

## Shipwrecks, Corrosion and Conservation

1. Oxidation occurs at the:

- a) anode
- b) cathode
- c) voltmeter
- d) electrolyte

2. Which of the following is a passivating metal?

- a) iron
- b) magnesium
- c) aluminium
- d) zinc

3. Who first extracted metals by electrolysis?

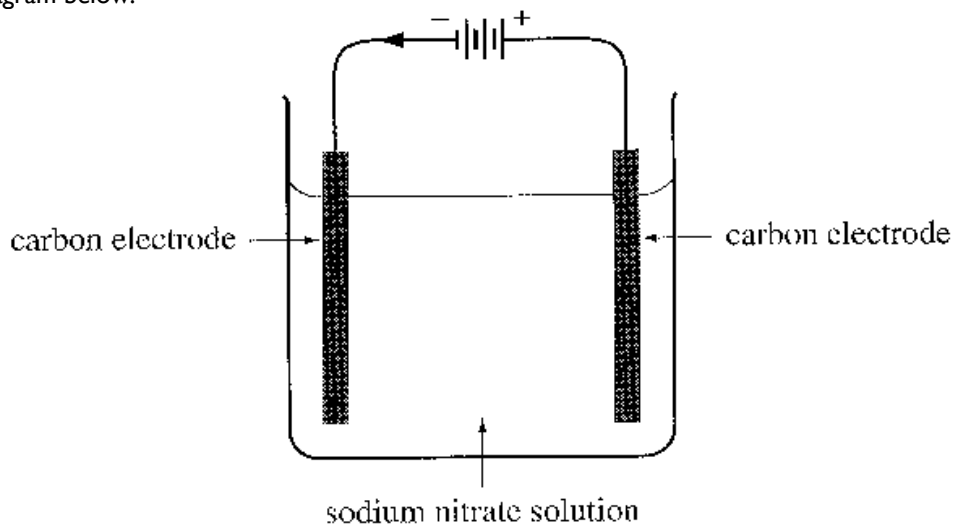
- a) Galvani
- b) Volta
- c) Davy
- d) Faraday

4. Identify the main source of mineral ions in the oceans

- a) biological processes in aquatic biota
- b) hydrothermal vents in mid-ocean ridges
- c) combustion of fossil fuels
- d) shipwrecks

5. Contrast the contributions of Galvani, Davy, and Faraday in relation to electron transfer reactions. (3)

6. Study the diagram below:



- (i) What is the minimum voltage required to produce a reaction in this cell? (1)
- (ii) How could you tell that a reaction is occurring? (1)
- (iii) Suggest a reason why you would not expect to find sodium plating at the cathode. (2)

7. Most ships are made of iron or iron alloys (steel). As iron corrodes in seawater, ship owners often use the technique of cathodic protection to help prevent this corrosion.

- (a) What is another method of preventing corrosion in iron ships that you have studied? (1)
- (b) Name one instance of cathodic protection in a terrestrial environment. (1)
- (c) Identify one metal, and justify its use as a sacrificial anode for an iron ship. (2)

1. a
2. c
3. c
4. b
5. Galvani identified the twitching of dead frogs in response to the contact of two metals (brass and iron). He suggested this was a new form of electricity, where the frogs formed part of the circuit, that is, electricity was transferred between the metals via the frogs. He was unaware of what was actually occurring. Davy Discovered electrolysis, the use of electricity to break down substance chemically. His contributions include the electrolysis of sodium and potassium using electron transfer processes. He demonstrated these procedures without specifically explaining them. Faraday quantified electrolysis with his laws in relation to the mass of the substances produced and amount of electricity passing through the circuit.
6. (i) The minimum value will liberate oxygen at the anode and hydrogen at the cathode. Hence the value will be  $(-0.40 + -0.83) = -1.23V$ .  
(ii) Bubbles would be present on both electrodes indicating the presence of hydrogen and oxygen gas.  
(iii) Water is a stronger oxidant than the sodium ions hence it will preferentially reduced at the cathode producing hydrogen gas.
7. (a) New corrosion resistant paints such as RustMaster Pro.  
(b) Crude oil pipelines  
(c) Zinc. It is a more reactive metal than iron, and thus will form a galvanic cell acting as the anode. The Zinc will be preferentially oxidised, protecting the iron from corrosion.