ELECTRONICS ENGINEERING DEPARTMENT SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY, SURAT
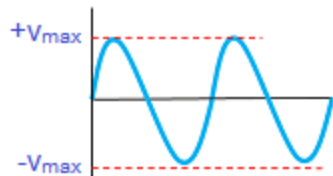
DIGITAL ELECTRONICS & LOGIC DESIGN LAB

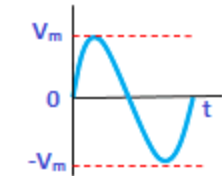(EC207)

OBJECTIVES & OUTCOMES OF THIS LAB

▶ Acquire knowledge about different types of diodes and circuits

▶ Apply the knowledge of Logic gates and Boolean algebra in design of logical circuits

▶ Analyze the integrated and Operational amplifier based circuits

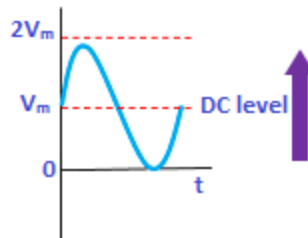▶ Evaluate different Transistor based circuits and compare their performance
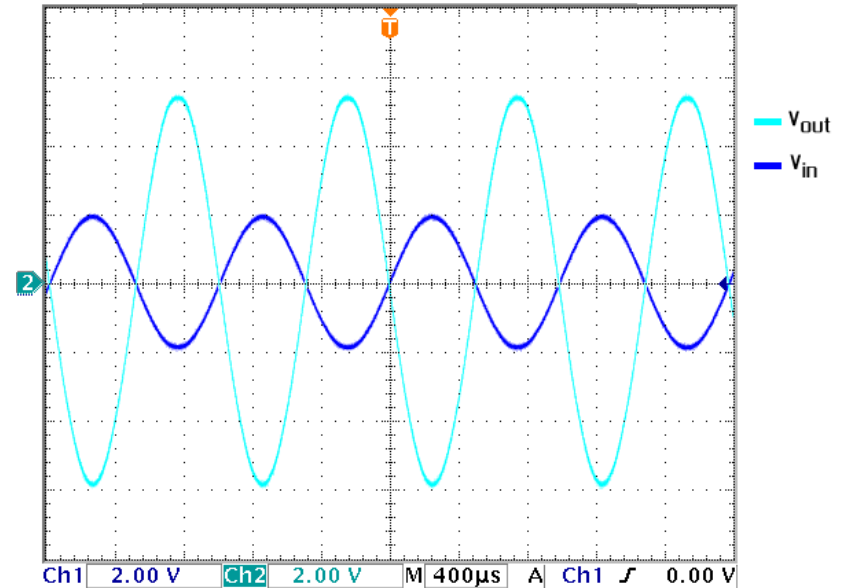
A FEW EXAMPLES OF APPLICATIONS

+V_{max}

$-V_{max}$

Input waveform

$-V_{max}$

Output waveform

V_m

0

$-V_m$

t

Input waveform

$2V_m$

V_m — DC level

0

t

Output waveform

v_{out}

v_{in}

Ch1   2.00 V   Ch2   2.00 V   M 400µs   A   Ch1 ∫   0.00 V

0 + 1 + 1 = 1

1 + 1 + 1 = 1

0 + 1 + 1 + 1 = 1

1 + 0 + 1 + 1 + 1 = 1

Noisy signal

Filtered signal

Time (s)

Time (s)
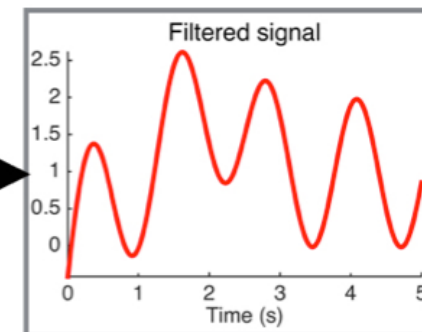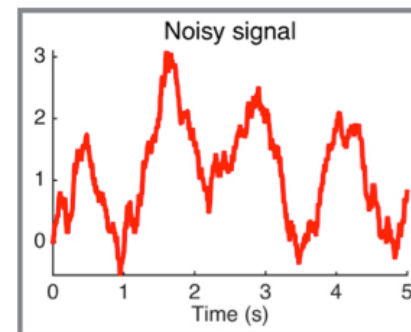
INTRODUCTION TO MULTISIM

‣ By National Instruments (NI)

‣ Tool for Schematic capture of electronic circuits

‣ Used to

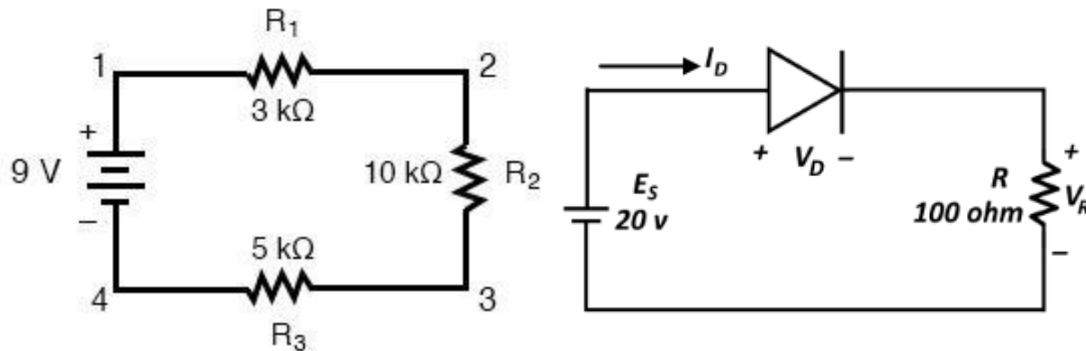 ‣ simulate electronic circuits and

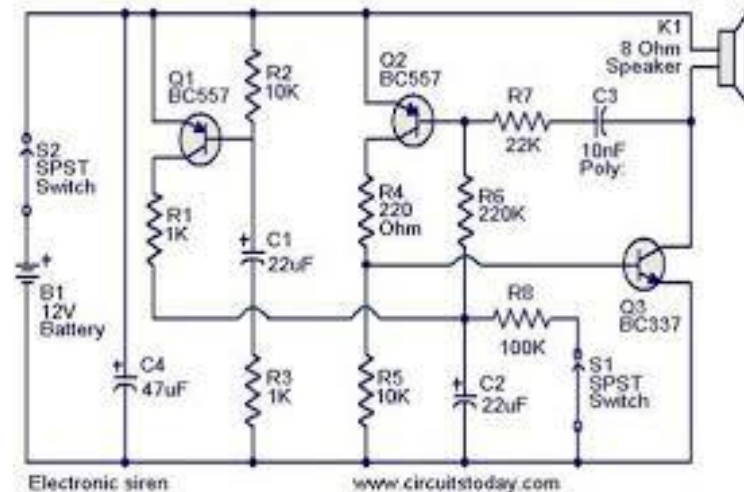 ‣ prototype Printed Circuit Boards (PCBs)

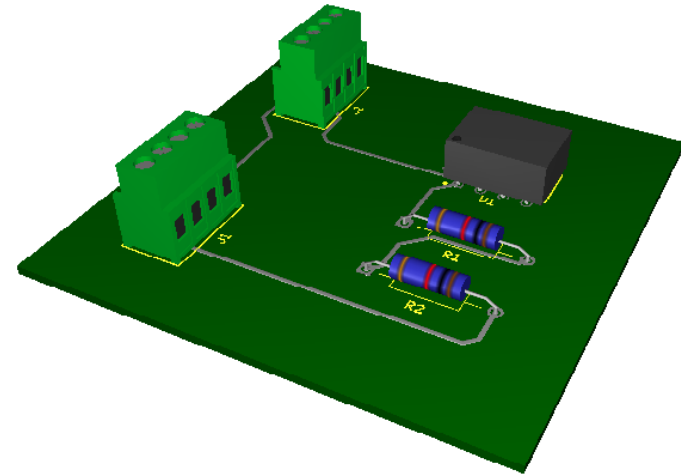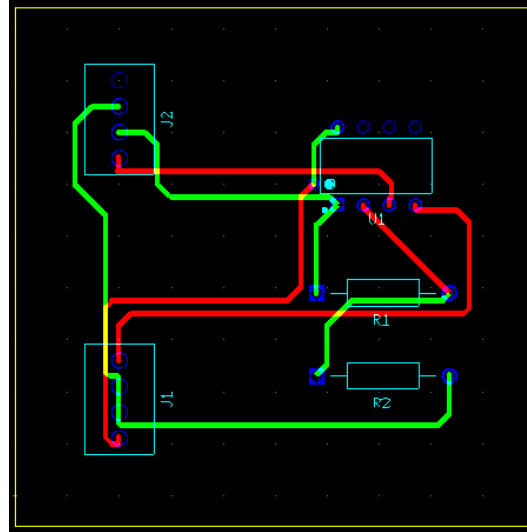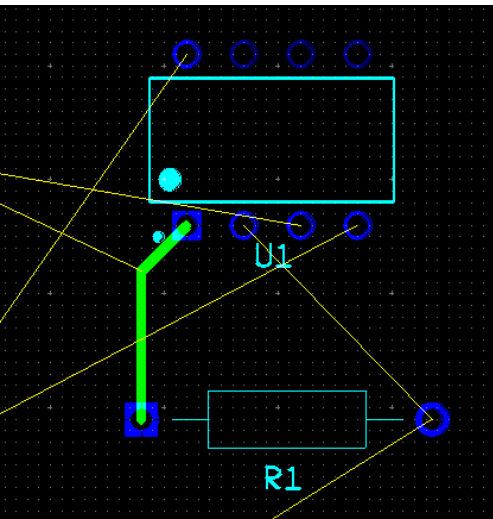Fig.: Examples of Electronic Circuits

INTRODUCTION TO MULTISIM

Fig.: Example- PCB Design

GETTING STARTED WITH MULTISIM

▶ Multisim Live is a free online circuit simulator that includes SPICE software, which lets you create, learn and share electronics circuits online.

▶ No installation is required!!

▶ Create a free profile on:

    https://lumen.ni.com/nicif/create.xhtml

GETTING STARTED WITH MULTISIM

- After Filling details, a verification mail would be sent to registered mail id
- Click on verification link and activate your account.
- That's it. You're ready!!!

- Login to your account and lets start exploring....

