



Website: contoureducation.com.au | Phone: 1800 888 300

Email: hello@contoureducation.com.au

VCE Chemistry $\frac{3}{4}$
AOS 2 Revision I [0.16]
Workshop

Error Logbook:



New Ideas/Concepts	Didn't Read Question
Pg / Q #: _____ Notes:	Pg / Q #: _____ Notes:
Algebraic/Arithmetic/ Calculator Input Mistake	Working Out Not Detailed Enough
Pg / Q #: _____ Notes:	Pg / Q #: _____ Notes:

Section A: Warm Up (11 Marks)

INSTRUCTION: 11 Marks. 7 Minutes Writing.



Question 1 (1 mark)

An aluminium can is to be silver-plated in an electrolytic cell. The can forms one electrode and a silver rod the other electrode. The electrolyte provides a source of $\text{Ag}^+(\text{aq})$.

The can to be plated, is connected to the:

- A. Positive terminal of a battery so that oxidation occurs at the can.
- B. Positive terminal of a battery so that reduction occurs at the can.
- C. Negative terminal of a battery so that oxidation occurs at the can.
- D. Negative terminal of a battery so that reduction occurs at the can.

Question 2 (1 mark)

Two types of electrochemical cells are the primary cell and the secondary cell. Which one of these features is exhibited by only one of these cells?

- A. An energy transformation is from chemical energy to electrical energy.
- B. The efficiency of the cell is close to 100%.
- C. Products of the cell reaction remain in contact with the electrodes.
- D. A spontaneous redox reaction is the overall reaction of the cell.

Space for Personal Notes

Question 3 (1 mark)

Which one of the following is the **most** accurate?

- A. All fuel cells are galvanic cells.
- B. All galvanic cells are primary cells.
- C. All secondary cells have porous electrodes.
- D. All fuel cells are more efficient than all secondary cells.

Question 4 (3 marks)

A solution containing 1.0 M of KBr(aq) is electrolysed with a silver attached to the positive terminal of the battery, and lead attached to the negative terminal of the battery.

a. Write the balanced half-equation which occurs at the:

i. Positive electrode. (1 mark)

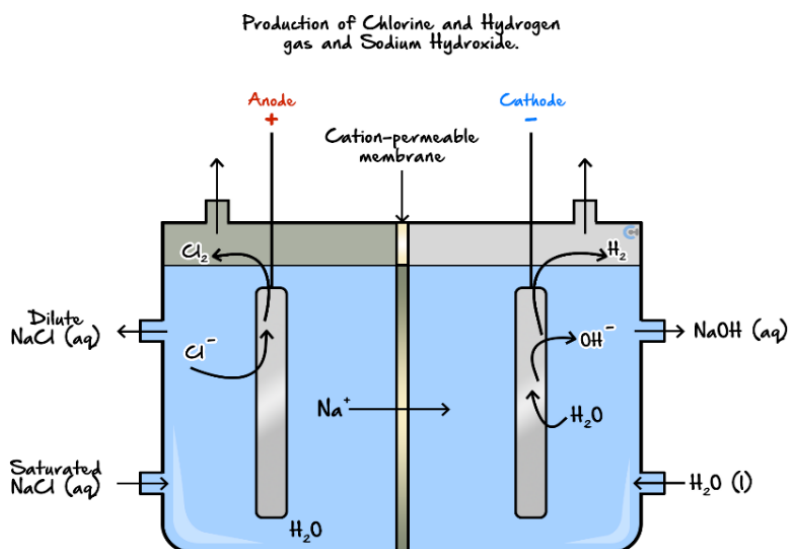
ii. Negative electrode. (1 mark)

b. State the EMF required to be inputted for the reaction to take place. (1 mark)

Space for Personal Notes

Question 5 (5 marks)

The set-up below is used to produce a number of important chemicals. Sodium chloride is used as the raw material.



a. Determine the reaction occurring at the:

i. Anode. (1 mark)

ii. Cathode. (1 mark)

b. Why is it important to remove diluted NaCl from the cell and replace it with saturated NaCl? (1 mark)

c. State **two** roles of the "cation permeable membrane". (2 marks)

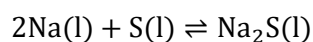
Section B: Ramping Up (9 Marks)

INSTRUCTION: 9 Marks. 7 Minutes Writing.

