

**ENGINEERING GATORTRAX MATH EXCELLENCE PROJECT**  
**ENGINEER-FOR-A-DAY LABORATORY MODULES**

**ELECTRICAL ENGINEERING**  
**ADVANCE LEVEL**  
**USE OF ELECTRICAL CIRCUITS FOR DEMONSTRATION**  
**OF**  
**LINEAR EQUATIONS**

**Introduction**

Electrical engineering is concerned with the uses of electrical energy. This energy is used in the various appliances, equipment, and instruments with which we come into contact on a daily basis. The key component of these appliances equipment and instruments is the electrical circuit.

Using this circuit electrical engineers are able to design

- Communications systems
- Computers
- Electronic components for computers, stereos systems and TVs
- Robots
- Aircraft and spacecraft controls
- Utility and industrial power systems
- Biological/medical systems

Electrical circuits general contains

- Switches
- Resistors
- Connecting wires

**Objective**

The objective of this lab is to demonstrate algebraic concepts using electronic circuits.

**Goal**

Link the use of classroom mathematics to the real world.

**Activity Description/Problem Statement**

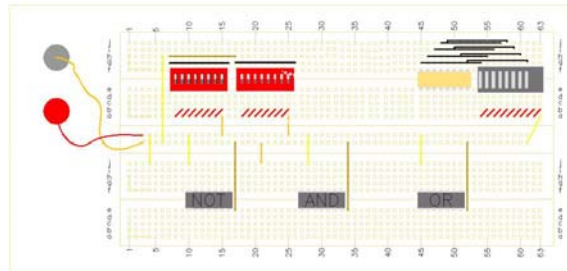
Today we are electrical engineers who are responsible for determine the voltage which will be received by an instrument equipped with a designed circuit board. We will be using a voltage source and resistors to build the

circuit, and a multimeter for the measurement of different voltages in the circuit.

**Materials for each Team**

First, go through the material inside the box and make sure you have the following:

1. Designed board



2. Power supply



3. Multimeter



4. 3 1k Resistors (black and red)



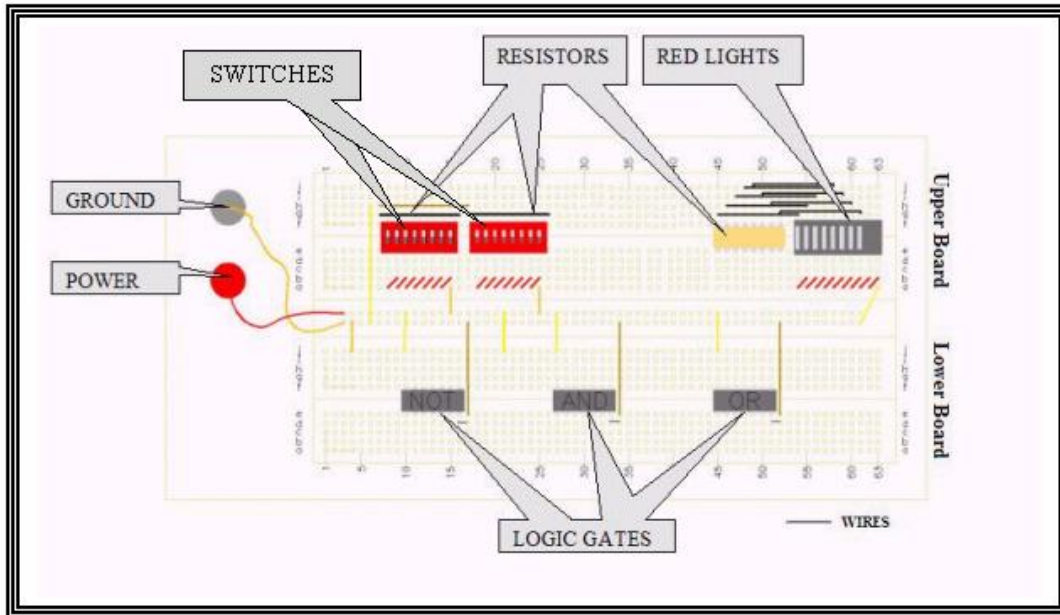
5. 3 2.2k Resistors (red and red)



