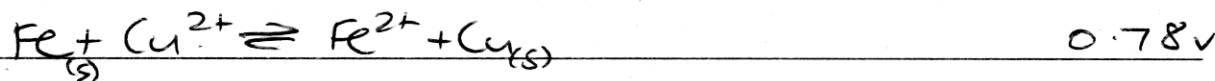
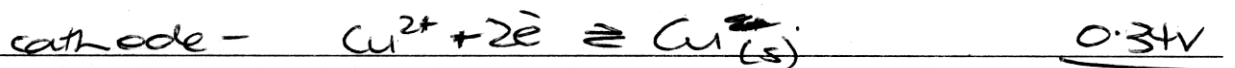
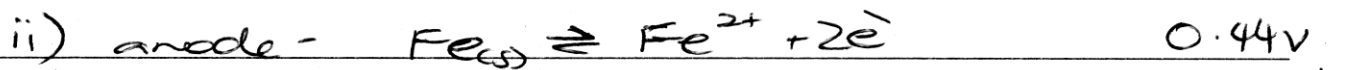


Question 29

a) i) a galvanic cell



$$\text{TOTAL EMF} = 0.78\text{V}$$

\therefore 0.78V required to operate cell.

b) Galvani stimulated interest in electricity by discovering that when 2 metals were passed through a frog, they conducted electricity, also known as 'animal electricity'. Because of this, Volta created the voltaic pile - which we now have as our batteries.

Davy then reassessed these ideas and came up with the idea that ionic compounds broke down into their elements through e^{-} transfer (electricity). Therefore he discovered that ionic compounds could be decomposed into their elements through the use of an electrical current.



Therefore increasing our knowledge of
new compounds can be decomposed.

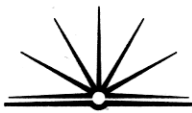
Then Faraday created his first laws
which involved a quantitative ^{analysis of} electrolysis.
He discovered that the quantity of mass
deposited at the cathode was in
proportion to the quantity/amount of electrical
current passed through the circuit. This
theory enables us to ~~be~~ have a figure
(amount) of the metal ^(deposited) at the cathode
2 grams. His theory is recognized as

$$\text{mass deposited } (m) \propto \text{quantity of current } (q) \text{ (time taken)}$$

proportional to.

where $q = I \times t$
(amps-current)

Both Faraday and Davy have
significantly impacted our
understandings of e^- transfer reactions.



c) i) A method for removing ~~silver~~^{salt} from an artefact would be electrolysis.

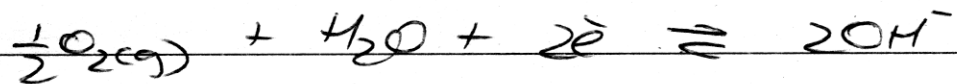
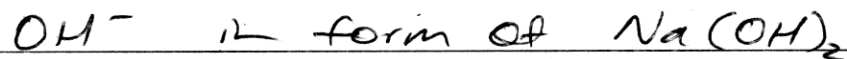
ii) Silver Artefacts

1/ cleaning of encrustations:- the artefact is cleaned by using dilute HCl or acetic acid (CH_3COOH)

2/ restoring:- the reaction occurring at the anode is:-



and the cathode is:-



~~where the this~~^{Electrolysis} is used to remove the black Ag_2S and maybe some AgCl from artefact and leave metal intact.

Once this has occurred the artefact should be free of all chemicals of the metal in question and able to be stabilized.



3/ preserving:- a clear lacquer is used to cover the artefact and prevent any O_2/H_2O getting in and causing further corrosion.

d) i) ~~4~~⁴ beakers are set-up.

One beaker with water and nail in it

One beaker with ^(weak) acid solution and nail in it

One beaker with ^(strong) acid solution and nail in it. and

One beaker with a basic solution + nail in it

These are left for several days and

then observed. ^{The amount of} ~~the~~ rust or corrosion

appearing is compared to one another.

ii) Acidic environments do enhance

corrosion of shipwrecks so this does

support the hypothesis. shipwrecks are

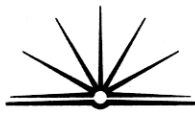
made from steel (an iron + carbon

alloy) similar to nails (steel/iron).

So the nails represent in a smaller

proportion, the shipwrecks.

When the nail is in the neutral environment (water and O_2 present) and $pH=7$, corrosion is at a constant rate and this is used as a control. However observed in the acidic environments the iron has noticeably corroded more rapidly than the neutral and basic environments. This is because the iron and the acid ~~produce~~ together push the equilibrium to the R.H.S. hence causing more rust. However in basic solution the eq'm is ~~shifted~~ pushed more to L.H.S. therefore not promoting rust.



e) It would be expected that at lower depths of ocean where there is less dissolved oxygen and temp. is much colder that corrosion would be at a slow rate. However ^{when Titanic was} discovered, it was noticed that it had decayed and corroded much more rapidly than first thought of. This is because, at the depths of the ocean, an anaerobic organism - called sulfate-reducing bacteria - form a porous layer on the metallic objects at bottom of ocean. The ~~bacteria~~ source of these sulfate-reducing bacteria are from hydro-thermal vents. They form this layer on the object which then causes it to decay much more rapidly. Instead of forming a non-porous layer which would resist corrosion.

These bacteria work on the objects quite easily as they are anaerobic and don't need oxygen to survive. Also at such cold temperatures, it~~s~~ enhances corrosion.

As depth decreases, oxygen and nitrogen decrease however CO_2 doesn't. The carbon dioxide can often react to create CaCO_3 (a white ppt) which can also form on metallic objects.

Copper is ~~strong~~^{soft} and costly and corrodes much more quickly than bronze which is cheaper also + more flexible. However the deeper the ocean depth, the more easily the metal will corrode no matter how resistant towards corrosion.

However if surface alloys or new paints were used to protect the



metal hull of a ship, less corrosion
would occur.