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VCE Chemistry ¾
AOS 2 Revision I [2.5]
Workbook

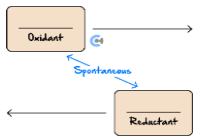
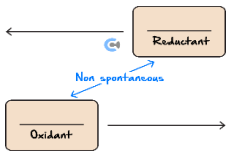
Outline:

Section A: Introduction to Electrolysis (21 Marks)

Sub-Section: Recap

Cheat Sheet

[2.1.1] – Identify differences between galvanic & electrolysis for electrodes, energy conversions, electron flow

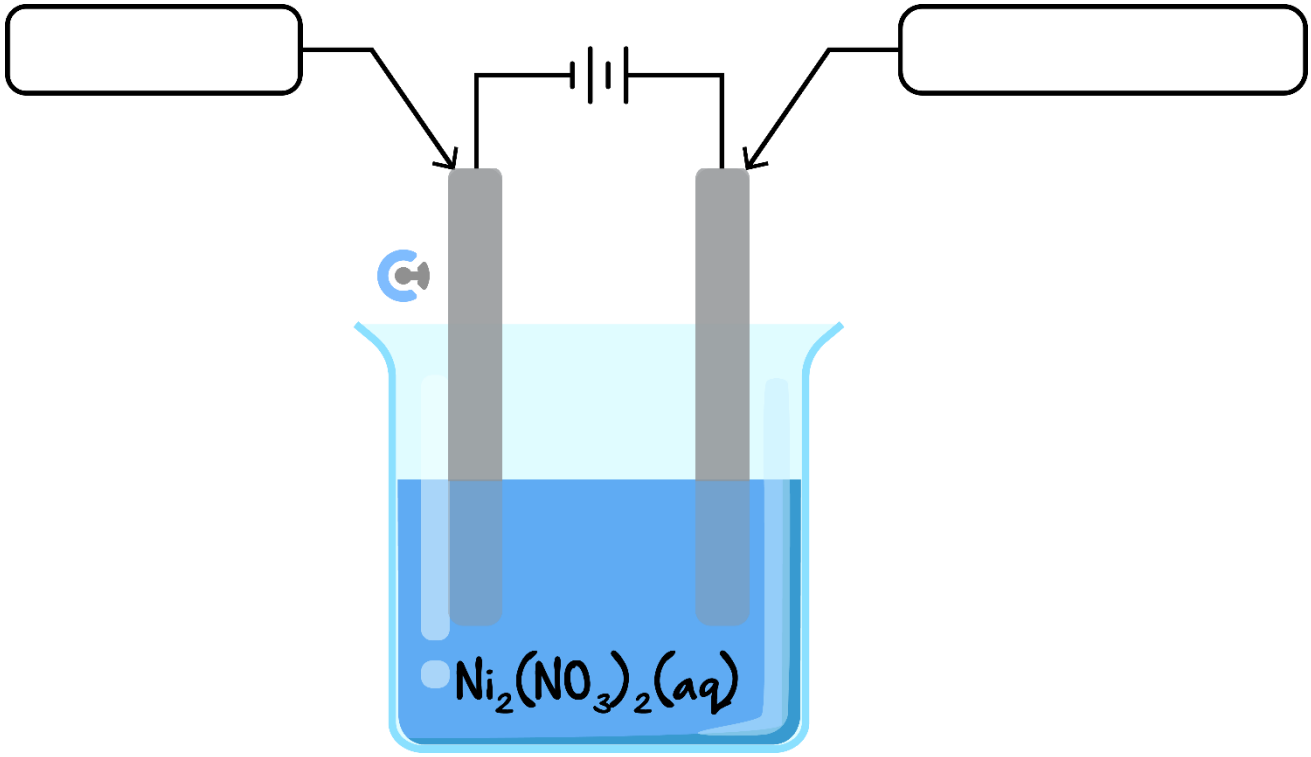
	Galvanic cells	Electrolytic cells
Spontaneous Reaction	[Yes] / [No]	[Yes] / [No]
Energy Conversion		
Type of Reaction	[Exothermic] / [Endothermic]	[Exothermic] / [Endothermic]
Oxidant / Reductant Relative Strength		
Electron Flow		
Anode		
Cathode		
Salt-Bridge / Electrolyte Ion Flow	Cations → [cathode] / [anode]	Cations → [cathode] / [anode]

[2.1.2] – Write equations & calculate EMF required for electrolytic reactions

- When predicting electrolytic reactions, do not forget to include _____.
- Metals at the cathode are _____.
- Voltage required is _____.

Question 1 (4 marks) **Walkthrough.**

During the electrolysis of $Ni(NO_3)_2(aq)$ with a tin cathode and graphite anode, the following setup is used below.



a. In the boxes provided above, label the material used at each electrode. (1 mark) **[2.1.1]**

b. Write the half-equations which occur at the: (2 marks**) [2.1.2]**

Tin electrode: _____

Graphite electrode: _____

c. State the voltage required to be inputted for the reaction to take place. (1 mark) **[2.1.2]**

_____

Space for Personal Notes

Sub-Section: Question Set A

INSTRUCTION: 6 Marks. 5 Minutes Writing.

Question 2 (1 mark) **[2.1.1]**

In an electrolytic cell:

A. Reduction occurs at the positive electrode.

B. Oxidation occurs at the positive electrode.

C. Electrons flow from the negative electrode to the positive electrode.

D. The reaction at the cathode will always involve the plating of a metal.

Question 3 (3 marks)

Copper sulphate ($CuSO_4$) solution undergoes electrolysis using inert electrodes.

a. Write the balanced half-equation for the reaction occurring at the positive electrode. (1 mark) **[2.1.2]**

_____

b. Write the balanced half-equation for the reaction occurring at the negative electrode. (1 mark) **[2.1.2]**

_____

c. Find the voltage required to be inputted for the reaction to occur. (1 mark) **[2.1.2]**

_____

_____

Space for Personal Notes

Question 4 (2 marks) **[2.1.2]**

For the electrolysis of $Fe(NO_3)_2(aq)$ with copper cathode and silver anode.

Write out the balanced equation for the overall reaction taking place.

_____

_____

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Sub-Section: Question Set B

INSTRUCTION: 9 Marks. 9 Minutes Writing.

Question 5 (3 marks)

An electrolytic cell involves some energy being inputted into a solution containing silver nitrate.

a. Write the overall equation. (2 marks) **[2.1.2]**

_____

_____

b. State the EMF required for the cell to operate. (1 mark) **[2.1.2]**

_____

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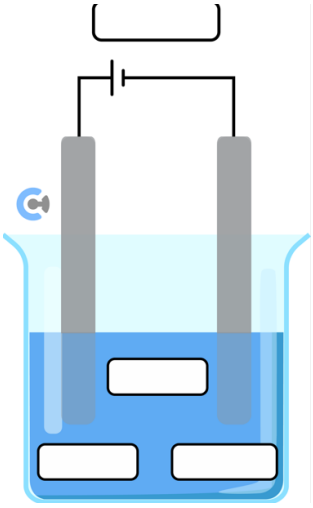
Question 6 (6 marks)

The electrolysis of a solution containing 1.0 *M* copper chloride is undertaken. Inert electrodes are used.



a. In the box provided, label the electrodes as either anode or cathode. (1 mark) **[2.1.1]**

b. Write the balanced half-equations for the:

i. Negative electrode. (1 mark) **[2.1.2]**

_____

ii. Positive electrode. (1 mark) **[2.1.2]**

_____

c. Label in the diagram above the direction of cations and electrons in the boxes provided. (1 mark) **[2.1.1]**

d. As the reaction proceeds, there are four observations that can be made regarding the solution.