Create an NI User Account

Already have an account? Log In >

Alias

First Name   **Last Name**

Role

Student

Company

Sardar Vallabhbhai National Institute of Technolo

Email Address

Password

●●●●●●●●●

CREATE ACCOUNT

- ▶ UI appears as shown.
- ▶ Click on Create Circuit
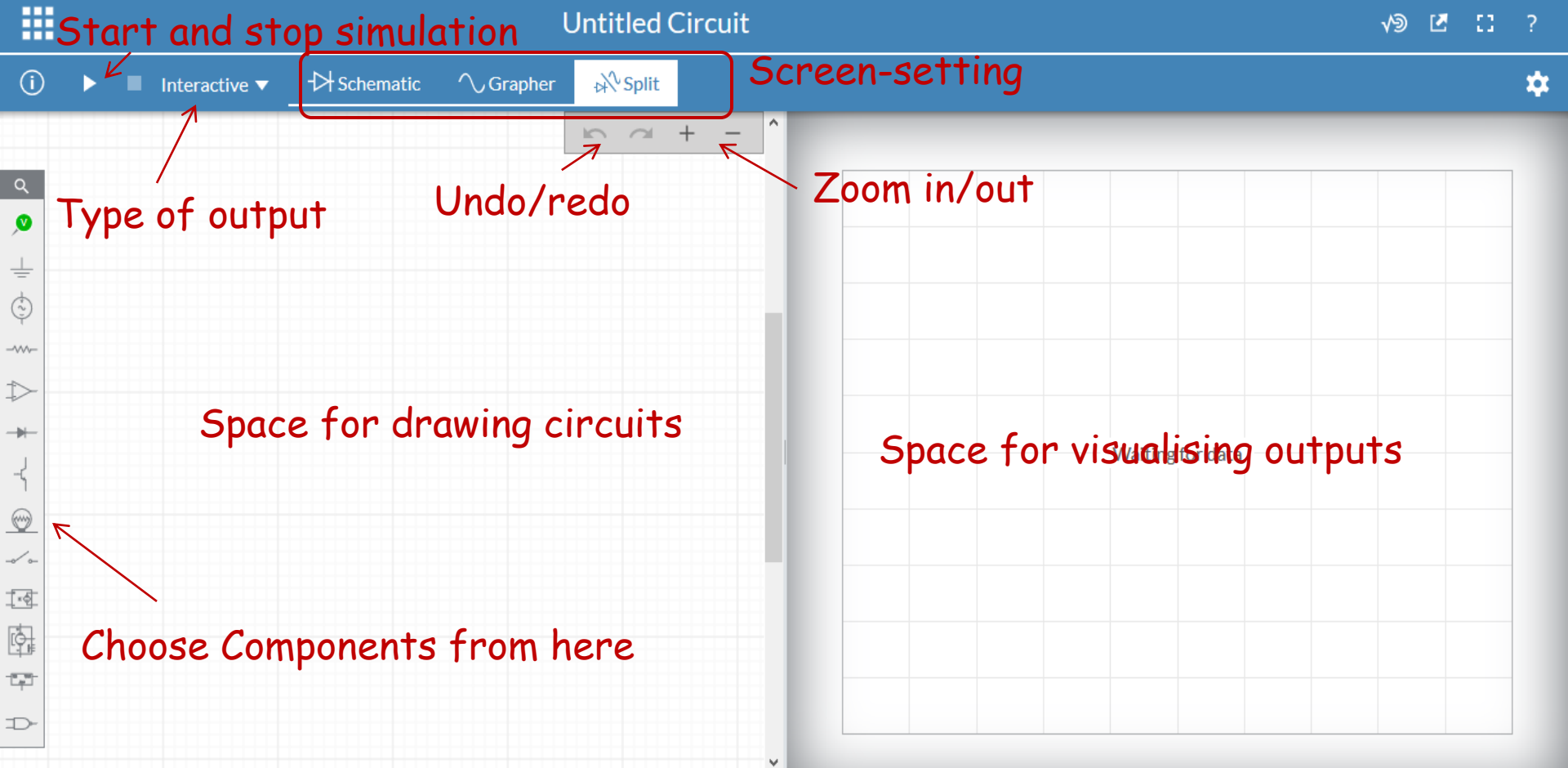
- The UI loads in a couple of seconds.
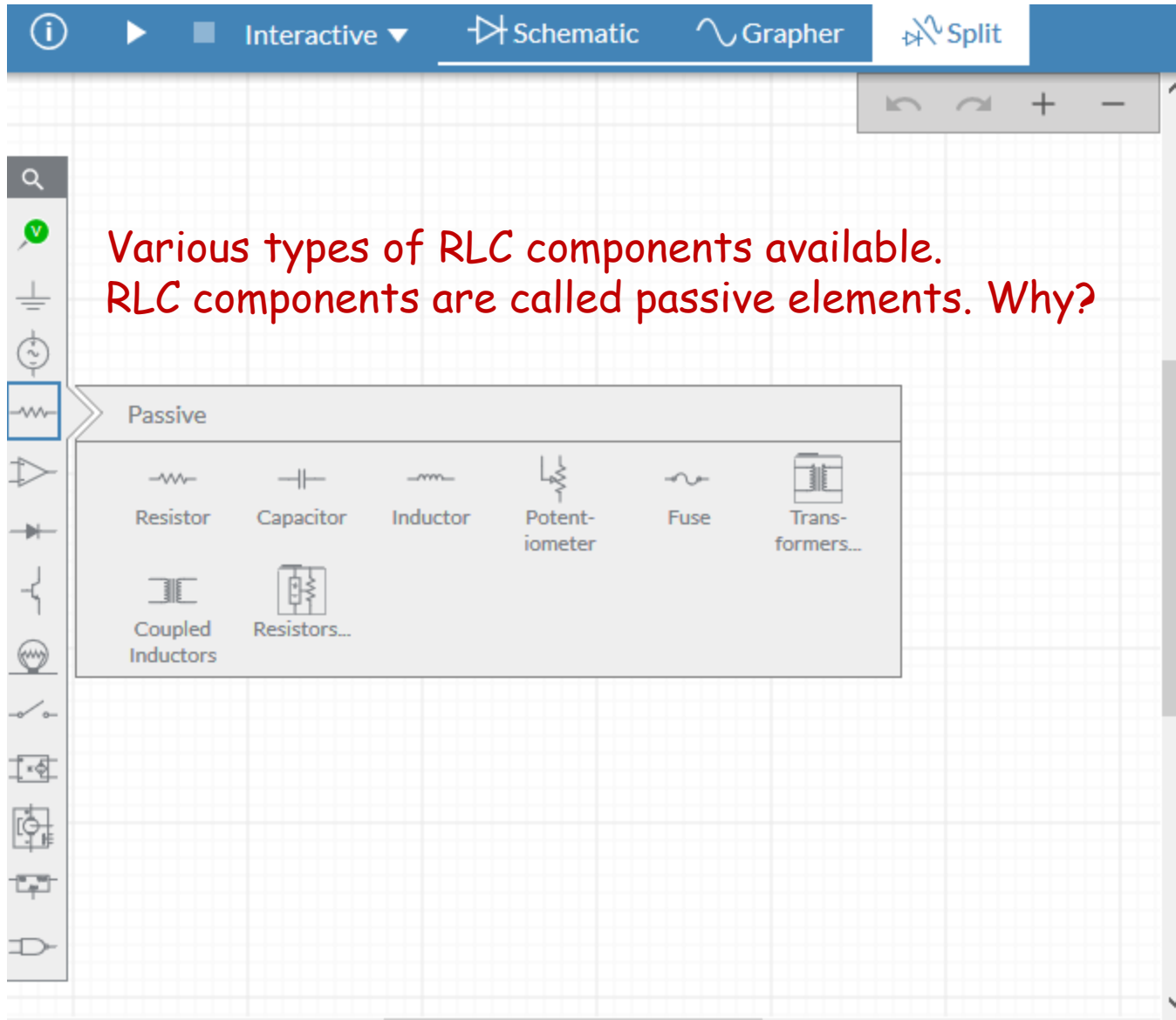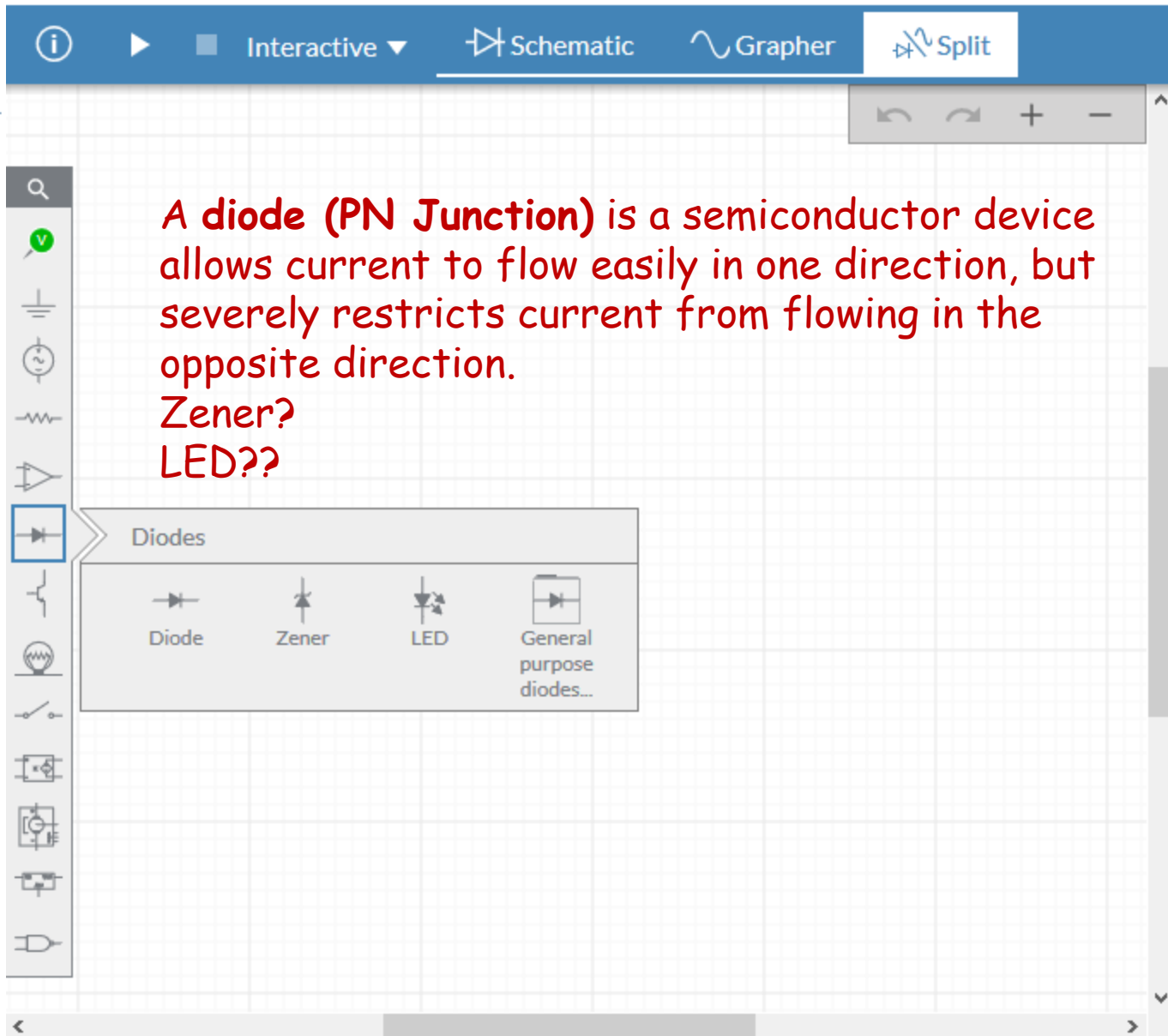- Lets understand the UI.
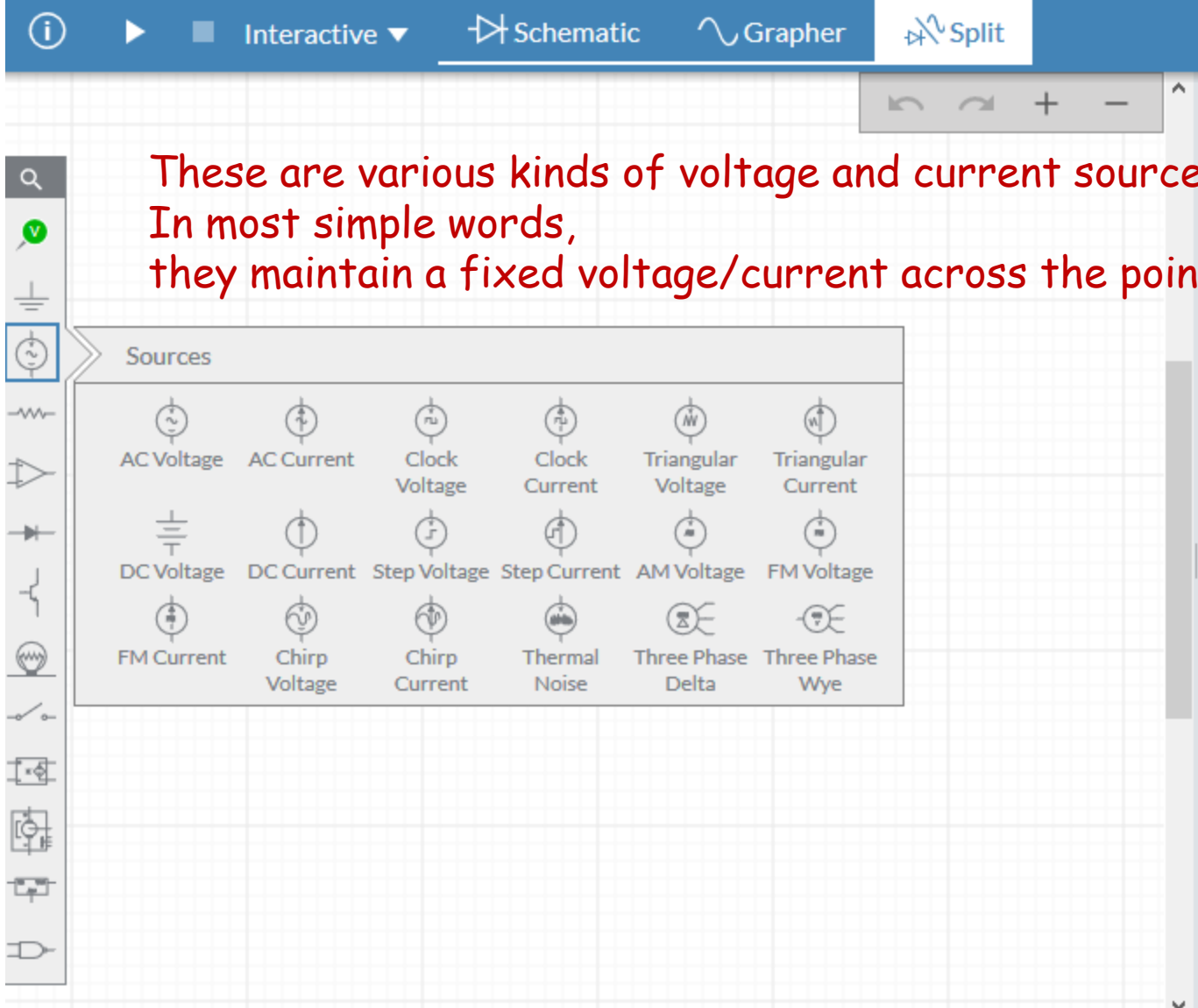
These are various kinds of voltage and current sources available.
In most simple words,
they maintain a fixed voltage/current across the points they are connected

