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VCE Chemistry $\frac{3}{4}$
Features of Electrolytic Cells [2.2]

Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing.

Results:

Test Questions	_____ / 15
Extension	_____ / 5



Section A: Test Questions (15 Marks)

Question 1 (4 marks)

Tick whether the following statements are **true** or **false**.

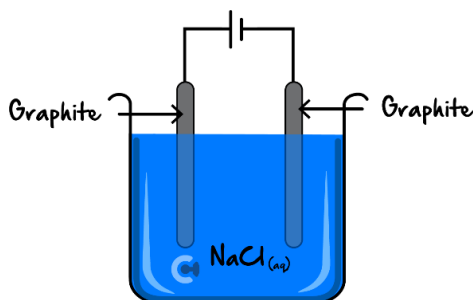
Statement	True	False
a. The conditions under which an electrolytic cell is set up will change the voltage needed but have no impact on the reactions taking place.		<input checked="" type="checkbox"/>
b. The reason 5.0 M NaCl is used in certain electrolytic cells is to produce sodium metal.		<input checked="" type="checkbox"/>
c. Molten conditions eliminate water as a potential reactant.	<input checked="" type="checkbox"/>	
d. Electrolytic cells are often constructed to produce chemicals.	<input checked="" type="checkbox"/>	
e. The reason CaCl_2 is added to NaCl in the electrolyte of the Down's Cell is so that there are more chloride ions available to react.		<input checked="" type="checkbox"/>
f. Major concerns surrounding hydrogen are that it is difficult to store, transport and detect leaks.	<input checked="" type="checkbox"/>	
g. The primary purpose of the PEM cell is to save energy and uphold the Green Chemistry Principle of "Design for Energy Efficiency".		<input checked="" type="checkbox"/>
h. Products of electrolysis are often immediately removed from the reaction vessel so as to prevent them from interfering with the cell.	<input checked="" type="checkbox"/>	

Space for Personal Notes

Question 2 (7 marks)

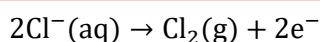
Ryan was cooking up some chicken for dinner when he realised that the brine solution (highly concentrated NaCl) he was marinating the chicken in could be electrolysed using inert electrodes.

He intends to produce oxygen and hydrogen gas.

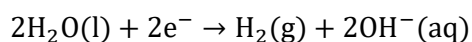


a.

- i.** Write the relevant half-equation occurring at the anode. (1 mark)



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



- b.** Hence or otherwise, outline 3 observations for this cell as it operates. (3 marks)

1. Bubbles (due to $\text{Cl}_2(\text{g})$) around the anode/positive electrode.

2. Bubbles (due to $\text{H}_2(\text{g})$) around the cathode/negative electrode.

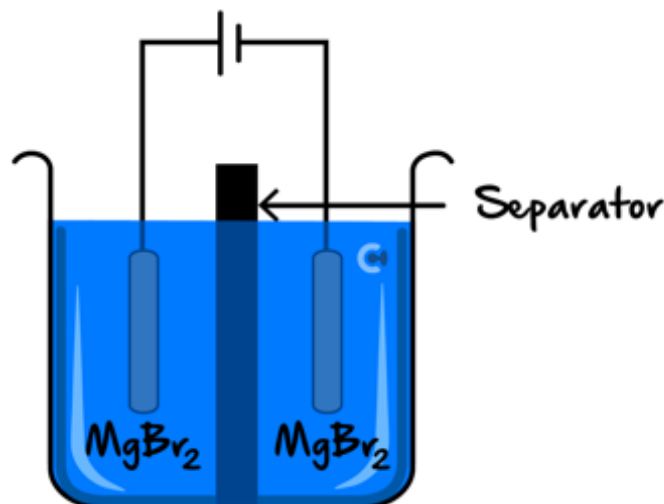
3. pH increase due to production of OH^- at cathode/negative.

- c.** State one Green Chemistry Principle which was unknowingly violated by Ryan in electrolysing brine. Justify your answer. (2 marks)

Designing safer chemicals (1). Due to the high concentration of the NaCl, Cl^- oxidised in preference to water, and thus instead of $\text{O}_2(\text{g})$, $\text{Cl}_2(\text{g})$ which is toxic, was produced instead (2).

Question 3 (4 marks)

A molten solution of magnesium bromide is being electrolysed by Feba in order to produce molten magnesium and gaseous bromine, using the set-up below.



- a. Write the overall equation occurring in this cell. (1 mark)



- b. Suggest one reason as to why Feba has placed a separator in the middle of the beaker. (1 mark)

In order to prevent the products of electrolysis from spontaneously reacting with one another.

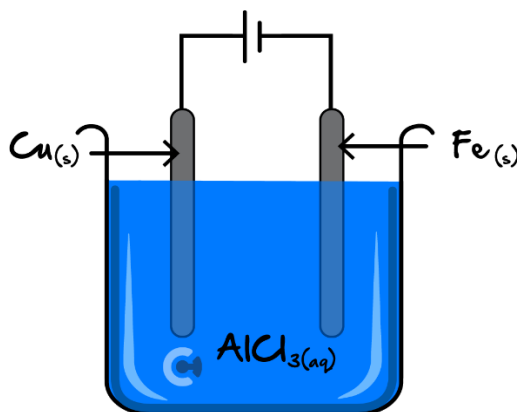
- c. The magnesium produced is less dense than water, resulting in it floating to the top of the electrolyte. Explain why this might be an issue, **and** propose a relevant precaution that should be undertaken by Feba to combat it. (2 marks)

The Mg(l) will spontaneously react with oxygen in the air, producing magnesium oxide, which defeats the purpose of producing Mg/causes an explosion (1). To combat this, she should pump out all the magnesium as it is produced/place the beaker into a sealed vessel (2).

Section B: Extension (5 Marks)

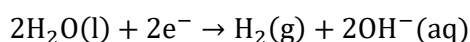
Question 4 (5 marks)

The following electrolytic cell was set up at 25°C using a highly concentrated, 10.0 M, AlCl_3 electrolyte.

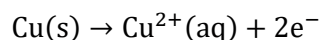


a.

- i. Write the relevant half-equation occurring at the negative electrode. (1 mark)



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



b.

- i. Instead of inputting electrical energy - like in this cell - what renewable energy source does artificial photosynthesis make use of? (1 mark)

Solar energy.

- ii. In artificial photosynthesis, list one of the United Nations Sustainable Development Goals which are not upheld. Justify your reasoning. (2 marks)

Clean water and sanitation (1). It makes use of clean water to produce hydrogen, and this water could be used as drinking water or for other purposes (2).



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