Why do metals rust? – 1

metal + air + water = rust

If a steel bicycle is left out in the rain, orange-red marks will soon appear on the chain, sprockets, handlebars and other places where the metal is unpainted. This is rust. If nothing is done to stop it, the rust will continue to corrode the metal.

Rusting is an irreversible change. Oxygen in the air and rain water have combined with the metal and created another substance, which is known as iron oxide.

Water is the main cause of rusting. When it comes into contact with an unprotected metal, two reactions begin. Hydrogen in the water combines with carbon dioxide in the atmosphere and forms a weak acid. As the acid begins to dissolve the metal, oxygen in the water combines with the dissolving metal and iron oxide (rust) is formed. This corrosion cycle will continue for as long as the metal is in contact with water or even if the air is heavy with moisture, like it is on a hot and humid day.

Scientists have discovered that some metals react with water and oxygen more readily than others. Reactive metals corrode easily. Through scientific discovery, a list ordering metals from the least reactive to the most reactive has been produced. This list has been valuable for scientific progress.

How to prevent rusting

- *Keep the metal dry or dry it thoroughly after it has been wet;* for example, keep your bicycle in the shed and always wipe it down if you have been cycling in the rain.
- *Cover the metal with oil or grease, which repel water;* for example, always oil your bike chain after you have cleaned it.
- *Paint the metal;* for example, the garden gate, outdoor metal furniture.
- *Use metal that has been galvanised—an industrial method for coating metals with a protective layer of a less corrosive metal;* for example, used in car manufacturing and ship building.
- *Use sacrificial protection;* for example, placing layers or blocks of more reactive metals next to or on ship hulls, oil rigs and underwater pipelines. The block or coating of metal rusts rather than the metal it is protecting. However, the sacrificial metal must be replaced before it is completely corroded.

During the rusting process, at the same time as the acid is dissolving, the metal it also dissolves the existing rust. Because of this, stronger acids are often used to clean rust because they will dissolve the rust before they attack the metal.

In some places, rust can be a significant problem because the presence of some chemicals in the environment adds to the rusting process; for example, where saltwater spray from the ocean reaches cars and buildings, or where acid rain is a problem. The salt and other chemicals which are dissolved in the water remain on the metal after the water evaporates, and can speed up the rusting process.

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Why do metals rust? – 2

1. Iron oxide is the chemical name for which common problem? _____

2. (a) Which two elements are required for the rusting process to occur?

   _____ and _____

   (b) Draw a flow chart to explain how rust is formed.

3. Rain causes metal to rust, but sea spray causes it to rust more quickly.

   Explain why this is so.

4. Explain how acid can:

   (a) damage metal.

   (b) clean rusty metal.

5. (a) What is a *reactive* metal?

   _____

   _____

   (b) If pieces of two different metals were left together in a tray of water, which would rust first? Tick the correct answer.

   the more reactive metal ☐ the less reactive metal ☐

6. Rusting would be a greater problem in a _____ (dry/humid) climate because

   _____

   _____

   _____

   _____

   _____.

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