SOURCES, ORIGINS, IRON, STEEL AND ALUMINIUM

This mobile revision pdf is based on detailed work found in the MATERIALS section.

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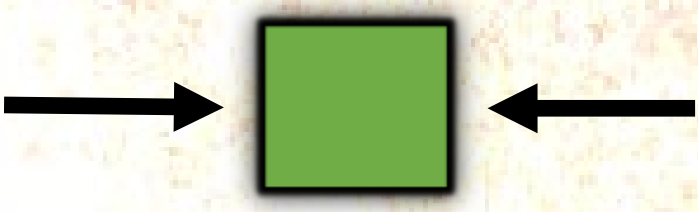

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SOURCES, ORIGINS, IRON, STEEL AND ALUMINIUM

1. IRON ORE TO IRON ORE PELLETS

2. WHERE IS IRON ORE MINED?

3. THE BLAST FURNACE - IRON PRODUCTION

4. PRODUCING STEEL THROUGH THE MODERN CONVERTER PROCESS

5. ALUMINIUM PRODUCTION

6. STOCKFORMS - METALS

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IRON ORE TO IRON ORE PELLETS (1)

Steel is the most common metal used by man. It is used in the construction of our buildings, bridges, aircraft, cars, ships and many everyday items. Without steel, our modern industrial world would not exist.

In order to produce steel, iron ore is required, in large quantities. Iron ore is dug out of the ground from open cast mines or mined deep underground. The ore is crushed into a fine powder, mixed with water, making a slurry. Clay is added to the slurry and the mixture shaped into pellets and baked, forming a hard shell. The pellets are sent to a steel mill in order to extract the iron which is normally converted into steel.

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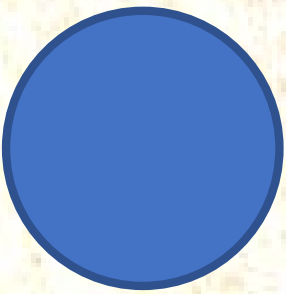

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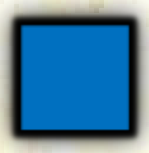

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IRON ORE TO IRON ORE PELLETS(2)

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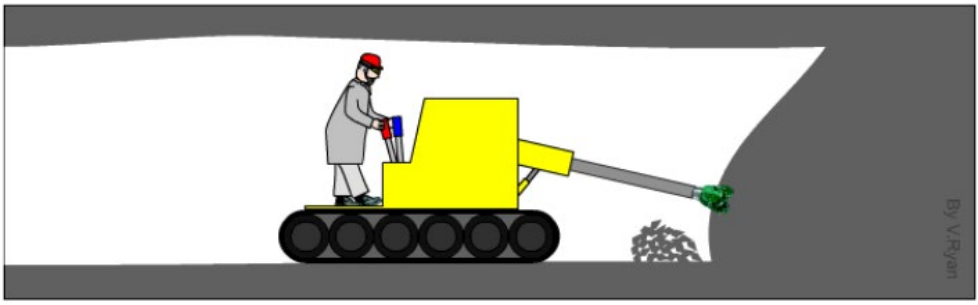
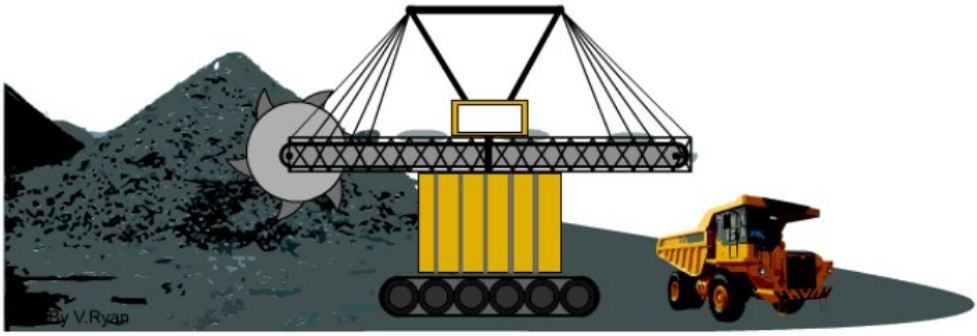
1. MINING UNDERGROUND



2. STORED AT MINE SURFACE - REMOVED FOR PROCESSING



3. IRON ORE ROCKS SEPARATED FROM OTHER MATERIAL

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IRON ORE TO IRON ORE PELLETS(3)

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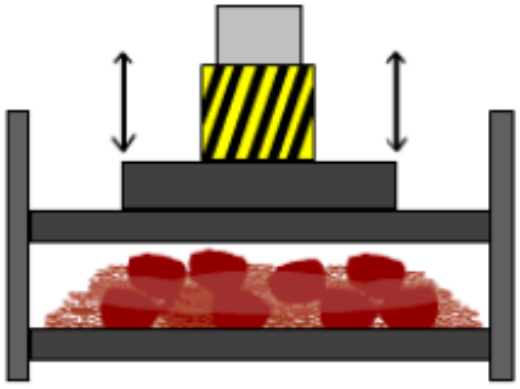
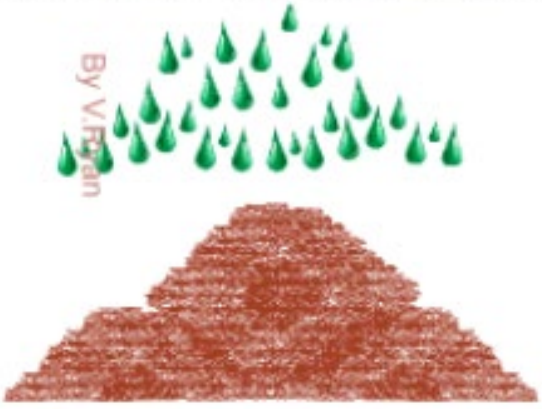
4. ROCKS CRUSHED TO POWDER - HYDRAULIC PRESS