▸ Lets explore the components available

▸ Some of these we shall explore as lab proceeds....

Various types of RLC components available.
RLC components are called passive elements. Why?

A **diode (PN Junction)** is a semiconductor device allows current to flow easily in one direction, but severely restricts current from flowing in the opposite direction.
Zener?
LED??

Diodes

| Diode | Zener | LED | General purpose diodes... |

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power.

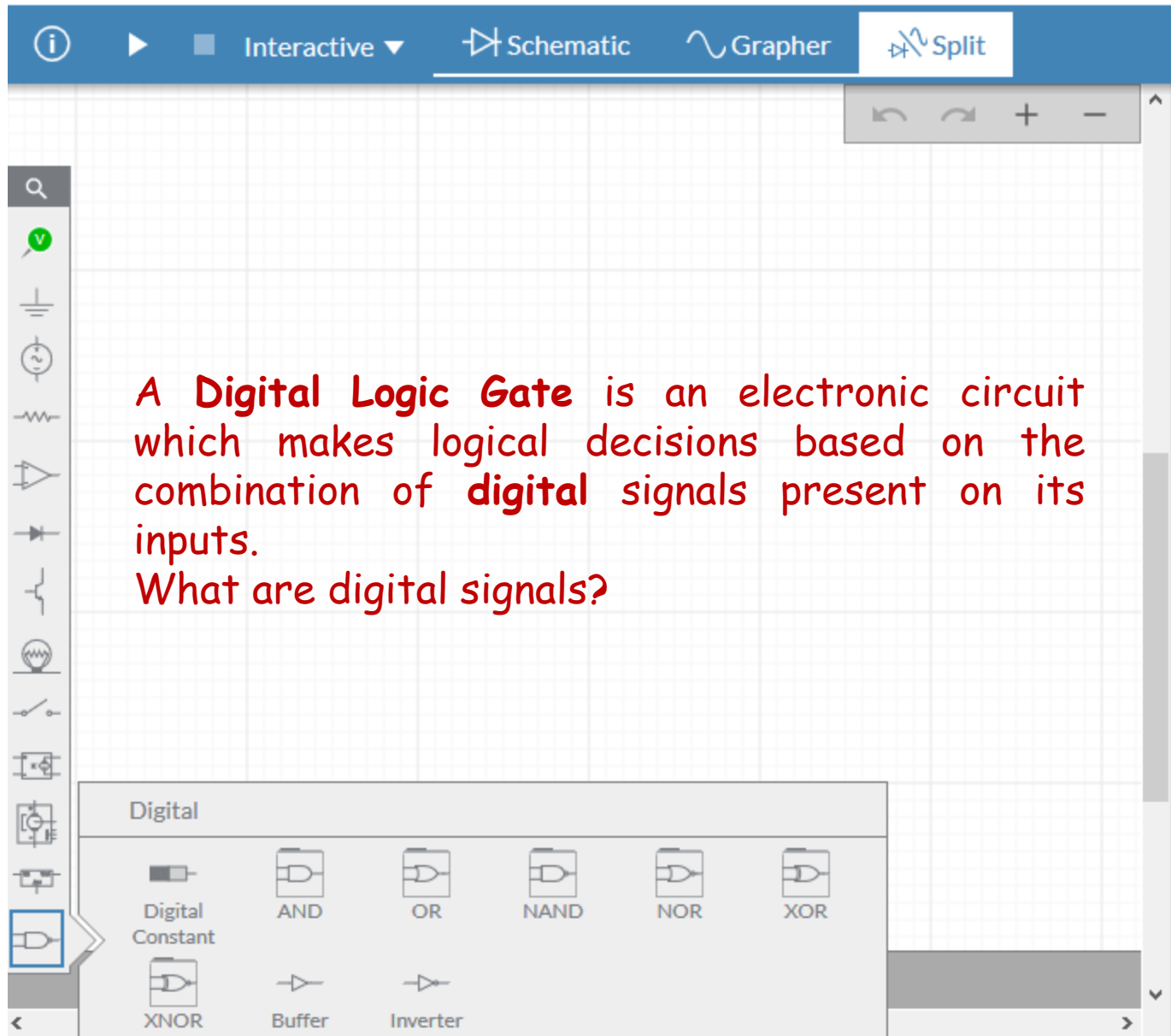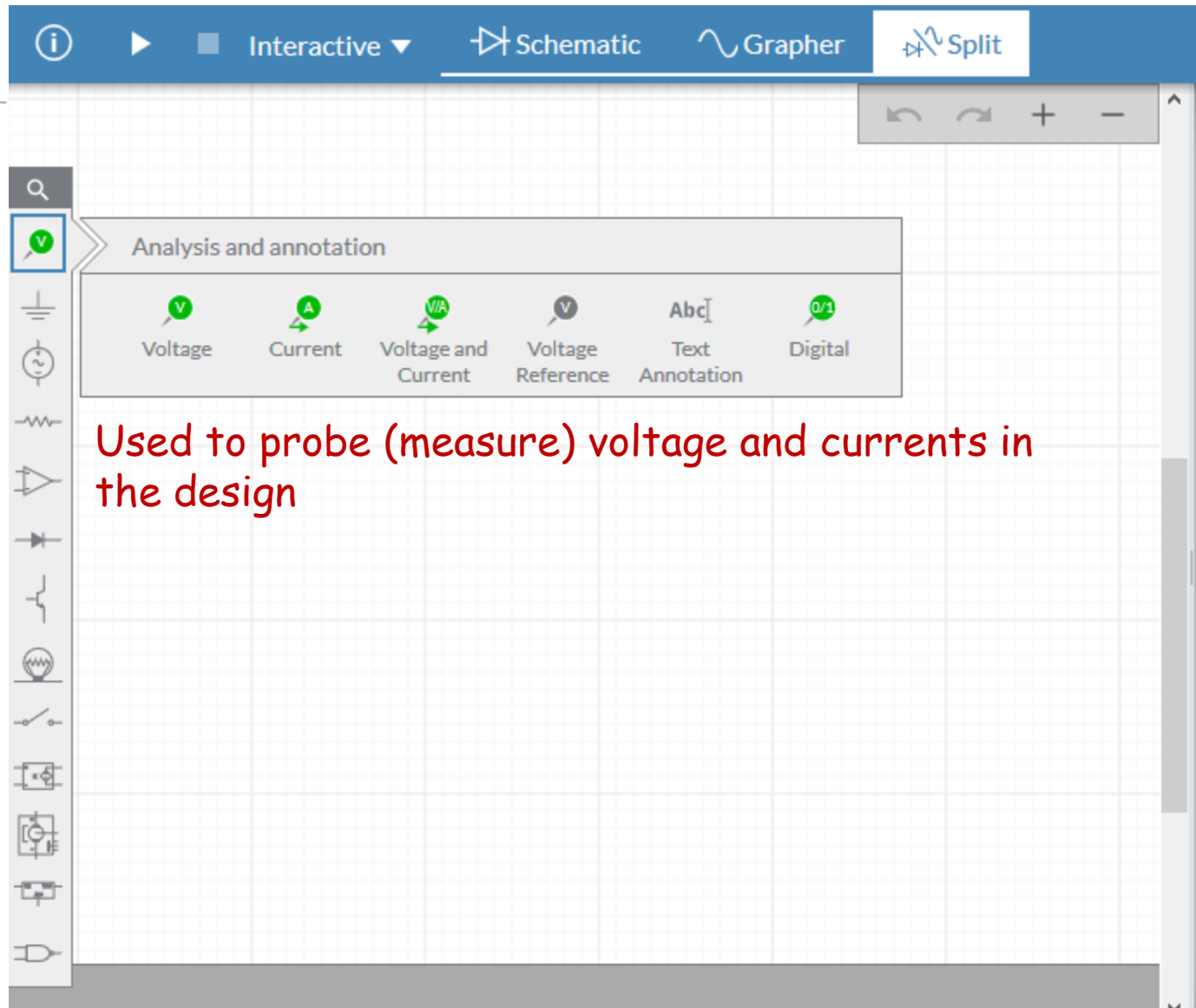We'll explore more about these in upcoming labs...
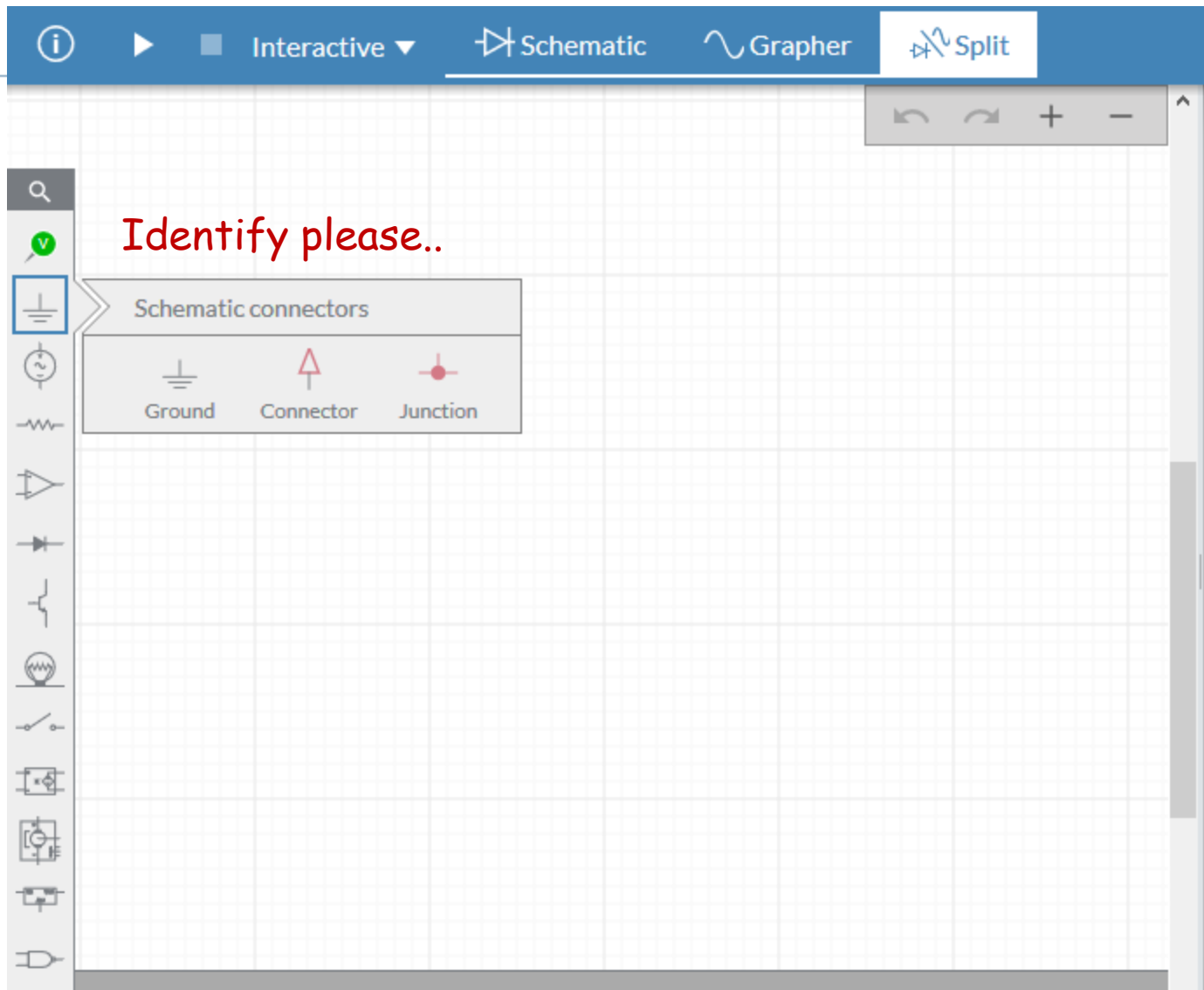
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Transistors