List all **four** observations and state the substances used or produced which are responsible for the observation. (2 marks) **[2.1.2]**

_____

_____

_____

_____

Sub-Section: Additional Questions

Question 7 (1 mark) **[2.1.2]**

An electrolytic cell that contains a solution of magnesium nitrate and sodium chloride is electrolysed. The positive terminal of the power source is attached to a gold electrode and the negative terminal is attached to a copper electrode.

Which of the following is true?

A. Both electrodes will have no change in mass/size.

B. No bubbles will be observed.

C. The overall pH increases.

D. The overall pH decreases.

Question 8 (1 mark) **[2.1.2]**

Platinum electrodes are placed in a solution that contains zinc nitrate, $Zn(NO_3)_2$ and sodium chloride, NaCl and is connected to a power source.

Which one of the following statements about the reaction is correct?

D. Zinc metal is produced at the anode and chlorine gas is produced at the cathode.

D. Zinc metal is produced at the cathode and oxygen gas is produced at the anode.

D. Hydrogen gas is produced at the anode and chlorine gas is produced at the cathode.

D. Hydrogen gas is produced at the cathode and oxygen gas is produced at the anode.

Space for Personal Notes

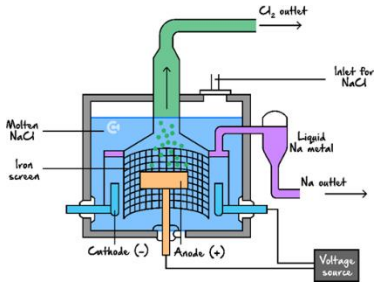
Section B: Features of Electrolytic Cells (29 Marks)

Cheat Sheet

[2.2.1] – Find electrolytic reactions in non-standard conditions (molten & high concentration)

- **High Concentration:**
  - Chloride ions at concentrations greater than _____ concentration become a [stronger] / [weaker] reductant and [react] / [do not] react in preference to water.
  - Sodium ions at concentrations greater than $4.0\ M$ concentration [react] / [do not] react in preference to water.
- **Molten Concentration:** _____ is not present, and the state of ions is _____.

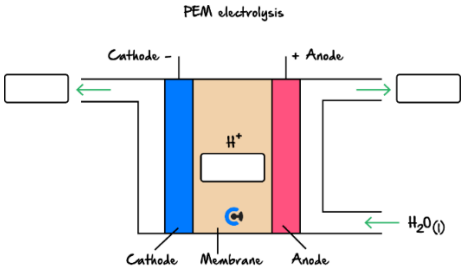
[2.2.2] – Identify features of electrolytic cells & their purpose



- Molten Electrolyte Purpose: _____.
- Iron at the cathode: _____.
- Other Electrolytes (e.g., $CaCl_2$) added:_____.
- Barrier within the cell:
  - _____.
  - _____.
- Products constantly removed:
  - _____.
  - _____.
- Enclosed container: _____.

[2.2.3] – Identify key features, write reactions & relate to sustainability & green chemistry principles regarding production of green hydrogen (PEM & artificial photosynthesis)

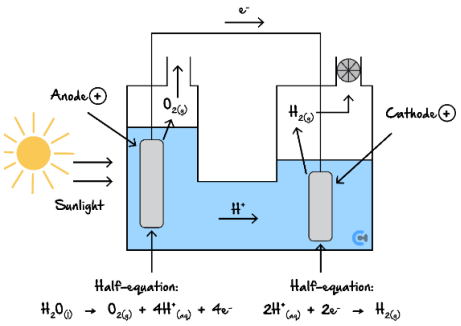
- Both PEM electrolyser & artificial photosynthesis involve electrolysis of _____.
- PEM Electrolyser:



Cathode	Anode

- Energy Used: _____.
- Green Chemistry Principle: _____.

- **Artificial Photosynthesis:**



- Energy Conversion: _____.
- Green Chemistry Principle: _____.

Question 9 Walkthrough.

A mixture of calcium chloride is electrolysed at high concentrations and is compared to when molten calcium chloride is electrolysed.

a. Write the half-equations that occur when it is electrolysed at **higher concentrations** at the:

i. Cathode. **[2.2.1]**

_____

ii. Anode. **[2.2.1]**

_____

b. Write the half-equations that occur when it is electrolysed at **molten conditions** at the:

i. Negative electrode. **[2.2.1]**

_____

ii. Positive electrode. **[2.2.1]**

_____

Space for Personal Notes

Sub-Section: Question Set A

INSTRUCTION: 9 Marks. 9 Minutes Writing.

Question 10 (2 marks)

A molten mixture of lithium bromide is electrolysed using an iron cathode and a graphite anode.

Write the half-equations which occur at the:

a. Positive electrode. (1 mark) **[2.2.1]**

_____

b. Negative Electrode. (1 mark) **[2.2.1]**

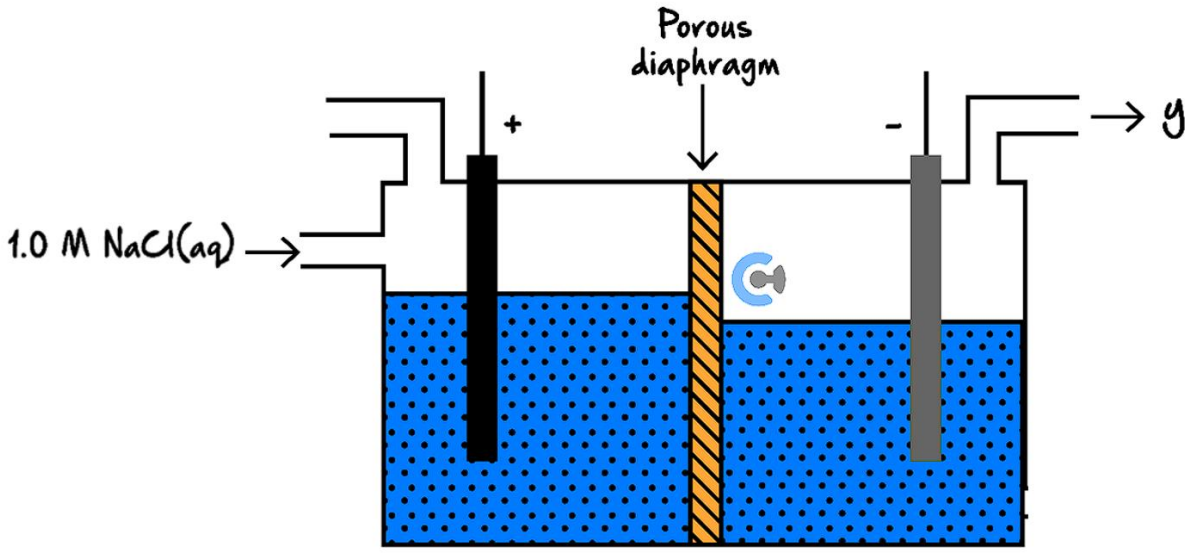
_____

Space for Personal Notes

Question 11 (7 marks)

