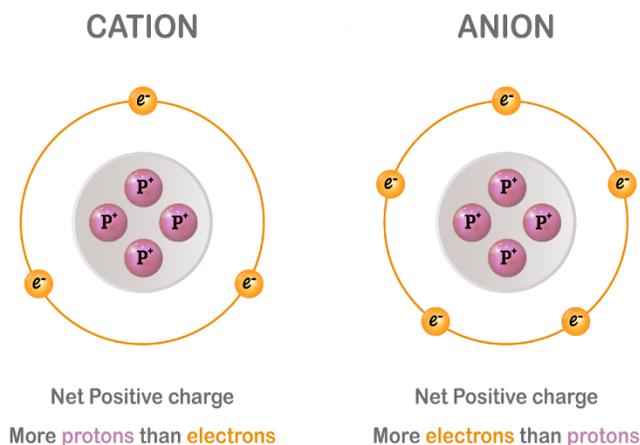


Reactions of Metals Guided Notes – Student Edition

Metals and Oxygen

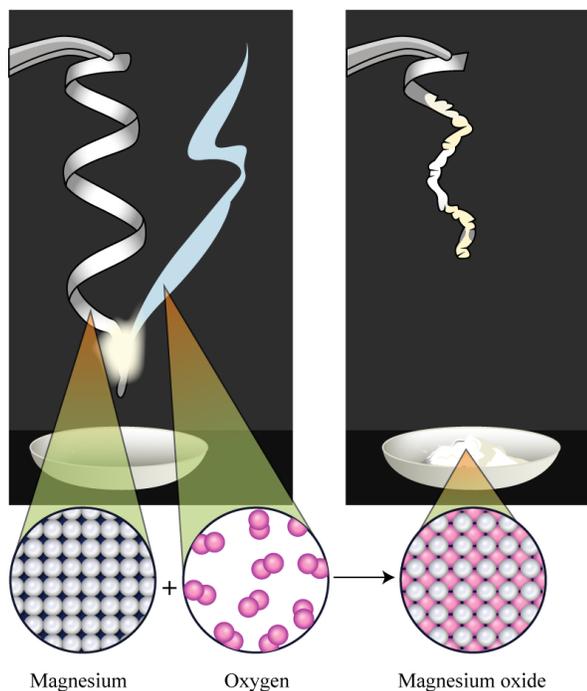
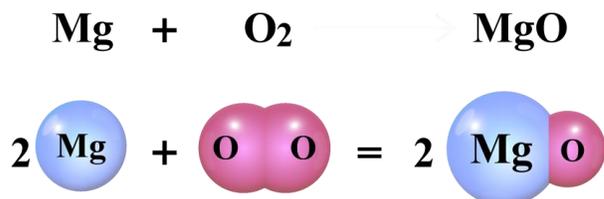
Oxygen gas is an extremely _____ chemical and readily combines with most other chemicals. When oxygen combines with other substances, the reaction is called an _____ reaction. When metals react with oxygen the product formed is called a _____. The metal atoms lose electrons to form _____ metal ions and the oxygen atoms gain electrons to form _____ ions (O^{2-}).



The general pattern for the reaction between metals and oxygen is:



An example of this reaction can be seen when magnesium reacts with oxygen to give _____, a white powdery, solid. The equation for this reaction is written as follows:



Name: _____ Period: _____ Date: _____

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There are two types of oxidation reactions:

1. Slow Oxidation - occurs over a _____ period of time, at ordinary temperatures and produces no heat or _____ energy during the reaction. Examples of slow oxidation reactions include rusting and _____.
2. Rapid Oxidation - also called _____, occurs very quickly. These reactions only take a few seconds to occur and produce heat and light. In some cases, these reactions require _____ to start the reaction e.g., burning magnesium on a Bunsen burner. Other metal oxidation reactions happen _____ e.g., sodium metal ignites if left in air.



Cars which have lost their paint are subject to slow oxidation called rusting.



Fireworks are an example of a rapid oxidation reaction which requires heat to start.