6. Wires



Second, check that your board is complete by comparing it to the picture below and checking with the check list below:



<b>CHECK LIST</b>	
	3 Resistors
	8 Red Lights (off)
	3 Logic Gates
	Power
	Ground
	Wires
	2 Set of Switches

- For this activity we will be using only the lower part of the board.
- For the **CONNECTIONS SECTION** in each step you would be asked to place a wire or resistor from one point to another, this will be given in coordinates form, composed of one letter and a number.
- Also make the distinction between the upper and the lower board. The **BOARD SCHEMATIC** will show the wire or resistor you are connecting at the given step. To check all the connections that are suppose to take place at the moment refer to the **CONNECTIONS SECTION**.

## **GENERAL LAB PROCEDURES**

The following procedures will take place in every step of the lab:

CONNECTIONS:

1. Make the connections as listed in the **CONNECTIONS SECTION**. Use the **BOARD SCHEMATIC** to have a better idea of where the connections take place.

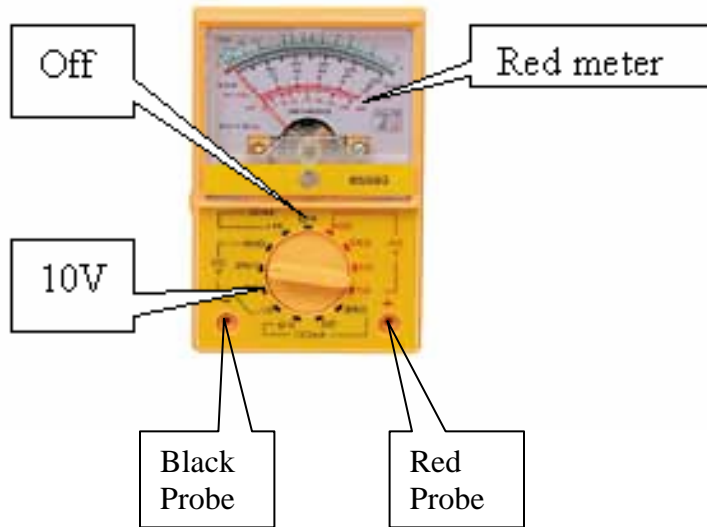
EXPERIMENT  
OBSERVATION :

2. Turn on the multimeter. In order to turn it on, move the knob from the 0 position to 10 DC which is the black portion on the left lower corner.
3. Use the multimeter to measure the voltage at a given point. The “callouts” on the **BOARD SCHEMATIC**, indicates where to place the red and black probe from the multimeter. The B callout refers to the black probe and the R callout to the red one. If there is more than one R on the **BOARD SCHEMATIC**, it means that you have more than one measurement to take.
4. Record the voltage measurement obtained from the multimeter (red meter) in the **ANSWER TABLE**.
5. Turn the multimeter off by positioning the knob back to 0.

ANALYZE  
YOUR ANSWERS:

6. Compare the answer obtained in your calculations during the lecture with the one obtained from the multimeter by contrasting the respective **ANSWER TABLE**. Make comments on it.

## Multimeter Information



## ELECTRICAL ENGINEERING

**ADVANCE LEVEL  
USE OF ELECTRICAL CIRCUITS FOR DEMONSTRATION  
OF  
ALGEBRAIC EQUATIONS**

**ACTIVITY LEVEL 1**

**CONNECTIONS:**

1. Make the connections as listed in **CONNECTIONS SECTION, Table 1**. Use the **BOARD SCHEMATIC** to have a better idea of where the connections take place. For an enlarge view of the **BOARD SCHEMATIC, Figure 1**, turn to the back of the page.

**BOARD SCHEMATIC**

Table 1

CONNECTIONS SECTION	
1	B4i => B21i (black & red resistor)
U= upper board	B= lower board

**EXPERIMENT  
OBSERVATION :**

2. Turn on the multimeter. In order to turn it on, move the knob from the 0 position to 10 DC which is the black portion on the left lower corner.
3. Use the multimeter to measure the voltage at a given point. The “callouts” on the **BOARD SCHEMATIC, Figure 1**, indicates where to place the red and black probe from the multimeter. The B callout refers to the black probe and the R callout to the red one.
4. Record the voltage measurement obtained from the multimeter (red meter) in the **ANSWER TABLE 1**.
5. Turn the multimeter off by positioning the knob back to 0.