Inspired from VCAA Chemistry Exam 2 2004
https://www.vcaa.vic.edu.au/Documents/exams/chemistry/chem22004.pdf#page=11

A student carries out the electrolysis of a 1.0 *M* solution of sodium chloride using graphite electrodes. The setup is shown below, whereby it is known that gas *y* is formed at the negative electrode as shown.



a. Write an equation for the half-reaction that occurs at the electrode which produces gas *y*. (1 mark) **[2.2.1]**

_____

b. Two different gases are produced at the anode. Write equations for the two half-reactions that result in the formation of these two gases.

i. The equation for the half-reaction that produces gas 1. (1 mark) **[2.2.1]**

_____

ii. Equation for the half-reaction that produces gas 2. (1 mark) **[2.2.1]**

_____

c. Using the same current and electrodes, the student carries out a second electrolysis, this time of a saturated solution (approximately 6 *M*) of sodium chloride instead of a 1.0 *M* solution. What difference, if any, would you expect in the product or products formed at the following electrodes? (2 marks) **[2.2.1]**

Cathode: _____

Anode: _____

d. List **two** functions of the diaphragm in the cell. (2 marks) **[2.2.2]**

_____

_____

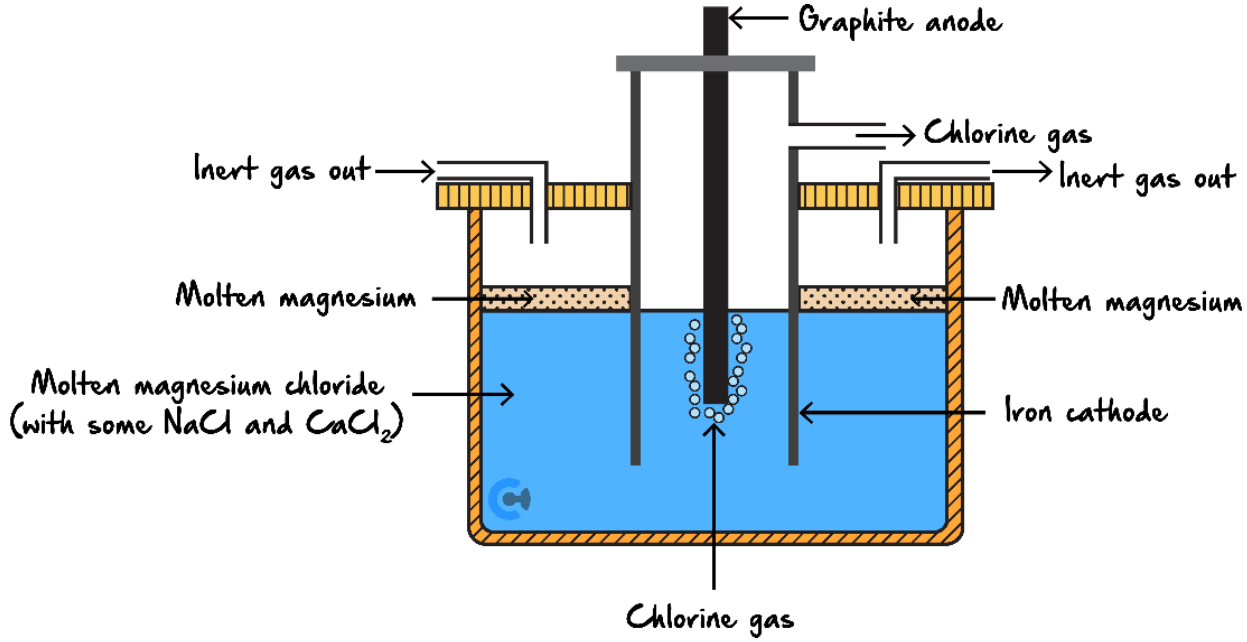
Space for Personal Notes

Sub-Section: Question Set B

INSTRUCTION: 15 Marks. 15 Minutes Writing.

Question 12 (8 marks)

Magnesium is one of the most abundant elements on Earth. It is used extensively in the production of magnesium-aluminium alloys. It is produced by the electrolysis of molten magnesium chloride. A schematic diagram of the electrolytic cell is shown below.



The design of this cell takes into account the following properties of both magnesium metal and magnesium chloride:

- Molten magnesium reacts vigorously with oxygen.
- At the temperature of molten magnesium chloride, magnesium is a liquid.
- Molten magnesium has a lower density than molten magnesium chloride and forms a separate layer on the surface.

a. Write a balanced half-equation for the reaction occurring at each of: (2 marks) **[2.2.1]**

Anode: _____

Cathode: _____

b. Explain why an inert gas is constantly blown through the cathode compartment. (1 mark) **[2.2.2]**

_____

c. In this cell, NaCl and $CaCl_2$ are added to the mixture. Propose **one** purpose for the addition of this and how it helps with the operation of the cell. (2 marks) **[2.2.2]**

_____

_____

_____

_____

d. What difference would it make to the half-cell reactions if the graphite anode were replaced with an iron anode? Write the half-equation for any different half-cell reaction. Justify your answer. (3 marks) **[2.2.1]**

