

## Heating Chemicals

Table to show the effect of heat on some chemicals

Chemical	Appearance	Effect of heat	Change in mass when heated.
Magnesium ribbon	Grey metal	Burns with an intense white flame to leave a white ash called magnesium oxide.	Gain because it combines with oxygen from the air
Copper foil	Pink metal	Oxidises. Forms a layer of black copper oxide on the surface.	Gain because it combines with oxygen from the air.
Hydrated cobalt chloride	pink/purple crystals	Decomposes. Turned to a blue powder called anhydrous cobalt chloride and gave off water vapour. The blue powder gradually turned pink again when it was left standing in the room.	Loss because it loses water vapour.
Potassium permanganate	dark purple/black crystals	Decomposes and produces oxygen gas	Loss because it loses water vapour
Calcium carbonate (chalk, limestone)	White solid	Decomposes, producing carbon dioxide gas and leaving a white solid called calcium oxide (lime)	Loss because it loses carbon dioxide
Hydrated copper sulphate	Blue crystals	Decomposes Turns to a white powder called anhydrous copper sulphate and produced water vapour.	Loss because it loses water vapour.
Sulphur	Yellow solid	Melts then burns with a blue flame to producing choking fumes of sulphur dioxide gas.	The sulphur dioxide would weigh more than the original sulphur.
Zinc oxide	White powder	Turned yellow when hot and white when cold.	No change.
Iodine	Dark grey/purple crystals	Sublimes Forms a purple vapour which turns back to grey iodine crystals when it cools.	No change because all of the iodine vapour turns back to solid iodine crystals.
Copper carbonate	Green Powder	Decomposes. Evolves carbon dioxide gas and leaves a black residue of copper oxide.	Loss because it gives out carbon dioxide gas.

## Notes

If a solid chemical is heated several things could happen:

- It could **melt** (change from a solid to a liquid)
- It could **boil** (change from a liquid to a gas)
- It could **burn** or **oxidise** (react with oxygen)
- It could **decompose** (split apart)

or..... nothing happens at all (eg copper oxide will do nothing when heated)

There are two main categories of change: Physical change and chemical change

- In a physical change no new substances are formed (eg melting or boiling)
- In a chemical change a chemical reaction takes place and a new substance is always formed (eg burning or decomposition)

### CHEMICAL CHANGE

The following are examples of chemical change because in each case a new substance is formed

#### 1. Decomposition

This is when a compound splits apart into two (or more) chemicals.

eg: copper carbonate decomposes when heated to form carbon dioxide gas and leave black copper oxide.

Word equation: *Copper carbonate -----> copper oxide + carbon dioxide*

#### 2. Oxidation

: When a chemical *combines* (joins up with) oxygen to form an *oxide*.

eg copper foil will oxidise when heated strongly in air

Word equation: *copper + oxygen -----> copper oxide*

**3. Combustion (or burning)** is a kind of oxidation where a flame is usually produced.

eg Magnesium will burn in air to form magnesium oxide:

Word equation: *Magnesium + oxygen -----> magnesium oxide*

**Signs for a chemical change are:**

1. A change in colour ( eg changes from pink to blue)
2. A change in temperature (eg gets warm or hot)

## 4. Reversible reactions

### Heating copper sulphate

If some copper sulphate (blue crystals) is placed into a test tube and heated gently it is seen to go white and steam come out of the test tube. The steam condenses into little drops of water.

This happens because the copper sulphate is **decomposing** (splitting apart) It gives off water and turns into a new chemical called **anhydrous copper sulphate** which is a white powder.

The blue copper sulphate is sometimes called hydrated copper sulphate

**Hydrated copper sulphate → anhydrous copper sulphate + water**

If the white anhydrous copper sulphate is scraped into a dish and water is added the white copper sulphate gets hot (steams) and goes blue again

**Anhydrous copper sulphate + water → hydrated copper sulphate**

Putting water on to anhydrous copper sulphate and seeing if it goes blue is sometimes used as a test for water

## PHYSICAL CHANGES

The following are types of physical change because in each case no new substance is formed

### 1. Melt

This is when a substance changes from a solid to a liquid when heated above its melting point

eg Ice will melt when heated to 0°C

### 2. Boil

This is when a substance changes from a liquid to a gas when heated above its boiling point.

eg Water will boil when heated to when heated to 100°C

### 3. SUBLIME

This is when a substance changes from a solid to a gas.

Eg Solid iodine crystals will sublime to a purple vapour when heated gently

## The Change in Mass when a chemical is heated

Some chemicals lose mass when heated

They do this because they are compounds that decompose and release a chemical to the air.

**Copper carbonate** loses mass when heated because it gives off **carbon dioxide gas**.

**Copper sulphate** loses mass when heated because it gives off **water vapour**.

Some chemicals (like **magnesium** or **copper**) will **gain in mass**.

They do this because they are elements **and** they **combine** with oxygen.

To find out if there is a change in mass the chemical needs to be weighed before and after heating.

**Example 1:** Copper foil will **gain in mass** when heated in air **because the copper oxidises** (combines with oxygen)

Word equation: *copper + oxygen -----> copper oxide*

**Example 2:** Magnesium will gain in mass when it burns because the magnesium combines with oxygen however care must be taken to make sure that the smoke produced all gets weighed (See Burning Magnesium).

When compounds that **decompose** are heated they will often **LOSE** mass

**Example 1:** When copper sulphate is heated it will lose mass because it decompose and give off water vapour. (See experiment to heat copper sulphate)

**Example 2:** When Copper carbonate is heated it will lose mass because it decomposes and gives off carbon dioxide gas.