Question 29 - Shipwreck and salvage.

a) (i) iron.

(ii) Even though aluminium is ~~more~~ a very reactive metal, it does not corrode as quickly as iron because it has properties of a passivating metal. This means that Aluminium is able to react with the oxygen in the atmosphere to form a impervious oxide layer which prevents it from further oxidation as water can not pass through this layer to contact the metal,

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

If the surface oxide layer is scratched, it can mend itself because the exposed $Al_{(s)}$ will react again with oxygen to form a new layer.

b) (i) zinc.

(ii) sacrificial anodes are added to metal-hulled ships to prevent the ship metal from corroding. The sacrificial anode is usually made from a more reactive metal than the metal used for ships (iron). When ~~oxidation~~ corrosion take place, the zinc acts as the anode and will be oxidised, $Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$ instead of the ship and therefore the ship is prevented from corrosion as it acts as the cathode,

$$Fe^{2+} + 2e^- \rightarrow Fe_{(s)}.$$

e) By adding other elements to iron the properties of it will alter to suit the purpose of its user.

Pure iron are softer and does not corrode as easily as impure iron. It is not often use commercially.

As carbon is added to the iron, it becomes harder, ~~and~~ tougher, and corrodes more easily. It is often used as constuction materials for buildings and ships.

Steel made from ~~impure iron~~ composition of Nichel and cadmium ~~to iron~~ does not corrode because iron is not prese and is often call stainlen steel. This is often use to make kitchenware, sinks and cutlery.

Steel with ~~less~~ more than 4% carbon are hard and brittle. These properties allow it to be used for steel bars for constuction. It is not malleable.

Steel with less than 4% carbon are hard and tough, not brittle so it is malleable and can be rolled into sheets to use for constuction of moto vehicles and ships.

d) (i) corrosion is the degradation of a metal usually caused by the oxidation of the metal causing it to lose its strength and properties and enables it to perform its normal function.

(ii) Aim: to determine and compare the corrosion rates of different metals or alloys in school lab.

Method: 1) Arrange ~~five~~ five testubes in a test tub rack.
2) Add water (tap) to each test tube.
3) place a different alloy/metal in each test tube. ~~and observe~~ eg, copper, zinc, iron, stainless steel, mild steel
4) Record observations of the changes taken place in each test tubes over a period of 3 weeks.

compare the results to determine the corrosion rates of each metal/alloy in contrast to the others

(iii) Make sure the water in each test tube ~~s~~ is from the same source as it may affect corrosion rate and all test tubes should be placed in the same environment

Another way to increase the accuracy of the result is to place cork tops on the test tube so that ~~it~~ one tube would not be contaminated during the ~~process~~ period of observation. Because the contaminant may be a piece of more reactive metal, which will cause the metal in test tube to corrode more quickly

e) To restore an iron artefact, several steps must be taken to clean, stabilise and preserve it. Step one is to chip all the coral of the artefact. If it is covered with $CaCO_3$ then prolong ~~soaking in citric acid will remove the precipitate.~~

($CaCO_3 + 2H^+ \rightarrow Ca^{2+}_{(aq)} + CO_{2(g)} + H_2O_{(l)}$)

Step 2: Remove the chloride in the artefact by electrolysis. The artefact is placed as the cathode as a voltage of at least 0.84V is passed through.

cathode: $Fe^{2+} + 2e^- \rightarrow Fe_{(s)}$ -0.44

anode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ $-0.4V$

$E° = -0.84V$

$Fe(OH)_2$ is converted back to $Fe_{(s)}$ to preserve the engravings on the object.

Step 3: Blow hot air through the object to dry it and then cover the entire ~~ob~~ artefact with a wax coating to preserve it from further corrosion.