**C4 Chemical Changes Pack for Year 10 – Metal Extraction**

**Facts**

**Reactivity of metals:**

* Metals react with oxygen to produce metal oxides. We call these reactions ‘oxidation’ reactions because the metal gains oxygen.
* When oxygen is lost from the reaction we call this a reduction reaction.
* Oxidation is the loss of electrons and reduction is the gain of electrons (OILRIG)
* When metals react with other substances, the metal atoms form positive ions. This is because metal atoms lose electrons to form a full outer shell.
* The reactivity of metals is based on how easily they form positive ions.
* Metals are arranged in order of their reactivity with water and dilute acids in a reactivity series. Non-metals carbon and hydrogen are often included in the reactivity series.

Least reactive ---------------------------------------------------------------------------->Most reactive

Copper, **hydrogen**, iron, zinc, **carbon**, magnesium, calcium, lithium, sodium, potassium

* More reactive metals displace less reactive metals to form a compound
* Unreactive metals are found in the Earth as the metal itself (e.g. gold), but most are found as compounds and so they require chemical reactions to extract the metal
* Metals which are less reactive than carbon can be extracted from their oxides by reducing them with carbon

**Task 1: Watch Free Science lessons (if you can) and do a mind map of the information**

**GCSE Science Chemistry (9-1) Reaction of Metals with Oxygen**

**GCSE Science Chemistry (9-1) The Reactivity Series**

**GCSE Science Chemistry (9-1) Extraction of Metals.**

**GCSE Science Chemistry (9-1) Oxidation and Reduction in terms of Electrons**

**Task 2: Test yourself! Answer these quick fire questions.**

1. Describe what happens when a metal reacts with oxygen.
2. List the order of the reactivity series.
3. How are unreactive metals found?
4. What is the formula of magnesium oxide?
5. What is the formula of calcium hydroxide?
6. What is reduction?
7. What is oxidation?

**Task 3: More reactive metals can displace less reactive ones, taking their place in a compound.**

For example, potassium reacts with sodium chloride to make potassium chloride and sodium. It has taken the place of the sodium in the chlorine.

Potassium + sodium chloride 🡪 sodium + potassium chloride

However, this would not occur in reverse: Potassium chloride + sodium 🡪 no reaction

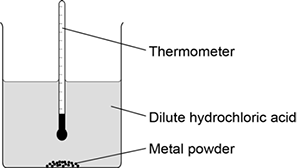
This is because sodium is *less reactive* than potassium so cannot displace it.

1. For the element pairs below, state which is more reactive and which is less reactive
   1. Calcium and lithium
   2. Gold and copper
   3. Sodium and iron
   4. Zinc and copper
   5. Copper and zinc
   6. Iron and zinc
   7. Iron and calcium
   8. Sodium and lithium
2. For each reaction below, state whether or not it would occur.
   1. Magnesium oxide + calcium
   2. Iron chloride + zinc
   3. Copper bromide + gold
   4. Zinc chloride + potassium
   5. Iron sulphate + copper
   6. Iron + lithium sulphate
   7. Magnesium + iron oxide

**Task 4 : Answer these practical questions**

**Question 1:** A student investigated the reactivity of different metals. The student used the apparatus shown in the figure to the right.

The student used four different metals. The student measured the temperature rise for each metal three times. The student’s results are shown in the table below.



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Metal** | **Temperature rise in °C** | | | **Mean temperature rise in °C** |
| Test 1 | Test 2 | Test 3 |
| **Calcium** | 17.8 | 16.9 | 17.5 |  |
| **Iron** | 6.2 | 6.0 | 6.1 | 6.1 |
| **Magnesium** | 12.5 | 4.2 | 12.3 | 12.4 |
| **Zinc** | 7.8 | 8.0 | 7.6 | 7.8 |

(a)     Give **two** variables the student should control so that the investigation is a fair test.

(b)     One of the results for magnesium is anomalous. Which result is anomalous? Suggest **one** reason why this anomalous result was obtained.

(c)     Calculate the mean temperature rise for calcium.

(d)     Aluminium is more reactive than iron and zinc but less reactive than calcium and magnesium. Predict the temperature rise when aluminium is reacted with dilute hydrochloric acid.

**Question 2:** A student investigated the reactivity of three different metals. This is the method used.

1.       Place 1 g of metal powder in a test tube.

2.       Add 10 cm3 of metal sulfate.

3.       Wait 1 minute and observe.

4.       Repeat using the other metals and metal sulfates.

The student placed a tick in the table below if there was a reaction and a cross if there was no reaction.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Zinc** | **Copper** | **Magnesium** |
| **Copper sulfate** |  |  |  |
| **Magnesium sulfate** |  |  |  |
| **Zinc sulfate** |  |  |  |

(a)     What is the dependent variable in the investigation?

(b) What is the independent variable?

(c)     The student used measuring instruments to measure some of the variables. Draw **one** line from each variable to the measuring instrument used to measure the variable.

|  |  |  |
| --- | --- | --- |
| **Variable** |  | **Measuring instrument** |
|  |  | Balance |
|  |  | Measuring cylinder |
| Mass of metal powder |
|  |  | Ruler |
|  |  | Burette |
| Volume of metal sulfate |
|  |  | Thermometer |
|  |  | Test tube |

(d)     Use the results shown in table above to place zinc, copper and magnesium in order of reactivity.

(e)     Suggest **one** reason why the student should **not** use sodium in this investigation.

(f)     Out of calcium, gold, lithium and potassium, which metal is found in the Earth as the metal itself?

(g)     Iron is found in the Earth as iron oxide (Fe2O3). Iron oxide is reduced to produce iron. Balance the equation for the reaction.

\_\_\_Fe2O3      +     \_\_\_C      →     \_\_\_Fe      +      \_\_\_CO2

(h)     Name the element used to reduce iron oxide. What is meant by reduction?