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VCE Chemistry $\frac{3}{4}$
Introduction to Electrolysis [2.1]
Homework

Admin Info & Homework Outline:

Student Name	
Questions You Need Help For	
Compulsory Questions	Pg 2 – Pg 14
Supplementary Questions	Pg 15 – Pg 24



Section A: Compulsory Questions (51 Marks)

Sub-Section [2.1.1]: Identify Differences between Galvanic & Electrolysis for Electrodes, Energy Conversions, Electron Flow

Question 1 (4 marks)



- a. Determine which of the following is true regarding the electrodes in electrolytic and galvanic cells. (1 mark)
 - A. The cathode is positively charged in a galvanic cell whilst negatively charged in an electrolytic cell.
 - B. The anode is positively charged in a galvanic cell whilst negatively charged in an electrolytic cell.
 - C. The anodes of an electrolytic cell and a galvanic cell are positively charged.
 - D. The anodes of an electrolytic cell and a galvanic cell are negatively charged.
- b. Determine the **false** statement regarding the properties of galvanic and electrolytic cells. (1 mark)
 - A. Oxidation in galvanic and electrolytic cells occurs at the anode.
 - B. Electrons flow from anode to cathode in both cell types.
 - C. Galvanic and electrolytic cells convert chemical energy to electrical energy.
 - D. The anode is negatively charged in a galvanic cell.

c. Select the option which accurately describes the properties of galvanic and electrolytic cells. (2 marks)

A.

Cell type	Polarity of cathode	Reaction occurring at the cathode	Polarity of anode	Reaction occurring at the anode
Galvanic	–	Reduction	+	Oxidation
Electrolytic	+	Oxidation	–	Reduction

B.

Cell type	Polarity of cathode	Reaction occurring at the cathode	Polarity of anode	Reaction occurring at the anode
Galvanic	+	Reduction	–	Oxidation
Electrolytic	–	Oxidation	+	Reduction

C.

Cell type	Polarity of cathode	Reaction occurring at the cathode	Polarity of anode	Reaction occurring at the anode
Galvanic	+	Reduction	–	Oxidation
Electrolytic	+	Oxidation	–	Reduction

D.

Cell type	Polarity of cathode	Reaction occurring at the cathode	Polarity of anode	Reaction occurring at the anode
Galvanic	+	Reduction	–	Oxidation
Electrolytic	–	Oxidation	+	Reduction

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Question 2 (2 marks)



Karthik is interested in the electrolytic cell which his lab teacher has set up for a practical session.

- a. State the energy conversion occurring in the cell. (1 mark)

- b. Hence, determine whether electrolysis is exothermic or endothermic. (1 mark)

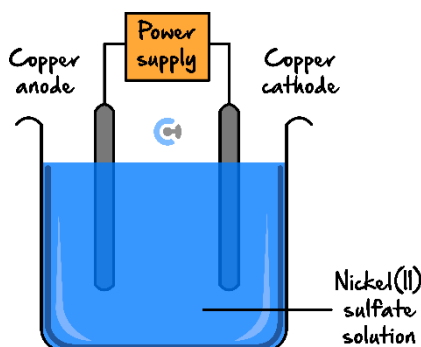
Question 3 (2 marks)



- a. Select the option which accurately describes the electron flow of galvanic and electrolytic cells. (1 mark)

	Galvanic Cells	Electrolytic Cells
A.	Anode to Cathode.	Cathode to Anode.
B.	Cathode to Anode.	Anode to Cathode.
C.	Cathode to Anode.	Cathode to Anode.
D.	Anode to Cathode.	Anode to Cathode.

- b. Katie is analysing the electrolytic cell shown below:

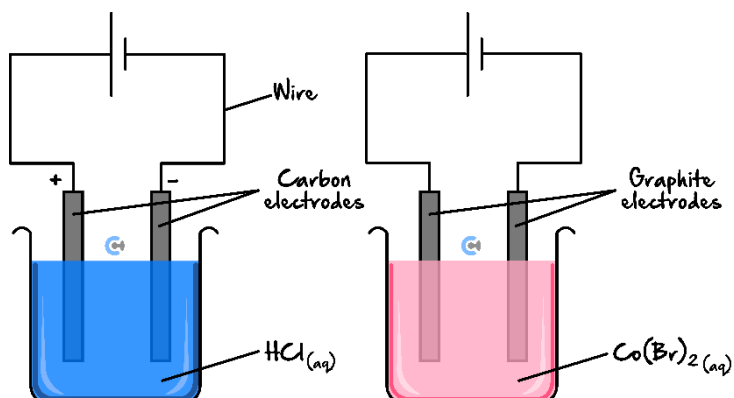


Determine the purpose of the nickel (II) sulphate solution. (1 mark)