NPN	NPN 4T	PNP	PNP 4T	NMOS	NMOS 4T
PMOS	PMOS 4T	JFET N	JFET P	GaAsFET N	GaAsFET P
NPN...	PNP...	NMOS...			

A **Digital Logic Gate** is an electronic circuit which makes logical decisions based on the combination of **digital** signals present on its inputs.
What are digital signals?

Digital

Digital Constant | AND | OR | NAND | NOR | XOR

XNOR | Buffer | Inverter

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Used to probe (measure) voltage and currents in the design

Identify please..

Schematic connectors

| Ground | Connector | Junction |

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Lets Draw A simple Circuit

Drag and Drop components to the schematic window.
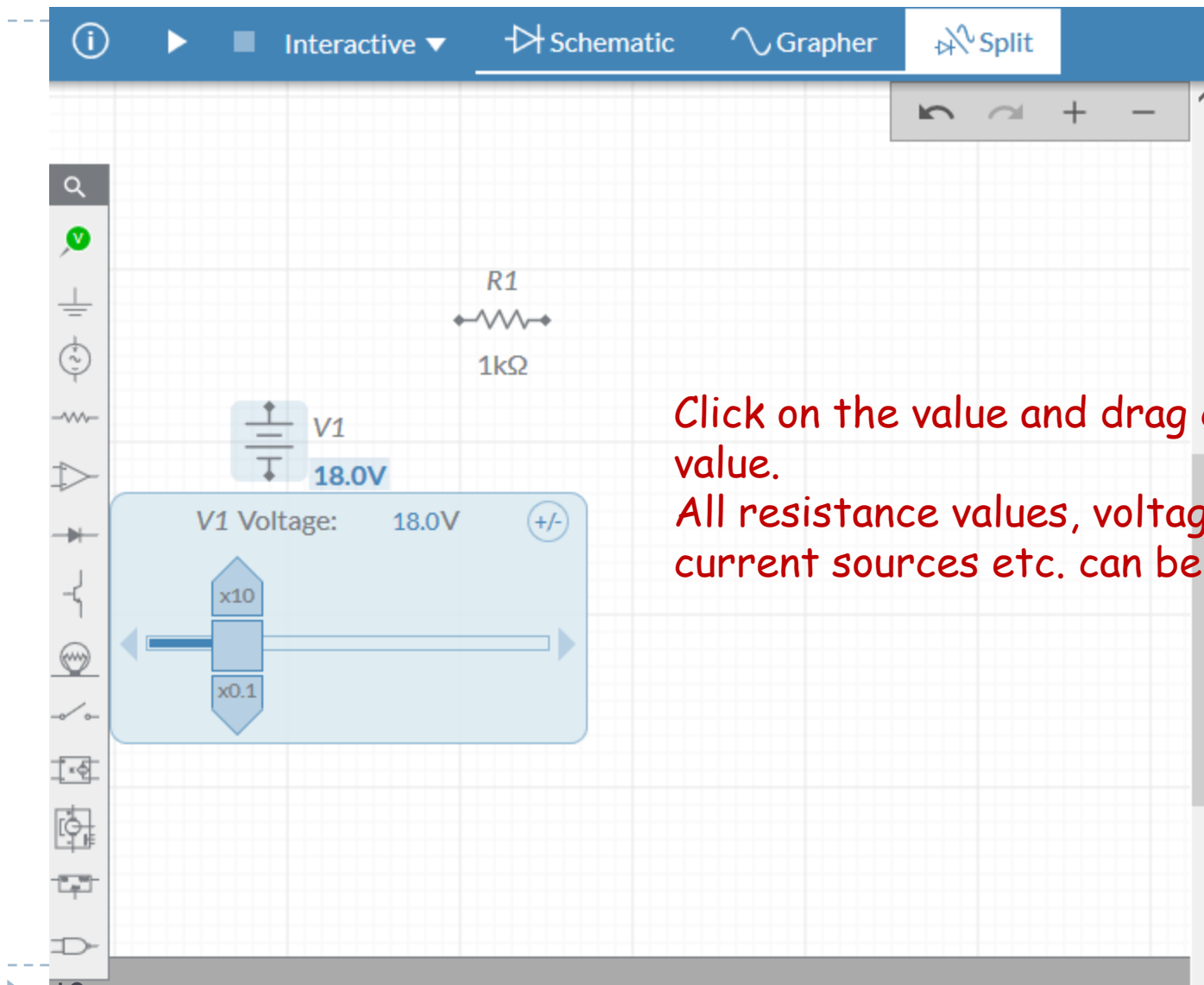
Click on the value and drag cursor to set the value.
All resistance values, voltage sources (values), current sources etc. can be set this way.

Click on end-points to draw wires. Draw wires as per your circuit (theory) and complete the circuit in Multisim.

Click if you wish to bend the wire.

- A simple circuit is drawn.

- A dc voltage source(battery) 18 V is connected through a resistor of 1k Ohms.

- A probe is inserted to measure current.

