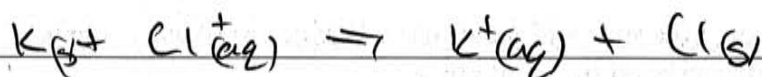
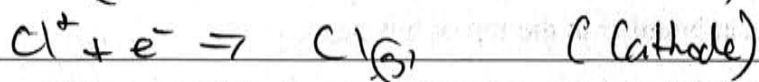
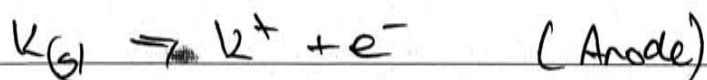
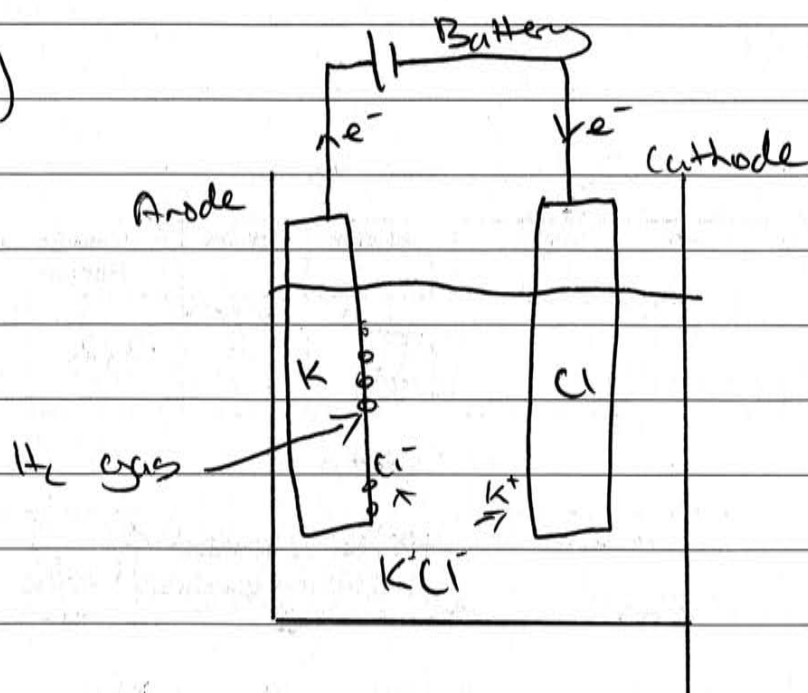


Start here.

Shipwrecks.

a) The wooden bucket would have had copper bracings around it. The marine environment would have corroded the copper quite substantially particularly where the rivets are. The wood would have also been damaged, with a build up of ions in the fibres, leading to its decay.

b) i)



ii) The cathode would be identified by the deposit of a solid.

Steel 1:

Contains 99.8% iron, and 0.2% Carbon.

Carbon alloys of iron make it stronger + rust resistant. However due to the very low percent percentage of carbon the rust resistance would be minimal.

Steel 2:

Contains 98.5% iron, 1.5% carbon. Again this alloy would be rust resistant, more so than steel 1. The carbon percentage in both steels make it more <sup>malleable</sup> flexible + hence they would both be used on the hulls of ships.

Steel 4:

The manganese + silicon percentages in this steel make it more ductile + malleable + hard. The rust resistance would be increased again + this steel would be used on the deck of a ship.

Steel 5:

The chromium percentage makes this steel the most resistant to corrosion + rust + makes it hard + strong. Likewise the nickel percentage contributes to its malleability + ductility. It would be used for railings + alike on a ship.

Additional writing space on back page.

d) i) Environmental factors that affect rate of corrosion include; pH, salinity + presence of water/moisture.

Using iron nails, ~~and~~ + test tubes this experiment can be carried out in a laboratory.

Test 1: pH

① Fill a test tube with an acid,  $H_2SO_4$  + drop in a nail.

② Fill a test tube with a base,  $NH_3$  + drop in a nail.

③ Leave each tube for 14 + record any corrosion each day.

NOTE: a tube with water should also be used as a control.

Test 2: salinity (ions in water).

① Using salt water (ocean water) fill a test tube + place a nail in it.

② Fill ~~as~~ a test tube with distilled water (tap water can have ions in it) + place a nail in it.

③ Leave each for 14 days + record any corrosion daily.

Test 3: water/moisture.

① Place a nail in a test tube with no water.

② Place a nail in a test tube with water

You may ask for an extra Writing Booklet if you need more space.

Start here.

③ leave each for 14 days + record any observations daily.

ii) Ions (salinity) in the water ~~could be~~ causes an increased rate of corrosion. On ships this is particularly harmful. Cathodic protection is used on ships to ~~reduce~~ <sup>reduce</sup> the amount of corrosion due to the ions in the water.

e). The ~~was~~ vernon anchor is a wooden artefact which had been at the bottom of Sydney Harbour for more than 100 years. It had endured a lot of corrosion due to the salt water of this time. The anchor was reclaimed in the 19th century + ~~it~~ was able to be restored. The salt ions had damaged the wood fibres considerably + rinsing was used for an extended period of time in order to rid the anchor of these ions. The anchor is on display at the National Maritime ~~museum~~ museum in Sydney. It sits on a mesh to allow water to drain from it so further ~~the~~ corrosion doesn't occur. It is also hoisted down regularly to prevent build up

of cons. This / conservation + restoration process has been well implemented + works well, as visitors can come + admire a great piece of Australian historical artefact.

The endeavor cannons from James Cook's ship were found off the Great Barrier Reef, more than 100 years after they were thrown overboard. They had ~~been~~ <sup>been</sup> corroded considerably, due to the salt water + marine conditions. Lengthy rinsing took place to remove any wax still on the cannons. Electrolysis was used to restore the copper to its historic state. The cannon is covered in wax + is ~~is~~ in ~~an airtight~~ a glass ~~enclosed~~ display at the Maritime ~~the~~ Museum to ensure further corrosion doesn't occur.

Visitors are able to enjoy + admire a brilliant piece of Australia's heritage because of the restoration + conservation techniques used.

Using the Vernon Anchor + Endeavor cannon as prime examples of wooden + copper artefacts which had been immersed in salt water for at least 100 years, it is evident that the ~~restored~~ modern

Additional writing space on back page.

restoration + conservation techniques of maritime artefacts are very beneficial for their survival.

Electrolysis of copper:

cathode:  $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu(s)}$  reduction.

You may ask for an extra Writing Booklet if you need more space.