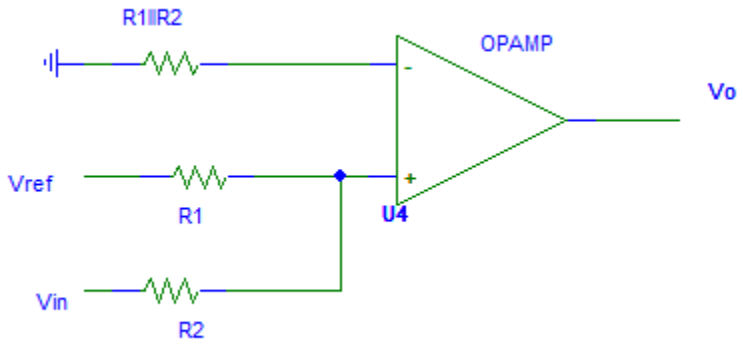
Comparator and Schmitt Trigger

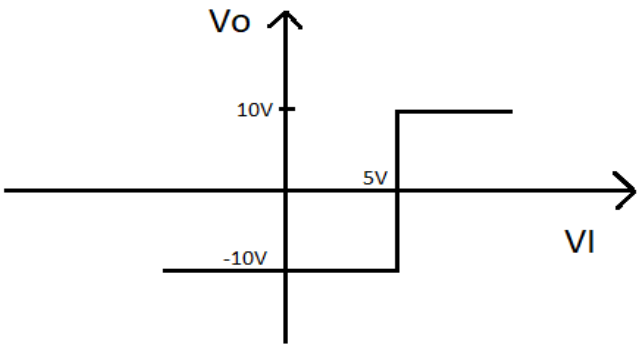
1.



Here R1 = 5k, R2 = 10k, Vref = 2V, VH=+10V and VL = -10V

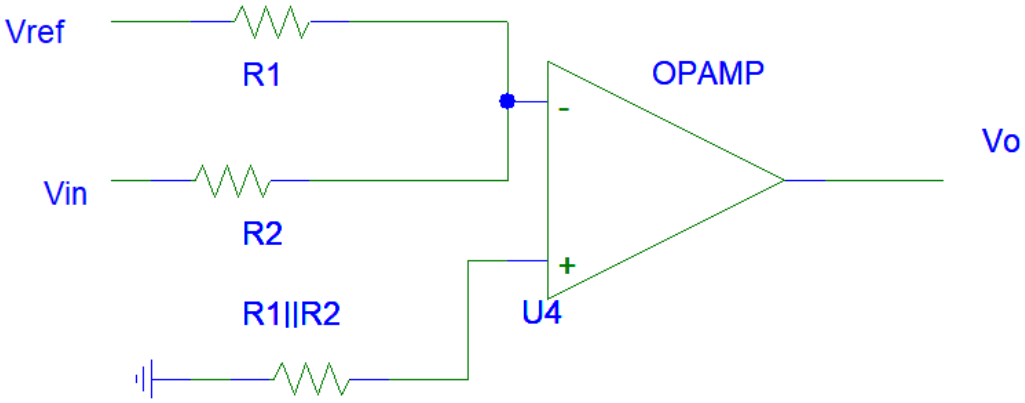
a. Draw the input and output characteristics plot for this circuit with proper labeling.
b. What is the type of this comparator? Explain your answer.

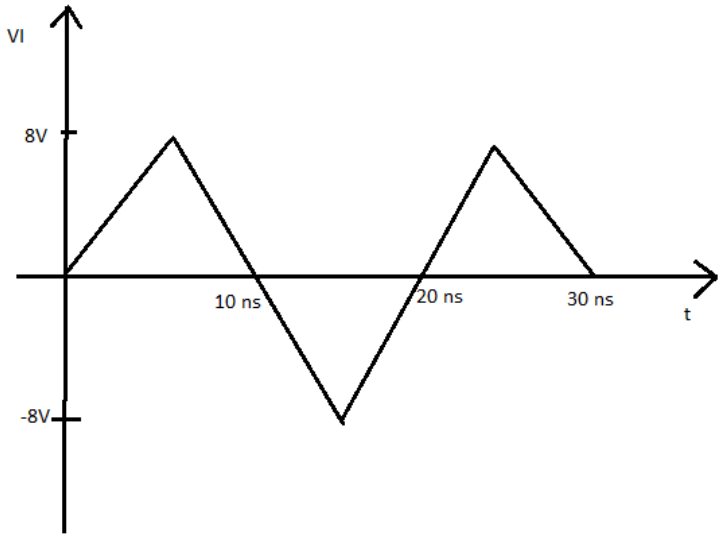
2.



Design a comparator circuit that can implement the above transfer characteristics.

3.