5. MIXED WITH WATER AND CLAY - FORMED INTO PELLETS



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IRON ORE TO IRON ORE PELLETS(4)

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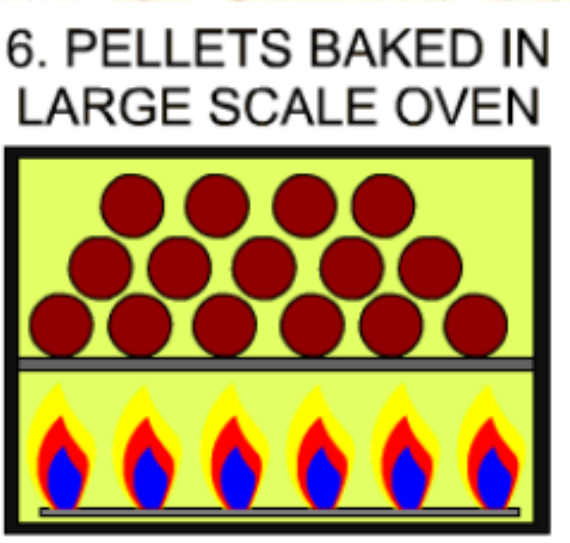

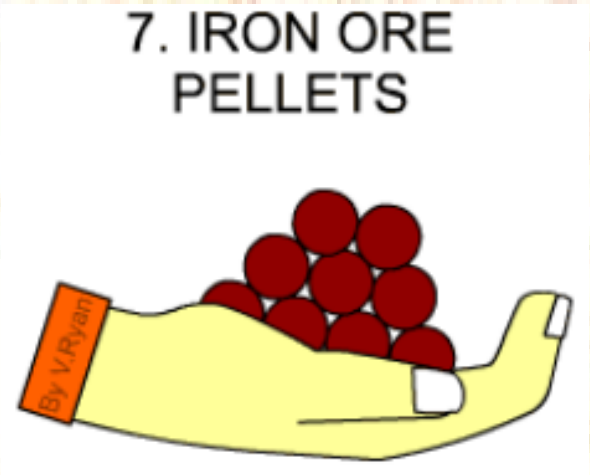

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WHERE IS IRON ORE MINED?

Iron ore can be found all over the world, in the form of rocks and other minerals. To be economically viable for mining, iron ore must contain at least 20% iron. Magnetite ore has the highest proportion of iron, at 65%. Haematite ore also has a high content of iron at 60%. All iron ore contains ferric oxide and it is from this that iron is extracted. Approximately two billion tonnes of iron ore are mined each year.

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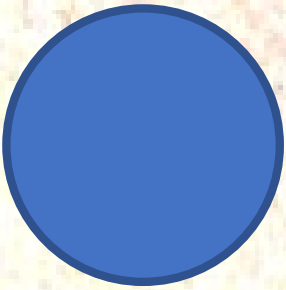
for more information
and exercises



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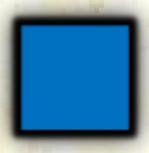
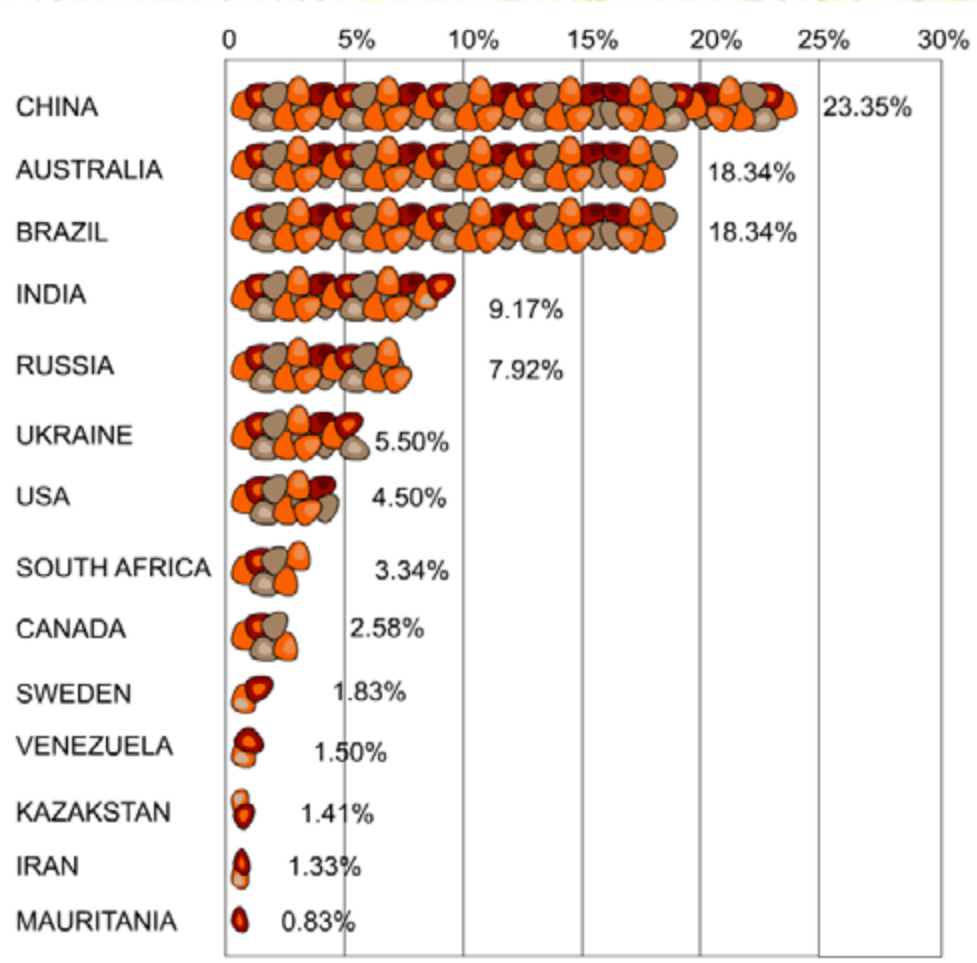


Tap the red button to return to the Contents page

WHERE IS IRON ORE MINED?