ANSWER TABLE 1	
$V_0$	5 V

Red0

ANALYZE

YOUR ANSWERS:

6. Compare the answer obtained in your calculations during the lecture with the one obtained from the multimeter by contrasting the two ANSWER TABLE 1. Comment on it.

---

---

---

---

---

**ACTIVITY LEVEL 2**

**CONNECTIONS:**

1. Make the connections as listed in **CONNECTIONS SECTION, Table 2**. Use the **BOARD SCHEMATIC** to have a better idea of where the connections take place. For an enlarge view of the **BOARD SCHEMATIC, Figure 2**, turn to the back of the page.

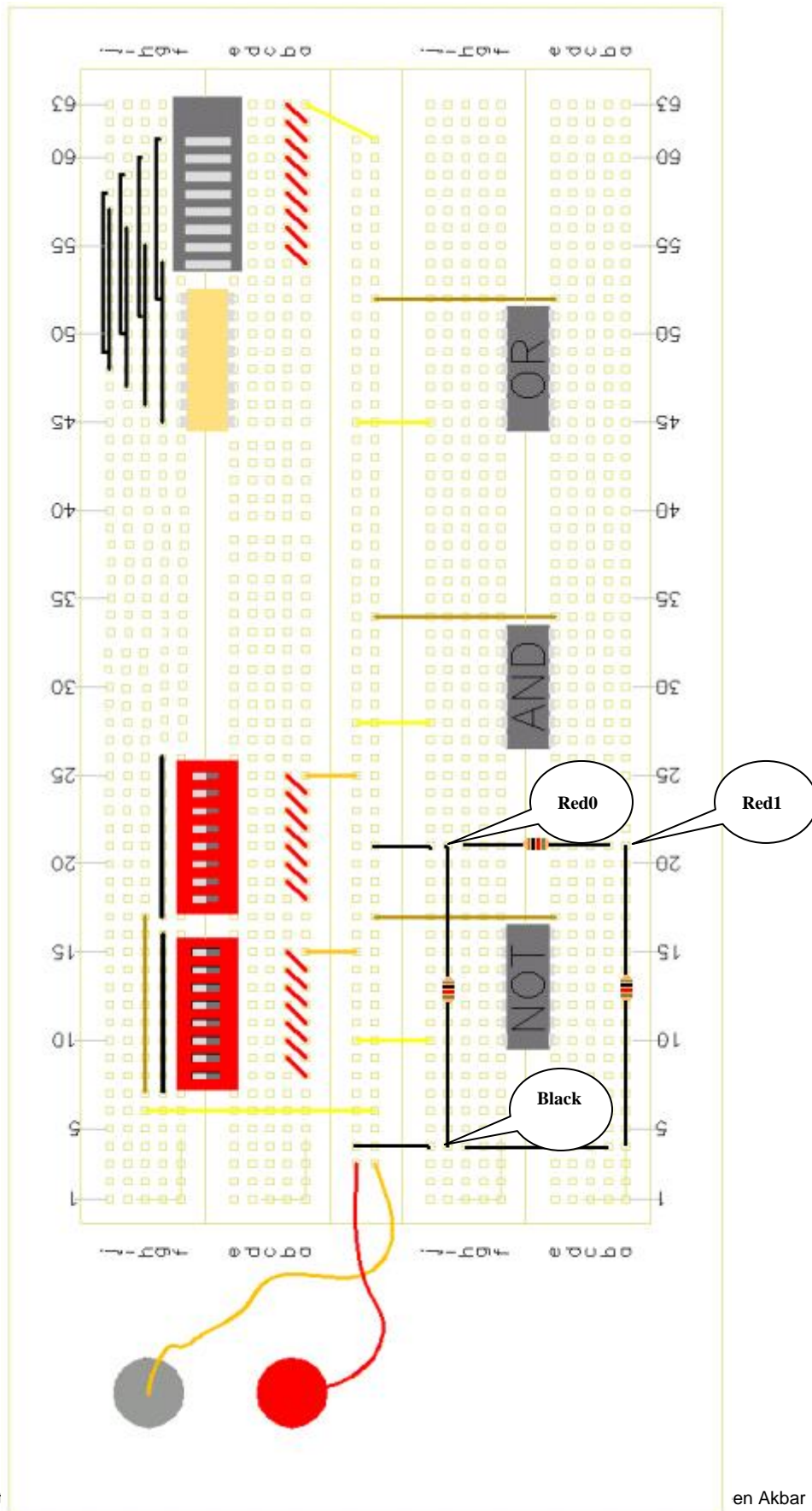
**BOARD SCHEMATIC**

<b>CONNECTIONS SECTION</b>		
1	B4i => B21i (black & red resistor)	✓
2	B4a => B21a (black & red resistor)	
3	B21b => B21h (black & red resistor)	
4	B4b => B4h (wire)	
U= upper board		B= lower board

**Table 2**

**EXPERIMENT**  
**OBSERVATION :**

2. Turn on the multimeter. In order to turn it look, move the knob from the 0 position to 10 DC which is the black portion on the left lower corner.
3. Use the multimeter to measure the voltage at a given point. The “callouts” on the **BOARD SCHEMATIC, Figure 1**, indicates where to place the red and black probe from the multimeter. The B callout refers to the black probe and the R callout to the red one. If there is more that one R on the **BOARD SCHEMATIC**, it means that you have more than one measurement to take.
4. Record the voltage measurement obtained from the multimeter (red meter)in the **ANSWER TABLE 2**.
5. Turn the multimeter off by positioning the knob back to 0.



**Figure 2**

ANSWER TABLE 2	
$V_0$	<u>5</u> V
$V_1$	<u>2.5</u> V