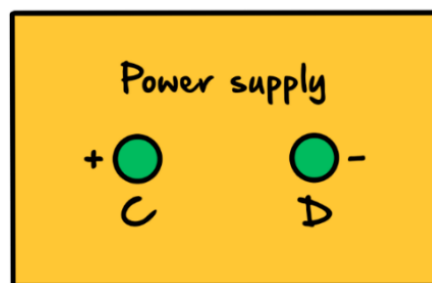
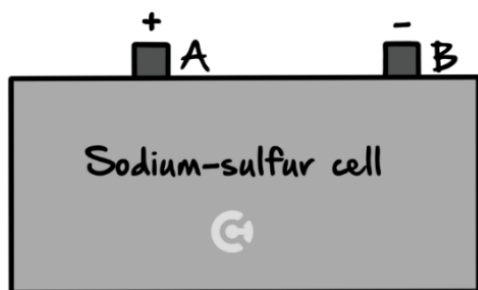


Question 6 (1 mark)

The sodium-sulphur cell shown below is a secondary galvanic cell with the overall cell reaction:



The cell produces 2.1 volts.



The cell is to be recharged by connecting it to the power supply.

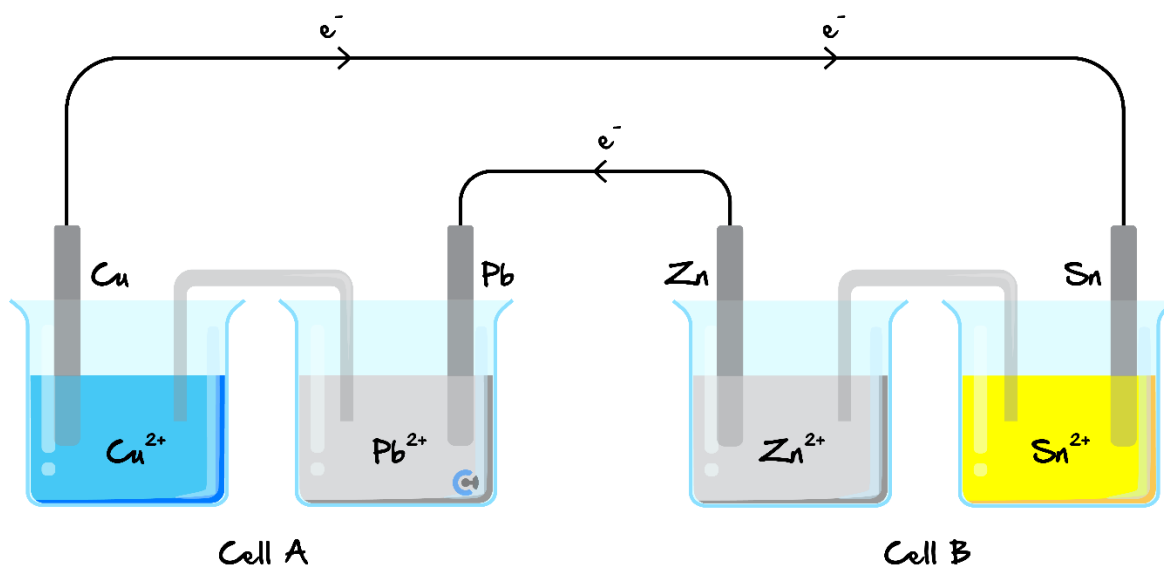
Which one of the following best describes the arrangement for recharging the cell?