_____

_____

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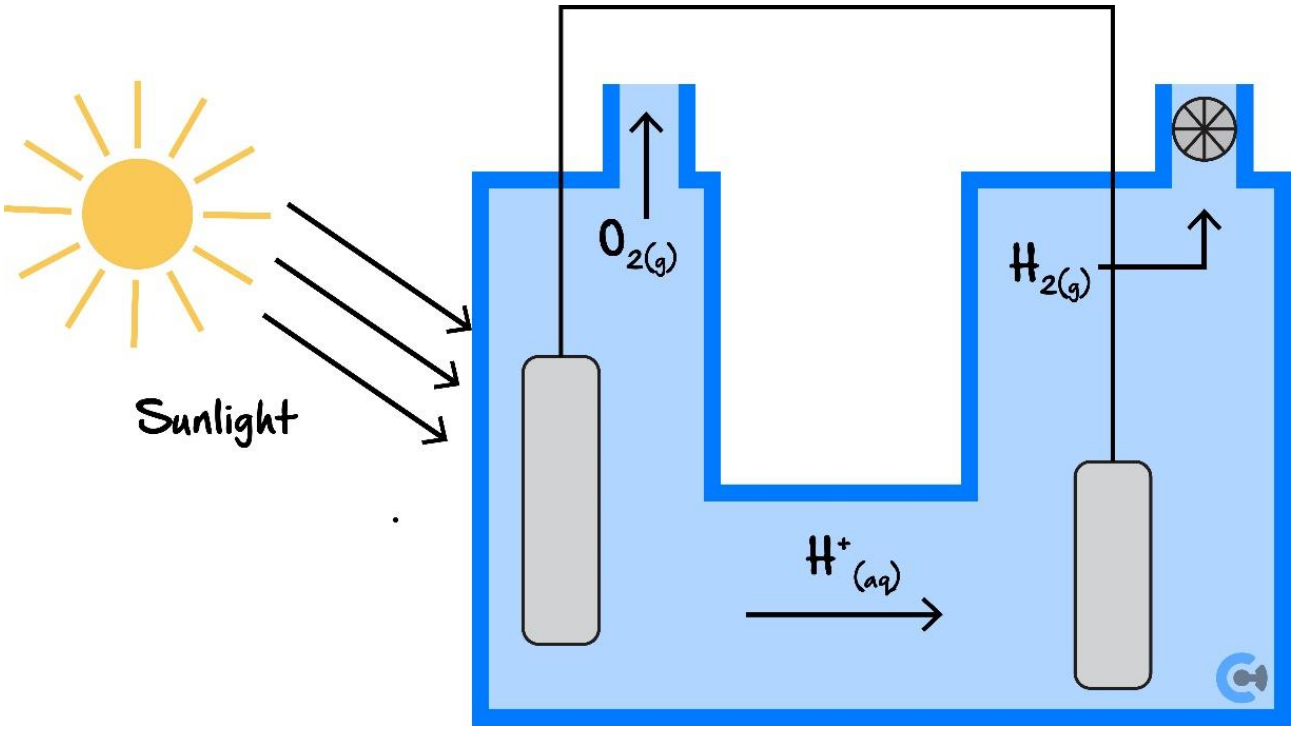
_____

Space for Personal Notes

Question 13 (7 marks)

For the artificial photosynthesis cell below:



a. Determine the reaction occurring at the: (2 marks) **[2.2.3]**

Cathode: _____

Anode: _____

b. The cell produces hydrogen gas which has some safety concerns.

i. State **one** safety precaution which should be taken to mitigate the safety concerns. (1 mark) **[2.2.3]**

_____

_____

ii. Hydrogen gas is often stored in a pressurised vessel as a liquid. Propose **one** reason why. (1 mark) **[2.2.3]**

_____

_____

c. By referring to **one** green chemistry principle, explain how the cell produces hydrogen gas to meet society's demands. (2 marks)

_____

_____

_____

_____

d. State **one** sustainability advantage the artificial photosynthesis cell has, with reference to the United Nations Sustainable Development Goal 12. (1 mark)

_____

_____

_____

Space for Personal Notes

Sub-Section: Additional Questions

Question 14 (5 marks)

An aqueous solution of 1.0 *M* calcium iodide is electrolysed using graphite electrodes.

a. Write the equations for the reaction:

i. At the cathode. (1 mark) **[2.2.1]**

_____

ii. At the anode. (1 mark) **[2.2.1]**

_____

b. Write the overall reaction that occurs if molten conditions are used instead. (1 mark) **[2.2.1]**

_____

c. The electrolysis of this solution is dangerous. Explain why it is dangerous, and identify **two** safety precautions that can be implemented to help mitigate this risk. (2 marks) **[2.2.3]**

_____

_____

_____

Space for Personal Notes

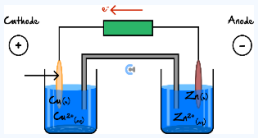
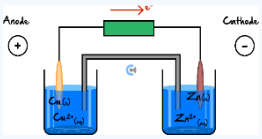
Section C: Secondary Cells & Connected Cells (24 Marks)

Sub-Section: Recap

Cheat Sheet

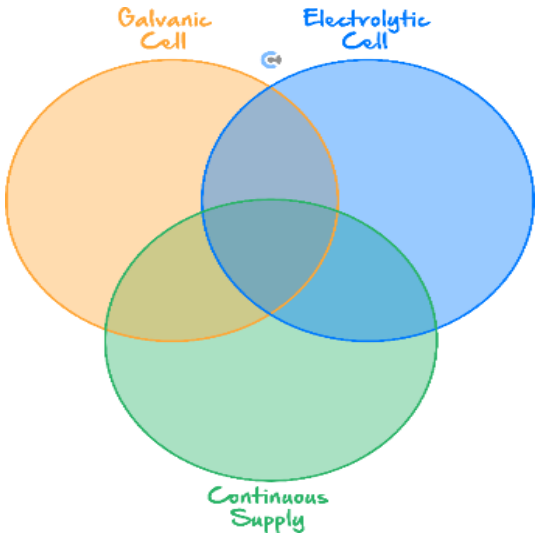
[2.3.1] - Write discharge & recharge reactions in secondary cells

Primary Cells	Secondary Cells
[Rechargeable] / [Non-rechargeable]	[Rechargeable] / [Non-rechargeable]

Discharge (Galvanic)	Recharge (Electrolytic)
	
Electron flow: [Left] / [Right]	Electron flow: [Left] / [Right]
Cathode: **Anode:**	**Cathode:** **Anode:**
Left Electrode Polarity: [+] / [–]	Left Electrode Polarity: [+] / [–]
Left Electrode Type: [Cathode] / [Anode]	Left Electrode Type: [Cathode] / [Anode]

- **During discharge/recharge:**
  - Polarities [stays same] / [swap].
  - Type of electrode (cathode/anode) [stays same] / [swap].

2.3.2] - Identify factors which affect rechargeability & compare similarities/differences between secondary cells and other cells



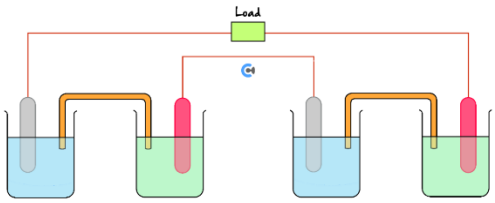
Primary Cell	Secondary Cell
[Rechargeable] / [Non-rechargeable]	[Rechargeable] / [Non-rechargeable]
Can act as [galvanic] / [electrolytic] cell.	Can act as [galvanic] / [electrolytic] cell.
[Chemical to electrical] / [Electrical to chemical].	[Chemical to electrical] / [Electrical to chemical].
[Cheap] / [Expensive]	[Cheap] / [Expensive]

- **Reasons for Rechargeability:**
  - _____.
  - _____.
- **Reasons for decreased battery life:**
  - _____.
  - _____.

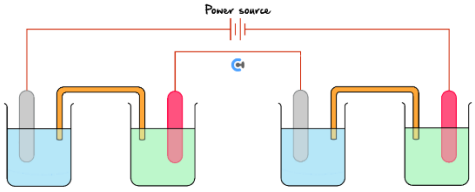
Cheat Sheet

[2.3.3] – Find reactions occurring in connected cells

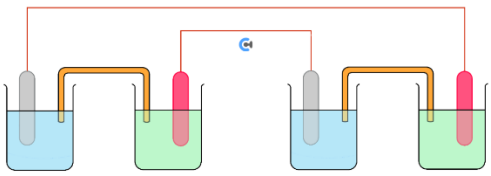
- Connected _____ Cells:



- Connected _____ Cells:



- Connected _____ Cells:



- TIPS:
  - First find: _____.
  - Treat each cell as: _____.

