BOARD OF STUDIES
NEW SOUTH WALES

Question 29 : Shipwrecks and Salvage

(a) i steel

ii Aluminium is a passivating metal which means that it forms a protective oxide ~~layer~~ layer when it reacts with water and oxygen.

$$4Al_{(s)} + 3O_{2(g)} \longrightarrow 2Al_2O_{3(s)}$$

the oxide layer, Al_2O_3, protects the metal from natural elements, such as water and oxygen, from penetrating the metal, and hence prevents the process of corrosion.

(b) i magnesium

ii Sacrificial anodes are added to metal-hulled ships as they are metals which are more readily oxidised. ~~and with~~ They therefore produce electrons which will flow onto the metal of the ship and hence ~~protecting~~ protect it from corrosion. The sacrificial anodes force the metal of the ship to become the cathodic site, ∴ protected by electrons from the sacrificial anode, ~~and~~ it will not corrode.

(c) By adding other elements to iron, the strength and durability of the iron increases. An alloy is created, comprised of many different elements and the added impurities increase the tensile strength. Pure iron is very malleable and soft, however when carbon is added, pig iron is created. Pig iron is much stronger and can be used for making buildings, the frameworks and reinforcements, and it is durable due to the added impurities.

Stainless steel, formed from iron, is comprised of carbon, chromium and nickel. The material is a shiny silver colour, is durable and ideal for kitchen sinks. Stainless steel does not corrode, as the carbon produces electrons which protect the metal, a useful property. Other uses of steels are for ship building and the tensile strength of the steel is a positive element.

(d) i Corrosion is the breaking down and destruction of an element by water and ~~oxygee~~ oxygen, a porous compound, and very often rust, ^ can be formed.

ii To compare the corrosion rates of different metals or alloys in the school laboratory, The various ~~metals~~ metals could be placed in different environments and different conditions applied.

Metals such as, iron nails, aluminium, magnesium, zinc and copper, could be placed in test tubes containing different substances:

Test tube 1 : tap water as a control

Test tube 2 : test tube with HCl

Test Tube 3 : ~~test~~ NaOH

Test Tube 4 : boiled water to remove the oxygen, and then a layer of oil on top

Test tube 5 : a low salt concentration

Test tube 6 : a higher salt concentration

Temperature

iii In the procedure in step (ii), the effect of temperature on the metals could also have been observed. Also, the different metals could have been alternatively wrapped around one another to take in to consideration, the possibility of sacrificial anodes.

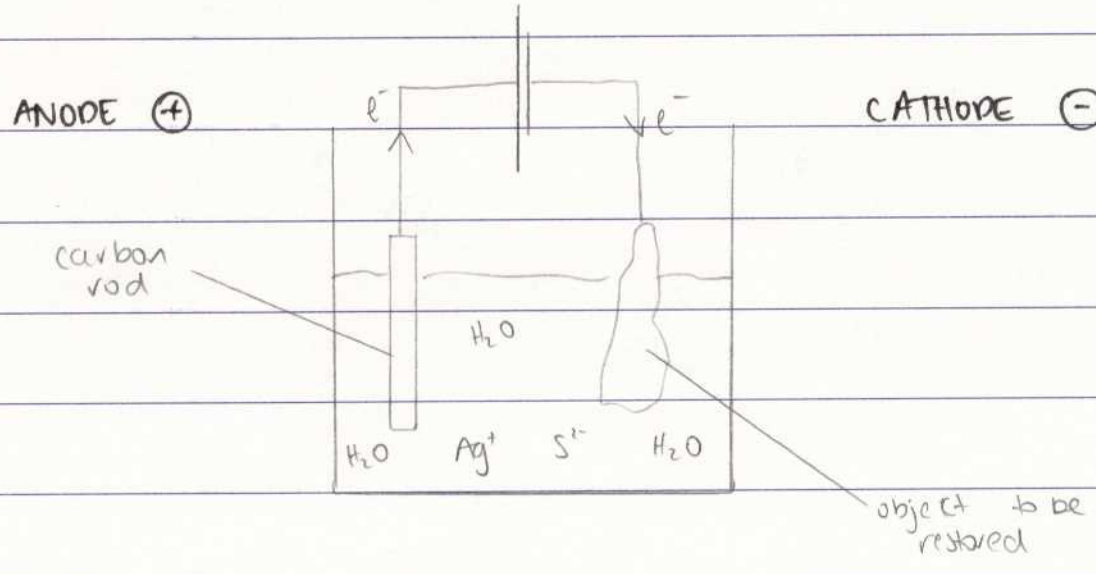
To improve reliability, the procedure could have been repeated in order to gain an average observation of the rate of corrosion. Also, to improve accuracy, the procedure could be carried out over a set period of time and measurements of the water used each time recorded.

Also, each nail and metal could be weighed before and after to test for a weight change in the metal due to corrosion.

(e) Very often, silver artefacts are recovered from shipwrecks and it is possible to clean, stabilise and preserve the silver artefacts.

Very often the recovered artefacts are covered with concretions, such as coral, $CaCO_3$ and $Mg(OH)_2$, which form a rough and hard layer on top of the metal, although often protecting it from corrosion. A with some metals an abrasive can be used to break and scrub off the concretions, however this can also damage the metal.

To restore silver, the methods of electrolysis can be used. In the electrolytic cell:



Silver sulfide, Ag_2S, solution is added in order to help restore the silver metal.

$$HS^- + H_2O \rightarrow H_2S + OH^-$$

$$H_2S + Ag^+ \rightarrow Ag_2S + H_2O$$

∴ the equation at the cathode becomes:

$$Ag^+ + e^- \rightarrow Ag_{(s)}$$

and at the anode:

$$2OH^- \rightarrow \frac{1}{2}O_{2(g)} + H_2O_{(l)} + 2e^-$$

The electrons flow onto the silver artefact, purifying the substance. The metal slowly becomes clean, and although silver is a relatively inactive metal, it is kept free from oxygen and water in order to preserve the quality.