The table below shows how some of the metals in the periodic table react with oxygen.

Metal	Reaction with Oxygen
Sodium, Calcium	Ignite in cold air and burn to form a solid metal oxide.
Magnesium	Burns strongly when heated to give a solid metal oxide.
Aluminium, Zinc, Iron	Burn when heated to give a solid metal oxide.
Lead, Copper	Do not burn, react slowly over time to form a solid metal oxide.
Silver, Gold	No reaction with oxygen.

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Task One:

Complete the reactions for the following metals with oxygen gas:

1. Zinc + Oxygen \rightarrow _____
2. Sodium + Oxygen \rightarrow _____
3. Aluminum + _____ \rightarrow Aluminum oxide
4. _____ + _____ \rightarrow Lithium oxide
5. _____ + _____ \rightarrow Calcium oxide

Metals and Water

Some metals react with water, or _____ . In this reaction, the water molecules pull _____ off the metal atoms, causing the metal to form a _____ ion. These electrons are then given to the oxygen atoms which form _____ ions (O^{2-}).

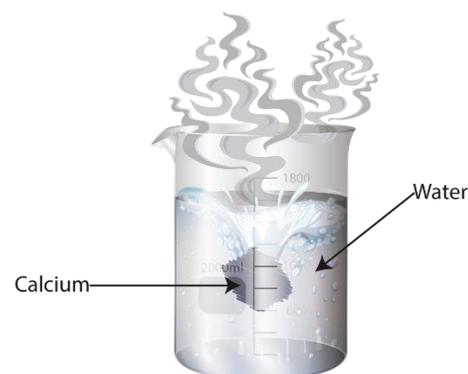
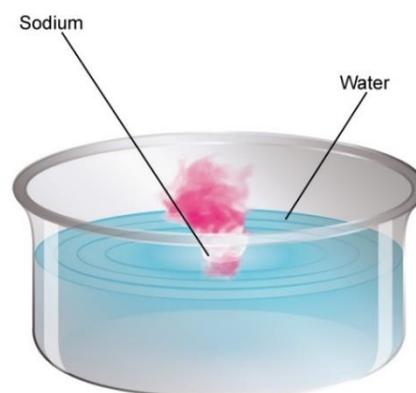
Some of the oxide ions join with hydrogen ions from the water to form negative hydroxide ions (OH^-). These are then _____ to the positive metal ions forming a metal hydroxide.

This reaction between metals and water can be summarized using the general word equation:



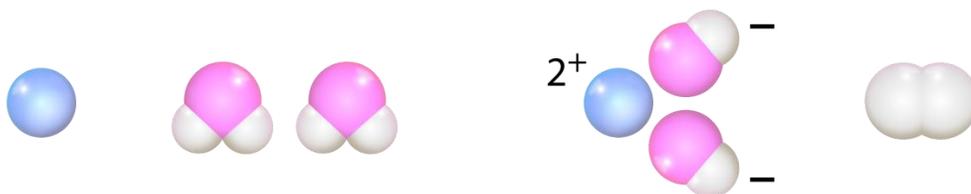
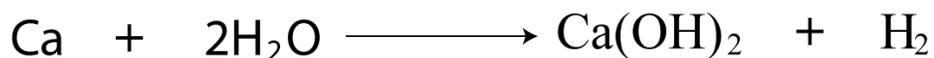
The formation of hydrogen gas can be confirmed by collecting it and testing it with a lit taper or _____. The liquid left in the test tube can be tested with _____ paper and will turn blue indicating that an _____ is present. If the liquid is evaporated, a solid, metal hydroxide will remain.

An example of this reaction can be seen when solid, calcium granules are dropped into water. The granules fizz and gradually disappear releasing a gas (hydrogen) and calcium hydroxide.



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Calcium + Water → **Calcium Hydroxide + Hydrogen Gas**



The table below summarizes how some of the metals from the periodic table react with water.