Question 15 Walkthrough.

The electrode reactions that occur when the nickel-cadmium battery is producing electrical energy are shown below.

$$NiO_2(s) + 2H_2O(l) + 2e^- \rightarrow Ni(OH)_2(s) + 2OH^-(aq)$$

$$Cd(s) + 2OH^-(aq) \rightarrow Cd(OH)_2 + 2e^-$$

a. Write the balanced half-equation for the reaction which takes place at the negative electrode during discharge. **[2.3.1]**

_____

b. Write the balanced half-equation for the reaction which takes place at the positive electrode during recharge. **[2.3.1]**

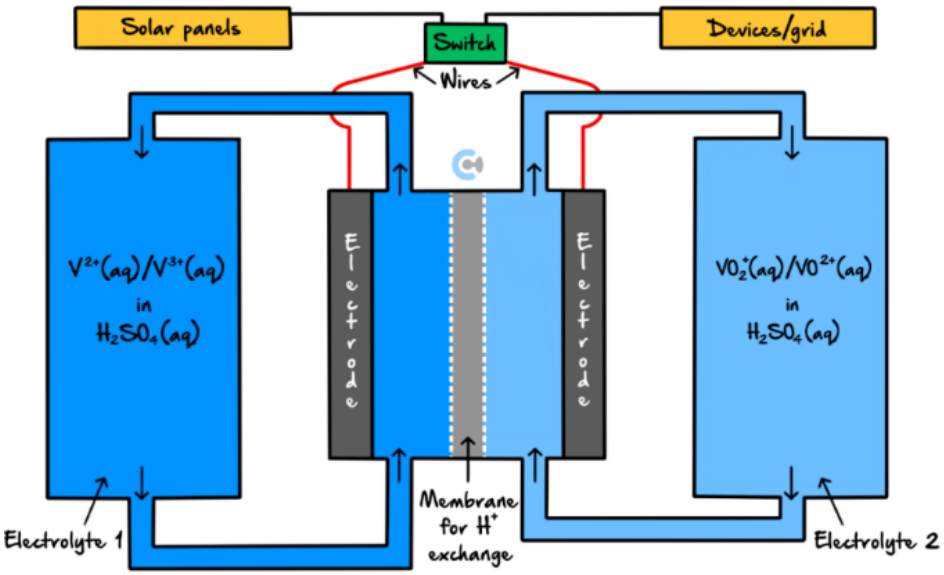
_____

Space for Personal Notes

Question 16 Walkthrough. [2.3.1]

An increasingly popular battery for storing energy from solar panels is the vanadium redox battery. The battery takes advantage of the four oxidation states of vanadium that are stable in aqueous acidic solutions.

A schematic diagram of a vanadium redox battery is shown below.



The two relevant half-equations for the vanadium redox battery are:

$$VO_2{}^+(aq) + 2H^+(aq) + e^- \rightleftharpoons VO^{2+}(aq) + H_2O(l) \qquad E° = +1.00\ V$$

$$V^{3+}(aq) + e^- \rightleftharpoons V^{2+}(aq) \qquad E° = -0.26\ V$$

Write the balanced equation for the overall reaction that takes place when the cell is recharged.

_____

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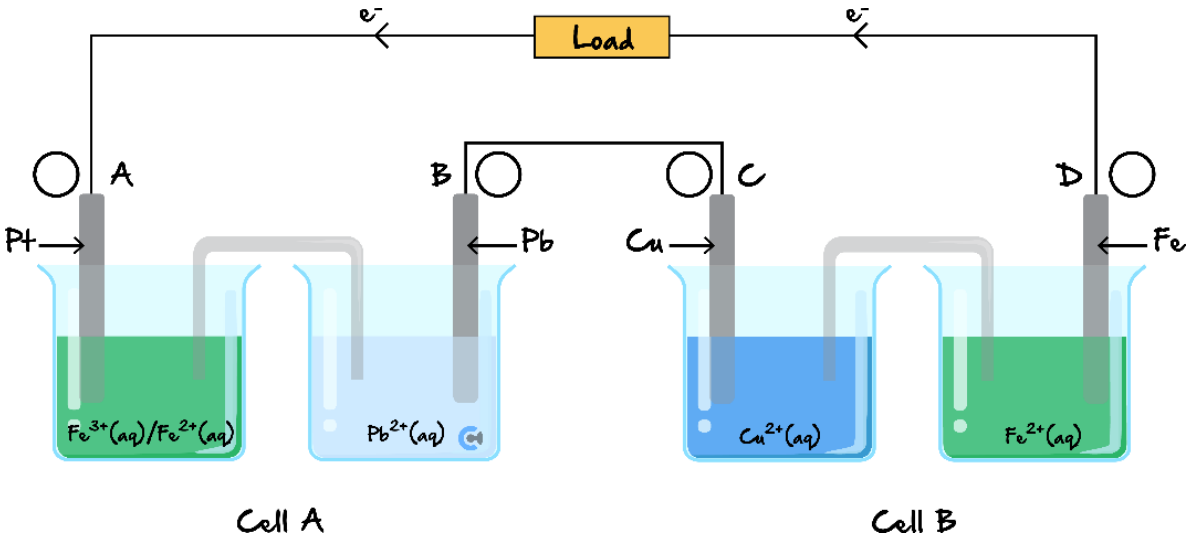
Question 17 (7 marks) **Walkthrough.**

Consider the following:



a. State whether cell *A* and *B* is a galvanic cell or electrolytic cell. (1 mark) **[2.3.3]**

Cell *A*	**Cell *B***

b. Label the polarities of the electrodes in the circles provided above. (1 mark) **[2.3.3]**

c. Write the balanced half-equation for the reaction which takes place at:

i. Electrode *A*. (1 mark) **[2.3.3]**

_____

ii. Electrode *B*. (1 mark) **[2.3.3]**

_____

iii. Electrode *C*. (1 mark) **[2.3.3]**

_____

iv. Electrode *D*. (1 mark) **[2.3.3]**

_____

d. Find the overall EMF produced by the cell. (1 mark) **[2.3.3]**

_____

_____

Space for Personal Notes

Sub-Section: Question Set A

INSTRUCTION: 9 Marks. 7 Minutes Writing.

