CELLS AND BATTERIES

Answer all the questions below then check your answers

1. What happens to the voltage when the difference in reactivity between two metals in a simple cell increases?

b. A simple cell consisting of the two metals copper and zinc dipped into an inert electrolyte produced a voltage of 1.2V. How could the voltage of this single cell be increased?

c. Describe how a simple cell made of zinc and copper works.

d. Describe an experiment to compare the voltages produced by simple cells made with different pairs of metals.

2. Why are rechargeable cells considered more environmentally friendly than non-rechargeable cells?

3. A simple cell is made using silver and magnesium electrodes. Which electrode is the positive terminal, and why?

4. A non-rechargeable alkaline cell is labelled as 1.5V. What does this voltage indicate?

5. Explain how the voltage of a simple cell would change if you replaced the zinc electrode with magnesium.

6. Describe two differences between rechargeable and non-rechargeable alkaline cells.

6. Explain why non-rechargeable cells cannot be reused after they are depleted.

7. Draw a simple cell diagram using copper and magnesium electrodes. Label the electrodes, electrolyte, and the direction of electron flow.

8. Explain why a simple cell using potassium and gold electrodes would produce a higher voltage than one using copper and zinc. Reference the reactivity series in your answer.

9. Compare and contrast the chemical reactions that occur in rechargeable and non-rechargeable alkaline cells. Discuss the implications for their reusability.

10. A company wants to develop a new type of simple cell with a high voltage. They are considering using a combination of lithium and lead. Explain the advantages and disadvantages of this choice, taking into account the reactivity series and safety considerations.

11. Compare and contrast a rechargeable alkaline cell with a non-rechargeable alkaline cell.

12. Discuss the environmental and economic implications of using rechargeable versus non-rechargeable cells, considering their life cycle and disposal.

Answers

1. What happens to the voltage when the difference in reactivity between two metals in a simple cell increases?

   The voltage increases as the difference in reactivity between the two metals increases.

b. A simple cell consisting of the two metals copper and zinc dipped into an inert electrolyte produced a voltage of 1.2V. How could the voltage of this single cell be increased?

   Use a metal higher in the reactivity series than zinc such as magnesium or sodium, or use a metal lower in the reactivity series than copper such as silver or gold.

c. Describe how a simple cell made of zinc and copper works.

   In a simple cell with zinc and copper, zinc acts as the negatively charged anode and copper as the positively charged cathode. Zinc, being more reactive, loses electrons (oxidation) and copper gains electrons (reduction). This flow of electrons through the external circuit generates electricity. Note IN ELECTROCHEMICAL CELLS the anode and the cathode have the opposite charges to those found in electrolytic cells. So the cathode has a positive charge while the anode has a negative charge.

d. Describe an experiment to compare the voltages produced by simple cells made with different pairs of metals.

   Set up several simple cells using pairs of metals such as zinc-copper, zinc-iron, and iron-copper. Use the same electrolyte solution for all cells. Measure the voltage of each cell using a voltmeter. Record and compare the voltages to determine the relationship between the metals used and the voltage produced. Metals further apart in the reactivity series should produce higher voltages.

2. Why are rechargeable cells considered more environmentally friendly than non-rechargeable cells?

Rechargeable cells can be used multiple times, reducing waste and the need for frequent replacement.

3. A simple cell is made using silver and magnesium electrodes. Which electrode is the positive terminal, and why?

Silver is the positive terminal because it is less reactive than magnesium.

4. A non-rechargeable alkaline cell is labelled as 1.5V. What does this voltage indicate?

This indicates the potential difference (or "push") between the two terminals of the cell.

5. Explain how the voltage of a simple cell would change if you replaced the zinc electrode with magnesium.

The voltage would increase because magnesium is higher in the reactivity series than zinc, leading to a greater potential difference.

