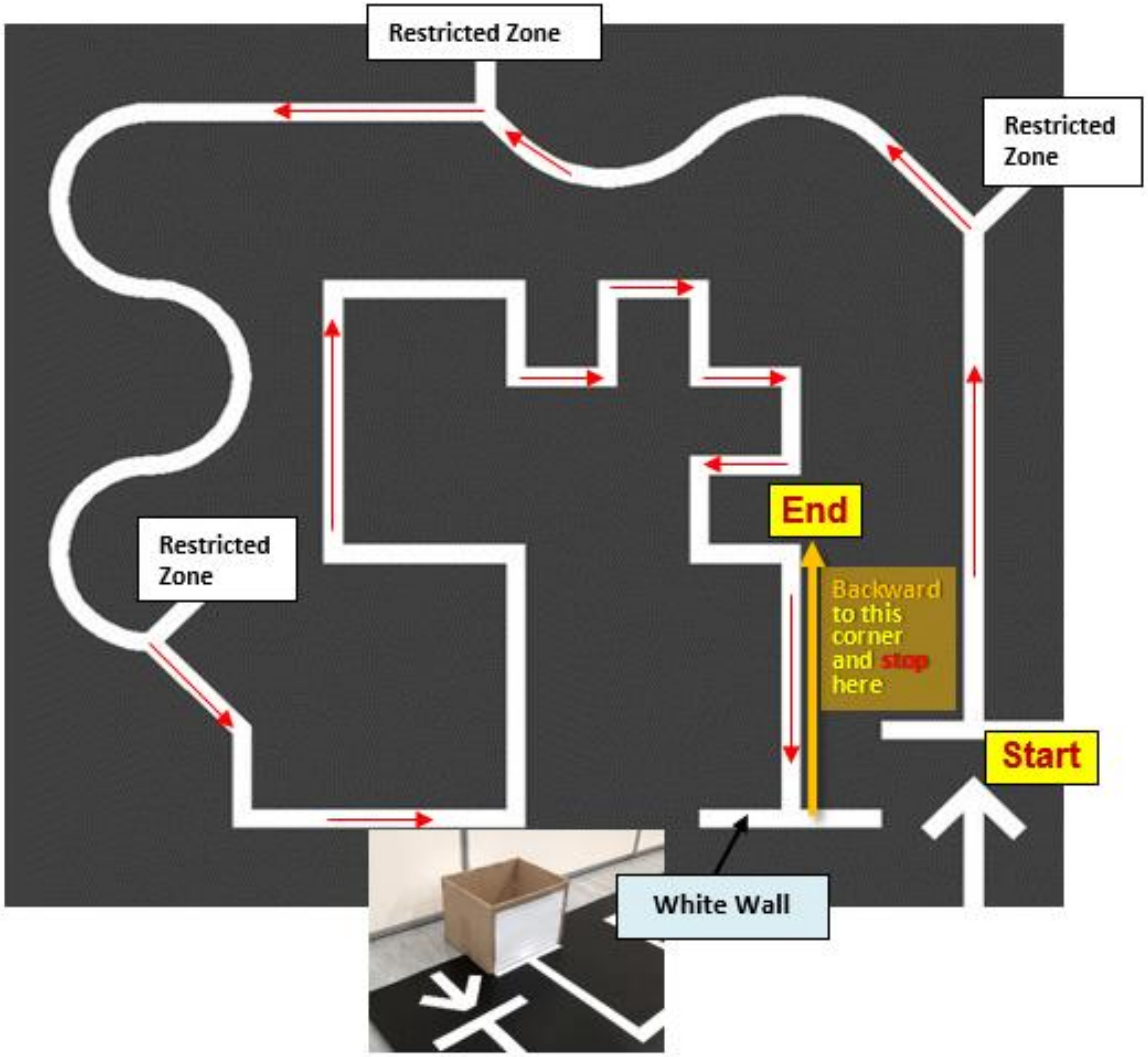
ELEC1100 - Tutorial 8

Final Project & Online Exam

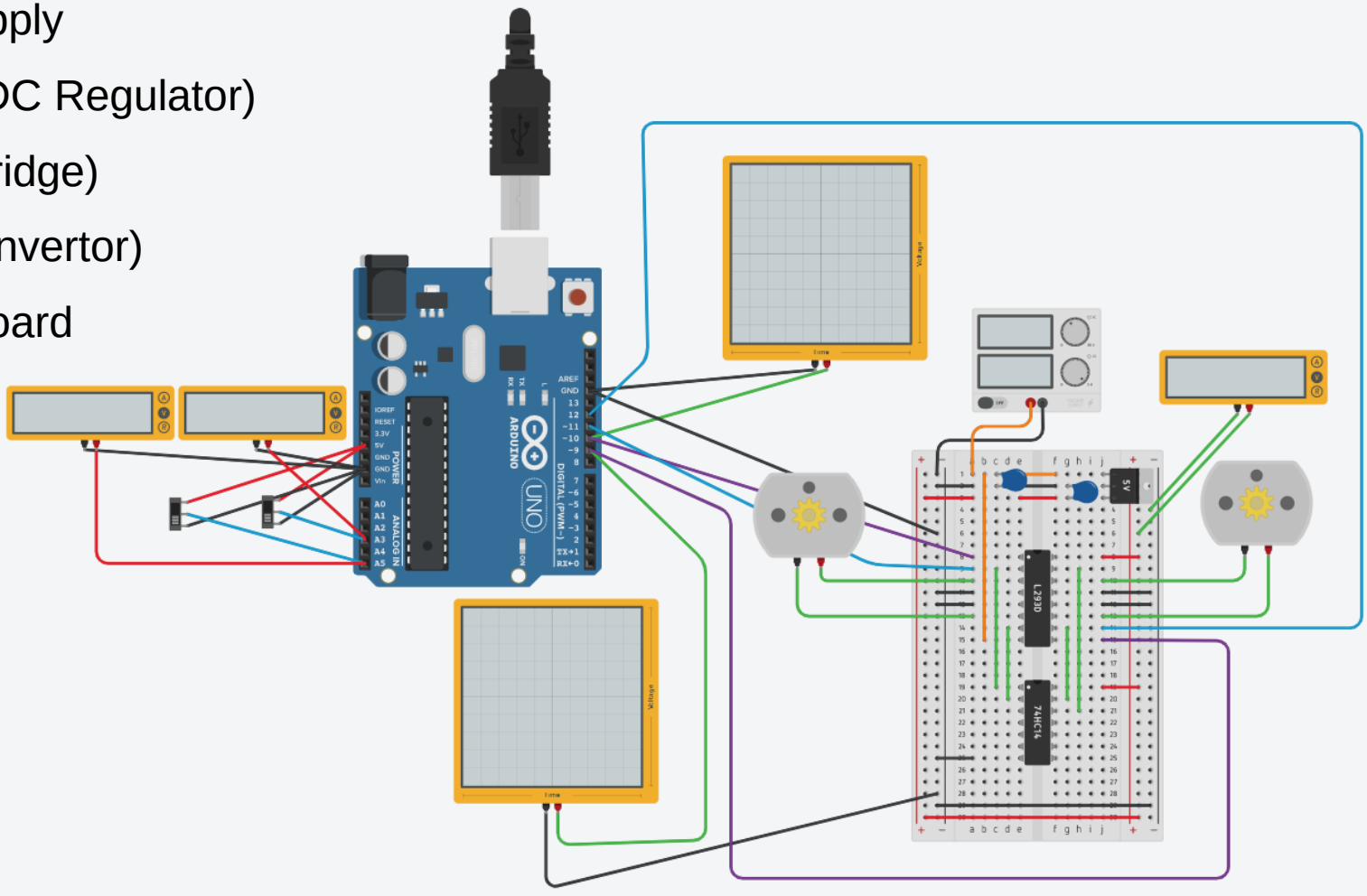
Project Demo Mat



The Robot Car Circuit