Sub-Section [2.1.2]: Write Equations & Calculate EMF Required for Electrolytic Reactions

Question 4 (9 marks)

a. Nour is electrolysing 1.0 M of HCl in the cell shown below.

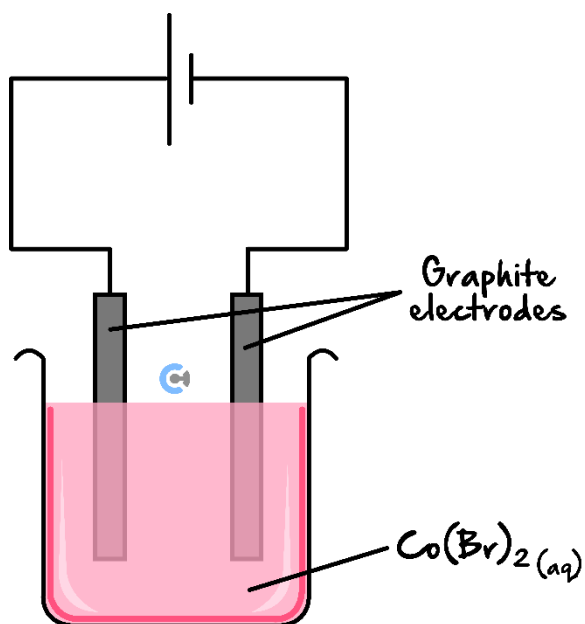


i. Write the equation which occurs at the cathode. (1 mark)

ii. Write the equation which occurs at the anode. (1 mark)

iii. Hence, write the overall equation for the cell. (1 mark)

- b. Rehansa is operating a cell containing 1.0 M of cobalt (II) bromide, shown below.

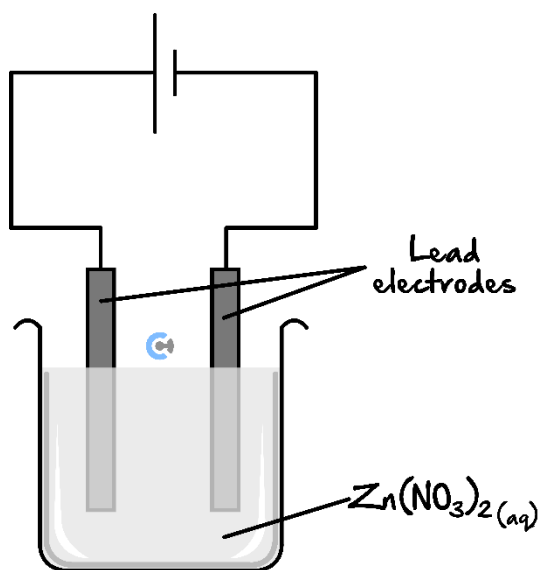


- i. Write the half-equation which occurs at the cathode. (1 mark)

- ii. Write the half-equation which occurs at the anode. (1 mark)

- iii. Write the overall equation for the cell. (1 mark)

- c. Priyanka is operating a cell containing 1.0 M of zinc nitrate. The cell is shown below.



- i. Write the half-equation which occurs at the cathode. (1 mark)

- ii. Write the half-equation which occurs at the anode. (1 mark)