	Power Supply Voltage	Connect Terminals
A.	2.1 volts.	<i>A to C and B to D.</i>
B.	2.1 volts.	<i>A to D and B to C.</i>
C.	More than 2.1 volts.	<i>A to C and B to D.</i>
D.	More than 2.1 volts.	<i>A to D and B to C.</i>

Space for Personal Notes

Question 7 (2 marks)

The following cell is set up.



- a. Identify if each of cell A and cell B act as galvanic or electrolytic cells. (1 mark)

Cell A	Cell B

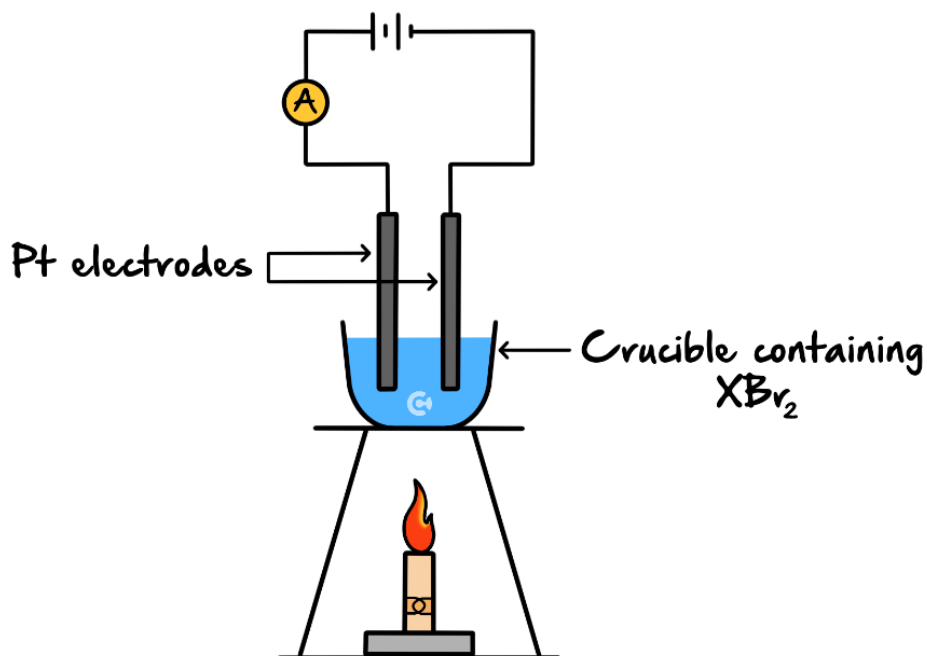
- b. Select the correct option. (1 mark)

- A. The copper electrolyte will become less intensely blue.
- B. The negative electrode in cell A will decrease in size.
- C. The mass deposited at the cathode of cell A will be greater than the mass deposited at the cathode of cell B.
- D. The concentration of tin (II) ions will increase with time.

Space for Personal Notes

Question 8 (6 marks)

A teacher demonstrated the process of electrolysis of a molten salt using an unknown metal salt, XBr_2 . The apparatus was set up as shown below.



At the conclusion of the demonstration, the students were provided with the following information.

- ▶ A current of 1.50 amperes was applied for 30.0 minutes.
- ▶ 2.90 g of metal X was produced.

a. Write a balanced half-equation for the anode reaction in this electrolytic cell. (1 mark)

b.

- i.** Determine the amount, in *mol*, of metal *X* that was deposited on the cathode. (3 marks)

- ii.** Identify metal *X*. (2 marks)

Space for Personal Notes

Section C: Getting Trickier I (13 Marks)

INSTRUCTION: 13 Marks. 10 Minutes Writing.