❖ **To be completed in an online mode using Tinkercad**

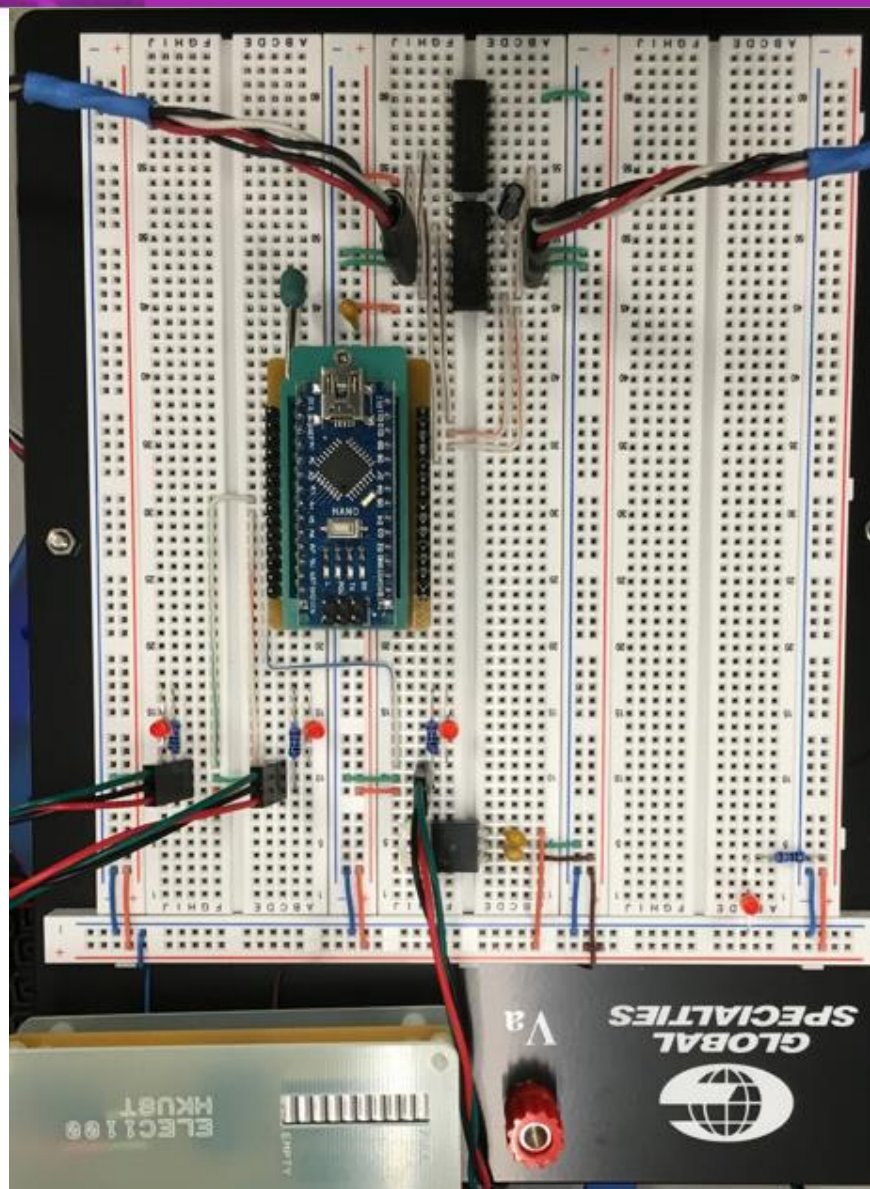
- ❑ Power Supply
- ❑ LM7805 (DC Regulator)
- ❑ L293 (H-bridge)
- ❑ 74HC14 (Invertor)
- ❑ Arduino Board
- ❑ Sensors
- ❑ Motors



