a) i) Galvanic Cell

~~[illegible]~~

ii) $Fe \longrightarrow Fe^{2+} + 2e^-$ $-0.44\ V$

$Cu^{2+} + 2e^- \longrightarrow Cu$ $0.34\ V$

voltage required = E° oxidation + E° reduction

$= 0.44 + 0.34$

$= 0.78\ V$

b) Galvani and Volta:

Galvani connected two differed metal together and placed the unjoined ends onto fresh muscle of a frog. This induced the twitching of the frogs legs which he wrongly called "animal electricity". Volta continued experiments done by galvani and volta concluded it was not "animal electricity" but it was a chemical reaction between salt in the frog and the two metals. Volta then demonstrated the production of electricity by placing two differed metals in a solution of salt. Their discoveries increased our understanding of electron

BOARD OF STUDIES
NEW SOUTH WALES

transfer. They had discovered electricity, the movement of electron. Volta went on to produce a voltaic cell. His cell is the first practical battery. The basis of this battery is used in modern batteries of today.

Davy and Faraday

Davy improved the battery of volta and used it to perform decomposition reactions. This led to the discovery of Na and K elements. Faraday continued the decomposition reactions and related the amount of substance formed at an electrode to the amount of current in the electrolytic cell. Davy and Faraday demonstrated electrolysis. This increased our understand of electron flow and allowed us to extract metals from smelting, electroplating and electrorefining of metals.

c) i) Electrolysis.

ii) Electrolysis can be used to remove the black sulphide that is found on silver objects such as silver coins on shipwrecks. In this process, the silver coin is made to be the cathode, an inert electrode is used as an anode and a suitable electrolyte of NaOH is used. The reaction removes any S in Ag_2S to the anode, removing the black sulphide layer of the zinc. A similar procedure of electrolysis is used to remove salts such as chlorine in artefacts. The artefact is made to be the cathode, the anode is stainless steel and electrolyte is NaOH. Cl^- is converted into Cl_2 atoms at the anode.

In the first process, the silver coins or objects are usually first soaked in dilute acid to clean them.

BOARD OF STUDIES
NEW SOUTH WALES

d) i) obtain a variety of metals and alloys including iron nails, stainless steel rivets and Aluminium ~~alloy~~ steel alloy.

d) i) 1. Obtain a variety of diffent metals and alloys including iron nails, steel rivets, stainless steel nails and Aluminum. Clean the metals

2. Obtain a variety of acidic and neutral solutions, each of equal concentrations (1.0M), ~~and~~ including HCl, H_2SO_4 and Salt water (NaCl).

3. Place the metals in the solutions and observe what happens each day for a week.

4. Repeat experiment (steps 1-3) using the same solution but with different concentrations (0.1 M).

BOARD OF STUDIES
NEW SOUTH WALES

iii) After 1 week data was observed.
In the 1M of HCl and H_2SO_4, the iron nail and steel rivet had significally corroded forming brown rusticles. In the neutral solution of salt the steel rivet and iron had corroded, but not as much as in the acid solutions. The stainless steel did not show evidence of corrosion in the salt water, but there was some cloudiness in 1M of HCl.

Data:

material	solution (1M)	observations
iron nail.	HCl	very corroded, large amounts of rust.
	H_2SO_4	similar corrosion to HCl
	salt (NaCl)	moderate corrosion, with rusticles
steel rivet	as above	as above
stainless steel	HCl	cloudiness
	H_2SO_4	cloudiness
	Salt (NaCl)	no reaction.

The experimental observations did support the hypothesis. Acidic solution seemed to corrode the iron and steel the most. When the concentration of the solutions were reduced so was the observed corrosion. Therefore if more acidic the environment the greater the corrosion.

e). As temperature is decreased and pressure increased, the solubility of oxides will increase. As temperature decreases the solubility of salts also will decrease. Therefore theoretically metallic objects at low depths should not corrode

e) As temperature is decreased and pressure increased, the solubility of oxides will increase. Oxygen is needed for rusting, therefore corrosion should occur at depths, as

oxygen will be become more soluble. But the ~~deep~~ deeper the water the less the oxygen concentration, because at depths oxygen is consumed by aneorobic bacteria. Low levels of oxygen and low temperatures means that corrosion of metal objects should not occur, ~~The~~ yet shipwrecks are very corroded. The corrosion of ~~metallic~~ objects at depth is not a electrochemical process but caused by ~~the~~ anaerobic bacteria that reduce sulphate to sulphide. This reduction reaction is:

$$SO_4^{2-} + 4H_2O + 4e^- \longrightarrow HS^- + 9OH^-$$

The production of Fe^{2+} is like the normal oxidation of iron

$$Fe \longrightarrow Fe^{2+} + 2e^-$$

The Fe^{2+} produced then reacts with OH^- and HS^- to produce black FeS and $Fe(OH)_2$. These both contribute to rust/ and corrosion of metallic objects

at depths. The anerobic bacteria is abundant due to large amounts of organic matter to feed on around shipwrecks and metals. The production of H_2S by the bacteria increase the acidity of area at depth, and this also favours corrosion.