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VCE Chemistry ¾
Introduction to Electrolysis [2.1]
Test Solutions

20 Marks. 1 Minute Reading. 17 Minutes Writing

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (3 marks)

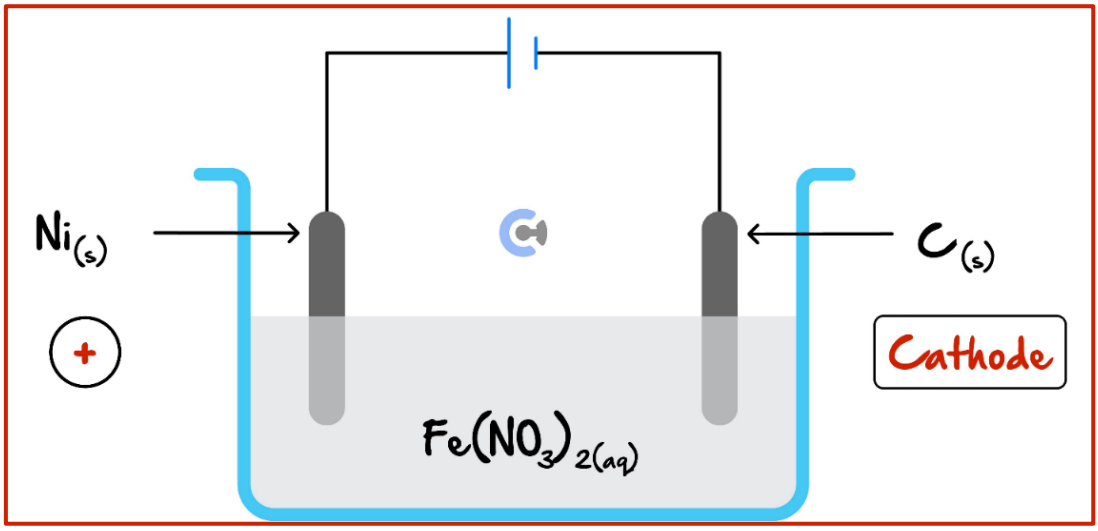
State whether the following statements are true or false by placing a tick in the appropriate box.

Statement	True	False
a. An electrolytic cell is characterised by the input of electrical energy.	✓	
b. The reactants are stored in the same beaker during electrolysis to ensure a direct, spontaneous reaction.		✓
c. The electrodes must be inert in an electrolytic cell.		✓
d. Water is often a reactant during electrolytic reactions.	✓	
e. In electrolysis, we no longer need to worry about the strongest oxidant present reacting with the strongest reductant present.		✓
f. If an electrolytic cell were to be constructed with inert electrodes placed into a solution of $SnCl_4$, there would be a pH decrease around the positive electrode.	✓	

Space for Personal Notes

Question 2 (6 marks)

Shriya is investigating the electrolysis of Iron (II) nitrate:



a.

i. Label the polarity of the left electrode by placing either a + or – sign in the circle provided on the diagram. (1 mark)

ii. Label the right electrode as either the anode or cathode in the box provided. (1 mark)

b.

i. Write the appropriate oxidation half-equation. (1 mark)

$Ni(s) \rightarrow Ni^{2+}(aq) + 2e^-$

ii. Hence or otherwise, calculate the EMF needed to be input in order to get this cell to operate. (1 mark)

$Ni(s) \rightarrow Ni^{2+}(aq) + 2e^-$

$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$

$-0.44 - (-0.25) = -0.19$. Therefore, $> 0.19\ V$ needed.

c. List three things that would be observed by Shriya as this cell operates. (2 marks)

1.

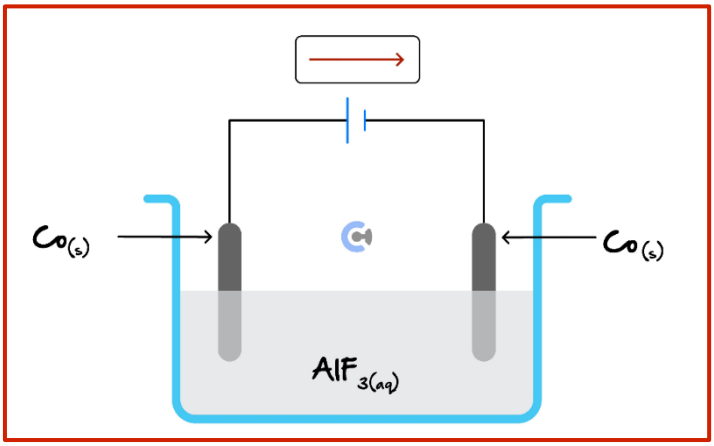
2.

3.

1. Decrease in mass of anode.
2. Iron coating forming on cathode/graphite electrode.
3. C (Fe^{2+}) ↓ ∴ solution becomes an even paler green.

Question 3 (6 marks)

The following electrolytic cell has been constructed by your friend using cobalt electrodes:



They are struggling with the operation of the cell and have come to you for assistance.

a. Label the direction of electron flow by placing an arrow in the box above. (1 mark)

b. Explain why both electrodes do not oxidise, despite Co being the strongest reductant present. (2 marks)

Only The Co (s) anode will oxidise (positive terminal) as the cathode (negative) is receiving electrons from the power source and can therefore not oxidise.

c.

i. Hence, write the balanced half-equation occurring at the anode. (1 mark)

$Co(s) \rightarrow Co^{2+}(aq) + 2e^-$

ii. Write the other relevant half-equation. (1 mark)

$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$

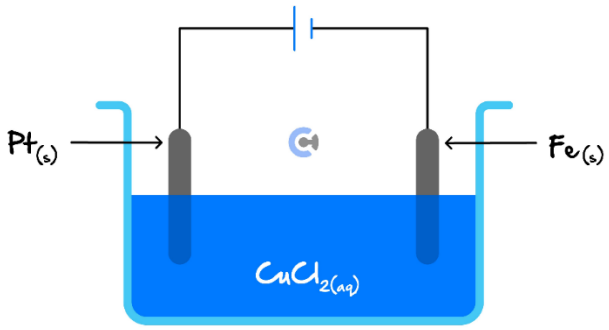
d. Hence or otherwise, explain what will happen to the pH of the electrolyte over time as the cell operates. (1 mark)

As OH^- is produced at the cathode, the pH will increase due to the solution becoming more basic around the negative electrode.

Section B: Extension (5 Marks)

Question 4 (5 marks)

Jonah constructs the following cell with scrap material he finds in his shed, with the hope of producing oxygen gas.



a. State whether or not this cell will achieve his goal. Justify your answer by using an appropriate half-equation. (2 marks)

Yes it would. The strongest reductant which can oxidise is water. ∴ Anode equation: $2H_2O(l) \rightarrow O_2(g) + 4H^+_{(aq)} + 4e^-$ Since this produces $O_2(g)$, Alice is happy. The reason Fe(s) cannot preferentially oxidise is because it is the cathode here.

b. Explain which electrode will increase in size. (1 mark)

$Cu^{2+}(aq)$ will reduce into Cu(s), coating the negative cathode and thus the Fe electrode will increase in size.

c. If Jonah had set up the cell in a professional laboratory at very high temperatures (with appropriate safety precautions being taken) such that the electrolyte were now molten (liquid), list one **other** safety precaution he would need to take, and explain why. (2 marks)

Water is no longer present → Cl^- is strongest reductant. Therefore, Cl^- will oxidise into $Cl_2(g)$, which is a toxic gas, so she must prevent the inhalation of it and trap and store the gas appropriately.

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