Sulfur dioxide is known to be an air pollutant.

Describe two harmful effects of sulfur dioxide on the environment.

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

- (ii) State one other source of sulfur dioxide.

..... [1]

- (b) Iron can also be manufactured in a blast furnace using iron ore, coke and limestone.

- (i) Name a suitable iron ore.

..... [1]

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(ii) Describe, with the aid of full chemical equations, how impurities are removed from iron.

.....  
.....  
.....  
.....  
.....  
.....  
..... [3]

(c) (i) What is meant by *recycling*?

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

(ii) Give one reason why iron is recycled.

..... [1]

Q4

The student placed a magnesium rod and a zinc rod into separate beakers containing aqueous copper(II) nitrate.

Describe and explain what he will observe during the experiments.

.....

.....

.....

.....

[3]

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Q5

You have samples of three metals, **G**, **H** and **J**.  
Only metal **G** is positioned below hydrogen in a reactivity series.  
Only metal **H** is positioned above carbon in a reactivity series.

(a) State two general physical properties of the three metals.

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

(b) Explain why metal **H** reacts faster with water when

(i) the water is hot,

.....  
.....  
.....

(ii) the metal is powdered.

.....  
.....  
..... [4]

(c) Explain why

(i) metal **G** will not react with water no matter how hot the water is, or how finely powdered the metal,

.....

(ii) strong heating of the carbonate of metal **G** forms a gas, while no gas is produced when heating the carbonate of metal **H** strongly.

.....  
.....  
..... [3]

(d) Suggest a possible name for any two of the metals G, H or J.

	letter of metal (G, H or J)	name of metal
(i)		
(ii)		

[2]



Answers

Metals Test 2.0

Q1

(a)	<p>Reactive metals such as sodium, which are high up in the reactivity series can only be extracted by electrolysis;</p> <p>Less reactive metals such as iron, lower down in the reactivity series can be easily extracted by reduction with coke;</p> <p>Unreactive metals such as gold, at the bottom of the reactivity series are found in the uncombined state;</p> <p>Any 2, max 2 marks</p> <p>A: metals high up in the reactivity series/ more reactive metals are more difficult to obtain/ extract than metals low in the reactivity series/ less reactive metals (1m)</p> <p>Note: 2<sup>nd</sup> mark to be awarded if correct example from each group given</p>	[1]
(b)	<p>Recycling metals uses less energy, thus reduces carbon emissions;</p> <p>Reduces emission of greenhouse gases/ toxic gases/ harmful gases;</p> <p>Uses less water compared with using raw materials;</p> <p>Metals such as lead and mercury are toxic and if placed in landfill, will leach and contaminate the soil and water system;</p> <p>A: any other possible answers</p> <p>R: cheaper/ cost effective/ reduces pollution/ metals are finite resources that will run out one day</p>	[1]

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Q2

(a)	These metals are unreactive and relatively stable. Hence they can be discovered in their natural form easily.	[1]
(b)	<p>It is expensive to collect/gather scrap metals for recycling.</p> <p>Recycling metals can lead to air/ water pollution due to the toxic waste generated.</p> <p>Recycling metals require more energy than the extraction of metals from their ores.</p> <p>Accept other possible answers.</p>	[2]
(c)(i)	<p>Slag is formed when <u>acidic impurities</u> such as <u>silicon dioxide</u> present in iron ore <u>react with calcium oxide</u> formed from the <u>thermal decomposition of limestone</u>.</p> <p><math>\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3</math></p> <p>[1m] for full description.                  [1m] for equation.</p>	[2]
(c)(ii)	Sodium is a <u>highly reactive metal</u> . It <u>forms compounds</u> that are <u>highly stable</u> and <u>cannot be reduced by</u> reaction with <u>carbon/carbon monoxide</u> .	[1]
(d)(i)	A metal oxide that reacts with acids to form salt and water.	[1]
(d)(ii)	<p>Add the metal oxide into a beaker of aqueous sodium hydroxide. If is it amphoteric, it will dissolve to form a salt. If is it basic, there will be no visible change.</p> <p>[1m] for correct test.                  [1m] for stating both results.</p>	[2]
(d)(iii)	<p>Oxides formed by non-metals are <u>covalent</u>. [1m]</p> <p>The weak intermolecular forces present can be overcome easily with a small amount of energy. [1m]</p>	[2]

Q3

- (a) (i) Dissolves/Reacts with rainwater to form acid rain  
[Must be present in the answer]  
Reject: mix / dissolve in rainwater to form acid rain

- 1) kills the aquatic plants and fishes
- 2) corrodes limestone buildings and statues
- 3) increase the pH of soil and make it unsuitable for plant/ crop growth

Any 2 [2]

[2]

- (ii) Volcanic eruption

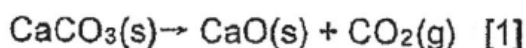
Reject if only mention volcano

[1]

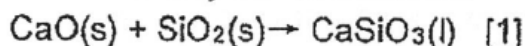
- (b) (i) Haematite

[1]

- (ii) 1) Limestone is decomposed by heat to produce calcium oxide and carbon dioxide.



- 2) The silicon dioxide will react with calcium oxide to produce molten slag which is mainly calcium silicate.



[1] for description of process

[3]

- (c) (i) Recycling metals means that metals that are no longer needed are collected and melted [1]  
to produce blocks of new metals so as to make new objects. [1] [2]

- (ii) 1. It helps to conserve finite natural resources.  
2. It helps to reduce environmental problems related to extracting metals from their ores.  
3. It saves the cost of extracting metals from their ores.

Any 1 [1]

[1]

Q4

In both reactions,

Blue solution turn colourless [1]

Reddish brown solid formed [1]

Both magnesium and zinc are more reactive than copper, thus they will displace copper from aqueous copper(II) nitrate. [1]

[3]

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Q5

(a) Any two. [2]

- High boiling point/ melting point;
- High density;
- Shiny;
- Good conductors of heat and electricity in solid state;
- Malleable and ductile

(b) (i)

- When temperature increases, energy of particles increases.
- Proportion of particles with energy larger or equal to activation energy increases.
- Frequency of effective collisions increases. Speed of reaction increases.

**[All 3 points – 2 marks; 1-2 points; 1 mark; 0 point – 0 mark]**

(b) (ii)

- When metal is powdered, a smaller particle size results in a
- larger total surface area being exposed for reaction;
- Frequency of effective collisions increases. Speed of reaction increases.

**[All 3 points – 2 marks; 1-2 points; 1 mark; 0 point – 0 mark]**

(c) (i)

Metal G is highly unreactive. [1] (Rej: G is less reactive than H/ G is below H)

(c) (ii)

Carbonate of metal G is thermally less stable than carbonate of metal H. [1]

Carbonate of metal G can hence undergo thermal decomposition to form metal oxide, accounting for change in colour of solid.

Carbonate of metal H cannot undergo thermal decomposition. Hence, no change observed. [1]

(d)

Metal G: copper/ gold/ silver/ mercury/ platinum [1]

Metal H: sodium/ potassium [1]

*(Reject: Calcium, magnesium, aluminium as these carbonates can undergo thermal decomposition to form metal oxide)*

Metal J: zinc/ iron/ tin/ lead [1]

**\*\*Only names allowed; reject if symbol of metal given instead.**