The diagram shows two callout boxes, one labeled 'Red0' and one labeled 'Red1'. Red0 has a line pointing to the '5' in the  $V_0$  row. Red1 has a line pointing to the '2.5' in the  $V_1$  row.

ANALYZE

YOUR ANSWERS:

6. Compare the answer obtained in your calculations during the lecture with the one obtained from the multimeter by contrasting the two ANSWER TABLE 2. Comment on it.

---

---

---

---

---

**ACTIVITY LEVEL 3**

**CONNECTIONS:**

1. Make the connections as listed in **CONNECTIONS SECTION, Table 3**. Use the **BOARD SCHEMATIC** to have a better idea of where the connections take place. For an enlarge view of the **BOARD SCHEMATIC, Figure 3**, turn to the back of the page.

**BOARD SCHEMATIC**

<b>CONNECTIONS SECTION</b>		
1	B4i => B21i (black & red resistor)	✓
2	B4a => B21a (black & red resistor)	✓
3	B21b => B21h (black & red resistor)	✓
4	B4b => B4h (wire)	✓
5	B21c => B27c (wire)	
6	B27b => B27h (red & red resistor)	
7	B21g => B27g (wire)	
U= upper board		B= lower board

**Table 3.1**

**EXPERIMENT  
OBSERVATION :**

2. Turn on the multimeter. In order to turn it look, move the knob from the 0 position to 10 DC which is the black portion on the left lower corner.
3. Use the multimeter to measure the voltage at a given point. The “callouts” on the **BOARD SCHEMATIC, Figure 3**, indicates where to place the red and black probe from the multimeter. The B callout refers to the black probe and the R callout to the red one.
4. Record the voltage measurement obtained from the multimeter (red meter) in the **ANSWER TABLE 3**.
5. Turn the multimeter off by positioning the knob back to 0.