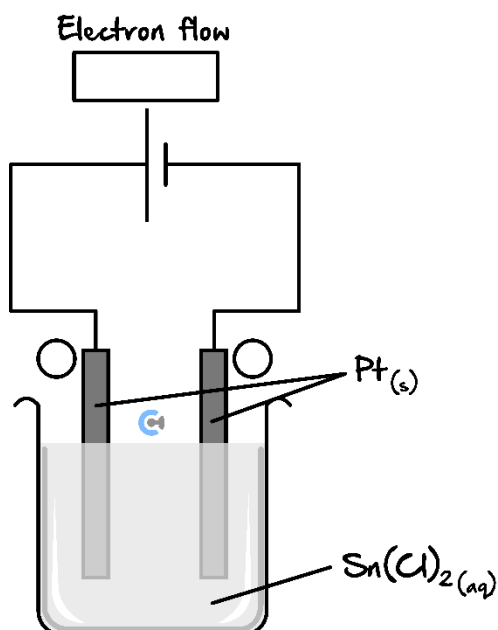
- iii. Write the overall equation for the cell. (1 mark)

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Question 5 (16 marks)

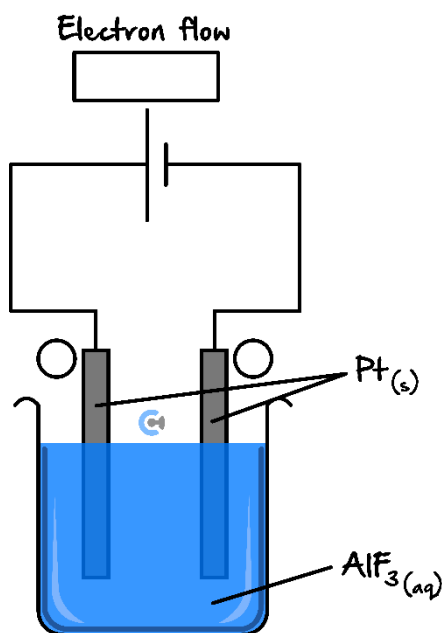
- a. Steven has set up an electrolytic cell containing tin (II) chloride, as shown below.



- i. Write the half-equations for Steven's cell. (2 marks)

- ii. Label the electrode polarities and direction of electron flow in the diagram above. (2 marks)

b. Ivy has set up a cell containing aluminium fluoride.

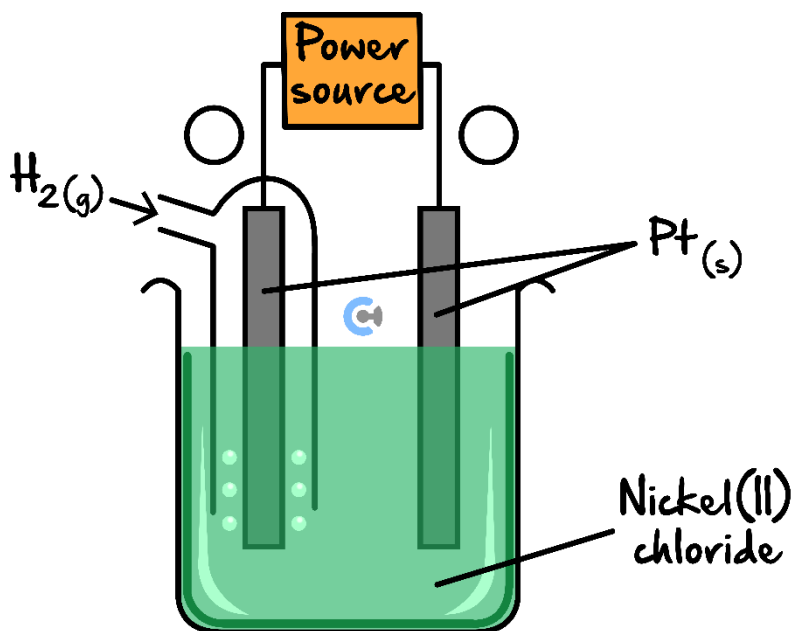


i. Write the half-equations for Ivy's cell. (2 marks)

ii. Label the electrode polarities and the direction of electron flow in the diagram above. (2 marks)

iii. Ivy inserts a pH metre into the electrolyte. State and justify the expected change in pH. (2 marks)

c. Leah sets up the following cell:



i. Write the half-equations which occur at the: (2 marks)

Cathode: _____

Anode: _____

ii. Label the electrodes as negatively and positively charged. (1 mark)

iii. As the reaction occurs, the colour of the electrolyte is seen to change. State and justify the expected change in the colour of the electrolyte. (2 marks)

