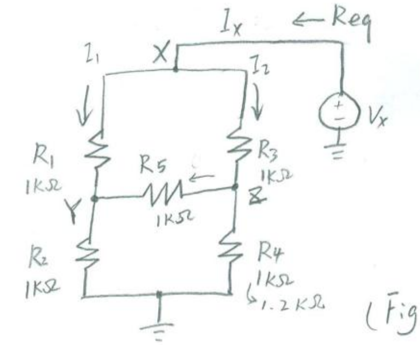
1.18 For the symmetric circuit, there's no current in R_5

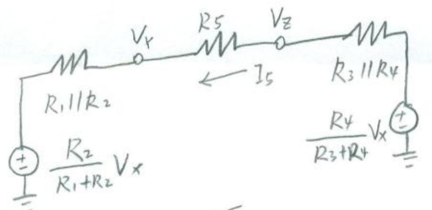


$$Req = (R_1+R_2) \,||\, (R_3+R_4) = 1\,K\Omega$$

(Fig 1.)

After raising R_4 to 1.2 KΩ, the circuit is not symmetric any more. There's a current I_5 in R_5, as shown in Fig 1. Using Thévenin's theorem, we can draw a equivalent circuit in Fig 2.

$$I_5 = \frac{\frac{R_4}{R_3+R_4}V_x - \frac{R_2}{R_1+R_2}V_x}{(R_1||R_2)+R_5+(R_3||R_4)} = \frac{(0.545-0.5)\,V_x}{(0.5+1+0.545)\,K\Omega} = 0.022\,V_x$$



(Fig 2)

$$V_Y = \frac{R_2}{R_1+R_2}V_x + (R_1||R_2)\cdot I_5 = 0.511\,V_x$$

$$V_Z = V_Y + R_5\cdot I_5 = 0.533\,V_x$$

Back to Fig 1, we can see

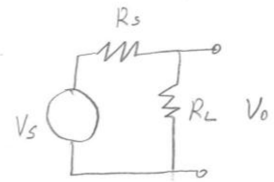
$$I_1 = \frac{V_x - V_Y}{R_1} = 0.489\,V_x$$

$$I_2 = \frac{V_x - V_Z}{R_3} = 0.467\,V_x$$

$$I_x = I_1 + I_2 = 0.956\,V_x$$

so, $$Req = \frac{V_x}{I_x} = 1.05\,K\Omega$$

1.23



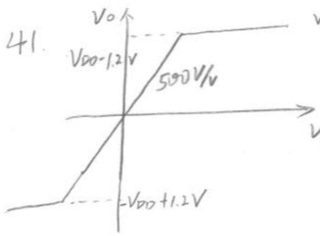
(Fig 3)

$$V_o = \frac{R_L}{R_S + R_L} V_S$$

$$\Rightarrow \begin{cases} 30mV = \dfrac{100K\Omega}{R_S + 100k\Omega} V_S \\ 10mV = \dfrac{10K\Omega}{R_S + 10K\Omega} V_S \end{cases} \Rightarrow \begin{cases} R_S = 28.6 K\Omega \\ V_S = 38.6 mV \end{cases}$$

$$i_S = \frac{V_S}{R_S} = 1.35 uA$$

1.41.



(Fig 4)

when $V_{DD} = 5V$, peak amplitude: $5V - 1.2V = 3.8V$ or $3.8/\sqrt{2} = 2.7 V_{rms}$

input: $\dfrac{3.8V}{500V/V} = 7.6mV$ or $5.4 m V_{rms}$

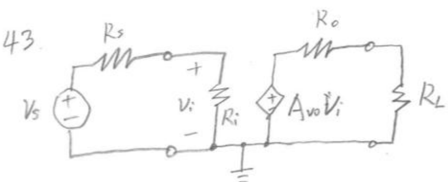
when $V_{DD} = 10V$, peak amplitude. $10V - 1.2V = 8.8V$ or $8.8/\sqrt{2} = 6.2 V_{rms}$

input: $\dfrac{8.8V}{500V/V} = 17.6 mV$ or $12.4 m V_{rms}$

when $V_{DD} = 15V$, peak amplitude $15V - 1.2V = 13.8V$ or $13.8/\sqrt{2} = 9.8 V_{rms}$

input: $\dfrac{13.8V}{500V/V} = 27.6 mV$ or $19.6 m V_{rms}$

1.43.



from figure 1.16 (b) "Sedra/Smith Micro-Circuits"

$A_{vo} = 10 V/V$. $\quad \dfrac{V_o}{V_S} = \dfrac{R_i}{R_i + R_S} \cdot A_{vo} \cdot \dfrac{R_L}{R_L + R_o}$

(a) $R_i = 10 R_S$, $R_L = 10 R_o$

$$\frac{V_o}{V_S} = \frac{10R_S}{10R_S + R_S} \cdot 10V/V \cdot \frac{10R_o}{10R_o + R_o} = 8.26 V/V$$

$20 \log 8.26 = 18.3 dB$.

(b) $R_i = R_S$, $R_L = R_o$

$$\frac{V_o}{V_S} = \frac{R_S}{R_S + R_S} \cdot 10 V/V \cdot \frac{R_o}{R_o + R_o} = 2.5 V/V$$

$20 \log 2.5 = 8 dB$

(c) $R_i = R_S/10$, $R_L = R_o/10$

$$\frac{V_o}{V_S} = \frac{R_S/10}{R_S/10 + R_S} \cdot 10 V/V \cdot \frac{R_o/10}{R_o/10 + R_o} = 0.083 V/V$$

$20 \log 0.083 = -21.6 dB$

1.45

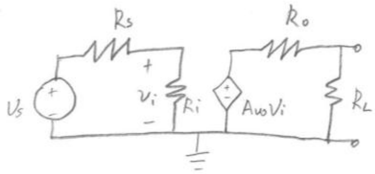


Fig 5 (a)

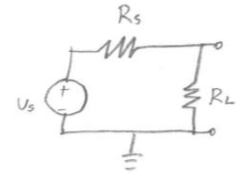


Fig 5 (b)

In Fig5 (a),

$$\frac{V_o}{V_s} = \frac{R_i}{R_i+R_s} \cdot A_{vo} \cdot \frac{R_L}{R_L+R_o} = \frac{10K\Omega}{10K\Omega+100K\Omega} \times 1000\,V/V \times \frac{100\Omega}{100\Omega+1K\Omega} = 8.26\,V/V$$

$1-\frac{R_i}{R_i+R_s} \approx 90\%$ The signal loses 90% of its strength when it passes through the Amp.

$1-\frac{R_L}{R_L+R_o} \approx 90\%$ Then it loses 90% of its rest strength after passing the load.

In Fig 5 (b),

$$\frac{V_o}{V_s} = \frac{R_L}{R_L+R_s} = \frac{100\Omega}{100\Omega+100K\Omega} \approx 0.001\,V/V$$ even worse

Ratio: $\frac{8.26\,V/V}{0.001\,V/V} = 8260$