The pictogram / graph below, shows the world distribution of iron ore mining. China, Australia and Brazil dominate this world trade.

Tap the image for more information and an exercise



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THE BLAST FURNACE - IRON PRODUCTION

A simplified diagram of a Blast Furnace is drawn on the next page. A typical blast furnace may be up to 32 metres in height and 10 metres in diameter. They have thick steel sides, lined with refractory bricks, to ensure that heat is not lost. Blast furnaces are used continuously and are only shut down when their brick lining needs replacing.

As the mixture of iron ore, coke and limestone heats, the hot waste gases are collected and cleansed. They are then used to help heat the air blast, required if blast furnace is to reach the high temperatures needed to produce molten iron.

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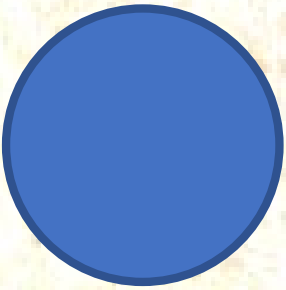

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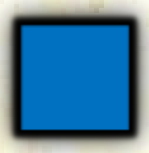

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THE BLAST FURNACE

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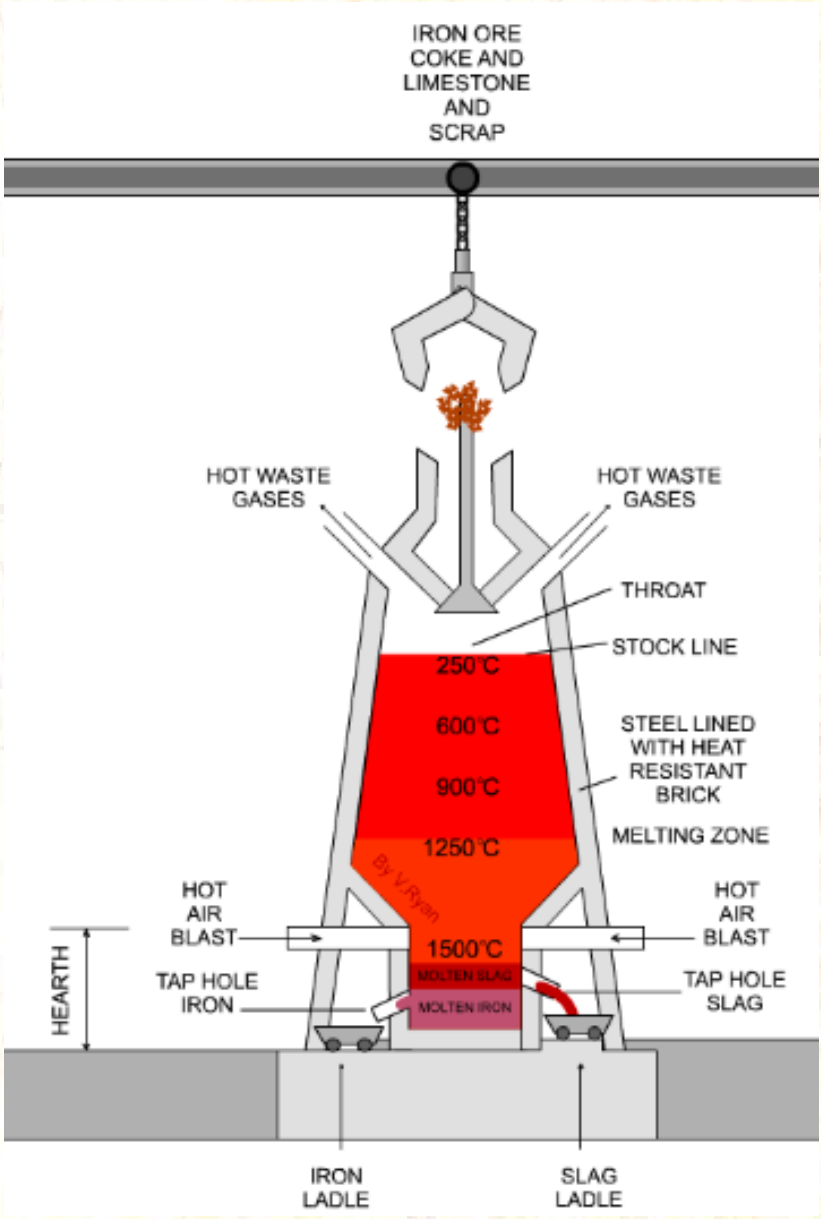

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PROCESSES INSIDE THE BLAST FURNACE

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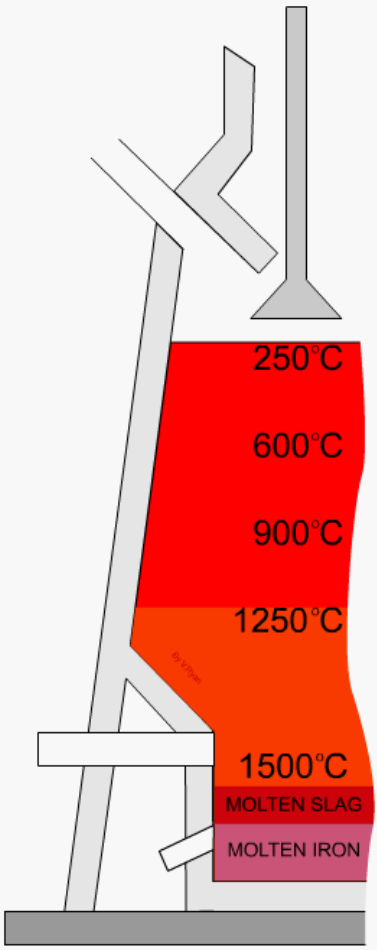

MOISTURE EVAPORATES.