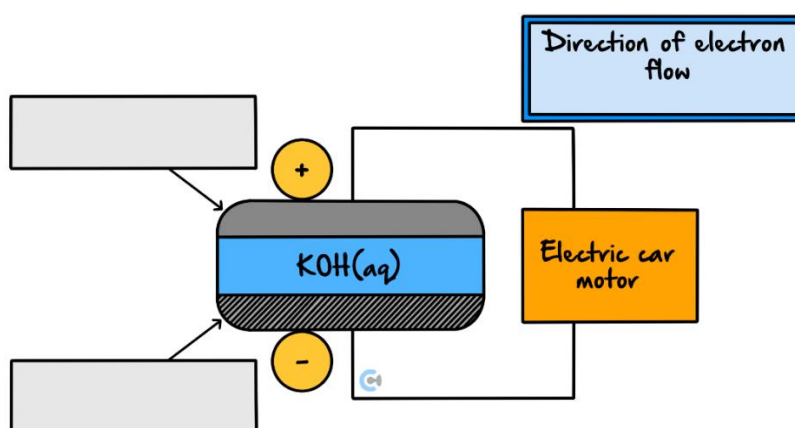
Question 9 (6 marks)



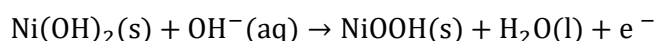
Inspired from VCAA Chemistry Exam 2015

<https://www.vcaa.vic.edu.au/Documents/exams/chemistry/2015/2015chem-w.pdf#page=37>

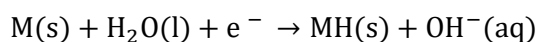
The storage battery to be used in the hybrid cars is comprised of a series of nickel metal hydride, NiMH, cells. MH represents a metal hydride alloy that is used as one electrode. The other electrode contains nickel oxide hydroxide, NiOOH. The electrolyte is aqueous KOH.



The simplified equation for the reaction at the anode while **recharging** is:



The simplified equation for the reaction at the cathode while **recharging** is:



a. What is the overall equation for the **discharging** reaction? (1 mark)

b. In the boxes on the diagram above, indicate which is the MH electrode and which is the NiOOH electrode. (1 mark)

c. In the bold box provided above the cell diagram, use an arrow, \rightarrow or \leftarrow , to indicate the direction of the electron flow as the cell is discharging. (1 mark)

- d. The battery discharged for 60 minutes, producing a current of 1.15 A. What mass, in grams, of NiOOH would be used during this period? (3 marks)

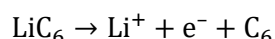
Question 10 (7 marks)

The lithium-ion battery is a secondary cell that is now widely used in portable electronic devices.

In these batteries, lithium ions, Li^+ , move through a special non-aqueous electrolyte between the two electrodes. The batteries are housed in sealed containers to ensure that no moisture can enter them.

Both electrodes are made up of materials that allow the lithium ions to move into and out of their structures. The anode consists of LiC_6 , where lithium is embedded in the graphite structure. Lithium cobalt oxide, LiCoO_2 , is commonly used as the material in the cathode. The reaction at the cathode is quite complex.

When the cell discharges, Li^+ ions move out of the anode and enter the cathode. During discharge, the half-cell reaction at the anode is:



- a. During discharge, what is the polarity of the graphite electrode? (1 mark)

- b. Write the half-equation for the reaction that occurs at the cathode of a lithium-ion battery when it is recharged. (1 mark)

- c. In a lithium-ion battery, lithium metal must not be in contact with water. Explain why and justify your answer with the use of appropriate equations. (3 marks)

- d. Identify **one** design feature of the lithium-ion battery that enables it to be recharged. (1 mark)

- e. What is **one** advantage of using a secondary cell compared to using a fuel cell? (1 mark)

Space for Personal Notes

Section D: Getting Trickier II (14 Marks)

INSTRUCTION: 14 Marks. 13 Minutes Writing.