6. Describe two differences between rechargeable and non-rechargeable alkaline cells.

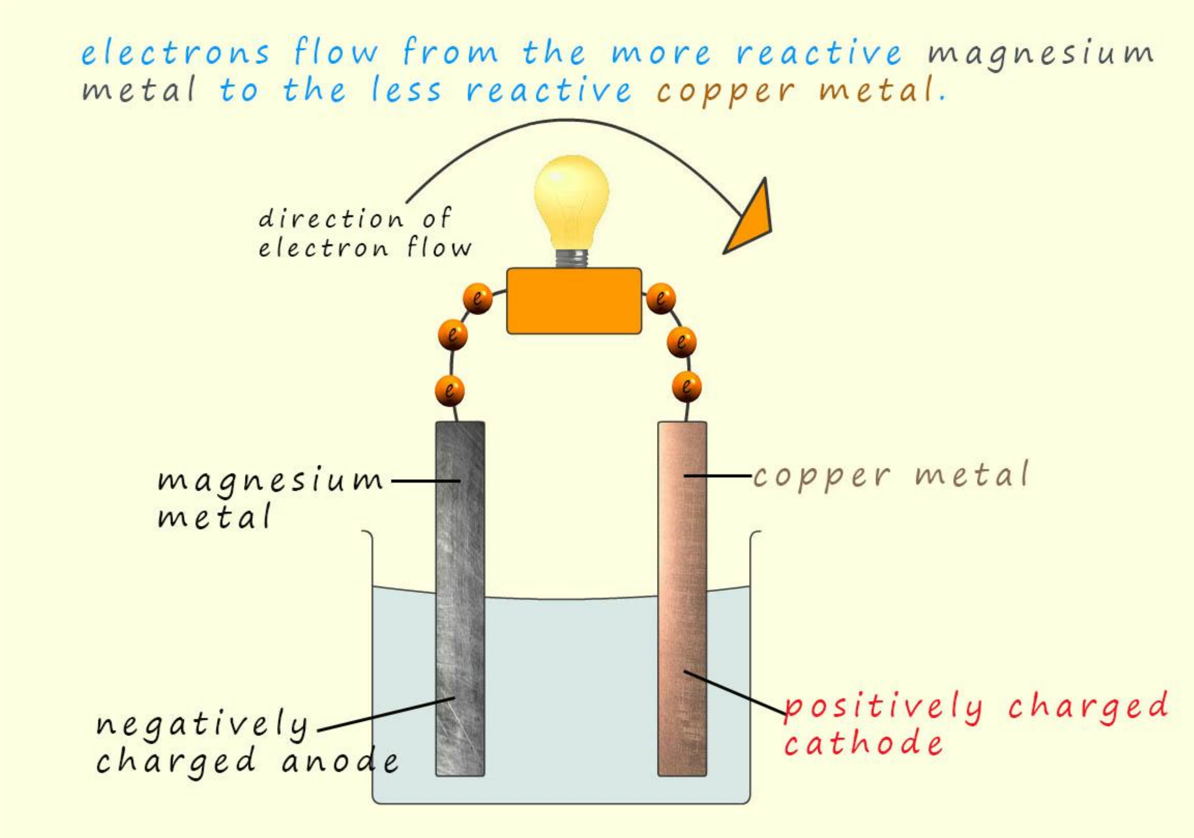
Rechargeable cells can be recharged multiple times, non-rechargeable cannot.

Rechargeable cells have a higher initial cost, non-rechargeable are cheaper.

b. Explain why non-rechargeable cells cannot be reused after they are depleted.

Non-rechargeable cells undergo irreversible chemical reactions that cannot be reversed by applying an external electrical current. Once the reactants are consumed, the cell can no longer generate electricity.

7. Draw a simple cell diagram using copper and magnesium electrodes. Label the electrodes, electrolyte, and the direction of electron flow.



8. Explain why a simple cell using potassium and gold electrodes would produce a higher voltage than one using copper and zinc. Reference the reactivity series in your answer.

Potassium is much higher in the reactivity series than copper, and gold is much lower than zinc.

This creates a much larger difference in reactivity, leading to a significantly greater potential difference and a higher voltage.

9. Compare and contrast the chemical reactions that occur in rechargeable and non-rechargeable alkaline cells. Discuss the implications for their reusability.

Non-rechargeable: The chemical reactions are irreversible. Once the reactants are used up, the cell cannot produce electricity.

Rechargeable: The chemical reactions can be reversed by applying an external electrical current. This allows the cell to be used multiple times.

10. A company wants to develop a new type of simple cell with a high voltage. They are considering using a combination of lithium and lead. Explain the advantages and disadvantages of this choice, taking into account the reactivity series and safety considerations.

Advantages:

Lithium is very high in the reactivity series, and lead is quite low, creating a large potential difference and a high voltage.

Disadvantages:

Lithium is highly reactive and can be dangerous if not handled properly.

Lead is toxic and poses environmental risks.

11. Compare and contrast a rechargeable alkaline cell with a non-rechargeable alkaline cell.

Rechargeable alkaline cells can be recharged by applying an external electric current, which reverses the chemical reactions. They have a higher initial cost but are more cost-effective over time due to multiple uses. Non-rechargeable alkaline cells undergo irreversible reactions and are disposed of after a single use, leading to more waste. Both types use similar chemicals, but rechargeable cells are designed to withstand the recharging process.

12. Discuss the environmental and economic implications of using rechargeable versus non-rechargeable cells, considering their life cycle and disposal.

Rechargeable cells, though initially more expensive, provide significant cost savings over time as they can be used multiple times. This reduces the frequency of purchasing new cells and minimizes waste. Environmentally, rechargeable cells generate less waste and decrease the need for raw materials, conserving resources and reducing pollution from mining and manufacturing processes. Non-rechargeable cells, while cheaper upfront, contribute to more frequent disposal and greater environmental impact due to the accumulation of toxic materials in landfills. Recycling programs can mitigate some of these issues, but the overall footprint of non-rechargeable cells remains higher compared to rechargeable ones. The transition to rechargeable cells is a crucial step towards sustainable energy consumption and environmental conservation.