LIMESTONE BEGINS TO DECOMPOSE.

C02 GIVEN OFF.

STOCK BECOMES POROUS

OXYGEN REMOVED FROM IRON OXIDES.

MATERIALS SUCH AS SILICA AND ALUMINA SEPARATED OUT.

REACTIONS SPEED UP AS STOCK DESCENDS

OXYGEN REMOVED FROM IRON OXIDES.

MATERIALS SUCH AS SILICA AND ALUMINA SEPARATED OUT.

MOLTEN IRON TAPPED.

SLAG TAPPED. THE SLAG FLOATS ABOVE THE IRON BECAUSE IT IS LIGHTER.

Tap the red button to return to the Contents page

PRODUCING STEEL THROUGH THE MODERN CONVERTER PROCESS

Molten iron is transported from the blast furnace to a steel furnace, sometimes called a 'converter'. At the converter, molten iron is added to scrap iron / steel which lowers the temperature, as it acts as an impurity. A high pressure stream of oxygen and powdered lime, is blow through the mixture, causing chemical reactions, removing some of the carbon from the iron.

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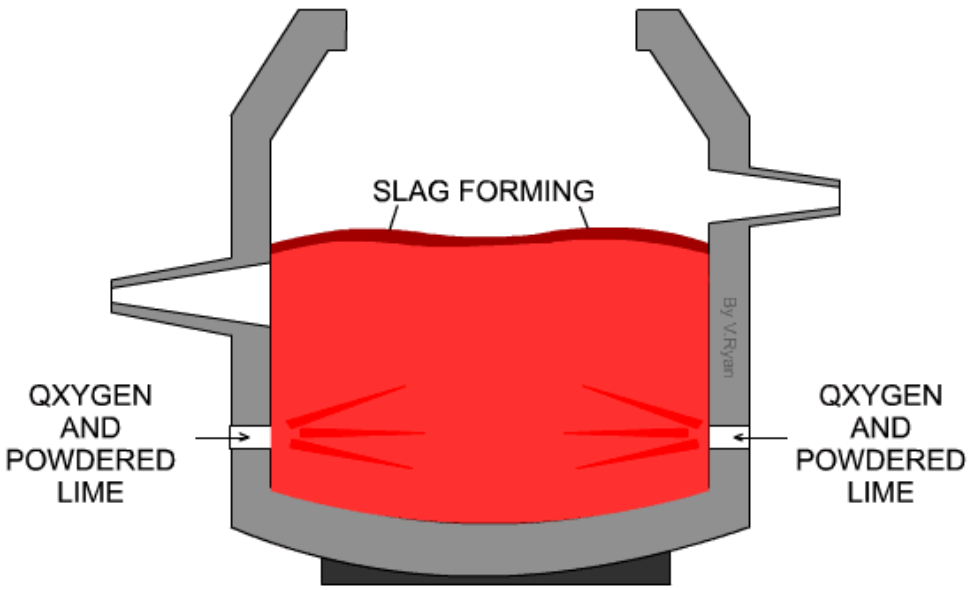

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Tap the red button to return to the Contents page

PRODUCING STEEL THROUGH THE MODERN CONVERTER PROCESS

The amount of carbon removed from the iron determines the quality / grade of steel produced.

The waste (called slag) floats to the top and is poured off, before the molten steel is poured.

The molten steel is poured into moulds, forming 'blooms'. It is common for the blooms to be formed into the final products, by forcing them through a number of rollers, such as steel rails for the railways.

Tap the image for more information and an exercise

GRADE OF STEEL	PERCENTAGE OF CARBON
LOW CARBON STEEL	0.0 TO 0.1
MILD STEEL	0.1 T0 0.33
MEDIUM CARBON STEEL	0.34 TO 0.6
HIGH CARBON STEEL	0.6 TO 0.9
TOOL STEEL	0.9 TO 1.3

