

## Lab B: Electrolysis (Electrolysis and Electrophoresis)



**Background:** Before learning about electrolysis and electrophoresis it helps to become familiar with the power supply and gel box. The electrode at which electrons enter the gel box from the power supply (along the black wire) is called the **cathode**, and is negative (-). The electrode at which electrons leave the box and re-enter the power supply (along the red wire) is called the **anode** and carries a positive charge (+). The flow of electrons sets up a potential energy difference between the electrodes. This is known as **potential** and is measured in **volts**. It establishes an electric field through which the ions in the gel box fluid move or "migrate." The migration of ions in the fluid creates electrical **current** that is measured in milliamperes (**milliamps**)

The splitting of water using electricity is called **electrolysis**. The chemical equation may be stated as:



As long as the hydrogen and hydroxide ions are in equal concentration the solution has a neutral pH. Relative increases in the hydrogen ion ( $\text{H}^+$ ) concentration will cause the solution to become acidic. Relative increases in the hydroxide ( $\text{OH}^-$ ) concentration will cause the solution to become basic.

### Materials:

power supply	sodium chloride solution [1M]	2 1mL Plastic Pipettors
gel box	300 mL distilled water	paper towels/Kimwipes
container for waste	measuring device (10 mL)	10 mL buffer [1X TAE or TBE]
liquid soap	phenol red dye solution	

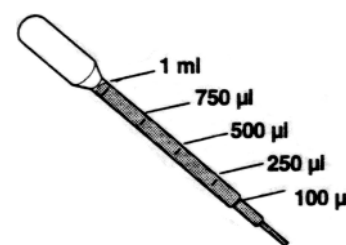
**Purpose:** To learn how to use the power supply and gel box in electrophoresis.

### CAUTION:

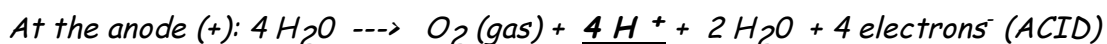
- Open and close the gel box according to the instructions given by your teacher. Slide the lid off the gel box off by using the small finger hold "mounds" on the top of the lid. **DO NOT, repeat, DO NOT PULL ON THE WIRE LEADS TO REMOVE THE TOP!!!**
- For your safety, the gel box is designed so that when the lid is slid off the is designed so electrodes are automatically disconnected.
- Since any wet surface can become conductive, it is advisable **NOT** to **touch** any part of the apparatus (gel box, wires) while the power supply is on. This is especially important if the outside of the box is wet, or if your hands are wet.

## Procedure

1. Examine the power supply and identify:  
on/off switch  
plugs for leads (2 sets)  
voltage select dial  
switch between volts/milliamps  
digital display  
lo/high switch (not present on all models)
2. With the power supply OFF, connect the empty gel box to the power supply.
3. Set the lo/hi switch (if present on your power supply) to LO, turn the power supply ON, and select a potential of 100V (volts). Record the current (measured in milliamperes) generated in the empty gel box in the data table.
4. Turn the power supply OFF.
5. Open the gel box, and add 300 mL of distilled water. Turn the power supply ON. With a potential of 100V, record the current in the in the data table.
6. Turn the power supply OFF.
7. Add 1 mL of the sodium chloride solution to the distilled water in the box. Note the markings on the pipette. Carefully "slosh" the box to mix the salt and water. Turn the power supply ON. Set the voltage to 100V. Record the current in table 1.
8. Continue to add one more milliliter of sodium chloride for a total of 2 milliliters and repeat the steps in number 7. Record the current in the data table.



*When current is flowing, the chemical reactions at the cathode and anode indicate that differences in pH develop at either end of the box:*



9. To verify that a change in pH is occurring during electrolysis, we will use an indicator dye called phenol red. Use a different pipette to add 0.1 ml (100 µl) of phenol red to the gel box. Gently slosh until the liquid in the gel box is a uniform color.
10. Now turn the power supply ON. At 100 V, record the current. Record the time it takes for color changes to take place.
  - (a) The accumulation of OH<sup>-</sup> makes the solution basic. This is confirmed by the phenol red remaining pink.
  - (b) The accumulation of H<sup>+</sup> makes the solution acidic. This is confirmed by the phenol red turning yellow.
11. Turn the power supply OFF.
12. Add 10 mL of buffer solution. Slosh well to mix. What color is the solution?
13. Turn the power supply ON again and select about 100 V. Record the current. Record the time for color changes, if any. What might the lack of a color change tell us about the effect of buffer on pH?

Data

<b>GEL BOX CONTENTS</b>	<b>POTENTIAL (volts)</b>	<b>Current (milliamps)</b>	<b>OTHER OBSERVATIONS (color changes, bubbles, etc.)</b>	<b><i>Time Required For color change</i></b>
Empty gel box (air only inside)	100 V			
+ 300 ml Distilled H <sub>2</sub> O	100 V			
Distilled H <sub>2</sub> O + 1 mL NaCl	100 V			
Distilled H <sub>2</sub> O +1 more mL NaCl	100V			
Distilled H <sub>2</sub> O 2 ml Na Cl + 100 μl phenol red	100 V			Time in seconds =
Distilled H <sub>2</sub> O 2 ml Na Cl, 100 μl phenol red + 10 ml buffer solution	100 V			Time in seconds =

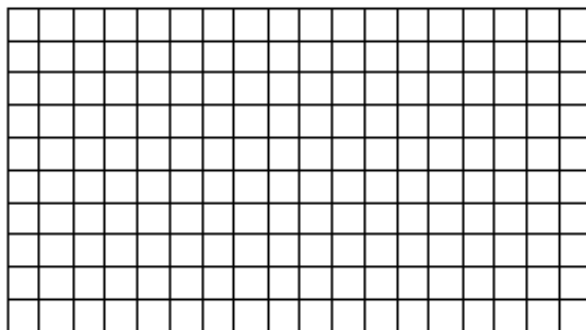
## Analysis

Use the graph below to create a bar graph indicating the milliamps produced under the following conditions:

1. The empty gel box
2. The gel box with 300 ml distilled water.
3. The gel box with 300 ml distilled water plus 1 ml NaCl.
4. The gel box with 300 ml distilled water plus a total of 2 ml NaCl.
5. The gel box with 300 ml distilled, the 2 ml NaCl plus 100  $\mu$ l phenol red
6. The gel box with 300 ml distilled, the 2 ml NaCl, 100  $\mu$ l phenol red plus 10 ml buffer solution

Title:

Current (in milliamps)



## Questions:

1. What was the effect of sodium chloride on the current?
2. What was the purpose of the phenol red? What were the color changes and what did they indicate?
3. What was the effect of the buffer?
4. What gas was produced at the anode and what gas was produced at the cathode?
5. Was the cathode side acidic or basic? Was the anode side acidic or basic?
6. What substance was produced to make one of the sides acidic? Basic?

## Conclusion