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VCE Chemistry ¾

Introduction to Electrolysis [2.1]

Test

20 Marks. 1 Minute Reading. 17 Minutes Writing

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (3 marks)

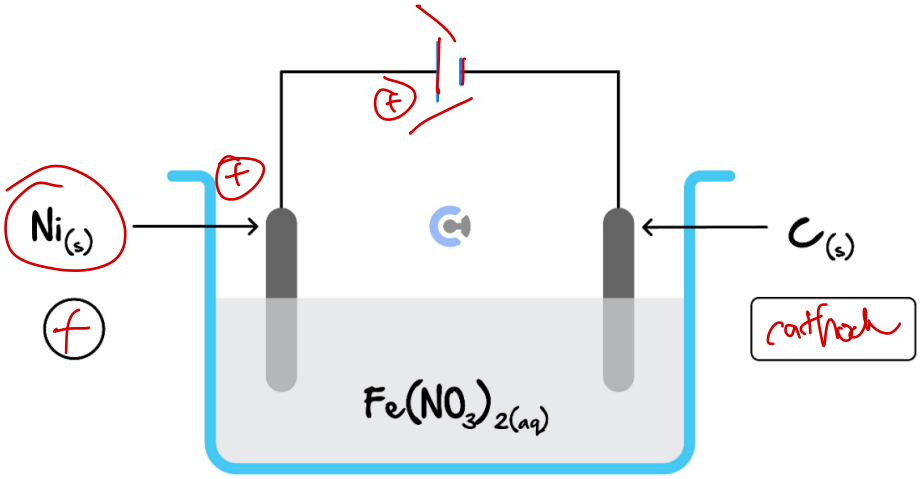
State whether the following statements are true or false by placing a tick in the appropriate box.

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)

$-0.44V - (-0.25V) = -0.19V$

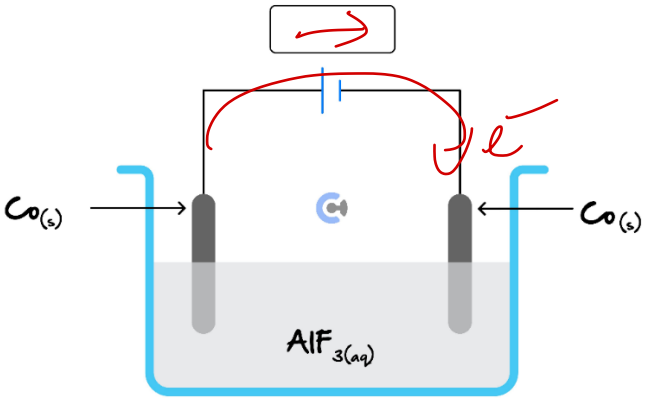
voltage required is $>0.19V$

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

1. Decrease in size of anode ($Ni_{(s)}$ reacts)
2. Iron coating / increase size of cathode
3. Colour of electrolyte turns less pale green (Fe^{2+} used)

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)

Both electrodes cannot oxidise as redox occurs in pairs & involves the transfer of electrons from anode → cathode. The cathode will not oxidise as it is receiving electrons. ∴ Co at cathode will 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)

$2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$

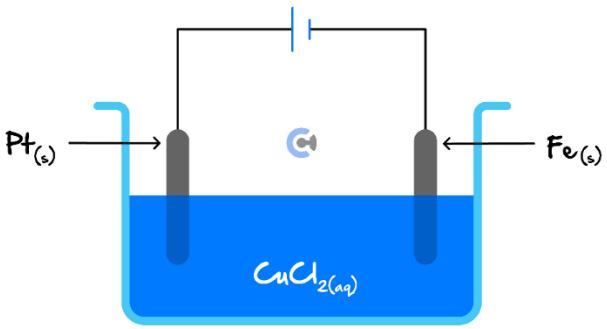
d. Hence or otherwise, explain what will happen to the pH of the electrolyte over time as the cell operates. (1 mark)

As OH^- is produced at cathode, solution turns more basic around negative electrode, & thus pH increase

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, Water is the strongest reductant & will oxidise:

$2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+ + 4e^-$

This reacts & produces $O_{2(g)}$.

While Fe(s) is the strongest reductant on paper, it is at the cathode & will not oxidise.

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

Fe/cathode. It gains size as Cu(s) is formed:

$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

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)

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