The Robot Car Circuit

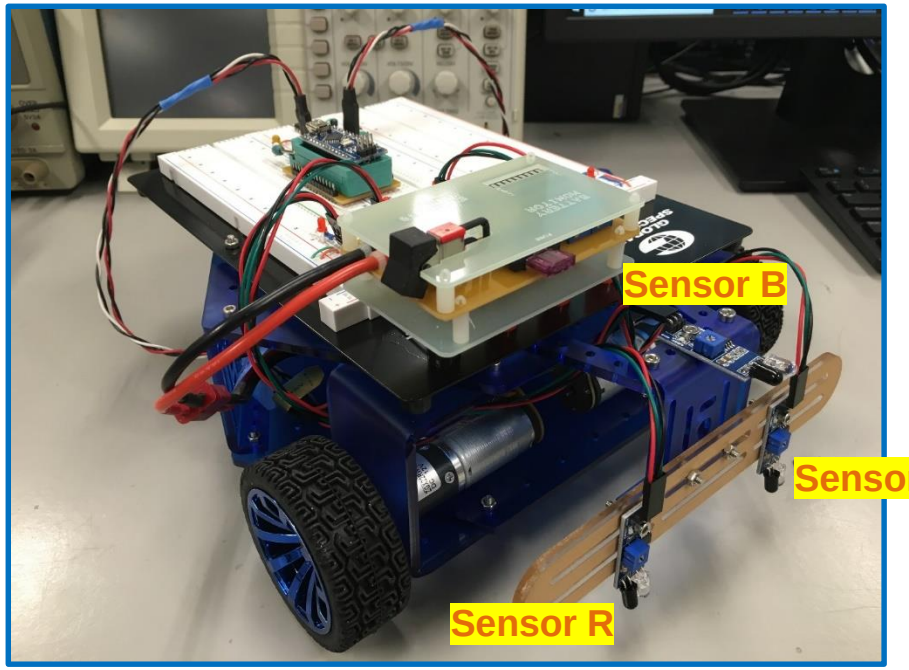
❖ Provided by the Teaching Team

- ❑ Battery
- ❑ LM7805 (DC Regulator)
- ❑ L293 (H-bridge)
- ❑ 74HC14 (Invertor)
- ❑ Arduino Board
- ❑ Sensors
- ❑ Motors

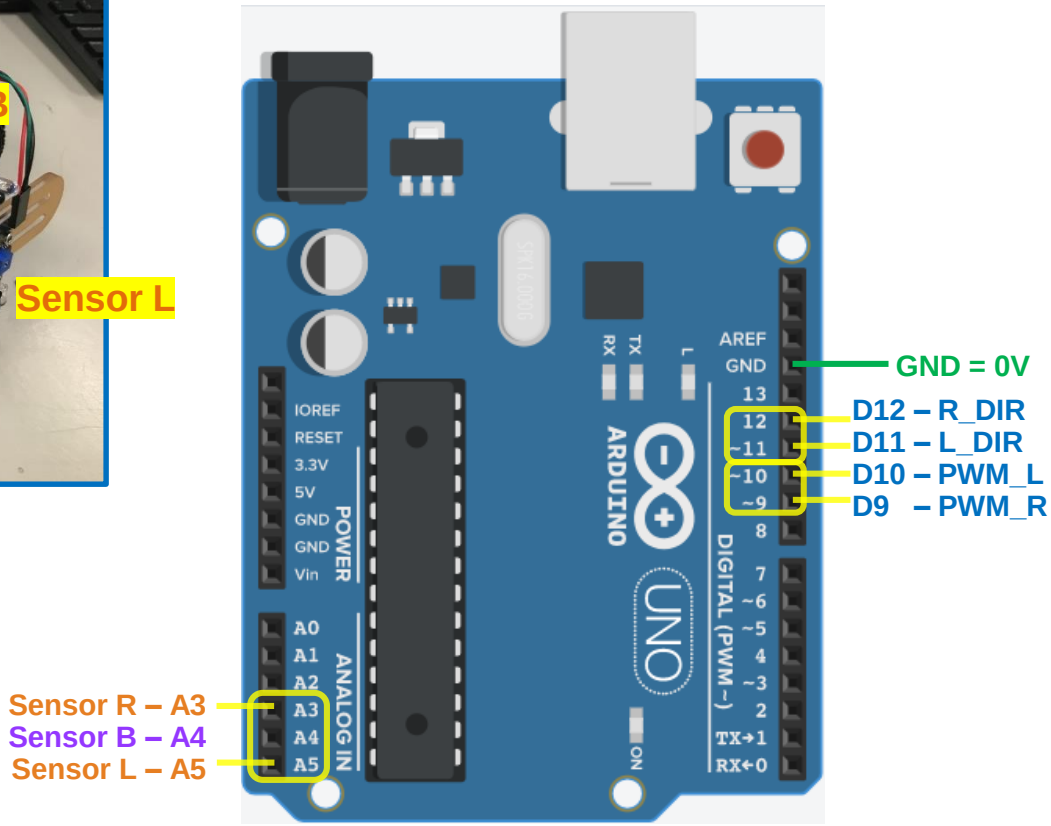


Car Sensor Placement

❖ Line Sensors (3 in total)