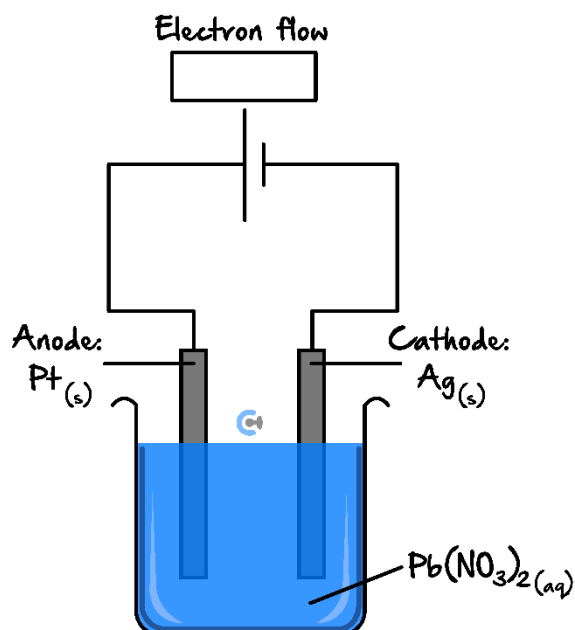
iv. Find the EMF required for the cell to operate. (1 mark)

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Question 6 (10 marks)

- a. Subin has set up a cell containing 1.0 lead (II) nitrate as shown below.



- i. Write the half-equations which take place at the: (2 marks)

Platinum electrode: _____

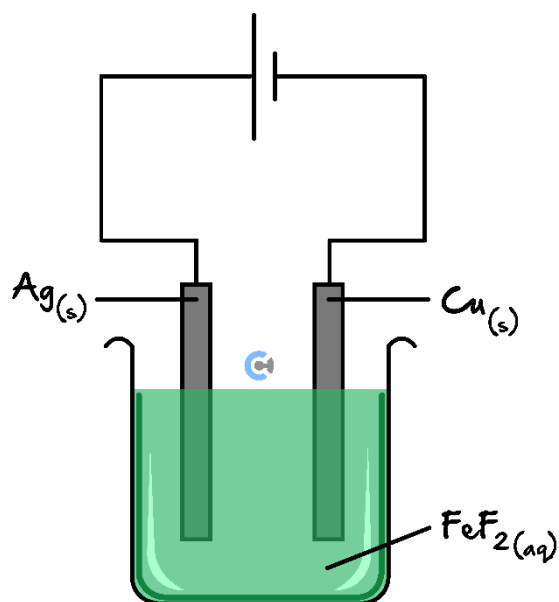
Silver electrode: _____

- ii. Label the flow of electrons in the external circuit on the diagram above. (1 mark)

- iii. State the EMF required for the cell to operate. (1 mark)

- iv. State and justify the change in mass of the positive electrode observed. (2 marks)

b. 1.0 M of iron (II) fluoride is electrolysed in the cell shown below.



i. Write the overall reaction which takes place in the cell. (2 marks)

ii. State the expected observation at the negative electrode. (1 mark)

iii. State the expected change in colour of electrolyte. (1 mark)