Question 18 (7 marks)

The lead-acid battery is made up of a series of secondary cells in which the following half-reactions are utilised.

$$PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightleftarrows PbSO_4(s) + 2H_2O(l) \qquad E° = +1.69\ V$$

$$PbSO_4(s) + 2e^- \rightleftarrows Pb(s) + SO_4^{2-}(aq) \qquad E° = -0.36\ V$$

a. During discharge, write the half-equation which occurs at each electrode. (2 marks) **[2.3.1]**

Cathode: _____

Anode: _____

b. When the battery is discharging state, how the pH changes? (1 mark) **[2.3.1]**

_____

c. State **one** feature of the lead-acid battery which makes it rechargeable. (1 mark) **[2.3.2]**

_____

_____

d. The reaction which occurs at the anode when the battery is recharging is: (1 mark) **[2.3.1]**

A. $PbSO_4(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}(aq)$

B. $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

C. $PbSO_4(s) + 2H_2O(l) \rightarrow PbO_2\ (s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^-$

D. $PbO_2\ (s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

e. When the lead-acid battery is recharging the energy transformation occurring is: (1 mark) **[2.3.2]**

A. Chemical → Electrical + Heat.

B. Kinetic → Chemical + Electrical + Heat.

C. Electrical → Chemical + Heat.

D. Electrical → Light + Kinetic + Heat.

f. When recharging the lead-acid battery the positive terminal of the power supply should be connected to the: (1 mark) **[2.3.1]**

A. Positive terminal of the battery where oxidation will occur.

B. Positive terminal of the battery where reduction will occur.

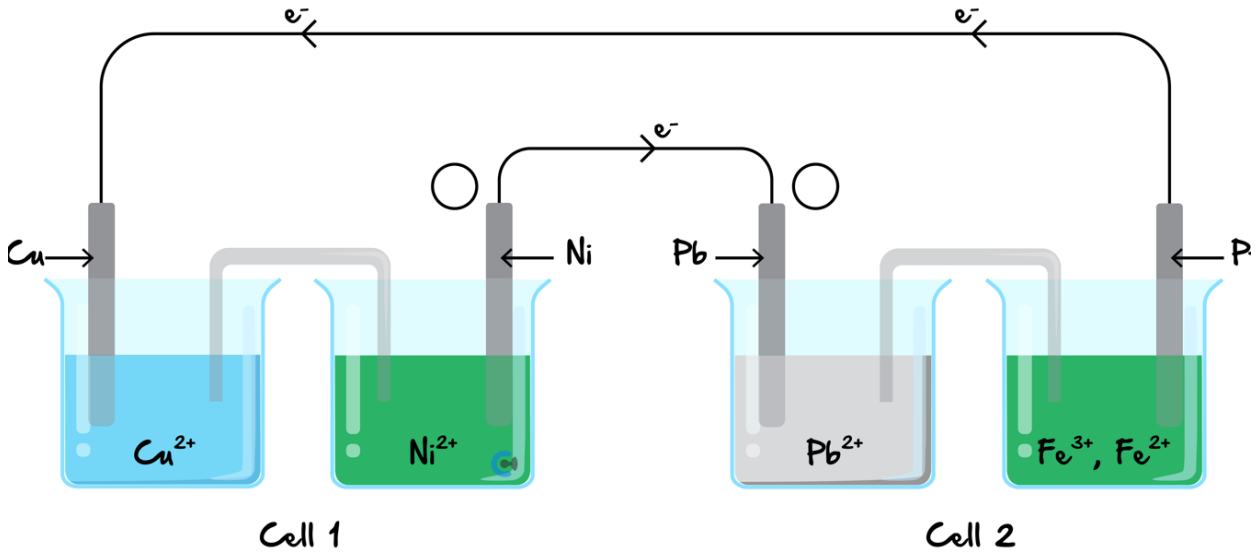
C. Negative terminal of the battery where oxidation will occur.

D. Negative terminal of the battery where reduction will occur.

Space for Personal Notes

Question 19 (2 marks)

The following connected-cell is to be investigated.



a. Label the polarities of the nickel and lead electrode in the circles provided above. (1 mark) **[2.3.3]**

b. The energy transformation occurring in each cell is: (1 mark) **[2.3.3]**

	Cell 1	Cell 2
A.	Chemical → Electrical	Chemical → Electrical
B.	Chemical → Electrical	Electrical → Chemical
C.	Electrical → Chemical	Chemical → Electrical
D.	Electrical → Chemical	Electrical → Chemical

Space for Personal Notes

Sub-Section: Question Set B

INSTRUCTION: 8 Marks. 5 Minutes Writing.

Question 20 (7 marks)

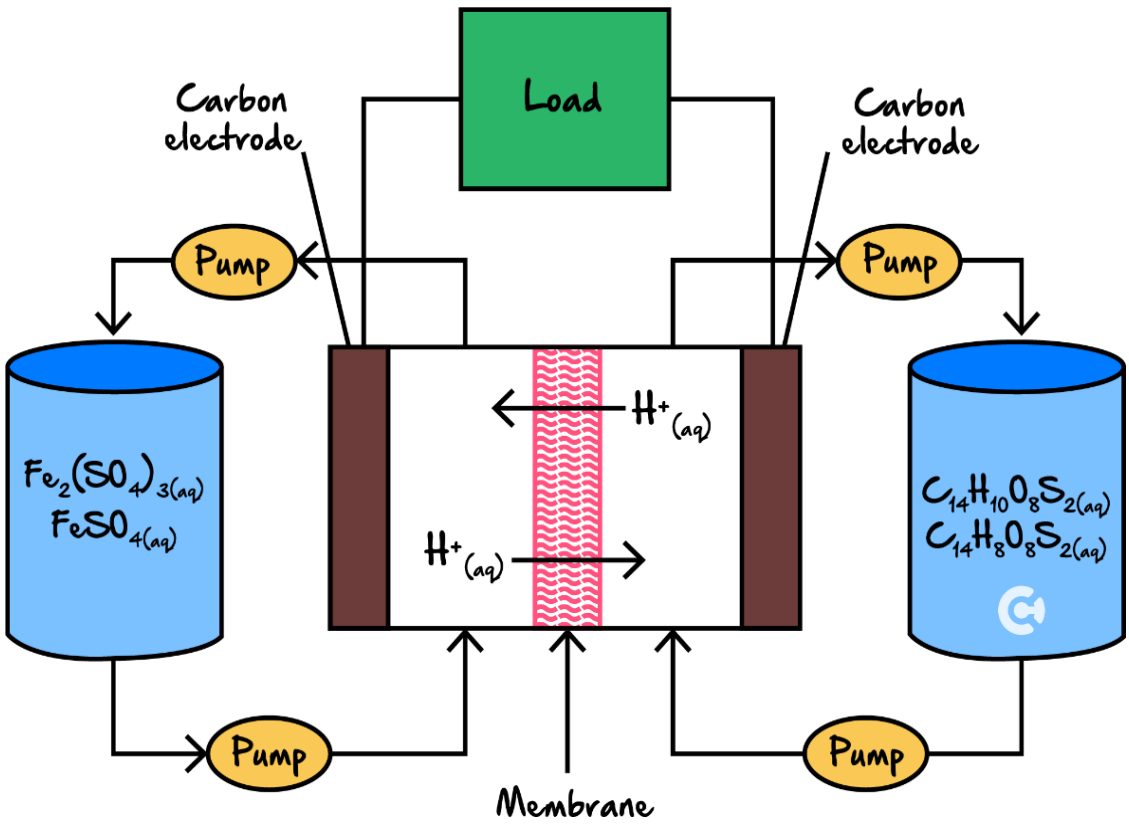
Inspired from VCAA Chemistry Exam 2023
https://www.vcaa.vic.edu.au/Documents/exams/chemistry/2023/2023chemistry-w.pdf#page=24

Scientists are currently researching an experimental secondary cell.