You need to include the bumper sensor (**Sensor B to A4**) into your circuit and to write in the coding text template given at Lab#06



Supplementary Documents

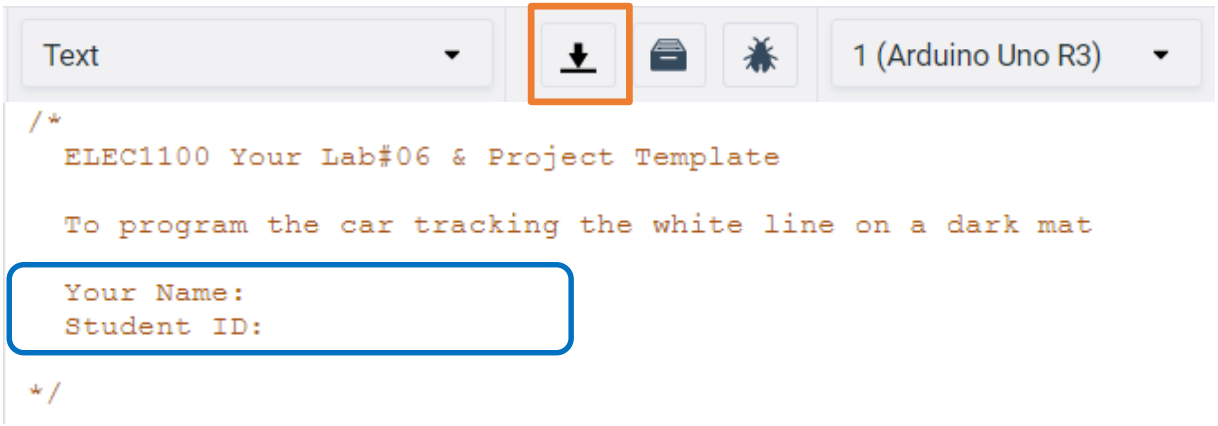
ELEC1100 Canvas page

→ LA1/LA2/LA3 → Home → Week 11-13 → Project Period

- Project Guide_2020s
- Project Report Format_2020s

Track Demo Arrangement

- **Download your completed Arduino code from Tinkercad**



- **Submit to your Canvas lab page (LA1/LA2/LA3) before the deadline of your test/demo lab session.**

Coding Test

	Coding Test Session	*Submission Deadline*	*Trials*
LA1	May 06 (Wed) 12:00-14:50	May 06 (Wed) 12:00	**2**
LA2	May 07 (Thu) 09:00-11:50	May 07 (Thu) 09:00	**2**
LA3	May 11 (Mon) 13:30-16:20	May 11 (Mon) 13:30	**2**

At your Coding Test lab session:

- If your code could already let the car achieve a "**perfect run**" on the demo mat out of 2 trials, you will receive a full mark of 20 points as your demo score and will not need to attend the demo session.
- If not, your test results will not be graded and you may come back one week later at the final demo session with an improved coding work.

Final Demo

	Final Demo Session	*Submission Deadline*	*Trials*
LA1	May 13 (Wed) 12:00-14:50	May 13 (Wed) 12:00	**2**
LA2	May 14 (Thu) 09:00-11:50	May 14 (Thu) 09:00	**2**
LA3	May 18 (Mon) 13:30-16:20	May 18 (Mon) 13:30	**2**

At your Final Demo lab session:

- If your car can achieve "**perfect run**", then you will obtain full marks.
- Otherwise, your score will be given depending on "**How far your car can go**" within each trial.
- To obtain more marks, you have to collect as many points as possible from the "Start" white line.

Points Awarding Scheme

Task No.	Task	Points
i	Car wheels should be **STOP** at the beginning and **START** running after the bumper sensor is triggered	2
ii	Follow the straight Line	1
iii	Navigate the 1st Left Split	2
iv	Gentle Curves I	1
v	Navigate the 2nd Left Split	2
vi	Gentle Curves II	1
vii	Navigate Right Split	4
viii	Right angle Curves I (finish all 6 right angles)	1
ix	Right angle Curves II (finish all 10 right angles)	1
x	Backward after the bumper sensor sense the wall	3
xi	Stop at the **End** corner	2
	Total	**20**

Tasks Demo

- After the demo trials, if you are not satisfied with the results at physical lab, you may select to do an online Tasks demo by showing your TA that your Tinkercad Arduino code can achieve the motor motions listed below.

Tasks	Points
Start your Tinkercad simulation, let **Sensor B = 0V** for the 1st time, both motors are with **+ve rpm**	**2**
Let **Sensor L & R = 0 0** for the 1st time, your left motor is with **-ve rpm** and right motor is with **+ve rpm**	**2**
Let **Sensor L & R = 0 0** for the 2nd time, your left motor is with **-ve rpm** and right motor is with **+ve rpm**	**2**
Let **Sensor L & R = 0 0** for the 3rd time, your left motor is with **+ve rpm** and right motor is with **-ve rpm**	**4**
let **Sensor B = 0V** for the 2nd time, both motors are with **-ve rpm**	**4**

However, by choosing to demo in **Tinkercad, you may obtain **at most 14 points** as your demo score.