- Current is always measured in series, while voltage is measured across (in parallel)
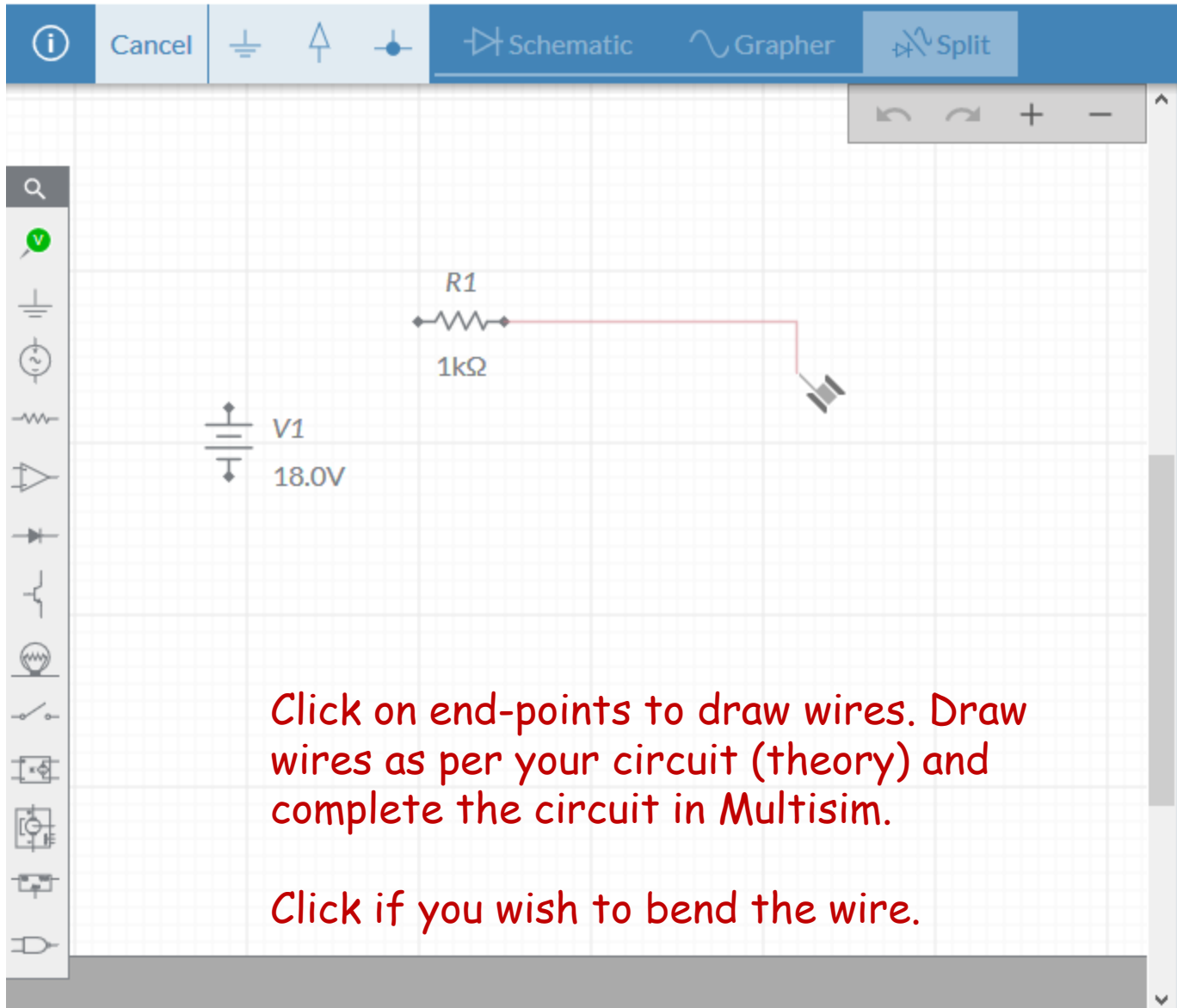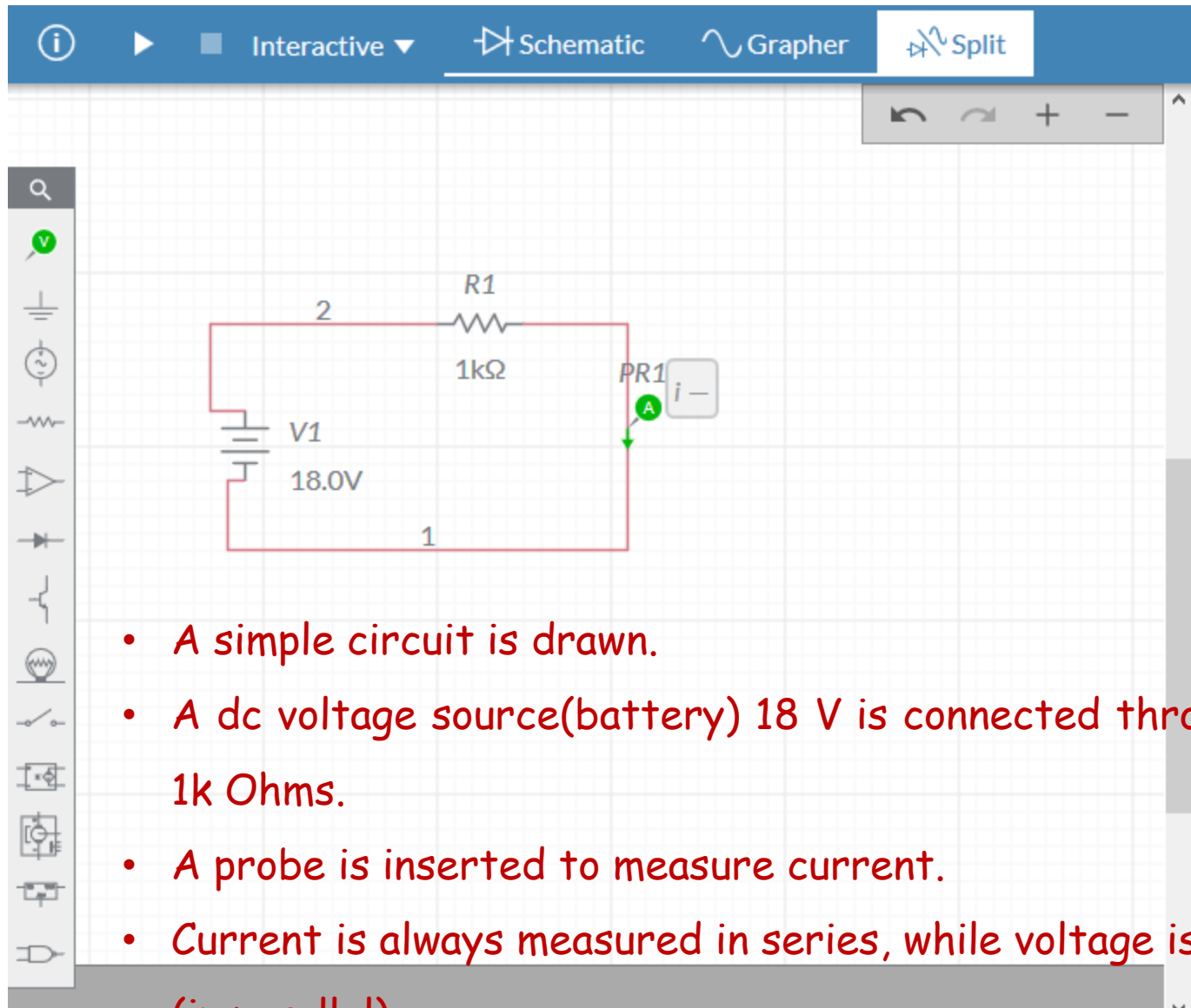
- The circuit is ready for analysis.

- Select the type of analysis as Transient.

- **Transient analysis** calculates a circuit's response over a period of time defined by the user.

- It usually is current vs time or volatge vs time

- The response will be current vs time in our case. Why?

- Guess the expected response!!

- Click start simulation

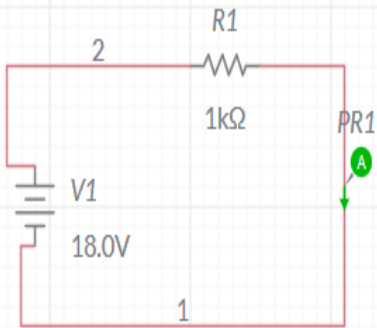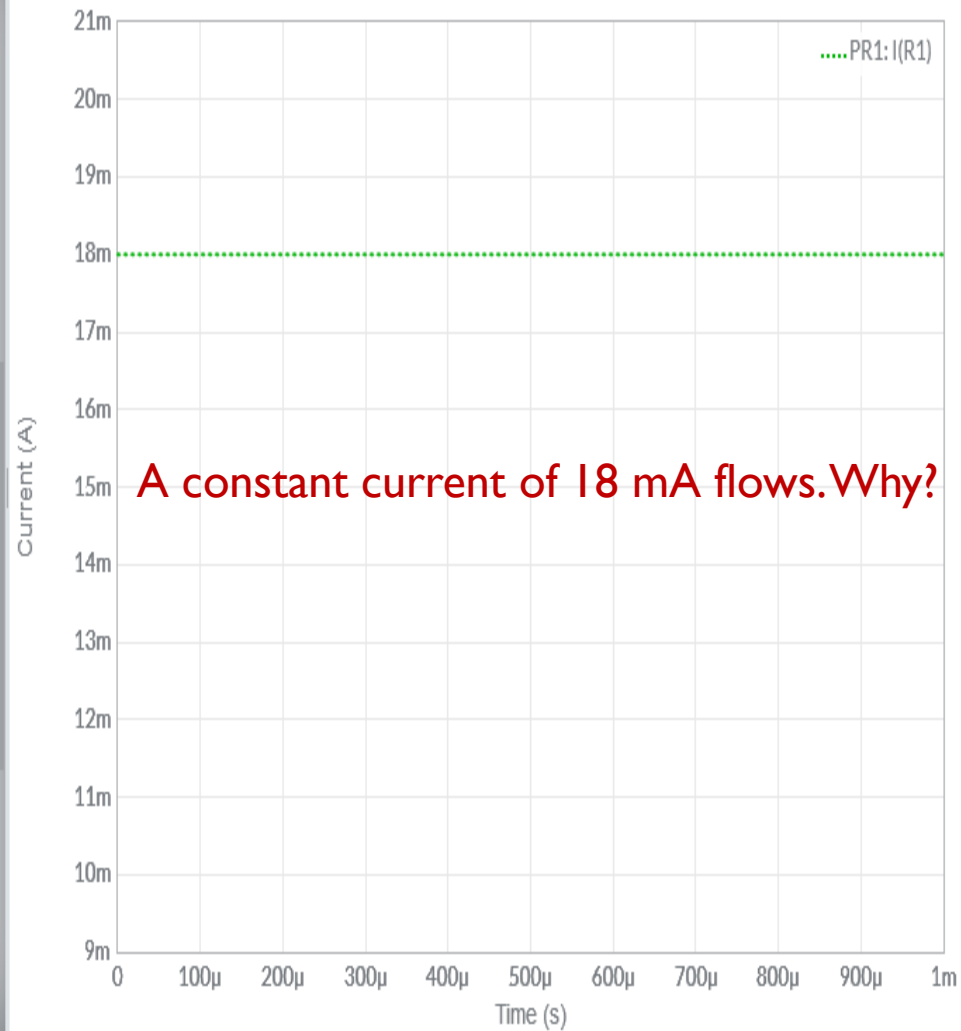- We may explore other analysis in future labs.
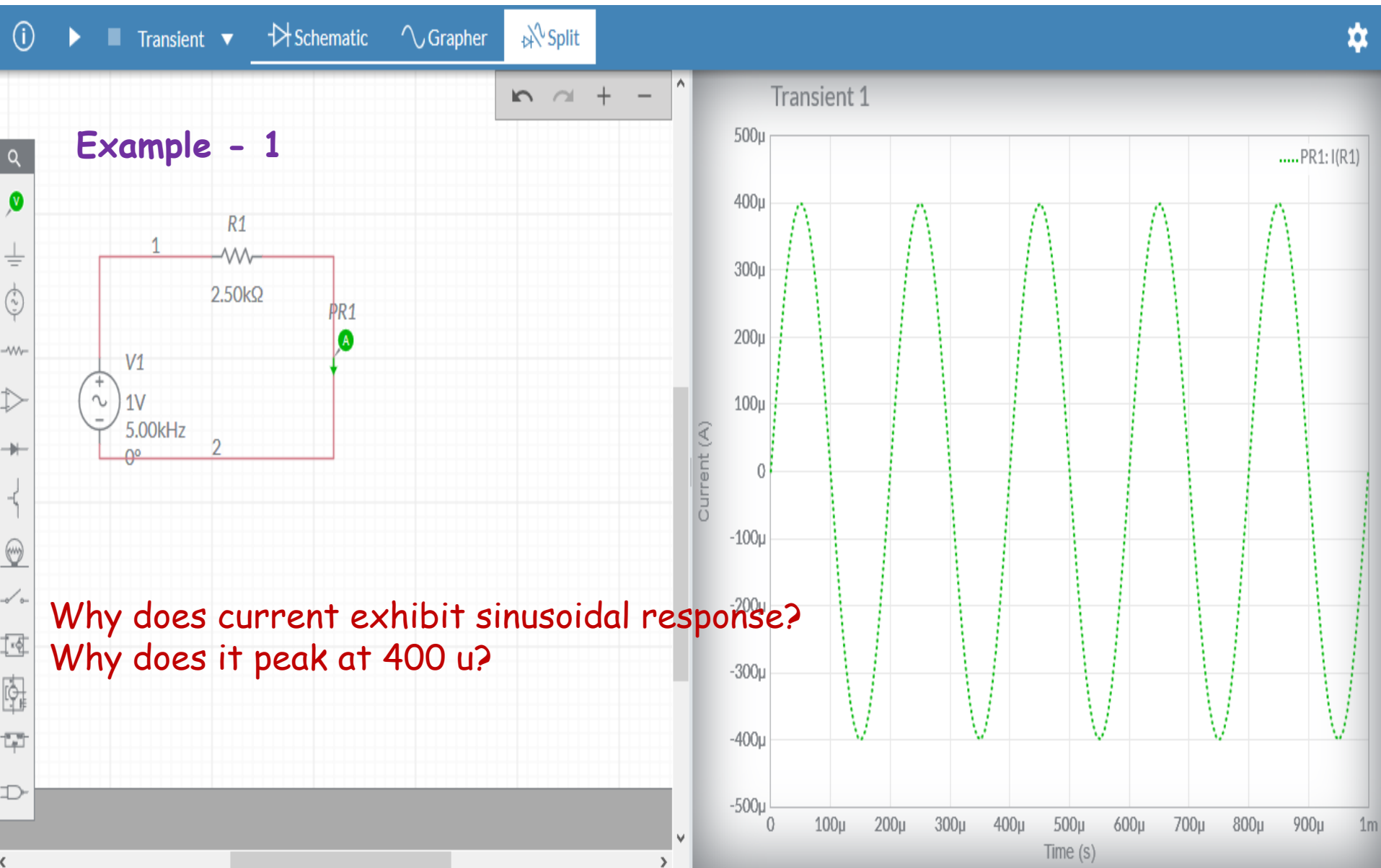
A constant current of 18 mA flows. Why?