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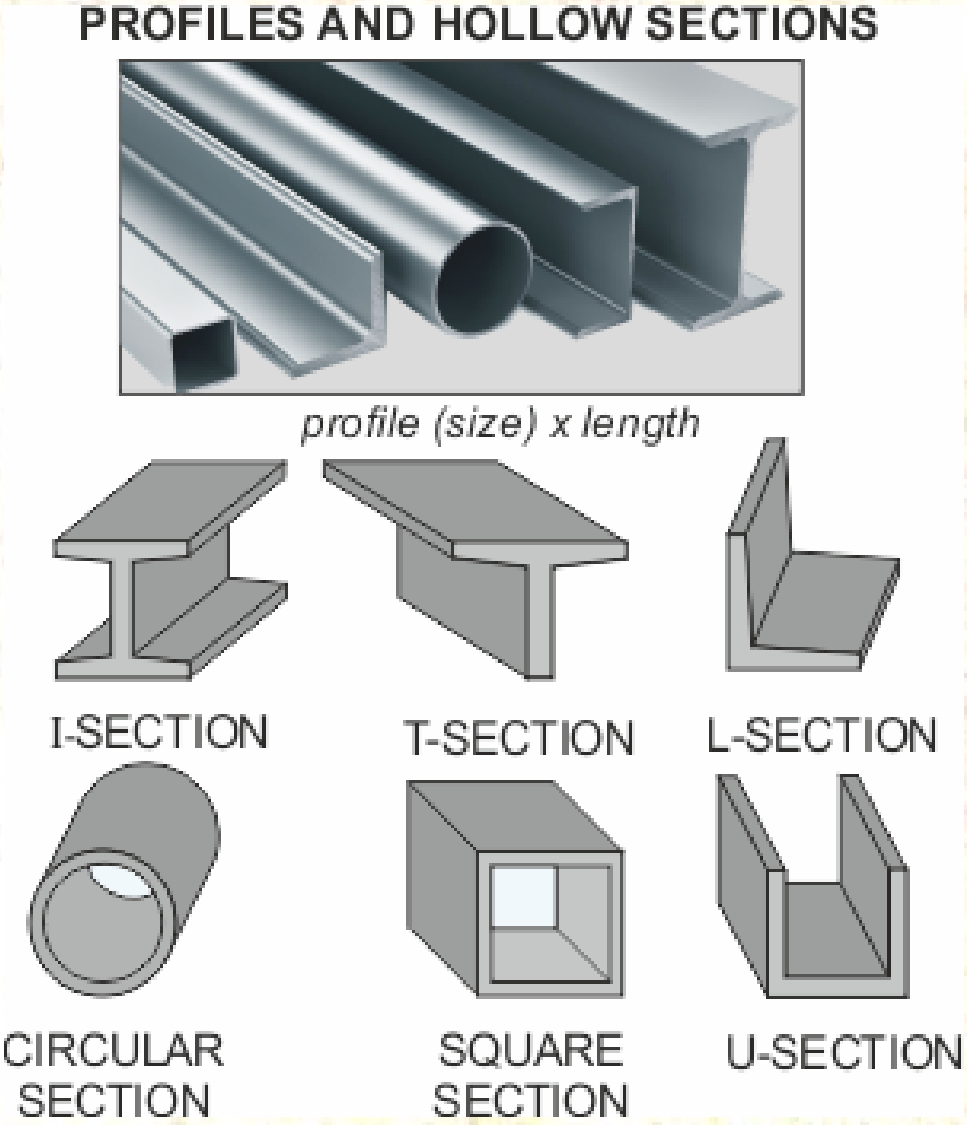

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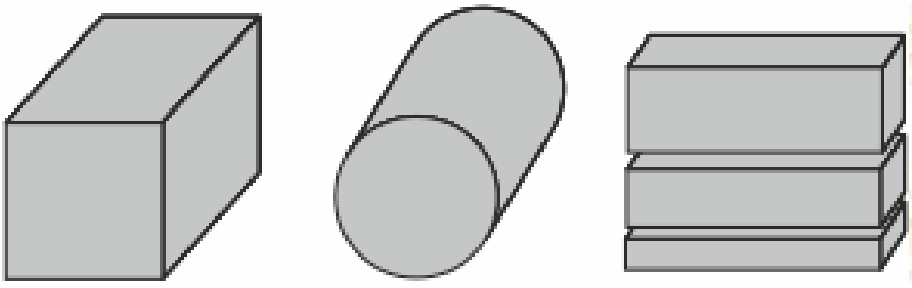
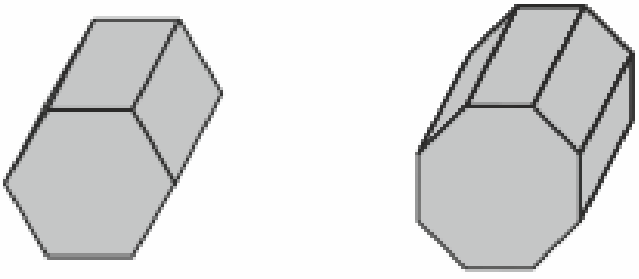
Tap the image for more information and exercises

SOLID / BAR SECTIONS AND RODS

length x width x thickness



SQUARE ROUND FLATS



HEXAGONAL OCTAGONAL

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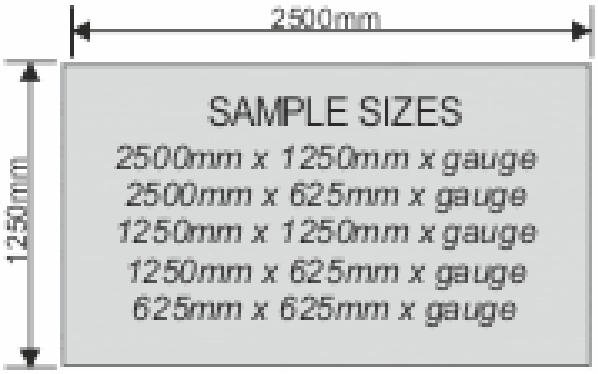
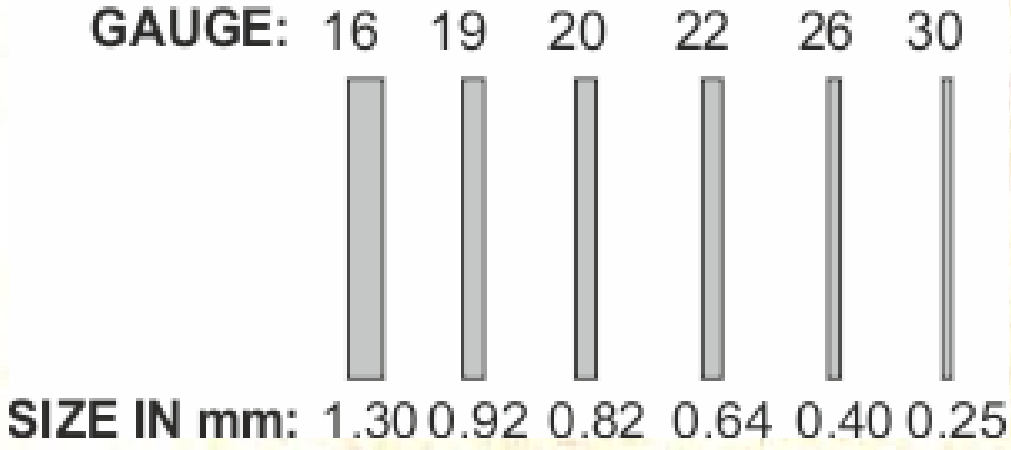
Tap the image for more information and exercises

METAL SHEETS
A VARIETY OF SIZES AVAILABLE



SAMPLE THICKNESSES



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ALUMINIUM

Aluminium is one of the most common non-ferrous metals, used widely. Including the aerospace industry, food and drink storage, kitchen wear, electronics, construction, automotive industry, shipping and many more.

