



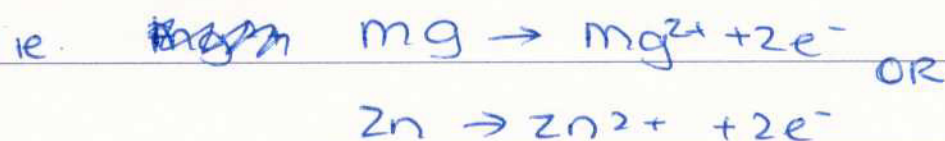
Question 29 - Shipwrecks and Salvage

a) i) Iron

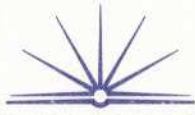
ii) Aluminium can be used because it is a passivating metal. When exposed to oxygen it reacts, but forms a protective coating^{of} Aluminium oxide, which is non-porous, and thus protects the underlying aluminium metal from any further ~~corrosion~~ oxidation. So it can be used, because it protects itself.

b) i) magnesium

ii) Blocks of zinc or magnesium are attached to hulls of ships to make the hull the cathode, in a form of ~~the~~ cathodic protection using sacrificial anodes. Because the Mg or Zn is more reactive than the ~~but~~ iron in the hull, it corrodes preferentially.



This ~~makes the~~ prevents the iron in the hull from oxidising by ions migrating to



potentially active sites on the hull and then being reduced. Only reduction of the iron occurs, so the iron doesn't oxidise, and the hull is protected from corrosion.

c) An alloy is made when other ~~sub~~ substances, such as carbon are added to iron. Iron with different percentages of carbon have different properties and different uses.

Structural steel is made when ~~the~~ carbon is added to ~~high~~ iron (about 4% carbon) and is much stronger than normal Fe. It is because of this, that it can be used in buildings, in applications such as beams.

Pig iron contains less ~~iron~~ carbon, and is softer and more malleable, and is thus used less commercially.

Stainless steel is very resistant to corrosion and is used commonly in household kitchens, as knives and pans.

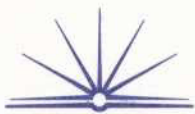


By adding carbon and other impurities such as nickel, tin, steel becomes more resistant to corrosion, and because of the different properties, can be used in a wide variety of applications.

d r) Corrosion is the oxidation of certain metals by substances (usually oxygen and water) in the environment.

ii) In ^{each} test tube place 2cm^{high} of water and in each place a ~~in~~ different metal ^{to be tested}. Arrange test tubes on a rack and compare ~~using~~ the ~~in~~ rates of corrosion each day (or after a set time period) by observing how much rust (in iron) or corrosion has taken place. Record results qualitatively or by taking photos / drawing pictures to indicate how much corrosion has taken place.

iii) Make sure the amount of water in each test tube is the same. Keep the temperature controlled.



and throughout the same for each metal throughout the whole experiment. The amount of oxygen could be controlled by blocking out oxygen from the surrounding air (by using a stopper), and bubbling a constant stream of oxygen through the water for the whole experiment. The volume and rate of oxygen bubbled needs to be the same for all test tubes. Ferric chloride could be used in the experiments, as through the different red and blue colours, reduction and oxidation can be more accurately identified respectively.

To increase reliability, ^{and accuracy} metals could be of the same weight, and surface area so that the experiment is more controlled.

By controlling the variables, accuracy and reliability can be greatly increased.

e) Artefacts recovered from shipwrecks can be ^{iron} ~~steel~~ in nature, ~~for example steel cans or other~~ ~~cutlery~~.

To remove any calcium carbonate deposits



they can be chipped off with a hammer, or a dilute acid, such as HCl, can be applied which will remove the encrusted deposits, by reacting with them.

To remove the salt which is impregnated in the artefact an electrolysis cell can be set up.

The object is placed made the cathode and a stainless steel anode is used, with the electrolyte being sodium hydroxide. As the electrolysis proceeds the chlorides are fused out of the object and into the solution.



The object can then be preserved by coating it with a wax or lacquer which will protect the object in the future.