Objective way to design and test a Schmidt trigger, using a standard operational amplifier with voltage characteristics:

- Input voltage $V_{in}$
- Output voltage $V_{out}$

The test gave the values for $V_n$ and $V_o$ to be $-11$V and $+11$V, respectively. Thus, the Schmidt trigger graph $V_n$ vs $V_o$ should have looked as shown in Figure 1.

![Figure 1. Voltage transfer characteristics.](image-url)
Figure 2. Schmitt Trigger Circuit

Figure 2 showed the circuit design used. Reference voltage for the circuit was pulled from the same power supply at $V_{cc}$, thus a voltage divider was created to adjust for the $V_{ref}$ required value. Positive feedback circuit was used, and the component (resistor) values were calculated using equations below.

$$V_L = -11V, \quad V_s = -2.5V,$$

and $V_{ref} = -6V$. So:

$$\text{...}$$
Thus,

Next of

and \( R_4 = 2.3 k\Omega \) as

effect was

\( V_5 = 8 V_{pp} \)

values of \( V_5 \)

This was due

\( V_T \) was a

signal. The problem is to check the

By increasing the value of \( R_1 \), \( V_{off} \) was more isolated from \( V_T \) and the variation of \( V_{off} \) was much smaller. Values of \( R_1 \) and \( R_2 \) were 22 k\( \Omega \) and 47 k\( \Omega \), respectively. Values of \( R_3 \) and \( R_4 \) were kept the same as before. Resistor \( R_1/R_2 \) was changed to 15 k\( \Omega \).

This circuit yielded net voltage transfer characteristics as shown in figure 3. On the x-axis \( V_5 \) was presented and \( V_6 \) on the y-axis.

The y-curves were measuring \( V_{x2} \) and \( V_{x1} \), which were \(-6V \) (x2) and \(-1V \) (x1) as required by the specifications. The y-curves showed the values of \( V_x \) and \( V_T \) to be \(-11V \) and \( 11V \).

Appendix A contained the MicroCap circuit and transient analysis, using sinusoidal signal as input, in figures 4 and 5. Also, Matlab simulation code and graph (figure 6) were presented in the appendix.
Figure 3. Circuit net voltage characteristics
Appendix A:

Figure 4. MicroCap Circuit

Figure 5. MicroCap Transient Analysis
Matlab Code:

```matlab
plot(vin,vol, 'r')
hold on
stem(Vs,0,'b')
```

Figure 6. Matlab Simulation