Aluminium is normally 'alloyed' (combined with other metals / compounds), in order to enhance its mechanical properties, such as improving machinabilty.

Aluminium can be recycled repeatedly, without the quality being reduced. Furthermore, recycling aluminium only uses five percent of the energy required to extract aluminium from bauxite ore. Therefore, it could be claimed that aluminium is a sustainable metal.

Tap the image for more information and exercises

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Tap the red button to return to the Contents page

PROPERTIES OF ALUMINIUM

Aluminium is 1/3rd the density of steel, lightweight and comparatively strong.
Has good properties of elasticity, especially when alloyed.
Can be cast, extruded, rolled, machined and cold or hot formed.
Can be joined through a variety of processes including, welding, riveting, adhesives and even soldering.
It resists corrosion.
Surface finishes can be applied, including anodising, paint and powder coating.
A good thermal and electrical conductor.
Non-toxic, making it ideal for kitchen utensils.
Non-magnetic metal, which is a useful property, with some practical applications.

Tap the image for more information and exercises

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Tap the red button to return to the Contents page

WORLD PRODUCTION OF ALUMINIUM

The graph below represents the international production of aluminium (2017). China clearly produces a large proportion of the worlds supply and is a major exporter of this important metal.

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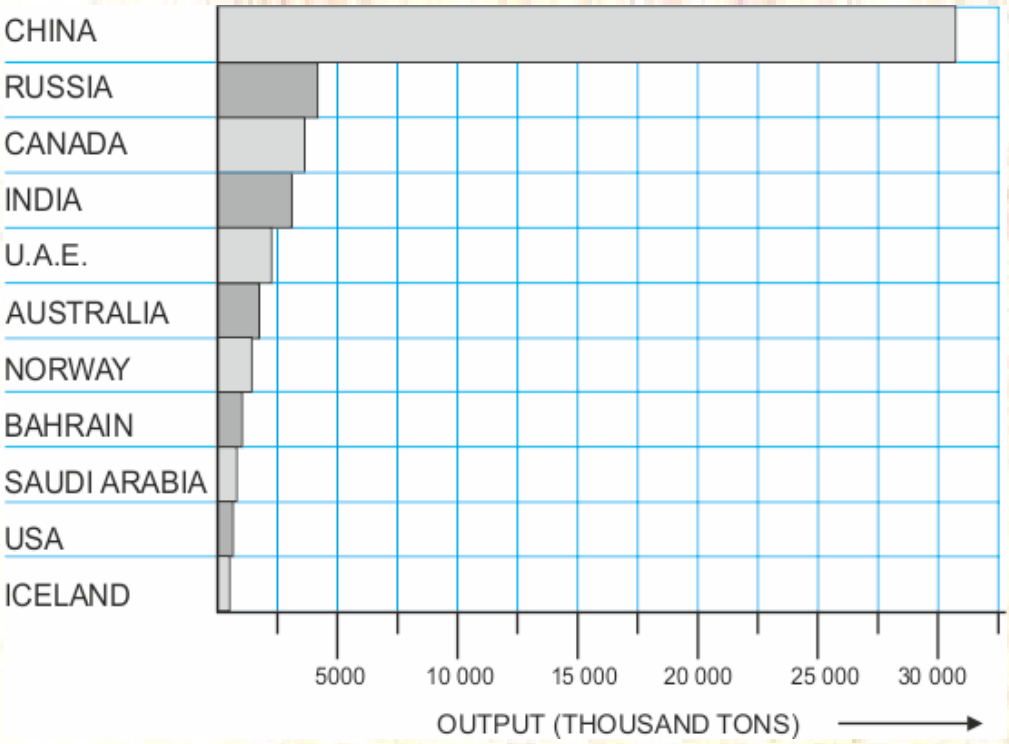

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Tap the red button to return to the Contents page

ALUMINIUM PRODUCTION (BAUXITE TO ALUMINIUM)

Aluminium is derived from bauxite, a sedimentary rock. One such source is Australia, where open cast mining allows easy access to the bauxite ore. However, this requires large amounts of electricity and consequently, aluminium production is usually associated with a source of cheap hydroelectricity.

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Tap the red button to return to the Contents page

BAUXITE TO ALUMINIUM - 1

Bauxite ore is crushed in a rotating grinding mill, where it is mixed with sodium hydroxide, producing a slurry. Unwanted impurities sink to the bottom of the slurry tank, where they are removed.