The following reaction takes place in the experimental cell during discharge.

$$Fe_2(SO_4)_3(aq) + C_{14}H_{10}O_8S_2(aq) \rightarrow 2FeSO_4(aq) + C_{14}H_8O_8S_2(aq) + HSO_4^-(aq) + H^+(aq)$$

A diagram of the experimental cell is shown below.



a. State the energy transformations that occur in the experimental cell during discharge. (1 mark) **[2.3.2]**

_____

b. Which reactant is the oxidising agent in the experimental cell during discharge? Use oxidation numbers to justify your answer. (2 marks) **[2.3.1]**

_____

_____

_____

_____

c.

i. Write the half-equation for the reaction that occurs in the $C_{14}H_8O_8S_2/C_{14}H_{10}O_8S_2$ half-cell during recharge. (1 mark) **[2.3.1]**

_____

ii. State the polarity of the $C_{14}H_8O_8S_2/C_{14}H_{10}O_8S_2$ half-cell electrode during recharge. (1 mark) **[2.3.1]**

_____

iii. Explain how the polarity of the electrodes is established during recharge to allow the recharge to occur. (2 marks) **[2.3.2]**

_____

_____

_____

_____

_____

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Question 21 (1 mark) **Additional Question.**

The lead-acid accumulator, used as a common car battery, converts chemical energy into electrical energy via the electrode reactions.

$$Pb(s) + SO_4{}^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$$

$$PbO_2(s) + SO_4{}^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$$

When the lead-acid accumulator is recharged:

A. Pb is produced at the negative electrode.

B. The pH increases.

C. $PbSO_4$ is produced at the positive electrode.

D. The changes in the oxidation numbers of lead are from 0 to $+2$ and $+4$ to $+2$.

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Section D: Electroplating (21 Marks)

Sub-Section: Recap

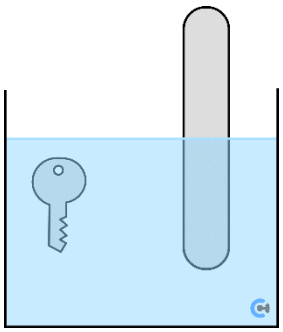
Cheat Sheet

[2.4.1] - Identify the electroplating setup (location of object) & find the electroplating reactions

- Definition

Object	Metal Used
[Cathode] / [Anode]	[Cathode] / [Anode]
[Positive] / Negative]	[Positive] / Negative]

- Setup:



Anode Reaction	Cathode Reaction

- Concentration of Electrolyte:
- EMF:

[2.4.2] - Find next-order reactions during electrolysis

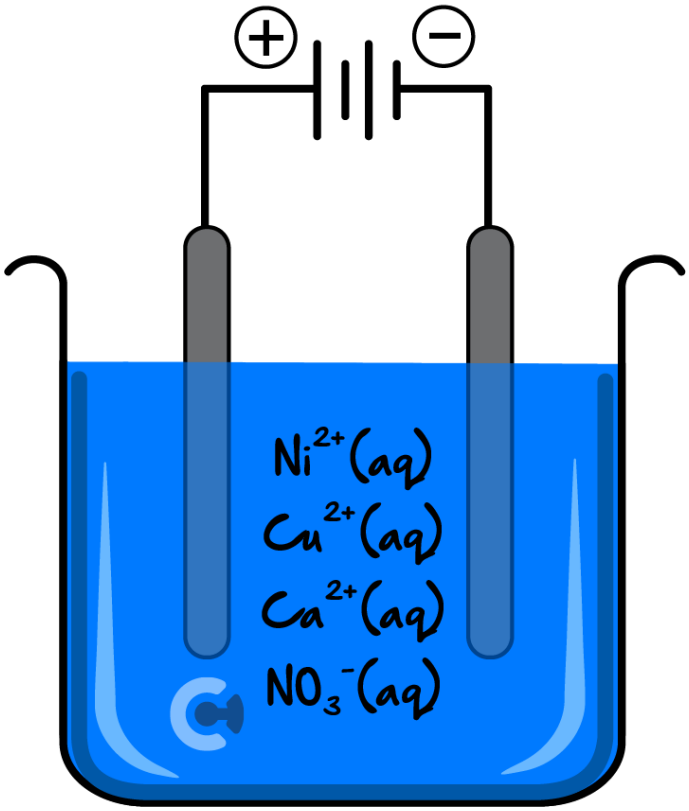
- Assume the current strongest oxidant runs out.
- Move to the next _____oxidant.
- End game scenarios:

[2.4.3] - Apply Faraday's laws to electroplating calculations

- Equations:
- Typical Steps:
  1.
  2.
  3.
  4.
- Faraday's First Law:
- Faraday's Second Law:
- **Molar Mass: Charge Ratio** (M_r/z)
  - **Use:** _____ mass deposited for different metals.
  - **Formula:**

Question 22 (5 marks) **Walkthrough.**

Consider the electrolysis of the following electrolytic cell, which contains aqueous solutions of 0.1 M concentrations of $Ni(NO_3)_2(aq), Cu(NO_3)_2(aq), Ca(NO_3)_2(aq)$ and inert electrodes.



a. Write the balanced half-equation for the reactions which occur at the: (2 marks) **[2.4.2]**

Positive electrode: _____

Negative electrode: _____

b. After some time has elapsed, the reaction which takes place at one of the electrodes is observed to change.

i. Write the balanced half-equation for the next reaction that takes place at this electrode. (1 mark) **[2.4.2]**

_____

ii. Write the balanced half-equation for the next reaction which takes place at this same electrode afterwards. (1 mark) **[2.4.2]**

_____

iii. Hence or otherwise, draw the products that form at this electrode. (1 mark) **[2.4.2]**

Question 23 Walkthrough.