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A few examples...

Example - 1

Why does current exhibit sinusoidal response?
Why does it peak at 400 u?

Example - 2

D1 1 2 PR2

V1
1V
10.0kHz
0 0°

R1
1kΩ
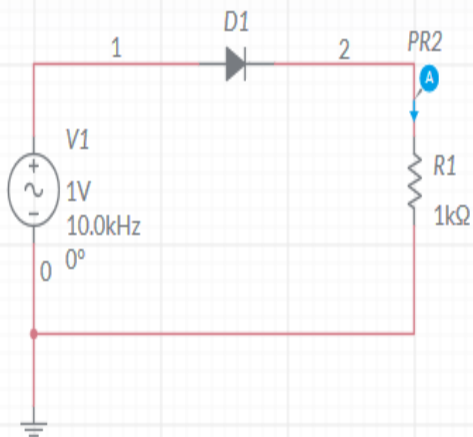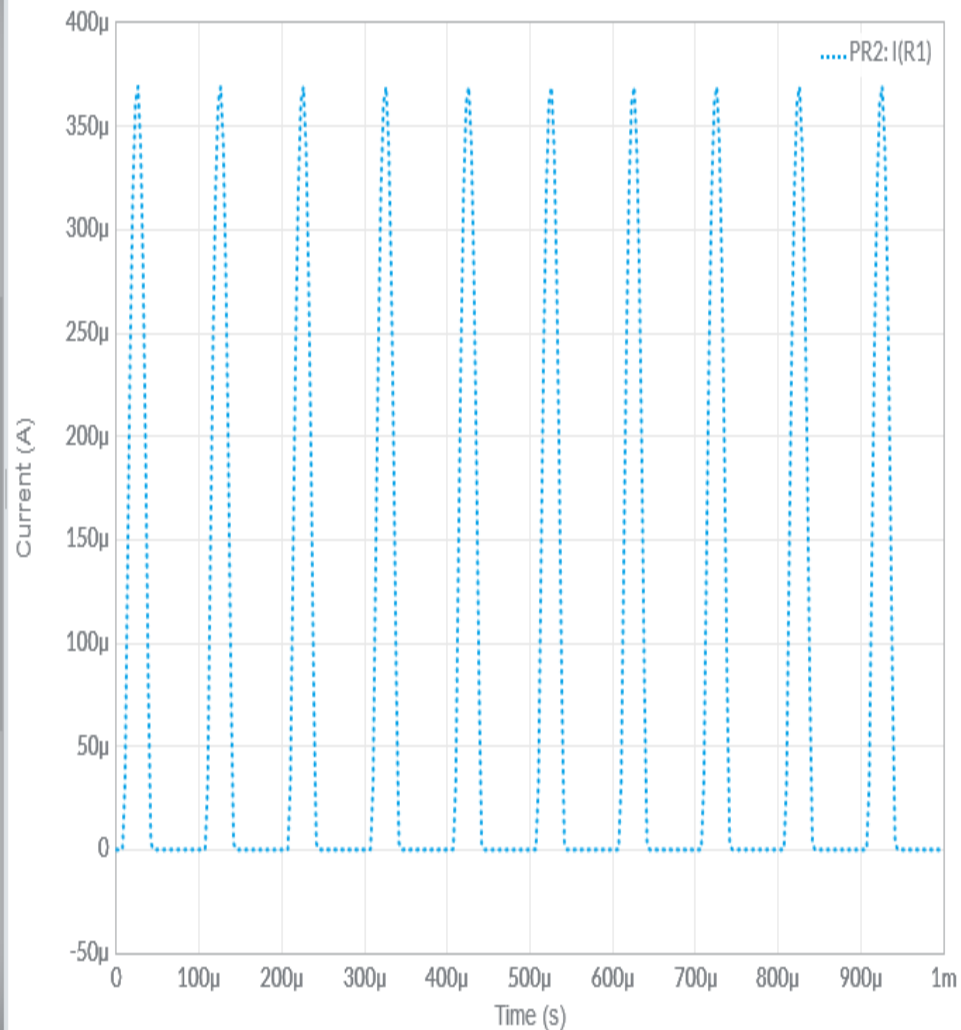
Why does the current become zero at some instance?
Why does current vary periodically?
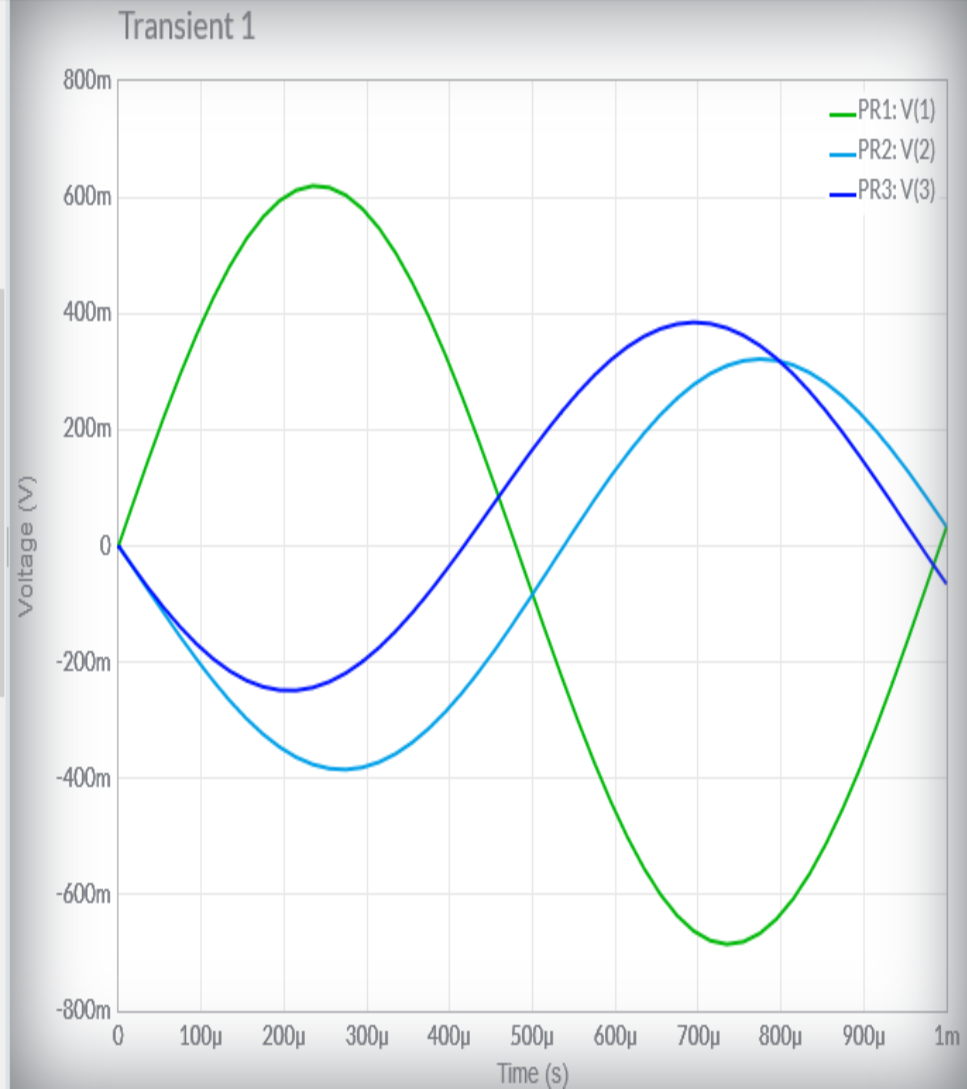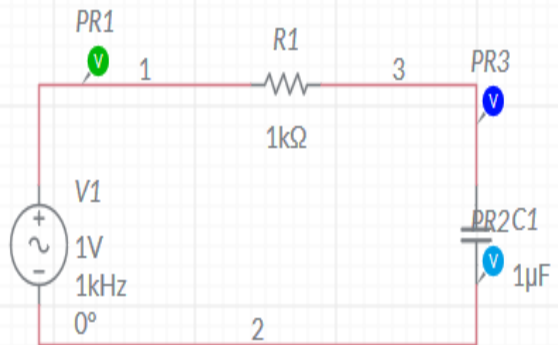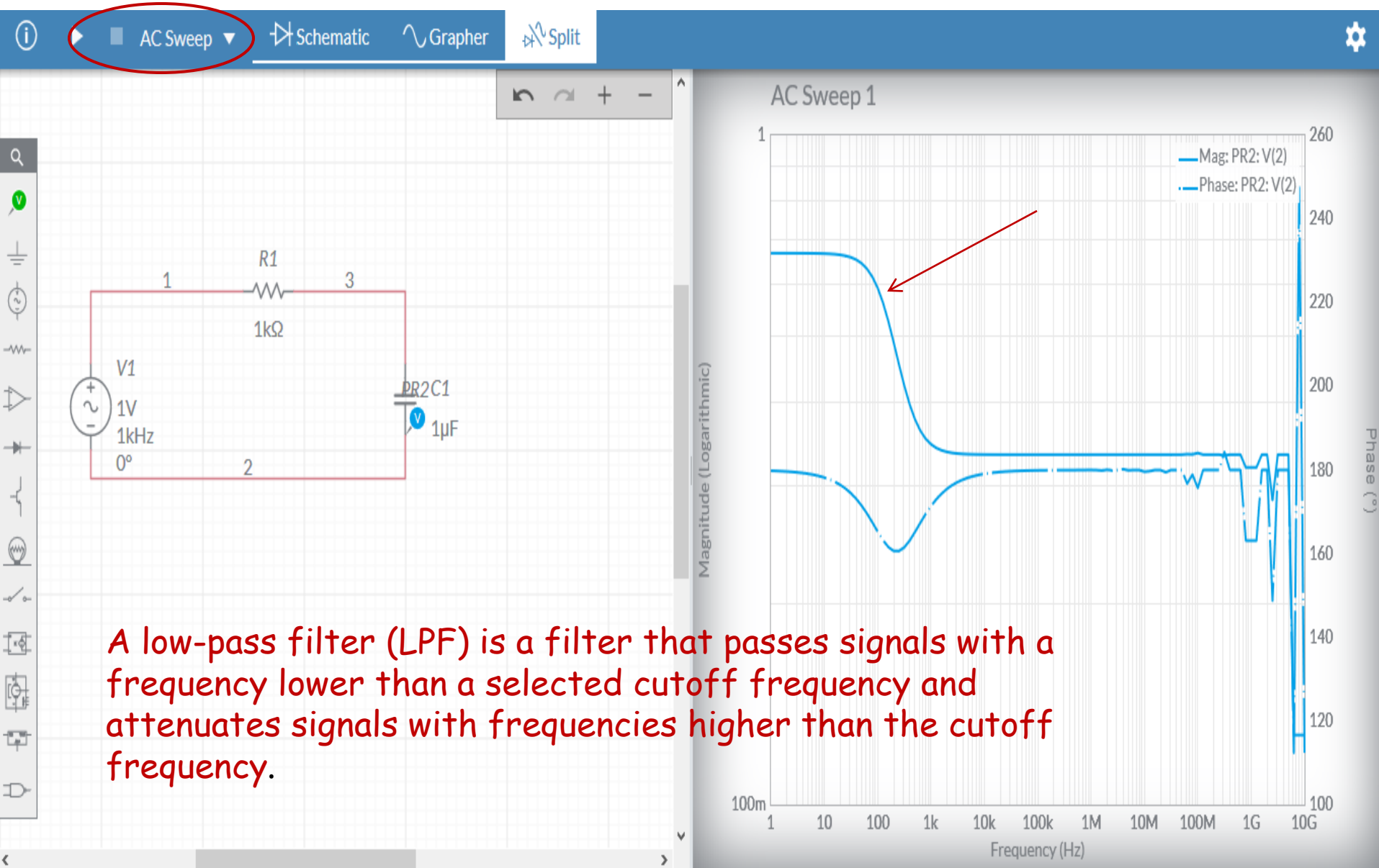What is drop across R1? What is drop across diode?
What is this circuit called?