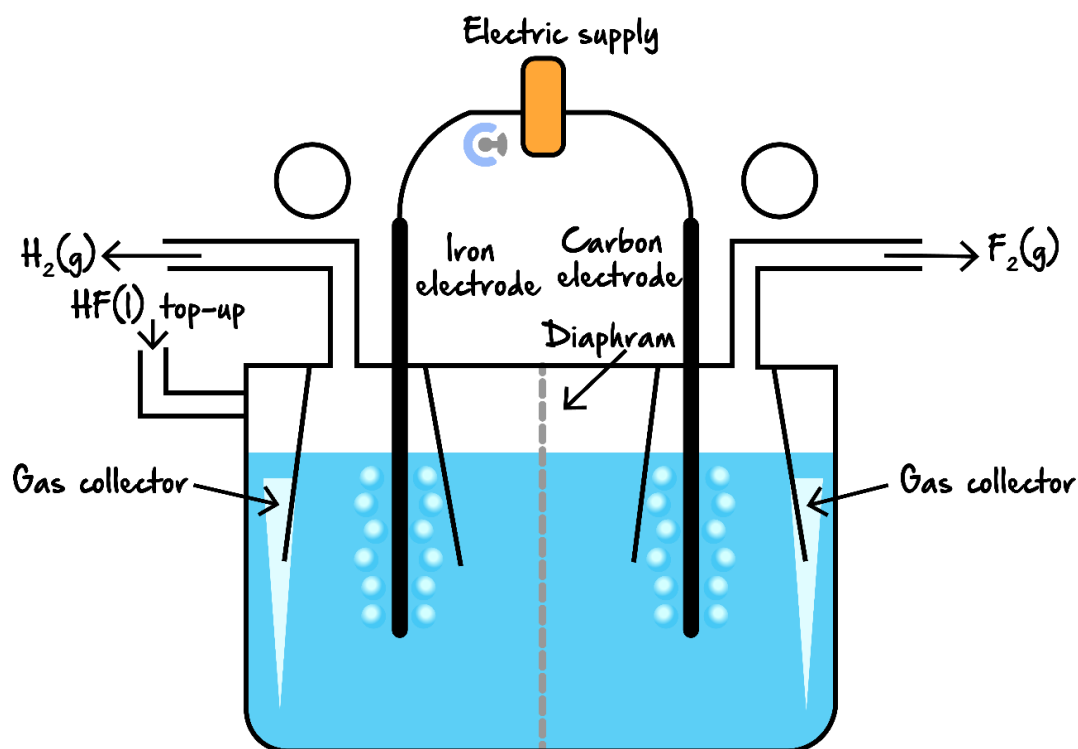
Question 11 (14 marks)



Inspired from VCAA Chemistry Exam 2017

<https://www.vcaa.vic.edu.au/Documents/exams/chemistry/2017/2017chem-w.pdf#page=30>

Given that fluorine gas, F_2 , is the most reactive of all metals, it is extremely beneficial to have access to it. In order to form fluorine gas, we electrolyse liquid hydrogen fluoride, HF, to form fluorine and hydrogen gases.



a. Write the equation for:

i. The half-reaction occurring at the cathode. (1 mark)

ii. The overall reaction. (1 mark)

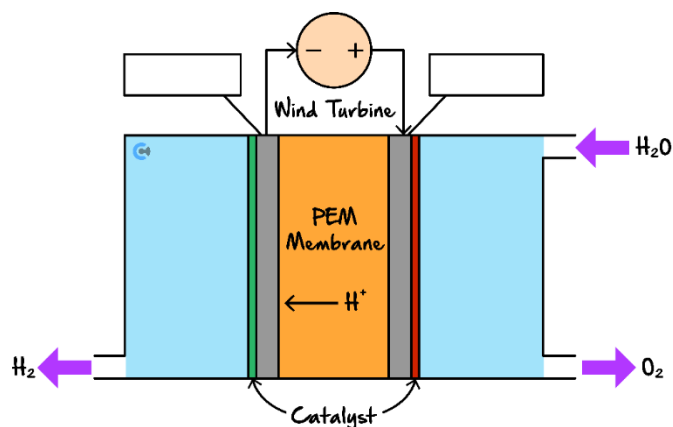
b. Label the polarities for each electrode in the circles provided above. (1 mark)

- c. Suggest why the diaphragm, as shown in the diagram above, is important for the safe operation of the cell. (2 marks)

- d. Explain why the carbon electrode cannot be replaced with an iron electrode. (2 marks)

- e. Explain why the left electrode as shown in the diagram above can be made of iron. (2 marks)

- f. This method of producing hydrogen gas is then compared to obtaining hydrogen gas from a Polymer Electrolyte Membrane (PEM) Electrolyser. An example of a PEM electrolyser powered by wind energy is shown below.