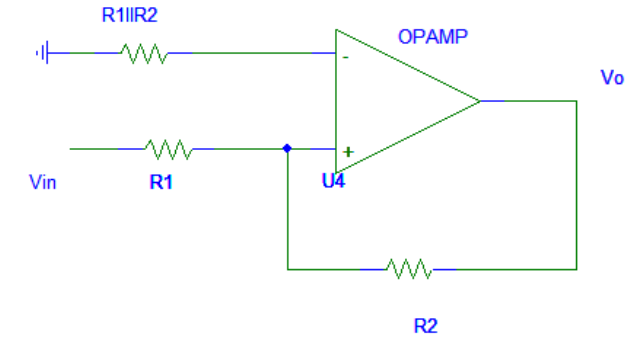


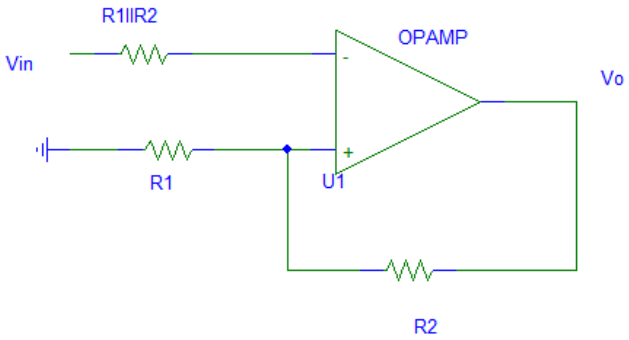


Here, R1 = 5k, R2 = 10k, Vref = 2V, VH=+10V and VL = -10V

a. Identify the type of comparator.
b. Suppose the above signal is applied to the circuit as input , what will be the output waveform? Draw the output waveform.

4.

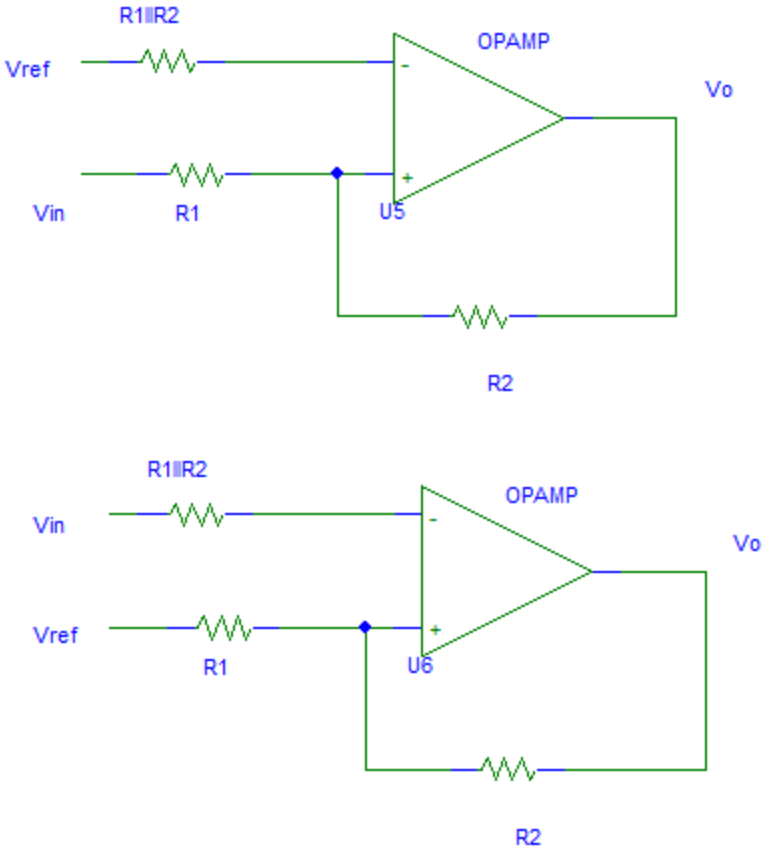




Here, R1 = 5k, R2 = 10k, Vref = 2V, VH=+10V and VL = -5V

a. Identify the type of the above schmitt trigger circuits and compare their input output characteristics.
b. What will be their higher threshold voltage, lower threshold voltage and hysteresis width?
c. Draw their transfer characteristics.
d. Is it possible to shift their center voltage from the origin with little modification of the circuits? Draw new circuits with this modification.

5.