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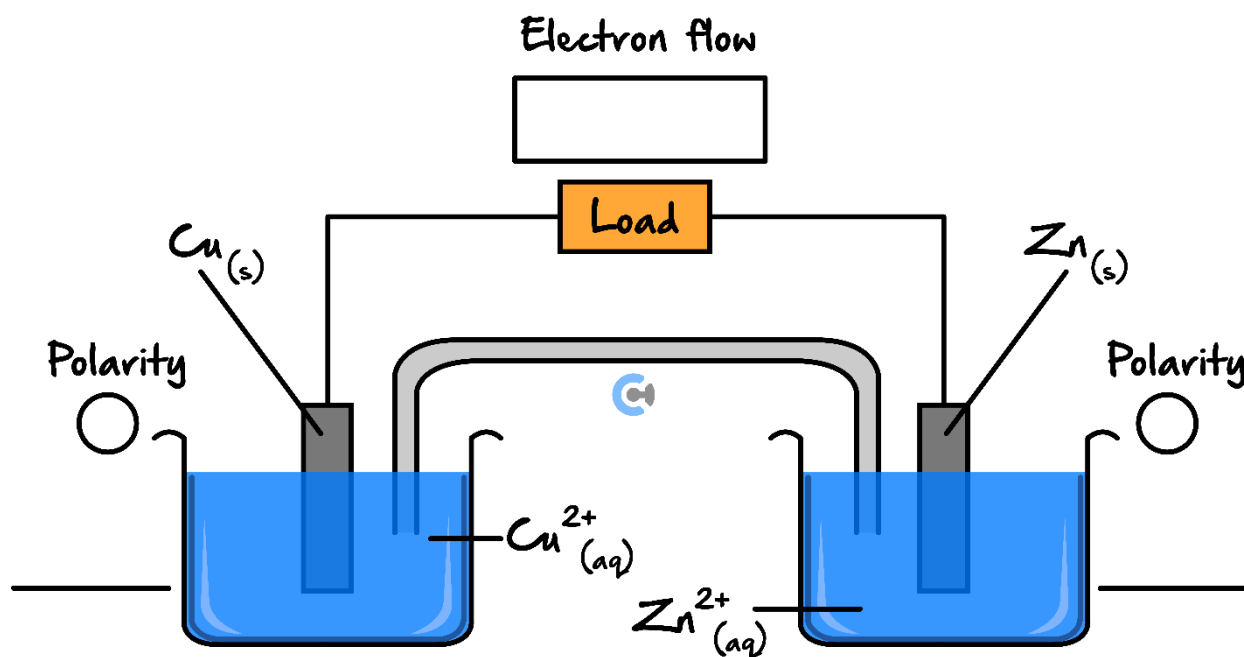
Sub-Section: The 'Final Boss'

Question 7 (8 marks)



- a. Galvanic and electrolytic cells are often compared with each other.

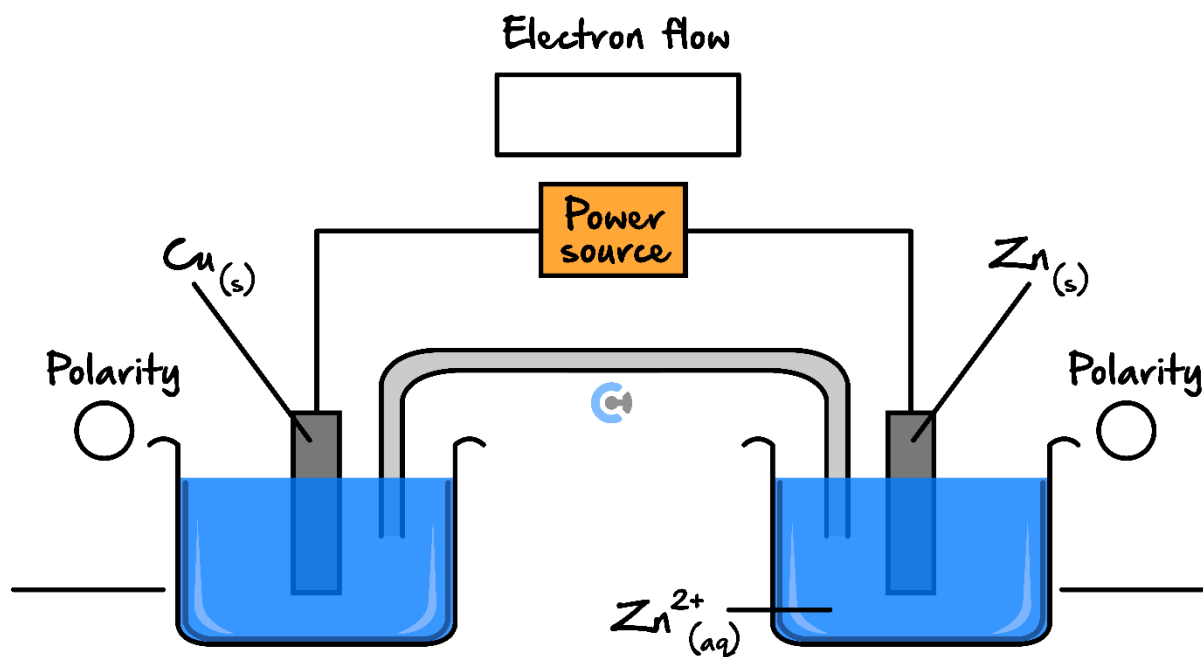
A galvanic cell is set up between copper and zinc as shown below.