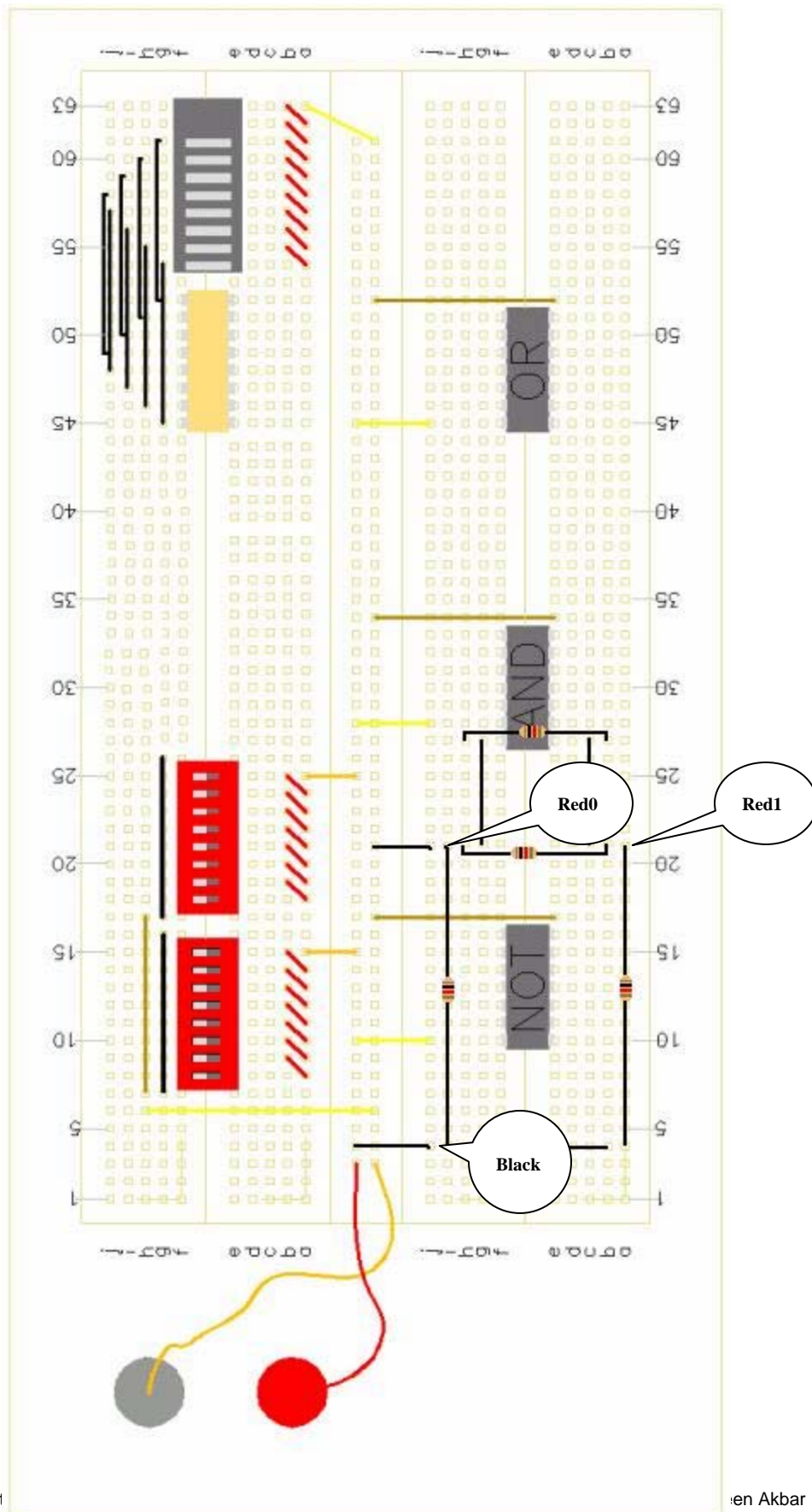


Figure 3

ANSWER TABLE 3	
$V_0$	<u>5</u> V
$V_1$	<u>2.96</u> V

The diagram shows two callout bubbles. The top bubble, labeled 'Red0', has a line pointing to the '5' in the  $V_0$  row. The bottom bubble, labeled 'Red1', has a line pointing to the '2.96' in the  $V_1$  row.

ANALYZE  
YOUR ANSWERS:

6. Compare the answer obtained in your calculations during the lecture with the one obtained from the multimeter by contrasting the two ANSWER TABLE 3. Comment on it.

---

---

---

---

---