Transient 1

····· PR2: I(R1)

Current (A) vs Time (s)

Example - 3

continued....

A low-pass filter (LPF) is a filter that passes signals with a frequency lower than a selected cutoff frequency and attenuates signals with frequencies higher than the cutoff frequency.

Example - 4
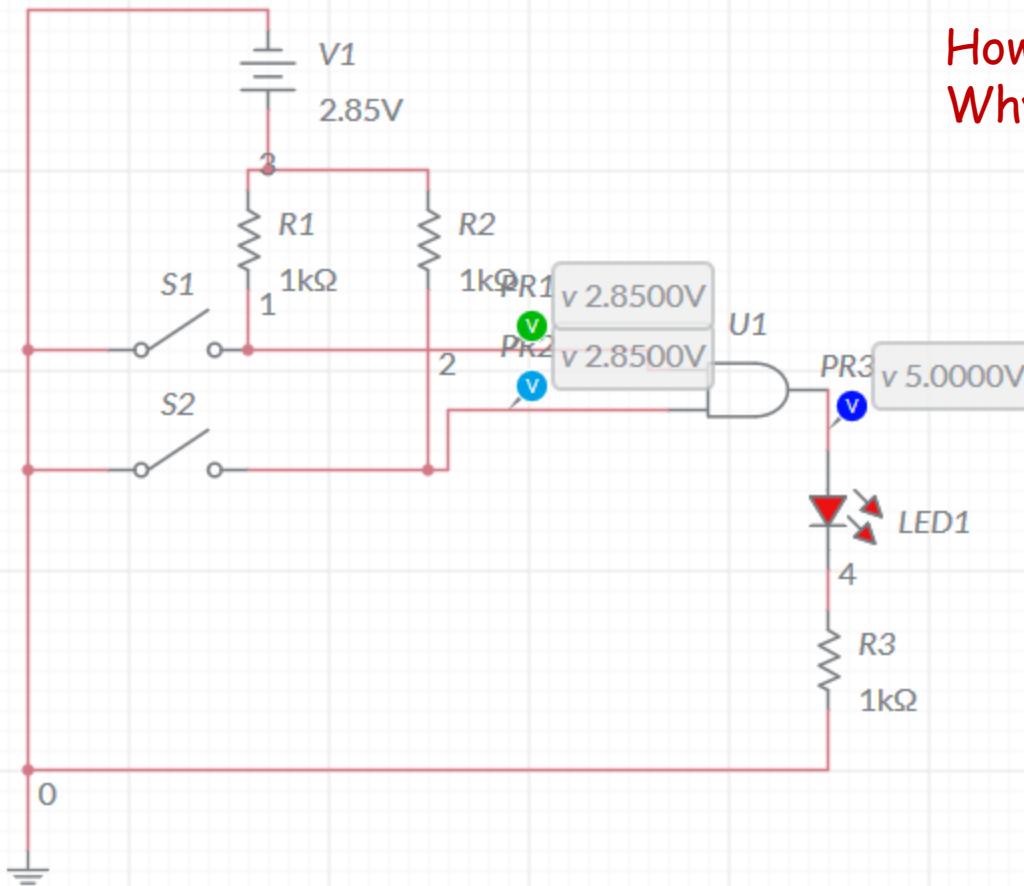
How does this circuit work?
Why is output 5V?
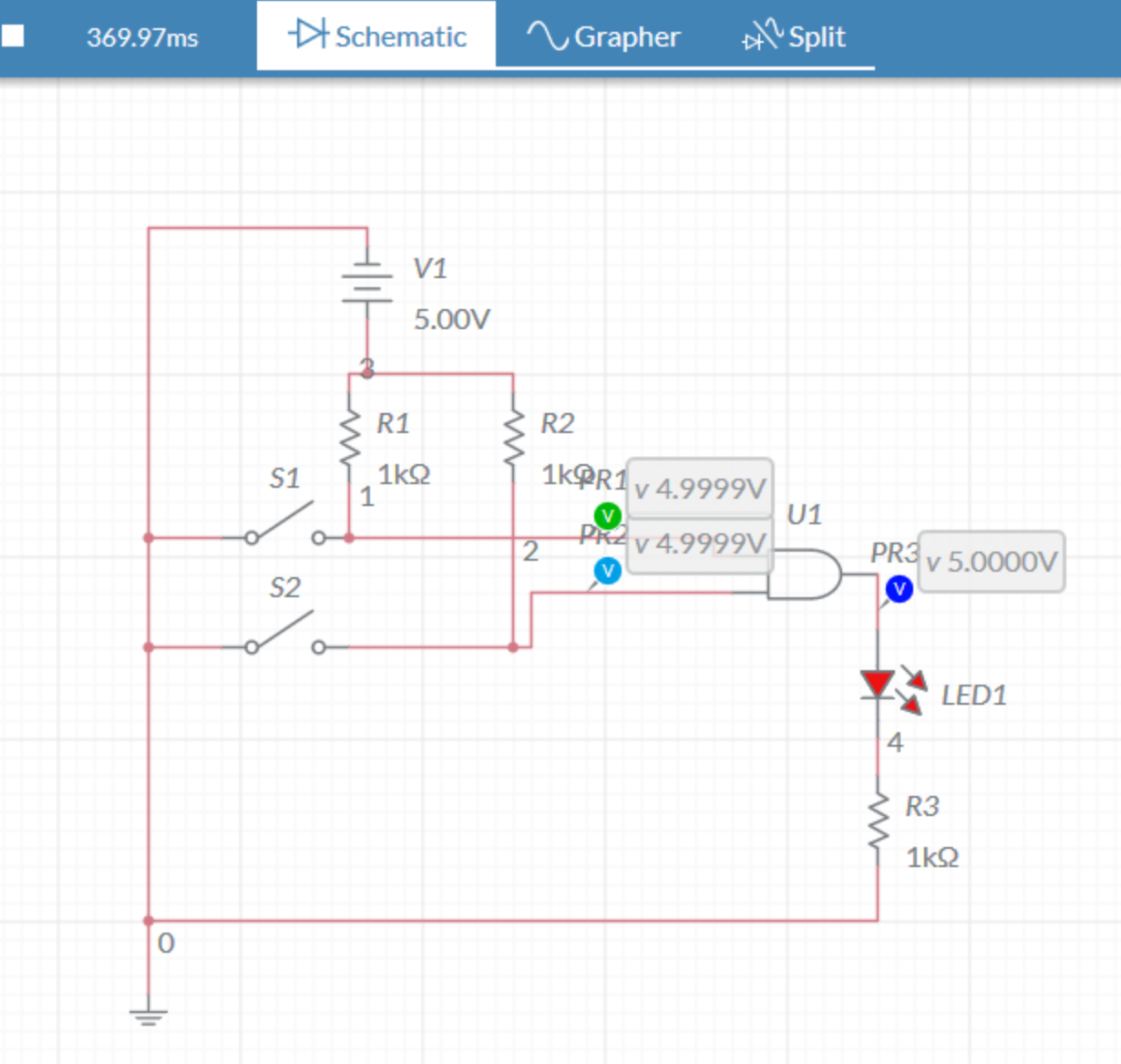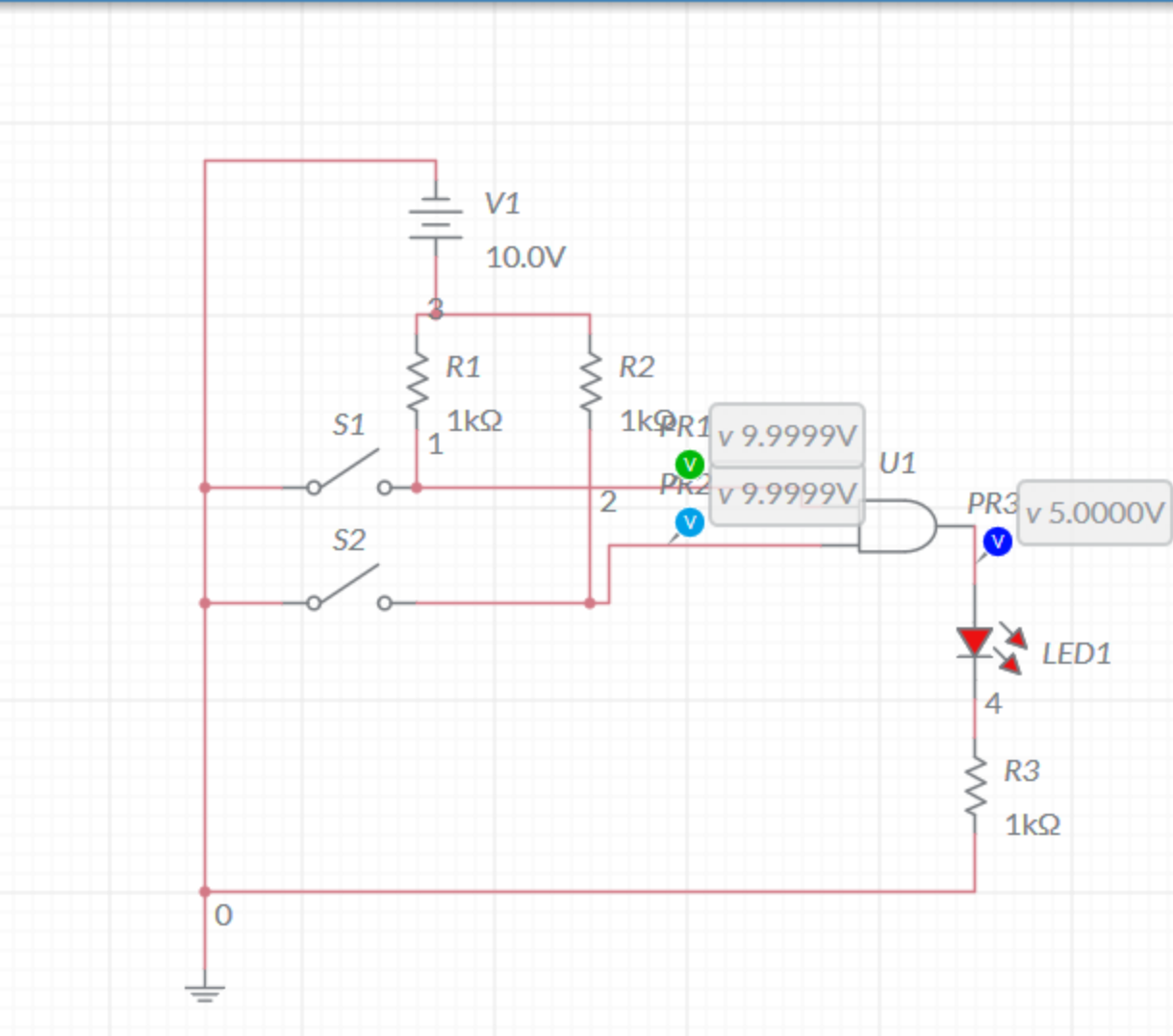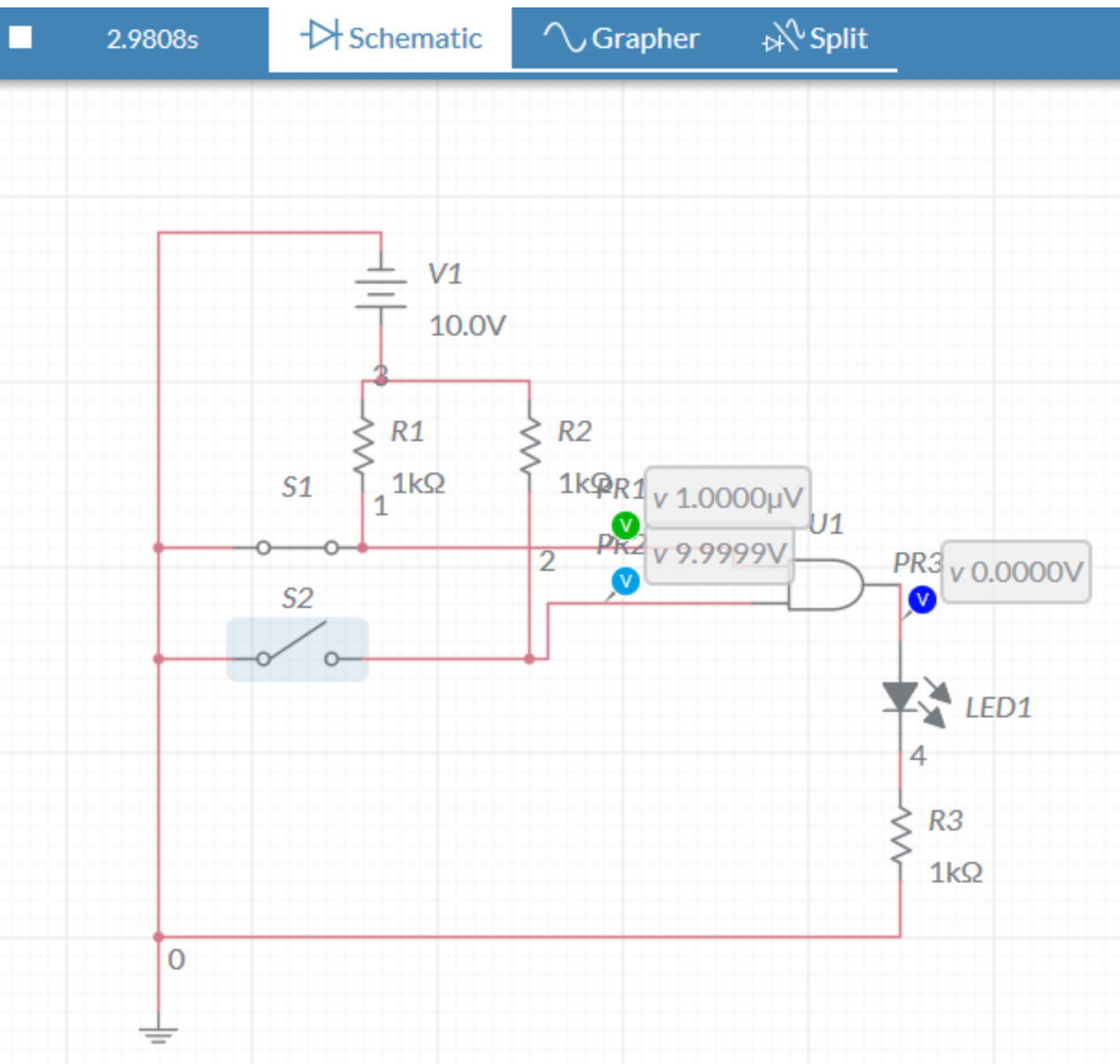
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continued....