- Label the flow of electrons in the box provided above. (1 mark)
- Label the polarities of electrodes and the cathode/anode on the diagram above. (1 mark)
- Write the half-equation which occurs at the copper electrode. (1 mark)

- State the energy conversion occurring within the cell. (1 mark)

- b. The cell can also undergo electrolysis when electricity is passed through it. A diagram of the cell has been shown below, after the Cu^{2+} ions have run out.



- i. Write the overall equation which takes place. (1 mark)

- ii. Label the flow of electrons in the diagram above. (1 mark)

- iii. Label the polarities of electrodes and cathode/anode on the diagram above. (1 mark)

- iv. State energy conversion occurring within the cell. (1 mark)

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Section B: Supplementary Questions (27 Marks)

Sub-Section [2.1.1]: Identify Differences between Galvanic & Electrolysis for Electrodes, Energy Conversions, Electron Flow



Question 8 (3 marks)



- a. Which of the following statements about electrolytic cells is correct? (1 mark)
- A. Electrolytic cells undergo exothermic reactions that result in a lower enthalpy of products than reactants.
 - B. Electrolytic cells are expensive to produce due to their requirement for Pt(s) catalysts.
 - C. Electrolytic cells have the weakest oxidant and weakest reductant react together.
 - D. Electrolytic cells are an example of non-spontaneous reactions that produce chemical energy.
- b. Determine the **false** statement regarding the properties of galvanic and electrolytic cells. (1 mark)
- A. Reduction in galvanic and electrolytic cells occurs at the cathode.
 - B. Electrons flow from cathode to anode in an electrolytic cell.
 - C. Galvanic cells convert chemical energy to electrical energy whilst electrolytic cells convert electrical energy to chemical energy.
 - D. The cathode is positively charged in a galvanic cell.
- c. The cathode of an electrolytic cell: (1 mark)
- A. Has a positive polarity and reduction occurs.
 - B. Has a positive polarity and oxidation occurs.
 - C. Has a negative polarity and reduction occurs.
 - D. Has a negative polarity and oxidation occurs.

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Question 9 (2 marks)


Betty has set up a cell at school which requires electrical input to operate.

- a. State the energy conversion occurring in the cell. (1 mark)

- b. Hence, determine whether electrolysis is exothermic or endothermic (1 mark)

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Question 10 (2 marks)

a. Select the option which accurately describes the electron flow of galvanic and electrolytic cells. (1 mark)

A.

Cell type	Electron flow
Galvanic	Positively to negatively charged electrode.
Electrolytic	Positively to negatively charged electrode.

B.

Cell type	Electron flow
Galvanic	Positively to negatively charged electrode.
Electrolytic	Negatively to negatively charged electrode.

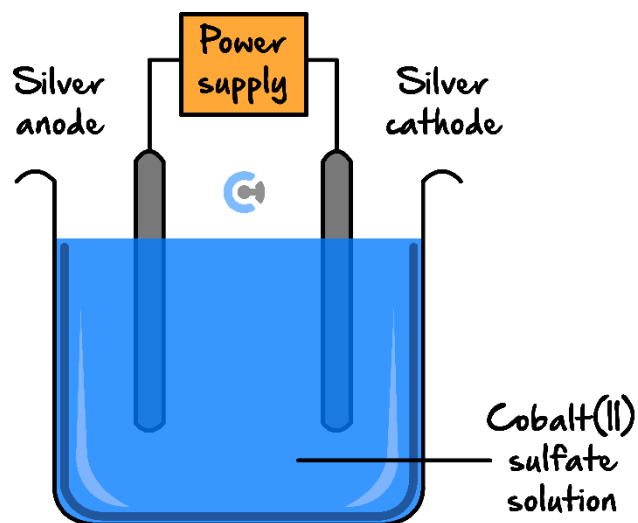
C.

Cell type	Electron flow
Galvanic	Negatively to positively charged electrode.
Electrolytic	Positively to negatively charged electrode.

D.