Project Report

- Follow the required scheme ("Project Report Format_2020s").
- Each student must write & submit ONE report.
- Upload to your Canvas LA1/LA2/LA3 page (a doc/docx file) before the deadline (11:50am, in the morning, on May 22, Fri).
  - 50% penalty mark will be given to a late submission within 3 hours.
  - Zero mark will be given to more than 3-hour late submission.

Warning: Copy from the others may result in **zero mark** in your **project** (demo & report) scores.

Online Exam

- **May 02 (Sat), 10:00am-12:00noon**

  Go to your Canvas Lecture page L1/L2/L3 to find:

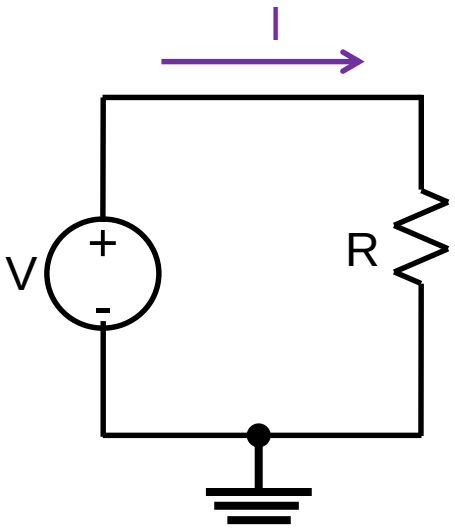
  - Online Exam Arrangement
  - Additional Exercises

- Coverage: Lectures 02-12

  Hot topics:

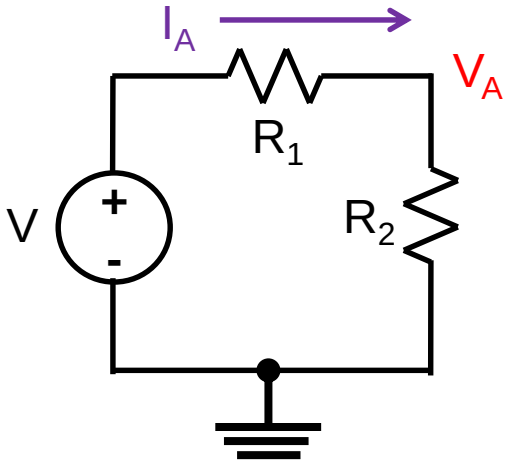
  - Resistance, Ohm's Law
  - Diodes, Transistor & H-bridge
  - KCL, KVL
  - Pulse, Timer, PWM, all ICs presented in Lab#03
  - Logic design (Truth table, Logic output expression)