- Label the cathode and anode in the boxes provided above. (1 mark)
- Write the balanced half-equation which takes place at the electrode attached to the positive electrode. (1 mark)

- Production of hydrogen gas using this cell is considered to be 'green'. State **one** requirement for a fuel to be considered to be 'green', and explain how the PEM electrolyser fulfils this requirement. (2 marks)

- One method to source the water used for this electrolysis is from freshwater sources in rivers and lakes. State **one** sustainability challenge which arises from this, with reference to United Nations Sustainable Development Goal 14. (1 mark)

Let's take a **BREAK!**

Section E: VCAA-Level Questions I (10 Marks)

INSTRUCTION: 10 Marks. 30 Seconds Reading. 10 Minutes Writing.



Question 12 (10 marks)

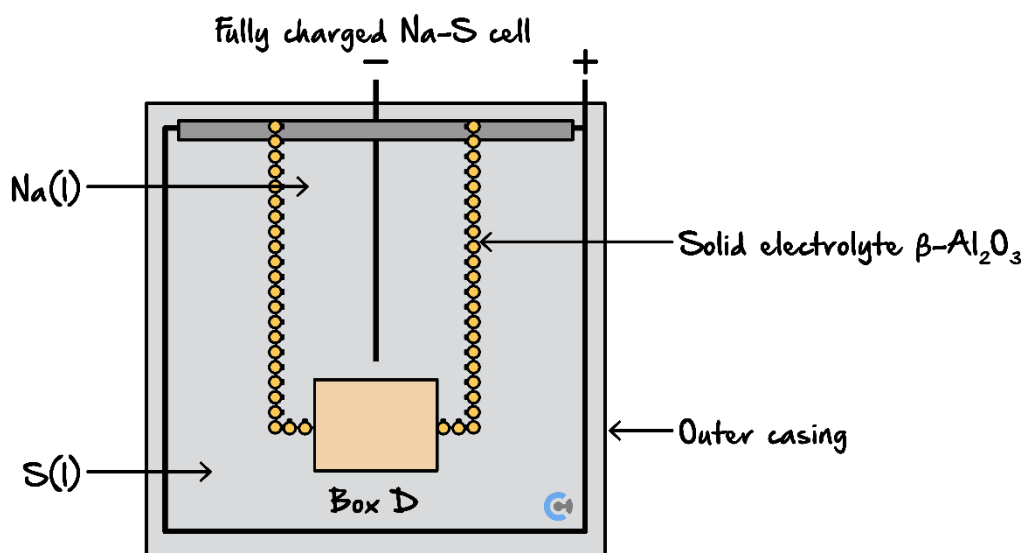


Inspired from VCAA Chemistry Exam 2022

<https://www.vcaa.vic.edu.au/Documents/exams/chemistry/2022/NHT/2022ChemistryNHT-w.pdf#page=28>

Researchers are developing rechargeable cells containing sodium, Na, and sulphur, S. A simplified diagram of a fully charged Na-S cell is shown below.

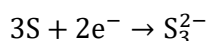
The solid electrolyte consists of ceramic beta-alumina, $\beta\text{-Al}_2\text{O}_3$. $\beta\text{-Al}_2\text{O}_3$ separates the two half-cells and selectively conducts sodium ions, Na^+ .



a.