Cell type	Electron flow
Galvanic	Negatively to positively charged electrode.
Electrolytic	Negatively to positively charged electrode.

b. Katie is analysing the electrolytic cell shown below:



Determine the purpose of the Cobalt (II) sulphate solution. (1 mark)

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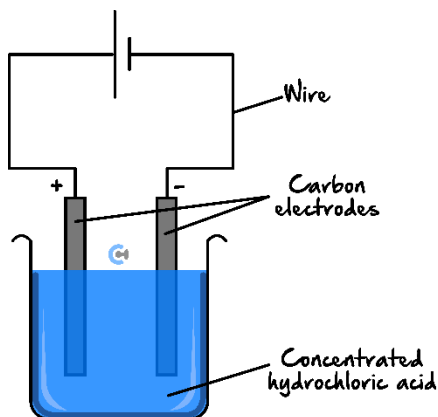


Sub-Section [2.1.2]: Write Equations & Calculate EMF Required for Electrolytic Reactions

Question 11 (9 marks)



- a. Michelle is electrolysing 3.0 M of HCl in the cell shown below.

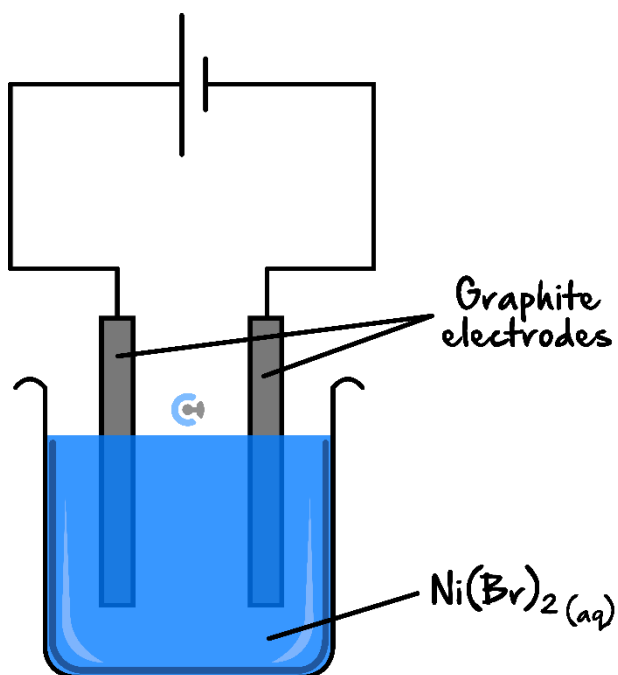


- i. Write the equation which occurs at the cathode. (1 mark)

- ii. Write the equation which occurs at the anode. (1 mark)

- iii. Hence, write the overall equation for the cell. (1 mark)

b. Dai is operating a cell containing 1.0 M of nickel (II) bromide, shown below.

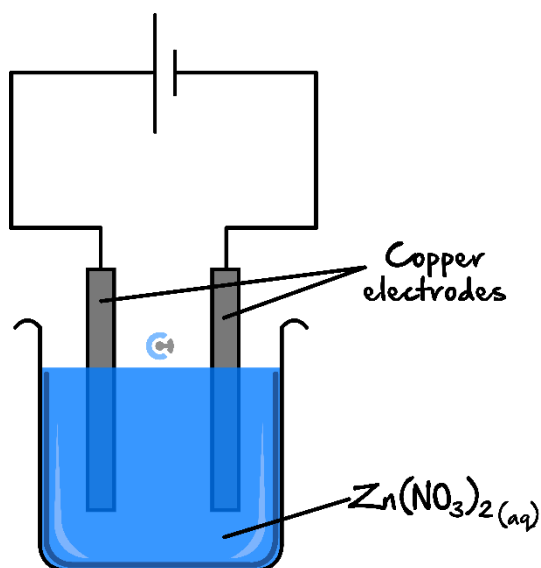


i. Write the equation which occurs at the cathode. (1 mark)

ii. Write the equation which occurs at the anode. (1 mark)

iii. Hence, write the overall equation for the cell. (1 mark)

c. Henry is operating a cell containing 1.0 M of zinc nitrate. The cell is shown below.



i. Write the equation which occurs at the cathode. (1 mark)

ii. Write the equation which occurs at the anode. (1 mark)

iii. Hence, write the overall equation for the cell. (1 mark)

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Question 12 (5 marks)

a. Draw a labelled cell for the electrolysis of $\text{CdSO}_4(\text{aq})$ with a lead cathode and platinum anode. (2 marks)

b. Write the balanced half-equations occurring at the:

i. Anode. (0.5 marks)

