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VCE Chemistry ¾

AOS 2 Revision (Electrolysis) [2.0]

SAC 2

50 Marks. 1 Minute Reading. 60 Minutes Writing.

Section A: Multiple Choice Questions (5 Marks)

Question 1 (1 mark)

Which of the following is not a method of safely handling hydrogen gas?

A. Using a well-ventilated area.

B. Storing under high pressure (and low temperature).

C. Storing in cool and wet areas.

D. Installing detection devices near the storage of hydrogen gas.

Question 2 (1 mark)

Emma is experimenting with half-reactions shown below, in a secondary cell.

$$2Cr^{3+}(aq) + 7H_2O(l) \rightarrow {Cr_2O_7}^{2-} + 14H^+(aq) + 6e^- \qquad E_0 = -0.81\,V$$

$$Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^- \qquad E_0 = 1.12\,V$$

What is the overall reaction and the voltage produced during discharge?

A. $1.93\,V;\ 14H^+(aq) + 6Fe^{2+}(aq) + {Cr_2O_7}^{2-}(aq) \rightarrow 6Fe^{3+} + 2Cr^{3+}(aq) + 7H_2O(l)$

B. $0.31\,V;\ 14H^+(aq) + 6Fe^{2+}(aq) + {Cr_2O_7}^{2-}(aq) \rightarrow 6Fe^{3+} + 2Cr^{3+}(aq) + 7H_2O(l)$

C. $1.93\,V;\ 6Fe^{2+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l) \rightarrow {Cr_2O_7}^{2-}(aq) + 6Fe^{3+}(aq) + 14H^+(aq)$

D. $0.31\,V;\ 6Fe^{2+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l) \rightarrow {Cr_2O_7}^{2-}(aq) + 6Fe^{3+}(aq) + 14H^+(aq)$

Question 3 (1 mark)

Which of the following is least likely to be a significant reason for the decreasing battery life of a phone battery?

A. Overheating of the battery.

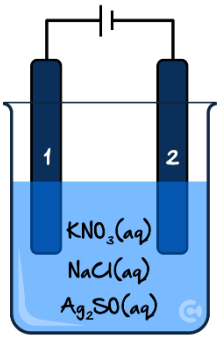
B. Excessive force exerted on the phone.

C. Side reactions occurring within the battery cells.

D. Battery is only partially charged during recharge.

Question 4 (1 mark)

Neha is operating the cell shown below with concentrated reagents. Which of the following describes the products produced at each electrode correctly?



A. Electrode 1: $H_2O(l)$, Electrode 2: $Ag(s)$

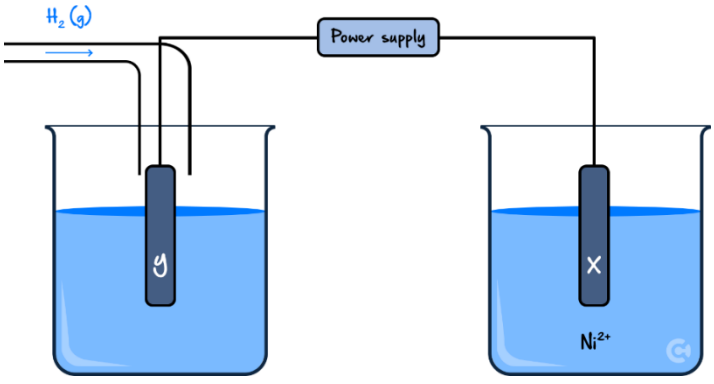
B. Electrode 1: $Cl_2(g)$, Electrode 2: $Ag(s)$

C. Electrode 1: $H_2O(l)$, Electrode 2: $H_2(g)$

D. Electrode 1: $Cl_2(g)$, Electrode 2: $K(s)$

Question 5 (1 mark)

Jayden is interested in the electrolytic cell shown below, where $H_2(g)$ is reacted with $Ni^{2+}(aq)$. Which of the following materials for electrodes *X* and *Y* would ensure the cell functions optimally?



A. *Y* - Lead, *X* - Nickel metal

B. *Y* - Platinum, *X* - Nickel metal

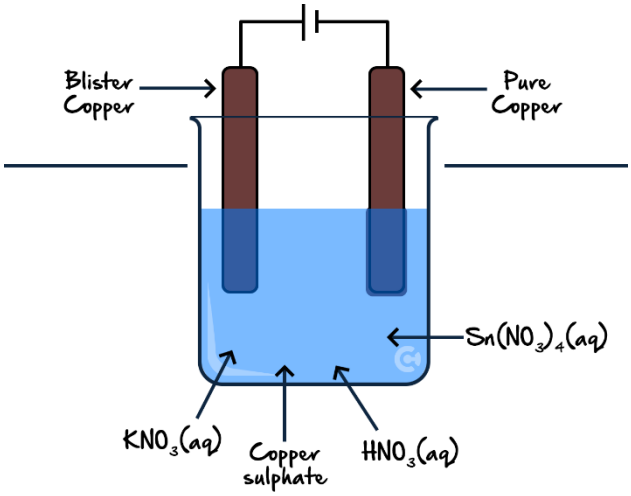
C. *Y* - Lead, *X* - Lead

D. *Y* - Lead, *X* - Platinum

Section B: Short Answer Questions (45 Marks)