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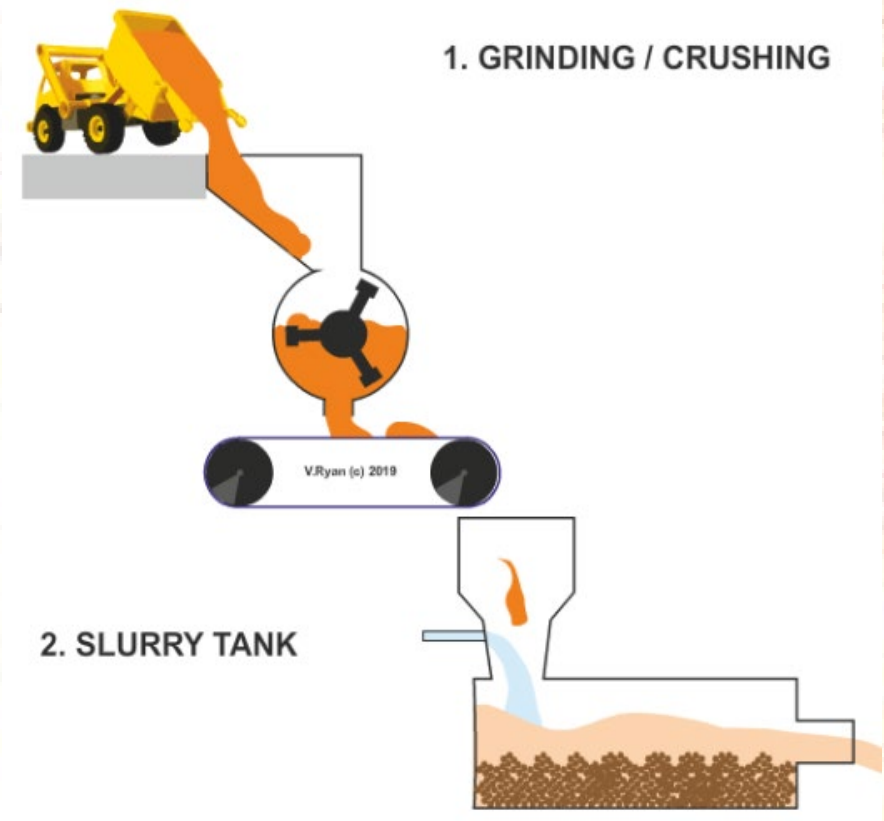

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Tap the red button to return to the Contents page

BAUXITE TO ALUMINIUM - 2

Chemical reactions take place in this tank (the Digester), further dissolving the alumina.

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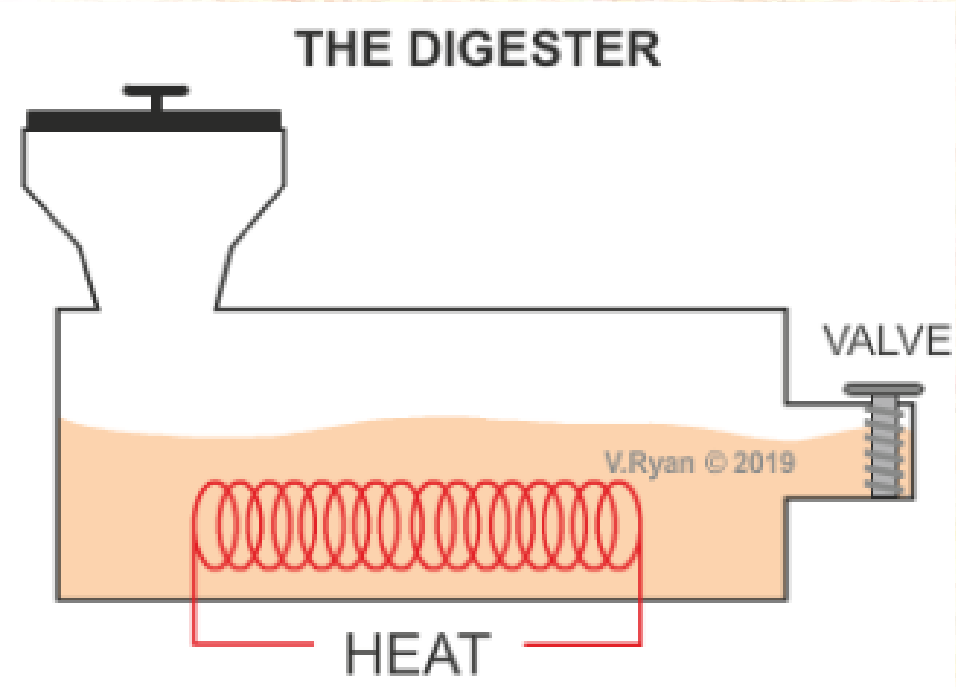

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Tap the red button to return to the Contents page

BAUXITE TO ALUMINIUM - 3

The solution is allowed to settle, which leaves more of the heavier unwanted metals, at the bottom of the settling tank and the alumina solution at the top.

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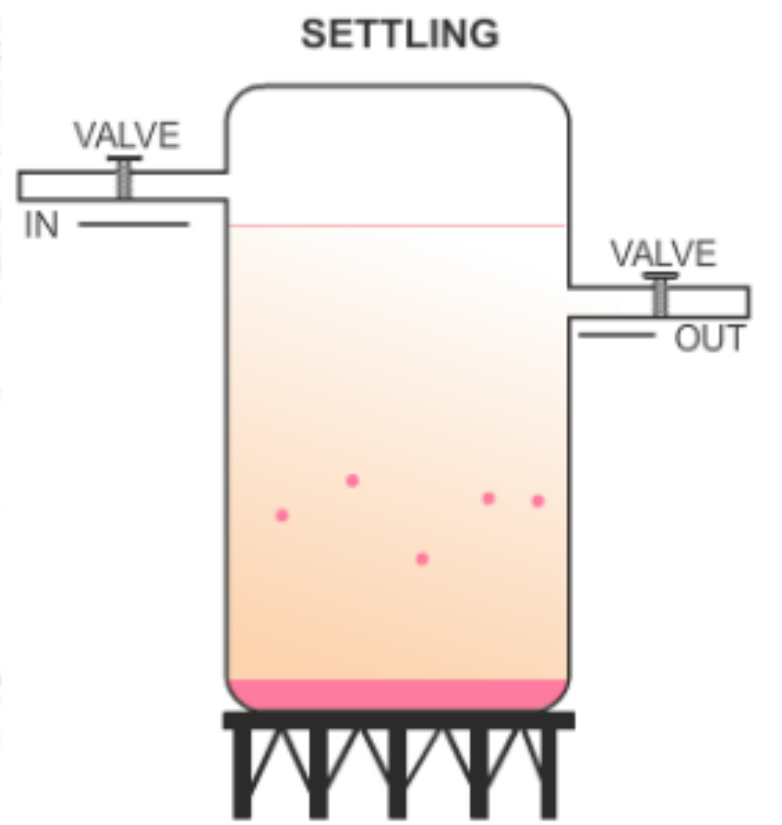

