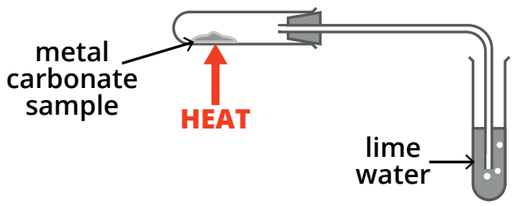
1.6 Limestone

Thermal decomposition:

Thermal decomposition is a common reaction of metal carbonates. Thermal decomposition is the process of breaking down a compound to simpler compounds or elements using heat.

As the calcium carbonate is heated, it decomposes to form calcium oxide and carbon dioxide.



We can prove that the gas produced is carbon dioxide by bubbling it through limewater. If carbon dioxide is present, the limewater will turn milky.

Stability of the metal carbonates:

Other metal carbonates also decompose thermally to form the metal's oxide and carbon dioxide. They have different observations, e.g. green copper(II) carbonate turns black when heated on a low heat and calcium carbonate (limestone or marble) glows when heated on a high heat for several minutes.

There is a relationship between the metal's reactivity in the metal carbonate and the stability of the metal carbonates. The more reactive the metal, the more stable the carbonate. As copper is a very unreactive metal, copper carbonate is fairly unstable and decomposes at a relatively low temperature. On the other hand, sodium is a very reactive metal and therefore sodium carbonate is very stable. As a result, sodium carbonate does not decompose at the highest temperature which can be reached using a Bunsen burner flame.

Use of limestone:

Limestone has a number of uses including:

- manufacturing iron
- manufacturing steel
- road building
- making cement
- neutralising acidic soil.

Quarrying for limestone:

Advantages

- Provides materials for the construction industry.
- More local jobs.
- Creates more wealth for the community.
- Build better road systems.

Disadvantages

- Dust from lorries and explosions.
- Spoils the landscape.
- Noise of explosions.
- Destruction of habitats.

Common name	Chemical name	Chemical formula
limestone	calcium carbonate	$CaCO_3$
quicklime	calcium oxide	CaO
slaked lime	calcium hydroxide	$Ca(OH)_2$

Possible QER questions:

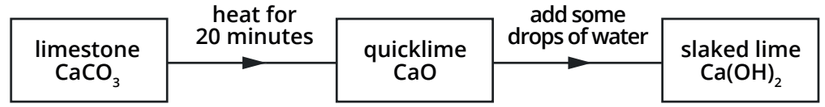
1. Discuss the advantages and disadvantages of quarrying for limestone.

2. Limestone is an important raw material. It can be used as building material or can be converted into quicklime and slaked lime. Describe and explain the sequence of reactions produced in the laboratory to convert limestone into slaked lime.

The limestone cycle:

Limestone is the raw material for production of slaked lime. The flow-diagram below shows the stages in the process, including the conditions.

Reaction 1: *Roast the limestone for 20 minutes.*



During reaction 1 we will observe the limestone shining orange.

Limestone $CaCO_3$ → calcium oxide CaO + carbon dioxide CO_2

Reaction 2: *Add drops of water to the quicklime*.

During reaction 2 we will observe whistling or hissing and the solid crumbling. This is an example of exothermic reaction.

calcium oxide CaO + water H_2O → calcium hydroxide $Ca(OH)_2$

Then the slaked lime can be converted back to calcium carbonate by adding carbon dioxide.

calcium hydroxide $Ca(OH)_2$ + carbon dioxide CO_2 → calcium carbonate $CaCO_3$ + water H_2O