Question 6 (27 marks)

Leviana is running an experiment to obtain pure copper from blister copper in the electrolytic cell shown below. Her lab technician tells her that the blister copper contains metal impurities such as silver and gold. Current runs through the apparatus at 4.00 *A*.



a. On the lines provided, label the cathode and anode with their respective polarities. (2 marks)

b. Draw the product/s formed at the cathode. (1 mark)

c. State the oxidation and reduction half-reactions occurring immediately when Leviana turns the cell on. (1 mark)

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d. Leviana runs the cell for 1.50 hours and finds that 4.74 g of metal has deposited on an electrode.

i. Given that 4.74 g of metal is deposited at the electrode, find the charge of the copper ion used in this reaction. (4 marks)

ii. Leviana's friend tells her that "The 4.74 g of metal deposited on the electrode is a combination of potassium and copper." Evaluate this statement. (4 marks)

e. In another trial, Leviana runs the cell at the same current but finds that the 6.98 g of metal has deposited on the cathode. Calculate the duration, in hours, for which the circuit was running, based on your answer for **part d. i.** (3 marks)

f. Explain the purpose of the electrolyte containing $HNO_3(aq)$. (3 marks)

g. Leviana notices that for the first thirty minutes, the intensity of the blue of the electrolyte remains constant. Explain this observation. (3 marks)

h. As the experiment progresses, Leviana notices that a sludge-like substance forms under the anode. Explain this observation. (2 marks)

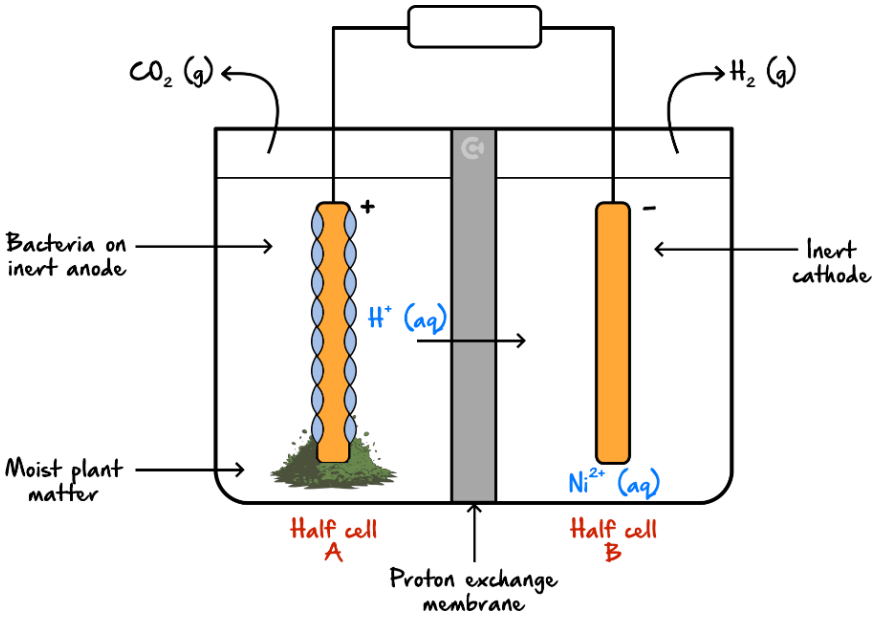
i. State two commercial applications of electroplating blister copper. (2 marks)

j. Explain why electroplating blister copper in this way may be preferred to traditional industrial processes. Traditional methods utilise different melting points of metals to purify copper. (2 marks)

Space for Personal Notes

Question 7 (18 marks)

Jody and Dawn are investigating the cell below where the moist plant matter will ferment into ethanoic acid, which is consumed by the bacteria on the inert anode.



a. Complete the following half-equations:

i. Anode Reaction. (1 mark)

_____

ii. Cathode Reaction. (1 mark)

_____

iii. Hence, or otherwise, determine if the cell is electrolytic or galvanic and write in the box above whether the cell is attached to a power supply or a load, providing a reason why. (2 marks)

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iv. Draw the direction of electron flow on the diagram above. (1 mark)

b. Given that the E_0 value $= 1.05\,V$ for the anode reaction, calculate the voltage input required to run the cell. (1 mark)

c. After 30 minutes of the cell running, Jody notices that the intensity of green is decreasing in half-cell B and bubbling occurring at the anode in half-cell A.

i. Suggest what has caused the intensity of green in the half-cell to decrease. (2 marks)

ii. Hence, explain both observations in relation to the redox reactions occurring with both half-cells. (4 marks)

d. Dawn notices that the cell produces large amounts of carbon dioxide and hydrogen gas. Explain why large accumulations of both gases can be dangerous and suggest a method to mitigate this situation. (2 marks)

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e. Hydrogen gas is used commonly as a fuel, such as in vehicles.

i. State a benefit of using hydrogen gas as a fuel in vehicles. (1 mark)

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ii. State two distinct disadvantages of using hydrogen gas as a fuel in vehicles. (2 marks)

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iii. Hydrogen detection equipment is often found near industrial hydrogen storage tanks. Explain why hydrogen gas is very hard to detect. (1 mark)

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