Resistor



Ohm's Law

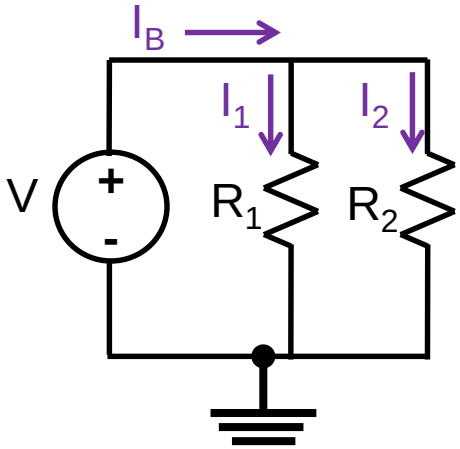
$$V = IR$$



Series

$$V = I_A(R_1 + R_2)$$

$$V_A = V\frac{R_2}{R_1 + R_2}$$



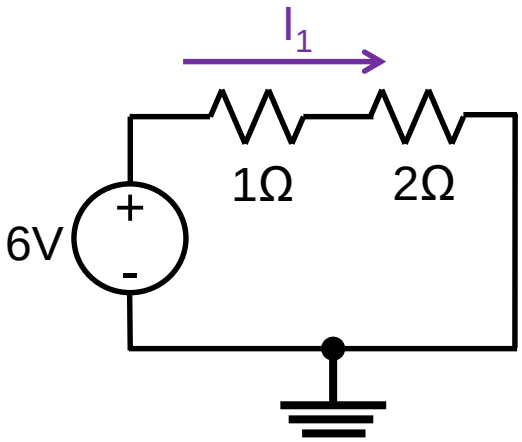
Parallel

$$I_1 = \frac{V}{R_1}; I_2 = \frac{V}{R_2}$$

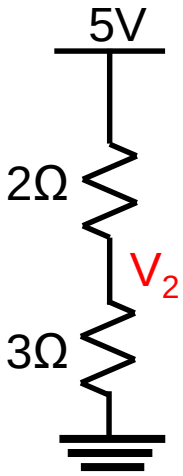
$$I_B = I_1 + I_2$$

$$I_B = V\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

Exercise

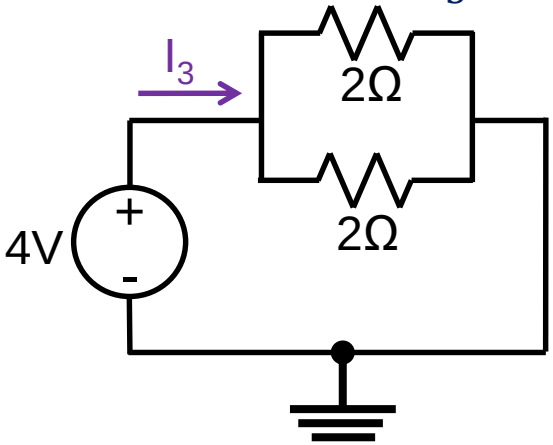


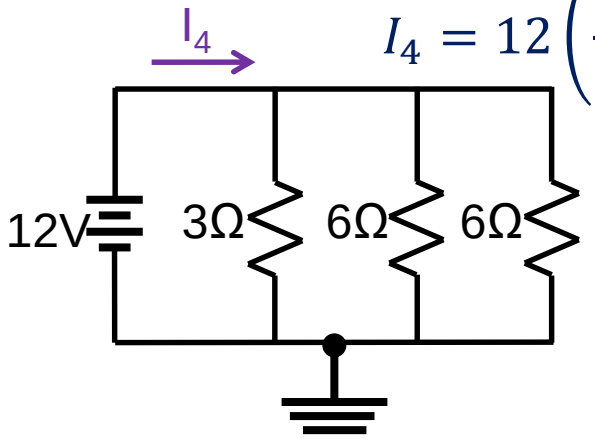
$$I_1 = \frac{6}{1+2} = 2A$$



$$V_2 = 5 \times \frac{3}{2+3} = 3V$$

$$I_3 = 4\left(\frac{1}{2} + \frac{1}{2}\right) = 4A$$

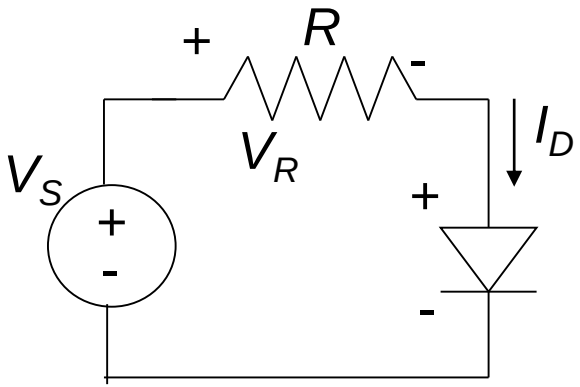




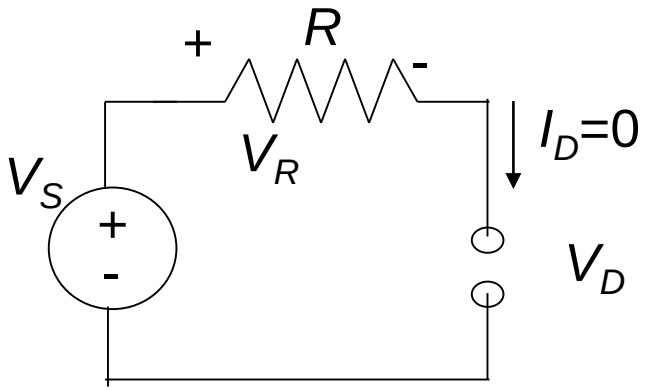
$$I_4 = 12\left(\frac{1}{3} + \frac{1}{6} + \frac{1}{6}\right) = 8A$$