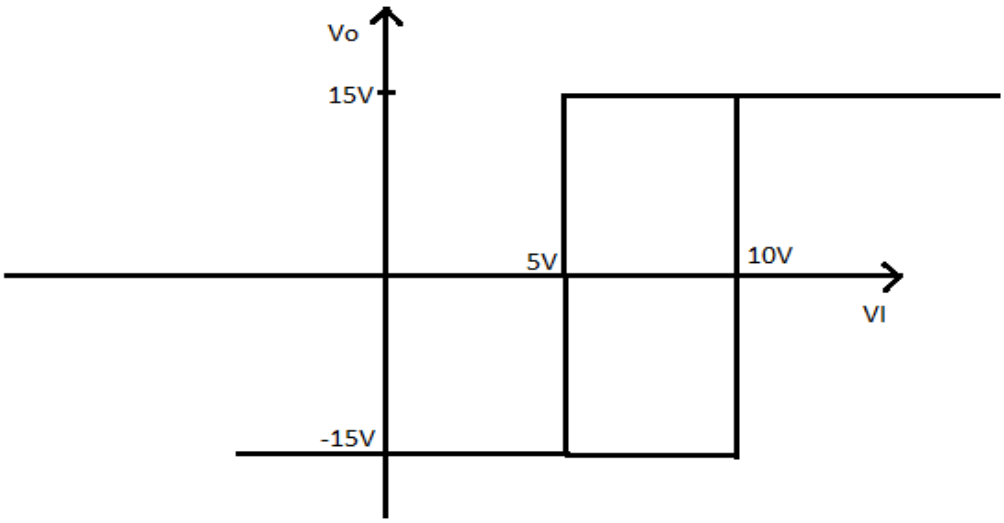
Here, R1 = 5k, R2 = 10k, Vref = 2V, VH=+10V and VL = -10V

a. Identify the type of the above schmitt trigger circuits and compare their input output characteristics.

b. What will be their higher threshold voltage, lower threshold voltage, shift voltage and hysteresis width?

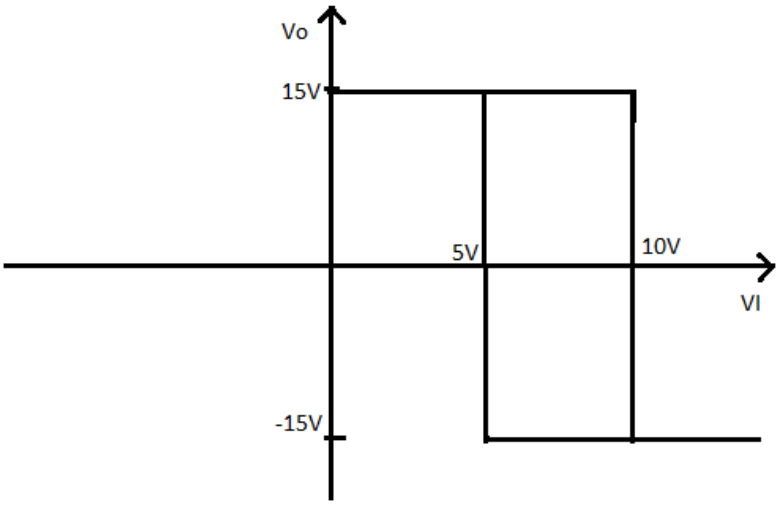
c. Draw the voltage transfer characteristics curve (V_{in} vs V_{out} plot). Clearly label the plot.

6.



a. Identify the schmitt circuit from the VTC.
b. What is the hysteresis width, Shift voltage, VH, VL , VTH and VTL from this VTC.
c. Design a schmitt trigger that will produce the same VTC.

7.



a. Identify the schmitt circuit from the VTC.
b. What is the hysteresis width, Shift voltage, VH, VL , VTH and VTL from this VTC.
c. Design a schmitt trigger that will produce the same VTC.

*8. Suppose you want to design a street light controller. You have a sensor that gives output as voltage as proportional to the light intensity. You need to switch off the light when the output of the sensor is above 5V. You need to switch on the light when the sensor output is below the 5V. (You can assume the VH and VL value)

a. **Draw** the voltage transfer characteristics curve (**V_{in} vs V_{out} plot**). Clearly **label** the plot.

b. Draw the circuit diagram that can be perfect for this specification.

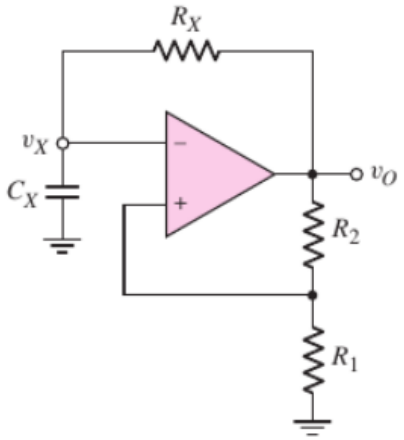
c. **Find out the parameter value of the circuit.**

9. Suppose you want to design a street light controller. You have a sensor that gives output as voltage as proportional to the light intensity. You need to switch off the light when the output of the sensor is above 5V. You need to switch on the light when the sensor output is below the 5V. There is a noise source of 1V peak-peak. Your instructor has told you to use a schmitt trigger circuit to improve performance. (You can assume the VH and VL value)

a. What VTH and VTL value can be used for this design to solve the problem of noise?
b. **Draw** the voltage transfer characteristics curve (**V_{in} vs V_{out} plot**) and clearly **label** the plot.
c. Draw the circuit diagram that can be perfect for this specification
d. Find out the parameter value of the circuit.

