**Using redox reactions in artificial reefs?**
We are surrounded by many different types of chemical reactions. Understanding how these reactions occur means we can manipulate them for our purposes. Redox reactions are an example of a chemical reaction that can be used in a positive way by ship builders and marine biologists.

 Redox reactions usually start with an oxidation reaction at a metal anode. The metal (such as Zinc) loses electrons and forms a positive ion (Zn2+). This reaction is usually paired with a reduction reaction at a cathode. The cathode contains a material that uses the electrons to form negative ions. Sometimes these two chemical reactions occur very close to each other. An example of this is the rusting of iron. Iron acts as the anode forming iron ions (Fe2+). In the presence of water and oxygen in the air, the oxygen acts as a cathode and uses the electrons in a reduction reaction. The result is the formation of iron oxide, or rust.

This is a problem on ships made of iron. The redox reaction between the iron, oxygen and water causes the ship to rust.

Not all metal react the same way. Some metals are more likely to undergo reactions than others. This is described in table of reactivity series of metals.

|  |  |
| --- | --- |
| K | Potassium |
| Na | Sodium |
| Mg | Magnesium |
| Al | Aluminium |
| C | Carbon |
| Zn | Zinc |
| Fe | Iron |
| Sn | Tin |
| Pb | Lead |
| H | Hydrogen |
| Cu | Copper |
| Ag | Silver |
| Au | Gold |
| Pl  | Platinum |

 Increasing reactivity

The metals at the top of the table are more likely to undergo an oxidation reaction than the metals at the bottom of the table. The metals at the top can be used as sacrificial anodes. Because these metals will oxidise before the other metals, they will protect them from corrosion. For example, if zinc metal is attached to an iron ship, it will oxidise before the iron on the ship. The iron ship is therefore protected from rusting whilst the sacrificial zinc anode is in place.

**Question 1**
Name three metals from the table above that could act as sacrificial anodes on an iron ship.

**Question 2**
The sacrificial anode corrodes over time. Describe what will happen to the ship if the sacrificial anode is not replaced regularly.

In a battery, the oxidation and reduction reactions are kept separate, so the electrons that are released by the cathode must travel through wires to reach the reduction reaction.

**Question 3**
Correctly identify the charge (positive or negative) of the cathode and anode.

When iron ships sink, they quickly become covered in a variety of coral. Marine scientists have compared the rate of coral growth on ship wrecks and natural reefs, and found that the coral polyps grow up to three times faster on iron ships than on natural reefs. Marine chemists preformed a series of tests and discovered that his is most likely due to redox reactions.

Many iron ships also contain tin objects. Tin is found below iron on the reactivity series table. This means iron is more likely to undergo oxidation than tin. This means the tin is able to undergo a reduction reaction. The oxidation of iron produces electrons that then travel through the water to the reduction reaction at the tin. This movement of electrons creates a small electromagnetic field that is thought to encourage the growth of coral.

**Question 4**
Does tin act as an anode or cathode? Explain your reasoning.

Marine biologists have started harnessing this redox reaction. They are creating artificial reefs made out of iron and tin. A coral frame of iron is made and covered in small pieces of living coral. When the frames are put in place, the coral is able to grow. When a structure of recycled tin cans are placed a short distance away from the iron frames, electrons will flow between the iron and tin. The electromagnetic field created by the flow of electrons encourages the growth of the coral. Chemical reactions helping nature.

**Question 5**
Draw a diagram of an artificial reef. On your diagram below correctly identify the anode and cathode. Draw an arrow to show the direction the electrons move.