Metal	Reaction with Water
Sodium	Combusts in water.
Calcium	Strong reaction with fizzing, gas given off.
Magnesium	Gas given off in hot water.
Aluminium, Zinc	Bubbling in steam.
Iron, Lead	Slow bubbling in hot water.
Copper, Silver, Gold	No reaction.

Task Two:

Complete the reactions for the following metals with water:

- Sodium + Water → _____ + _____
- Magnesium + Water → _____ + _____
- Lead + _____ → Lead hydroxide + _____
- _____ + _____ → Lithium hydroxide + Hydrogen gas
- Iron + _____ → _____ + Hydrogen gas

Metals and Acids

Many metals react with acids to form a new compound called a _____.

Like the reactions with water and oxygen, the range of reactivity _____ between metals.

Metals such as lithium and sodium react _____, while zinc and magnesium show a

_____ reaction. Copper, silver, and gold _____ react at all with acids.

Name: _____ Period: _____ Date: _____

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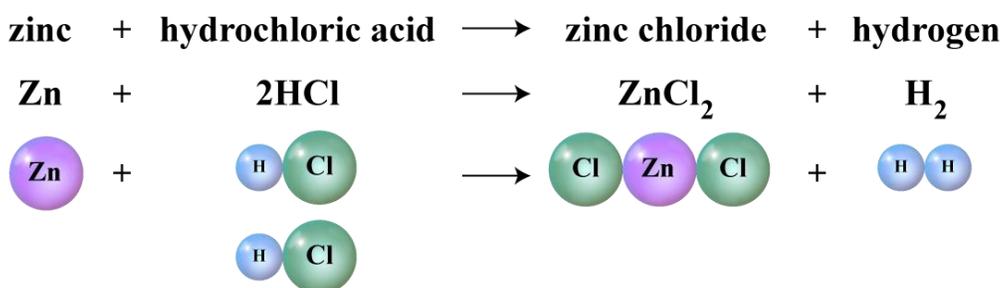
When a reaction between a metal and an acid does occur, the acid releases _____ (H^+) particles. These particles remove electrons from the _____ atoms causing the metal to form a _____ . The positive metal ions are attracted to the other part of the acid e.g., the _____ in hydrochloric acid or the sulfate in _____ acid because these compounds are negatively charged. This enables the metal salt to form.

The general word equation for the reaction between a metal and an acid can therefore be written as:



Metal + Acid \rightarrow Metal Salt + Hydrogen Gas

When a metal reacts with an acid, the first part of the metal salt is named after the _____ and the second part of the name comes from the _____. Hydrochloric acid forms a metal _____ salt, sulfuric acid forms metal _____ and nitric acid forms metal _____. For example, when zinc metal reacts with hydrochloric acid it forms zinc chloride and hydrogen gas:



The table below shows the varying reactivity of metals with acids:

Metal	Reaction with Acid
Sodium, Calcium	Violent reaction in cold acid.
Magnesium	Strong reaction with fizzing, gas given off in cold acid.
Zinc	Strong reaction with fizzing, gas given off in cold acid.
Iron, Lead	Slow bubbling in warm acid.
Copper, Silver, Gold	No reaction in warm acid.

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Task Three:

Complete the reactions for the following metals with acid:

1. Sodium + Sulfuric acid → _____ + _____
2. Magnesium + Nitric acid → _____ + _____
3. Lead + _____ → Lead chloride + _____
4. _____ + _____ → Lithium sulfate + Hydrogen gas
5. Iron + _____ → Iron nitrate + _____

Summarizing the Activity of Metals

How each metal behaves when exposed to oxygen, water, and acid determines their ranking on the activity series.

METAL	REACTION WITH:		
	WATER	ACID	OXYGEN
Potassium	React with water to produce a METAL HYDROXIDE + HYDROGEN GAS	React with acid to produce a METAL SALT + HYDROGEN GAS	React with oxide to produce a METAL OXIDE
Sodium			
Lithium			
Calcium			
Magnesium			
Aluminum			
Zinc			
Iron			
Tin			
Lead			
Copper			
Mercury			
Silver			
Gold			