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Tap the red button to return to the Contents page

BAUXITE TO ALUMINIUM - 4

The alumina solution is stored in a precipitation tanks. Crystals of alumina are added and start to grow, as the alumina cools and forms into larger crystals.

Tap the image for more information and exercises

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Tap the red button to return to the Contents page

BAUXITE TO ALUMINIUM - 5

The alumina crystals are heated to remove water. The central screw moves the crystals to the end of the heated calcification tank. With the water removed, the result is a white powder of pure alumina (aluminium oxide).

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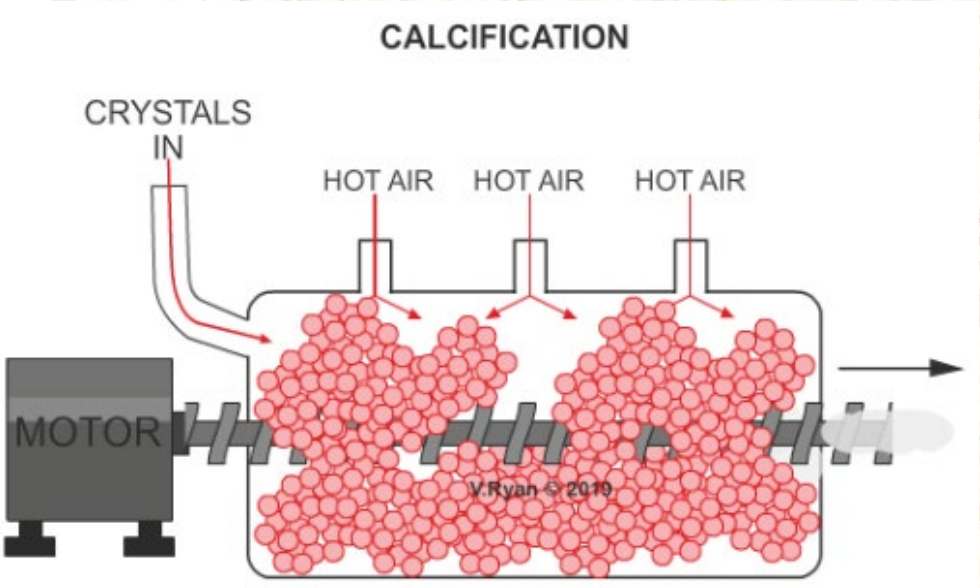

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Tap the red button to return to the Contents page

BAUXITE TO ALUMINIUM - 6

The pure alumina is dissolved in a molten solution of 'fused' cryolite and fluorspar. An electric current keeps the mixture molten, at a temperature of 900 degrees centigrade. Aluminium forms at the bottom of the furnace and can be poured into a cradle.

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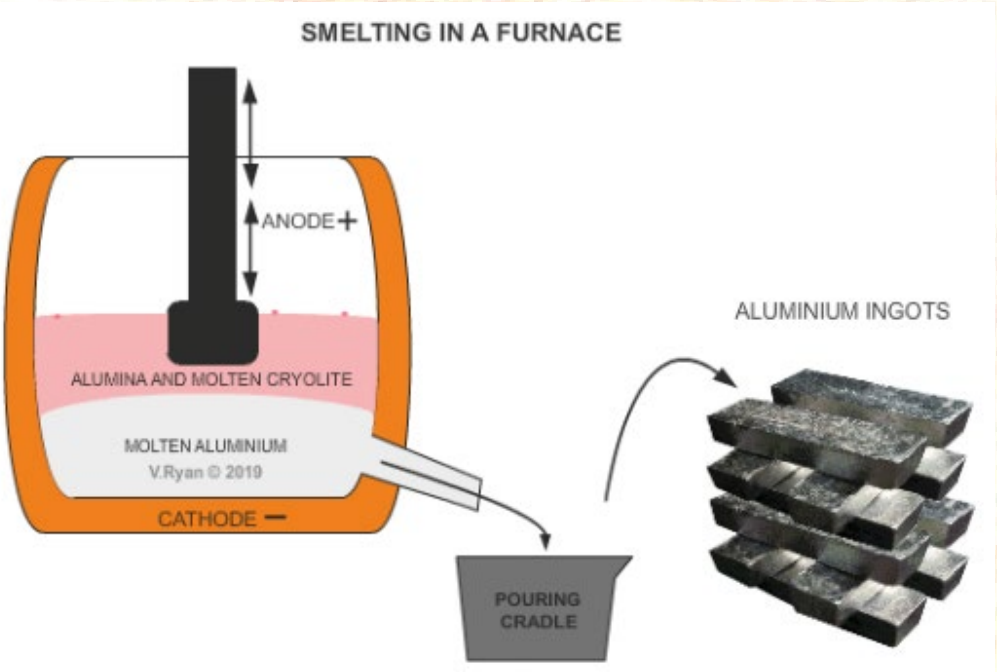

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SAMPLE - ALUMINIUM PRODUCTS

Tap the image for more information and exercises

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