- Draw an arrow in Box D to show the direction of flow of Na^+ across the membrane when the cell is charging. (1 mark)
- Identify and explain **one** of the features of the Na-S cell that would make it suitable to power electric vehicles. (2 marks)

- b.** Environmental conditions can influence reactions during the discharge of the battery. When a particular Na-S test cell is discharging, the half-equation for the reaction at one of the electrodes is:



- i.** Write the half-equation that occurs for the reaction at the other electrode. (1 mark)

- ii.** When the Na-S test cell is discharging, solid sodium trisulphide, Na_2S_3 , is formed. Write the overall equation for the charging process in this cell. (1 mark)

- iii.** Identify and explain one factor that may affect the useful life of the Na-S test cell. (2 marks)

- c.** The Na-S cell contains pure Na metal. Safety information for a Na-S cell includes the requirement that the system must be protected from water. Explain why this would be one of the safety requirements. Include any relevant equations in your answer. (3 marks)

Section F: Multiple Choice Questions (5 Marks)

INSTRUCTION: 5 Marks. 5 Minutes Writing.



Question 13 (1 mark)

A highly concentrated salt solution, called brine, is used as the electrolyte.

The main reason that a highly concentrated, rather than a dilute solution is used is in order to:

- A. Allow an electric current to pass through the cell.
- B. Produce chlorine gas, in preference to oxygen gas.
- C. Allow sodium hydroxide to be separated from the salt by crystallisation.
- D. Create non-standard conditions that ensure hydrogen gas production.

Question 14 (1 mark)

A student prepares aqueous solutions of 1.0 M AgNO_3 , $\text{Co}(\text{NO}_3)_2$, and KNO_3 all in the same beaker. Platinum electrodes were placed in the solution and the cell undergoes electrolysis with the current applied under SLC. Each cathode is then dried and weighed to determine mass change. The cell runs for a very long time until no reaction occurs. The last product that was produced at the cathode is:

- A. Potassium.
- B. Cobalt.
- C. Silver.
- D. Hydrogen gas.

Space for Personal Notes

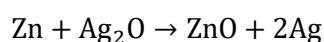
Question 15 (1 mark)

When comparing the electrolysis of molten CuI_2 with that of a 1.0 M aqueous solution of CuI_2 , which one of the following statements is correct?

- A. The products at the anode and the cathode are the same in both cases.
- B. The product at the cathode is the same in both cells but the products at the anode are different.
- C. The product at the anode is the same in both cells but the products at the cathode are different.
- D. The products at the cathodes of both cells are different as are the products at the anodes.

Question 16 (1 mark)

The silver oxide-zinc battery is rechargeable and utilises sodium hydroxide, NaOH , solution as the electrolyte. The battery is used as a backup in spacecraft, if the primary energy supply fails. The overall reaction during discharge is:



When the silver oxide-zinc battery is being recharged, the reaction at the anode is:

- A. $2\text{Ag} + 2\text{OH}^- \rightarrow \text{Ag}_2\text{O} + \text{H}_2\text{O} + 2\text{e}^-$
- B. $\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{Ag} + 2\text{OH}^-$
- C. $\text{ZnO} + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{Zn} + 2\text{OH}^-$
- D. $\text{Zn} + 2\text{OH}^- \rightarrow \text{ZnO} + \text{H}_2\text{O} + 2\text{e}^-$

Question 17 (1 mark)

Which of the following processes will **not** produce a gas at the anode?

- A. Electrolysis of silver nitrate solution using carbon electrodes.
- B. Electrolysis of dilute lead (II) nitrate using platinum electrodes.
- C. Electrolysis of very concentrated sodium chloride solution using carbon electrodes.
- D. Electrolysis of dilute copper (II) chloride solution using a carbon cathode and a copper anode.