Diode

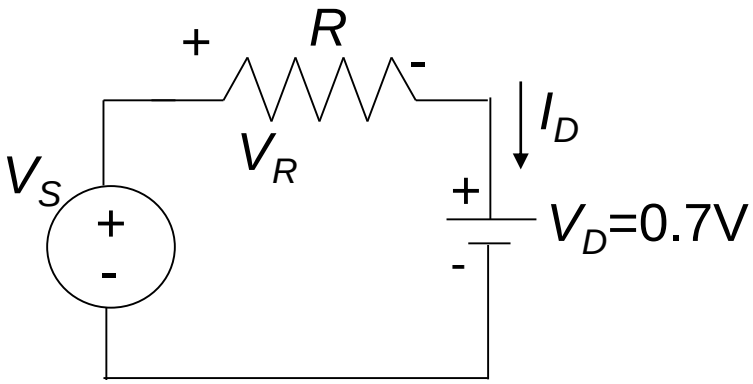
- Given the turn on voltage = 0.7V



$V_s < 0.7V$

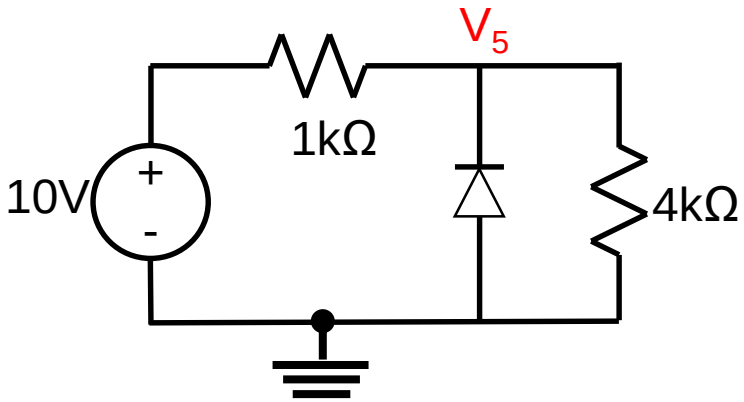


$V_s > 0.7V$



$I_D = (Vs – 0.7) / R$

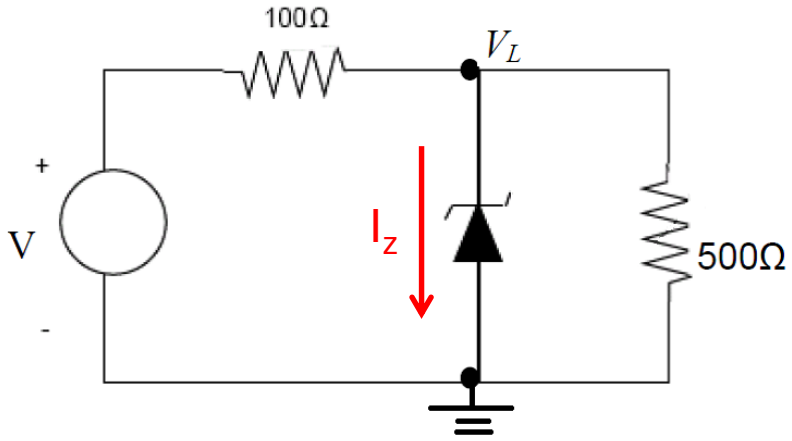
Exercise



$$V_5 = 10 \times \frac{4k}{1k + 4k} = 8V$$

Additional Exercises - Q3

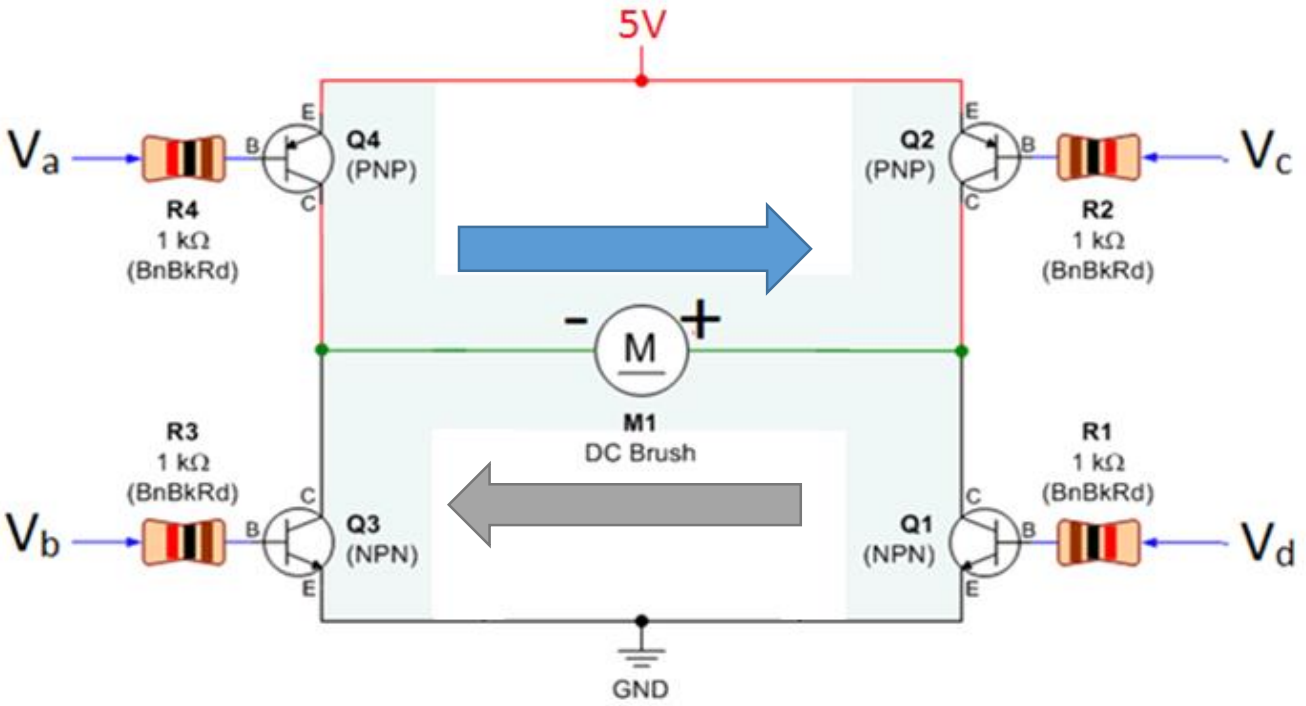
(a) V = 5V (b) V = 8V (c) V = 12V



I_z = ?

Zener diode Vbd = 6.8V

Transistor & H-bridge

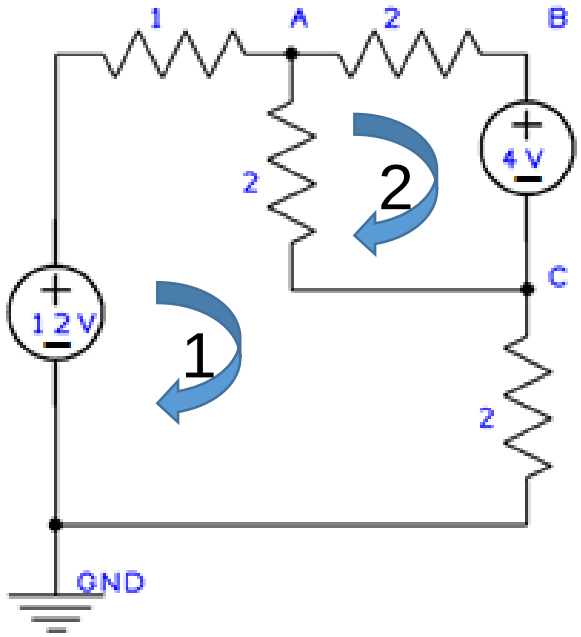


V_a = ? V_b = ? V_c = ? V_d = ?