Square Wave Generator

1.

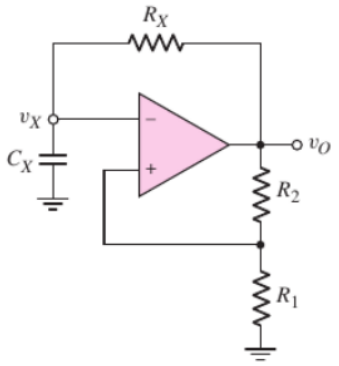


Here suppose R1 = 10k, R2 = 20k, Rx = 1k, Cx = 1 mF, VH= 10V and VL = -10 V

a. Find the period and frequency of the square wave?

b. What will be the value of the duty cycle of the square wave?
c. Draw the output waveform with proper labeling.

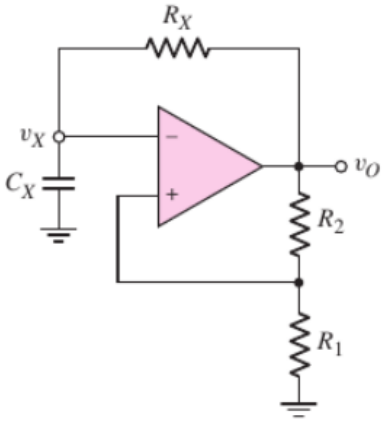
2.



Here VH = 10 V and VL = -10 V

Design the circuit so that it can generate a square wave with 1 kHz frequency and 50% duty cycle.

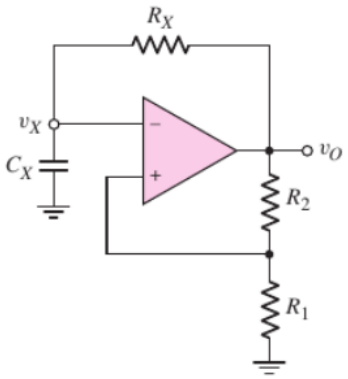
3.



suppose R1 = 10k, R2 = 20k, Rx = 1k, Cx = 1 mF

Design the circuit so that it can generate square wave with a 30% duty cycle. Find the frequency of your designed circuit.

4.

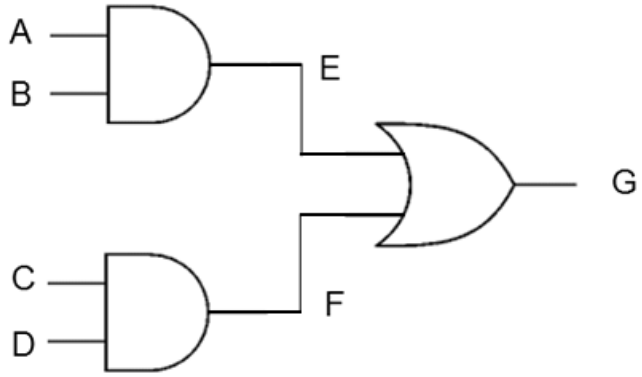


Here suppose R1 = 10k, R2 = 20k, Rx = 1k, Cx = 1 mF, VH = 10V and VL = -5V

Find out the duty cycle of inverted output signal of the above circuit.

CMOS logic design

1. Design a CMOS logic circuit to implement the given compound gate in Figure below. First derive the logical expression of output Y and then design the CMOS network.



2. a) Design a static CMOS logic circuit that implements the logic function Y= AB
   b) Design a static CMOS logic circuit that implements the logic function Y= (A+B)
3. Design a static CMOS logic circuit that will implement the following logic
   a. NAND gate ($Y = \overline{AB}$)
   b. XOR gate ($Y = A\overline{B} + \overline{A}B$)
3. Design a static CMOS logic circuit that will implement the following logic
   a. NOR gate ($Y = \overline{A + B}$)
   b. XNOR gate ($Y = AB + \overline{AB}$)
4. Design static CMOS circuit for the following expression,
   a. Y = AB + CD

b. Y = AB +C
c. Y = (A+B)C
d. Y = (A+B)(C+D)
e. Y = $\overline{AB + CD}$
f. Y = $\overline{AB + C}$
g. Y = $\overline{(A + B)C}$
h. Y = $\overline{(A + B)(C + D)}$
i. $Y = \overline{A} + \overline{B} + \overline{C}$

5.

Truth Table

Input A	Input B	Output
0	0	1
0	1	0
1	0	0
1	1	1

Design a static CMOS logic circuit that will implement the above truth table.