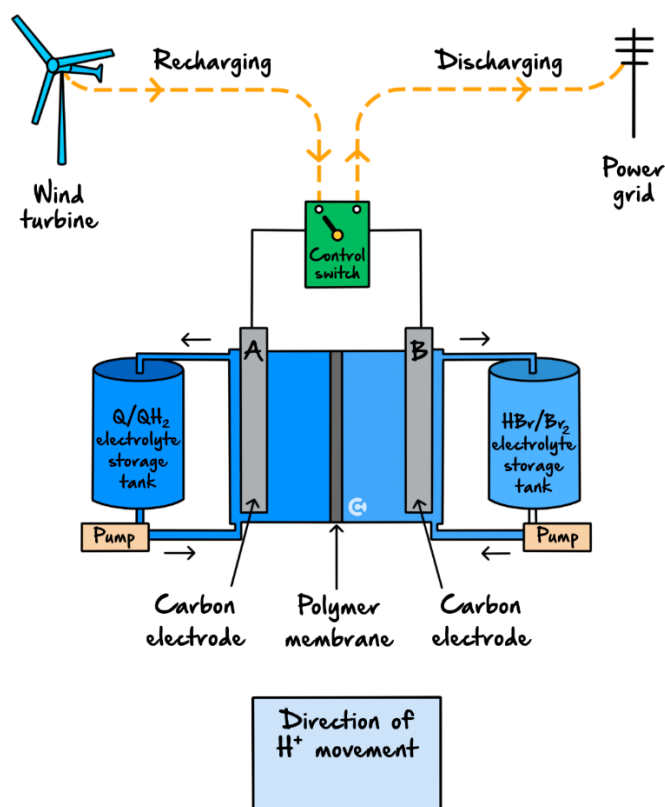
Section G: VCAA-Level Questions II (7 Marks)

INSTRUCTION: 7 Marks. 30 Seconds Reading. 7 Minutes Writing.



Question 18 (7 marks)

Redox flow batteries are used to store the excess electrical energy generated by commercial wind and solar farms. The batteries are recharged using electricity generated by the wind turbines or solar cells. A scientific report, published in January 2014, described a redox flow battery that used a family of chemicals commonly occurring in plants such as rhubarb. These are organic and are known as quinones and hydroquinones. A diagram showing how such a redox flow battery might operate is provided below. In the diagram, Q represents the quinone and QH_2 represents the corresponding hydroquinone. The researchers made a model of the redox flow battery using aqueous solutions of the redox pairs, Q/QH_2 and Br_2/Br^- . Refer to the diagram below.



During discharge, QH_2 is converted to Q and Br_2 is converted to HBr .

- a. Write balanced half-equations for the reactions occurring at the positive and negative electrodes as the cell is **discharged**. Assume the electrolytes are acidic. (2 marks)

Positive electrode: _____

Negative electrode: _____

- b. Write an overall equation for the reaction that occurs when the cell is **recharged**. (1 mark)

- c. The researchers reported that their tests indicated that only hydrogen ions were able to move through the polymer membrane separating the cells.

- i. In the box provided on the diagram, use an arrow, \rightarrow or \leftarrow , to indicate the direction of movement of hydrogen ions as the cell is **recharged**. (1 mark)
- ii. Why is it important that the other reactants in the half-cells are not able to pass through the polymer? (1 mark)

- d. The researchers also reported that the voltage applied to the cell during recharging was kept below 1.5 V to avoid the electrolysis of water.

Write an equation for the overall reaction that occurs when water is electrolysed. (1 mark)

- e. Quinones have a number of industrial applications and are cheaply synthesised on a large scale from anthracene, which is found in crude oil. The report's researchers suggest that because these compounds also exist in plants such as rhubarb, the electrolyte material is itself a renewable resource.

What is meant by the term 'renewable' in this context? (1 mark)

VCE Chemistry $\frac{3}{4}$

Free 1-on-1 Support



Be Sure to Make the Most of These (Free) Services!

- Experienced Contour tutors (45 + raw scores, 99 + ATARs).
- For fully enrolled Contour students with up-to-date fees.
- After school weekdays and all-day weekends.

<u>1-on-1 Video Consults</u>	<u>Text-Based Support</u>
<ul style="list-style-type: none">➤ Book via bit.ly/contour-chemistry-consult-2025 (or QR code below).➤ One active booking at a time (must attend before booking the next).	<ul style="list-style-type: none">➤ Message +61 440 137 304 with questions.➤ Save the contact as "Contour Chemistry".

Booking Link for Consults

bit.ly/contour-chemistry-consult-2025



Number for Text-Based Support

[+61 440 137 304](tel:+61440137304)