KCL & KVL

- Find the values of voltage at node A and voltage at node B, versus to ground, respectively.

  (Note: the unit of each resistor is Ω)

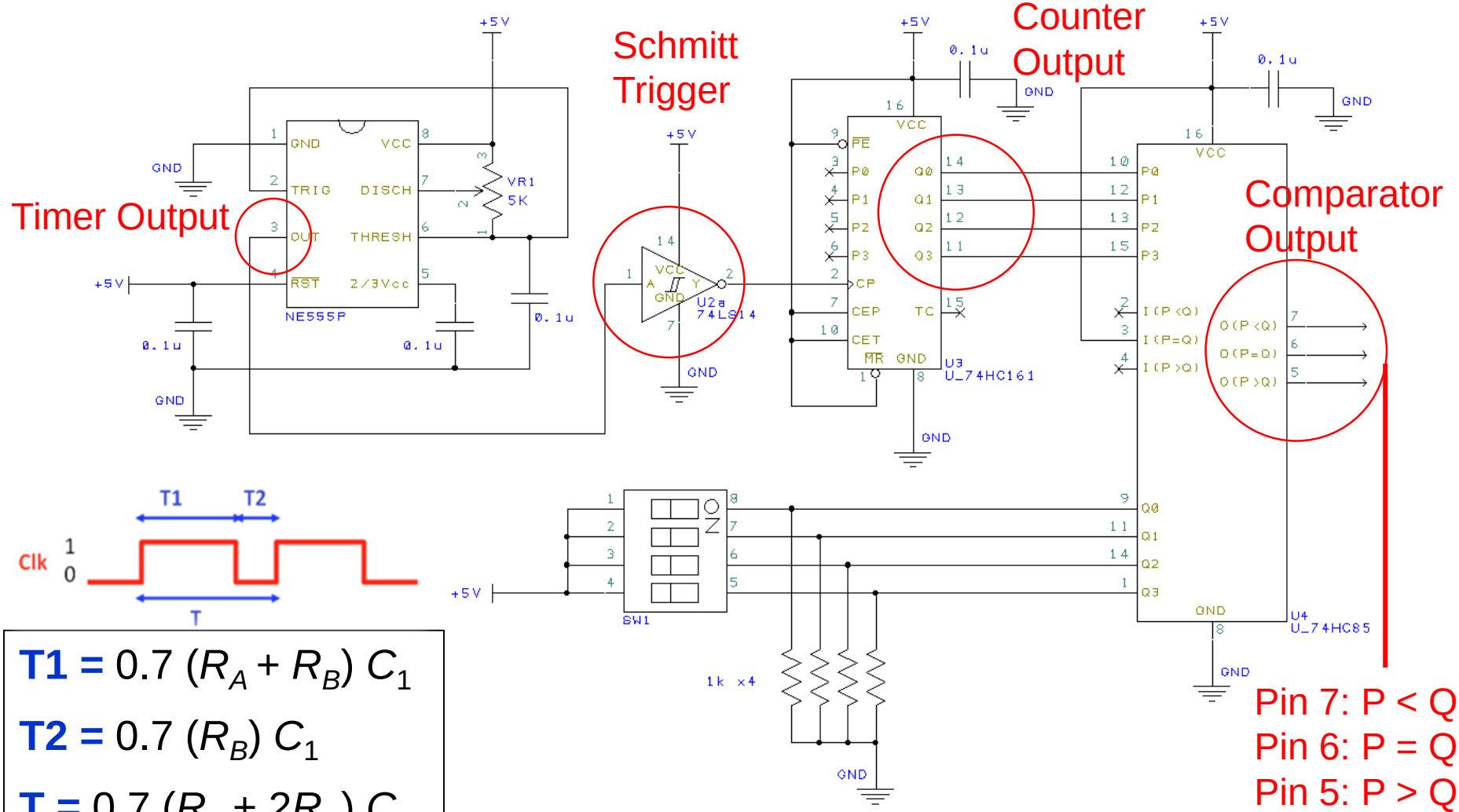


Using KVL:

$$\begin{cases} 12 = 1*I_1 + 2*(I_1 - I_2) + 2*I_1 \\ 2*(I_1 - I_2) = 2*I_2 + 4 \end{cases} \Rightarrow \begin{cases} 5I_1 - 2I_2 = 12 \\ 2I_1 - 4I_2 = 4 \end{cases}$$

$$\begin{cases} I_1 = 2.5A \\ I_2 = 0.25A \end{cases} \Rightarrow \begin{cases} V_A = 12 - 1*I_1 = 9.5V \\ V_B = V_A - 2*I_2 = 9V \end{cases}$$

Pulse Generation & PWM Control



$$T1 = 0.7\,(R_A + R_B)\,C_1$$

$$T2 = 0.7\,(R_B)\,C_1$$

$$T = 0.7\,(R_A + 2R_B)\,C_1$$

Pin 7: P < Q
Pin 6: P = Q
Pin 5: P > Q

Logic Design

❖Given truth table: 3 inputs

A	B	C	Output
0	0	0	1
0	0	1	1
0	1	0	X
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

❖ K-map

C \ AB	00	01	11	10
0	1	X	1	0
1	1	1	0	0

BC’

A’

❖ Logic equation:

$$O = A' + BC'$$

Reminder

- Join the Exam Rehearsal meeting on Apr 25.
- Get your electronic devices ready before the exam.
- Close-book & close-note exam.
- Read the given information carefully.
- Show your calculation steps in the long questions.