Michael wants to electroplate cobalt metal onto his copper key chain. To do so, he attaches the positive terminal of the power source a sheet of cobalt metal, and he attaches the negative terminal to the copper key chain. The electrolyte is comprised of cobalt (II) chloride.

a. Draw the electroplating cell. **[2.4.1]**

b. Find the change in mass of the key chain, if 4.20 *A* of current is passed through for 15.0 minutes. **[2.4.3]**

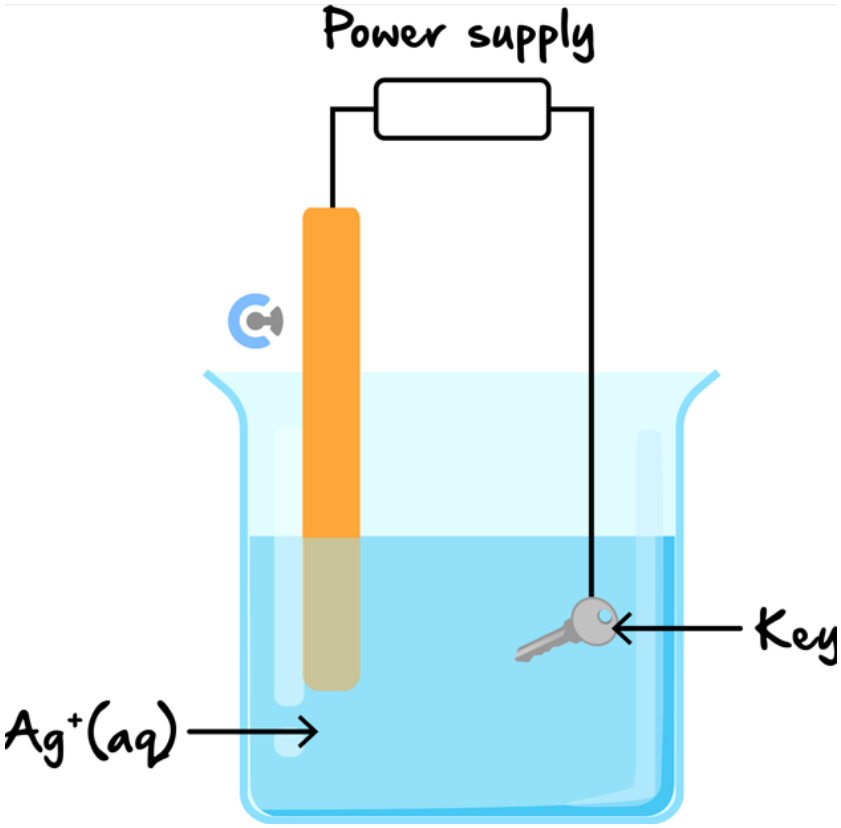
Sub-Section: Questions

INSTRUCTION: 10 Marks. 13 Minutes Writing.

Question 24 (1 mark) **[2.4.1]**

Inspired from VCAA Chemistry Exam 2002
https://www.vcaa.vic.edu.au/Documents/exams/chemistry/chem22002.pdf#page=4

A student decided to silver-plate a locker key with a silver electrode using the apparatus shown:



In this cell, the silver electrode is the:

A. Anode, and is connected to the positive terminal of the power supply.

B. Anode, and is connected to the negative terminal of the power supply.

C. Cathode, and is connected to the positive terminal of the power supply.

D. Cathode, and is connected to the negative terminal of the power supply.

Question 25 (6 marks)

A nickel rod is placed as the anode and a metal key is used as the cathode. A solution of 1.0 M $Ni(NO_3)_2$ is placed in the cell. $Ni^{2+}(aq)$ ions are green in colour.

a. Determine the reaction at the cathode. (1 mark) **[2.4.1]**

_____

b. Determine the reaction at the anode. (1 mark) **[2.4.1]**

_____

c. After 10 minutes, with a low current of 2.00 A, the beaker is electrolysed.

i. Explain how the colour of the solution changes. (1 mark) **[2.4.1]**

_____

_____

ii. Find the expected change in mass of the metal key. (3 marks) **[2.4.3]**

_____

_____

_____

_____

_____

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Question 26 (1 mark) **[2.4.2]**

A solution containing 0.1 mole each of Ag^{+}, Ni^{2+}, Co^{2+} and Mg^{2+} ions was prepared by dissolving their respective nitrates in 1.0 L of deionised water. This solution was then subjected to electrolysis using platinum electrodes. As electrolysis proceeded, the metal ions were sequentially reduced and deposited onto the cathode.

In which order did the metals deposit on the cathode, from the first to the last?

_____

Question 27 (2 marks) **[2.4.3]**

The passage of 2960 C of electric charge through a molten vanadium compound yields 0.39 g of vanadium metal. Find the oxidation number of vanadium in the compound.

_____

_____

_____

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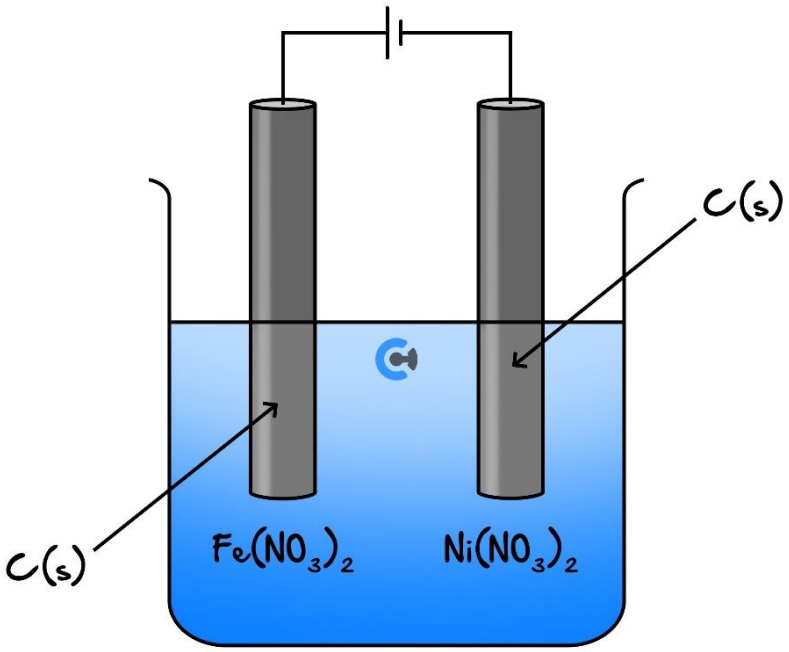
Sub-Section: Additional Questions

Question 28 (5 marks)

Consider an aqueous solution of both iron (II) nitrate and nickel nitrate. The solution is electrolysed using inert electrodes, as shown below:



a. Write the balanced half-equations for the reaction which takes place at the:

i. Cathode. (1 mark) **[2.4.2]**

_____

ii. Anode. (1 mark) **[2.4.2]**

_____

b. After some time has elapsed, a new equation occurs at one of the electrodes. Write the half-equation for the new reaction which takes place. (1 mark) **[2.4.2]**

_____

c. As the cell operates, a coating is seen to form over one of the electrodes. Draw the coating(s) that form at the electrode on the diagram above. (2 marks) **[2.4.2]**

Question 29 (1 mark) **[2.4.3]**

Inspired from VCAA Chemistry NHT 2018
https://www.vcaa.vic.edu.au/Documents/exams/chemistry/2018/nht/2018chem-nht-w.pdf#page=11

An electroplating cell containing two platinum electrodes and an electroplating solution is operated at 5.0 A for 600 s. After the cell is turned off, 0.54 g of metal is found to have been deposited on the cathode. Which electroplating solution was used in this process?

A. 1 M $AgNO_3$

B. 1 M $Ni(NO_3)_2$

C. 1 M $Pb(NO_3)_2$

D. 1 M $Cr(NO_3)_3$

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