Open Loop Transfer Characteristics

1. Assemble the circuit shown in Fig. 1:

2. Apply a sine wave of 1kHz at $4V_{PP}$.

3. An op-amp operating in open loop has a transfer characteristic of two possible outputs; positive saturation and negative saturation.

4. Place channel 1 of the oscilloscope at V_{IN} and channel 2 at V_{OUT}.

5. Sketch the both waveforms in Fig. 2 and label the two possible outputs of the op-amp.
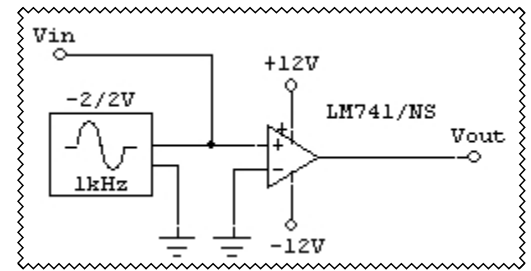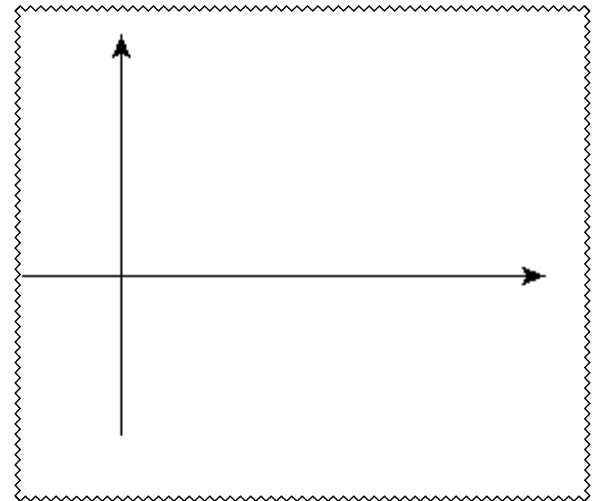
Fig. 1

Fig. 2

Open Loop Comparator

6. Assemble the circuit shown in Fig. 3: Notice that D1 is forward but D2 is reversed biased.

7. Use the voltmeter to measure V_{REF}:

V_{REF} = _____

8. Connect the voltmeter to V_{IN}. Turn the potentiometer up and down so that the LEDs alternate.

Fig. 3

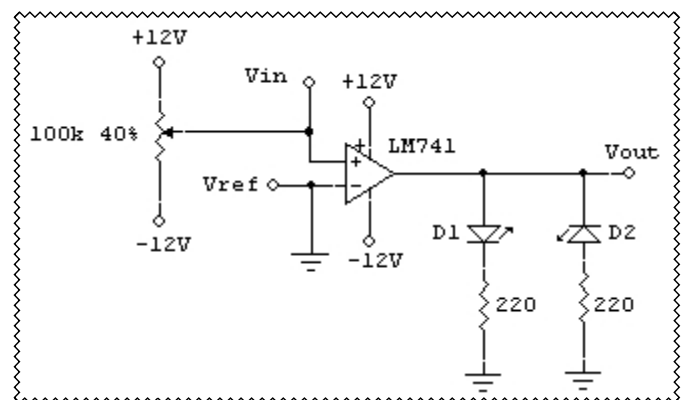8. Measure V_{IN} when the D1 is turned on:
   V_{IN} = _____

9. Measure V_{IN} when D2 is turned on:
   V_{IN} = _____

10. It seems that if V_{IN} is above the reference voltage, one LED turns on, but if V_{IN} is below the

reference the other LED lights up, what is the reason for this response?

11. Vary the potentiometer and try find a position where neither of the LEDs are on; is this possible?

Open Loop Comparator with Threshold

12. Assemble the circuit in Fig. 4:
     Notice that instead of a reference voltage, we now have a threshold voltage, V_{TH}.

13. Calculate V_{TH}: V_{TH} = _____

14. Use the voltmeter and measure V_{TH}:

     V_{TH} = _____

15. Measure V_{IN} when D1 is turned on:

     V_{TH} = _____

16. Measure V_{IN} when D2 is turned on:

     V_{TH} = _____

Fig. 4

17. The circuit in Fig. 4 is used to detect if a certain threshold voltage or a "trigger" is present.

18. Modify the circuit so that a threshold of -6V is created.

19. Use MultiSim to draw your modified circuit. For all the circuits in this lab, be sure to first simulate the operation in 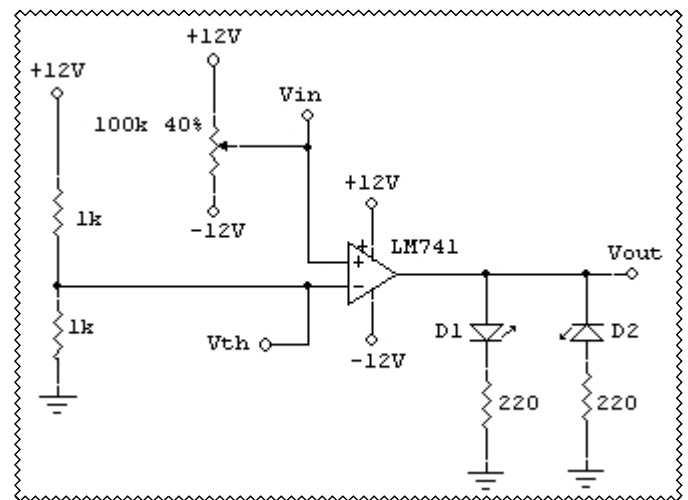MultiSim and then build the circuit in hardware.