V1
5.00V

R1
1kΩ

R2
1kΩ

S1

S2

PR1 v 4.9999V
PR2 v 4.9999V
U1
PR3 v 5.0000V

LED1

R3
1kΩ

0

continued....

continued....

V1
10.0V

R1
1kΩ

R2
1kΩ

S1

S2

PR1 v 1.0000μV

PR2 v 9.9999V

U1

PR3 v 0.0000V

Conclusions?

LED1
4

R3
1kΩ

0

Assignment – 1

a. Implement the circuit as shown in Figure in Multisim online.
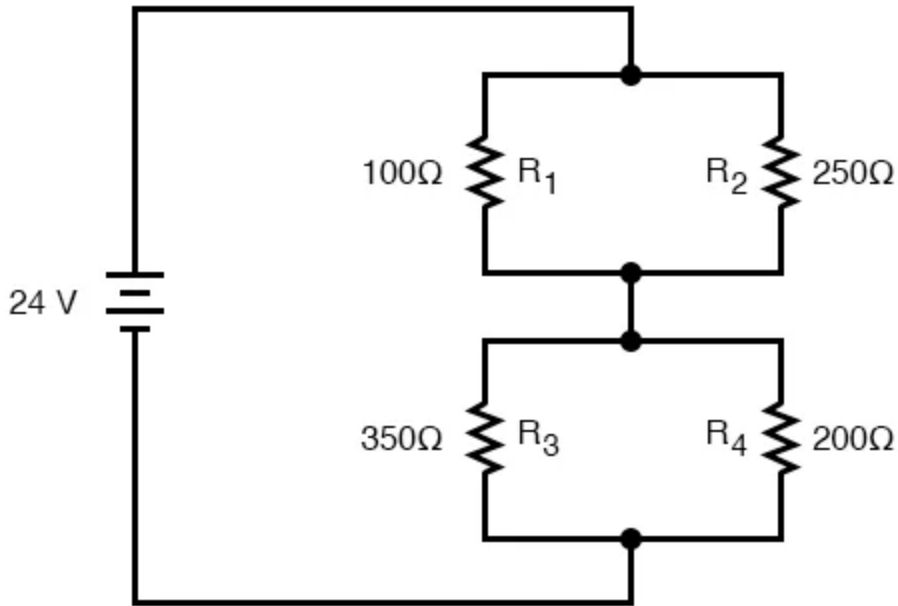b. Evaluate the current and voltage across each resistor using simulator.
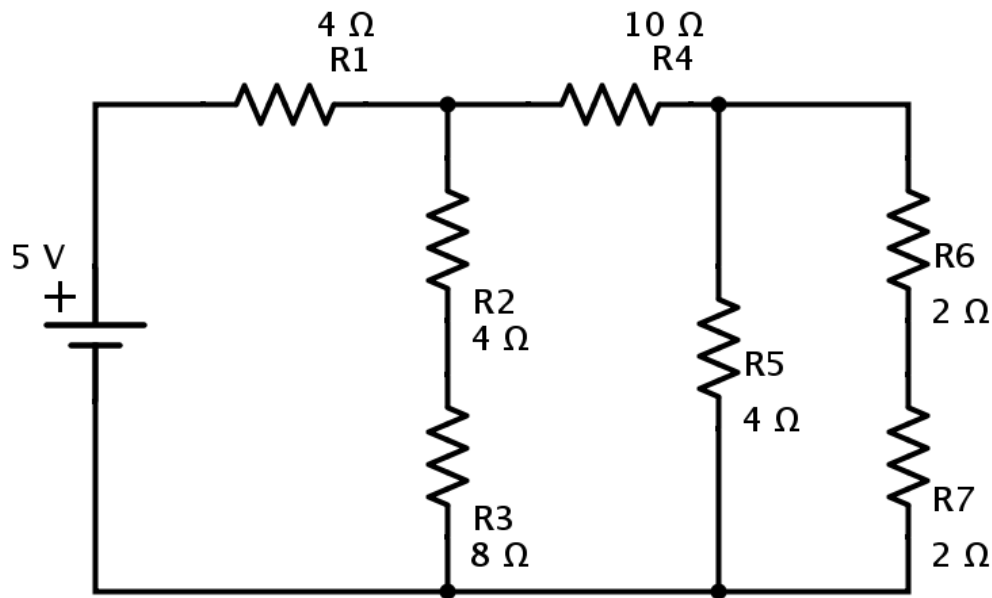c. Compare with theoretical values.

Assignment – 2

a. Implement the circuit as shown in Figure in Multisim online.
b. Evaluate the current and voltage across each resistor using simulator.
c. Compare with theoretical values.