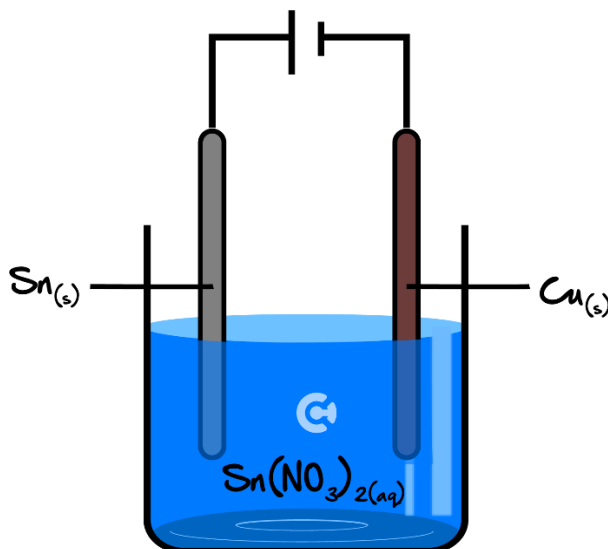
ii. Cathode. (0.5 marks)

c. List any observations made at either electrode. (2 marks)



Question 13 (3 marks)

A solution of Tin (II) nitrate is being electrolysed in an electrolytic cell containing a copper cathode and tin anode. A diagram of the electrolytic cell is shown in the diagram below.



a. Write the balanced half-equations occurring at the:

i. Anode. (0.5 marks)

ii. Cathode. (0.5 marks)

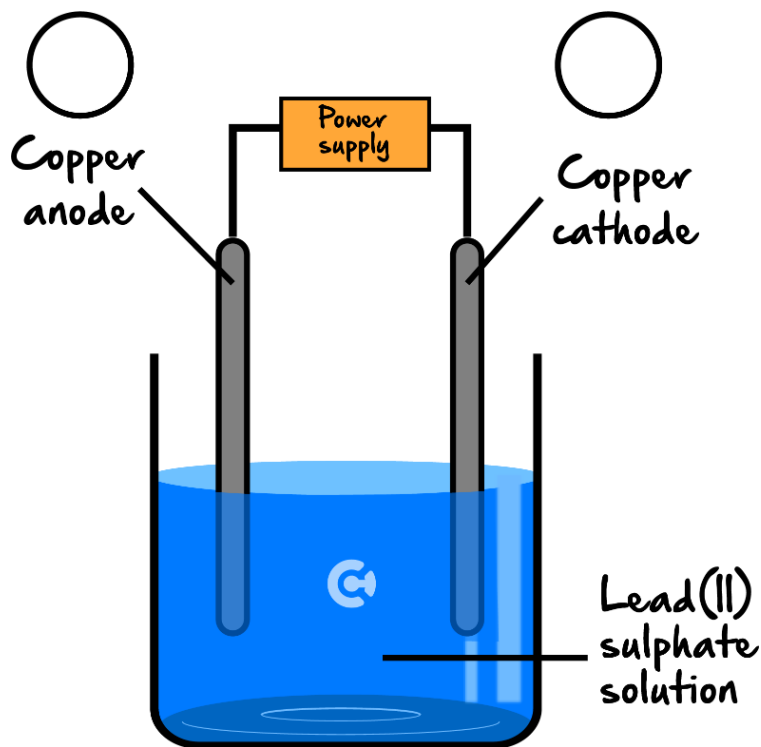
b. The cell is able to be ran for 30 minutes under standard conditions. When a separator membrane was added that prevented the flow of ions, the cell was only able to be run for 5 minutes. Explain what the separator membrane did to limit the run time of the cell. (2 marks)

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Question 14 (3 marks)

The electrolysis of 1 M solution of Lead (II) sulphate (PbSO_4) is undertaken with copper electrodes at 25°C. A diagram of this electrolytic process is shown in the following diagram below.



a. Label the polarity of each electrode in the diagram above. (1 mark)

b. Write the half-equations which occur at the:

i. Cathode. (0.5 marks)

ii. Anode. (0.5 marks)

c. List any observations seen at either electrode. (1 mark)

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