### UNIT 7 POTENTIAL DIFFERENCE AND CURRENT IN DC CIRCUITS: AN INTRODUCTION

### Objectives

- to understand the concept of potential difference as applied to electric circuits
- to understand the concept of current as the amount of charge per unit time crossing a cross-sectional area of a wire

### Equipment:

Wimshurst machine
parallel plate capacitor
electroscope
circular piece of Lexan
alligator clips
bulb
socket

## 1.1

Set up a Wimshurst machine in connection with a parallel plate capacitor, with a piece of Lexan in between the plates, and an electroscope as shown in the diagram below.



**a.** When you turn the crank of the Wimshurst Machine what will happen to the charge on the capacitor plates? Explain your reasoning. Devise a test to determine if this is actually the case.

**b.** Carry out the test in part **a**.

**c.** What happens to the electroscope when you turn the crank of the Wimshusrt Machine? Explain your reasoning.

**d.** Can the electroscope be used as an indicator of the charge on the capacitor plates? Explain your reasoning.

**e.** What would happen if there were a lot of charge on the two capacitor plates and you connected a wire between the two plates? Explain your reasoning.

**f.** Crank up the Wimshurst Machine at a fairly slow cranking rate until the movable electroscope leaf is at about a 45 degree angle with the vertical. Then connect one end of a bulb (in a socket) to one capacitor plate and the other end of the bulb to the other capacitor plate, but do this simultaneously. **You must connect each end of the bulb to the capacitor plates at the same time.** Describe what you see. Discuss your observations with an instructor.

g. Explain why the bulb lights briefly and then goes out.

**1.2** Consider a capacitor with charge +Q on one plate and charge –Q on the other plate.

**a.** If a wire is now connected, as in the diagram below, would charge flow in the wire?



(i) If so, explain why charge would flow in terms of the electric field.

(ii) If not, explain why not.

**b.** If you could keep a constant charge +Q on one plate and charge –Q on the other plate, would charge flow through the wire?

(i) If so, explain why charge would flow in terms of the electric field.

(ii) If not, explain why not.

Discuss your answer with an instructor.

The amount of charge per unit time passing a cross-sectional area of a wire is called current. The symbol for current is I. Mathematically,

$$I = \frac{\Delta Q}{\Delta t}$$

The unit of current is the Ampere (A). One Ampere is equal to one Coulomb per second: 1A = 1C/s.

# 1.3

**a.** Describe the potential difference between the two plates in parts **1.2.a** and **1.2.b**. Would the potential difference increase, decrease, or remain the same in each case? Explain your reasoning.

**b.** How could you keep the potential difference between two plates constant? Explain your reasoning.

Explain your reasoning to your instructor.

A battery is a mechanism for keeping the potential difference between two plates constant. When working with circuits, the potential difference between the two ends of the battery is called the voltage of the battery.

## SUMMARY

You should understand the concept of potential difference as applied to electric circuits. You should understand the concept of current as the amount of charge per unit time passing a cross-sectional area of a wire.