Homework 1: Circuits Review: Rev 2
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Student Name:

1. Impedances

a. At a frequency of $f = 1\,\text{GHz}$, what is the impedance of a capacitor, $C = 1\,\text{pf}$?

b. At a frequency of 1 GHz, an inductor has an impedance of $j \times 1\,\text{k}\Omega$. What is the inductance?

c. A cosine voltage of 1 Volt, RMS, is applied across the inductor in part b.

What is the current phasor?

Write the current as a function of time.

2. Node Analysis

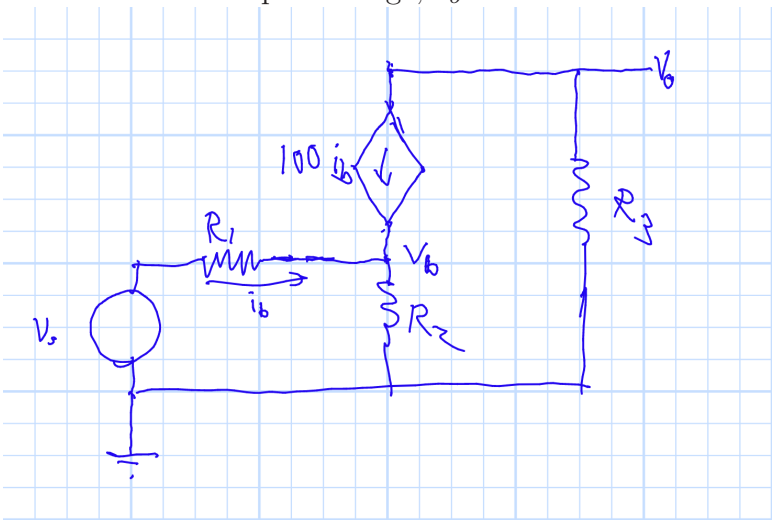
In the circuit shown in the figure below, $R_1 = 90\,\mathrm{k}\Omega$, $R_2 = 990\,\Omega$, and $R_3 = 10\,\Omega$. The voltage source is $v_s = 1\,\mathrm{Volt}$.

a. How many nodes are needed to solve the circuit?

b. Write the equation(s) needed to solve the circuit.

c. What is the voltage, v_b?

d. What is the output voltage, v_o?

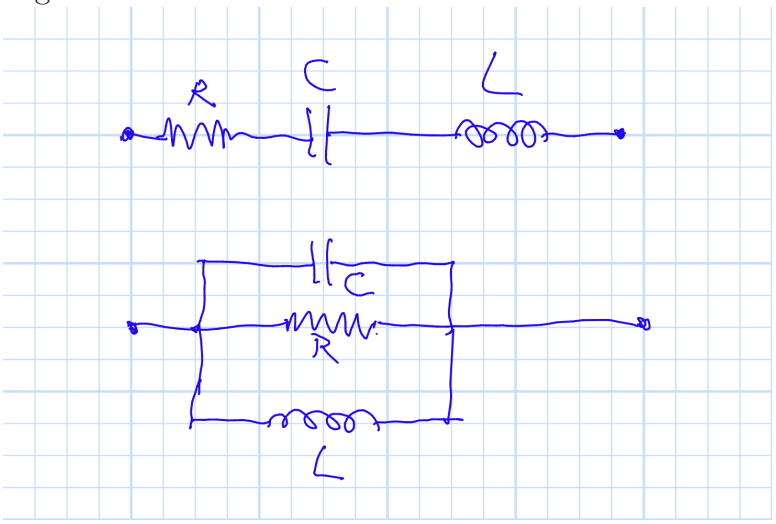


3. Series and parallel

In this figure, $R = 1\,\mathrm{k}\Omega$, $C = 20\,\mathrm{pf}$, and $L = 20\,\mu\mathrm{H}$. The frequency is $f = 10\,\mathrm{MHz}$.

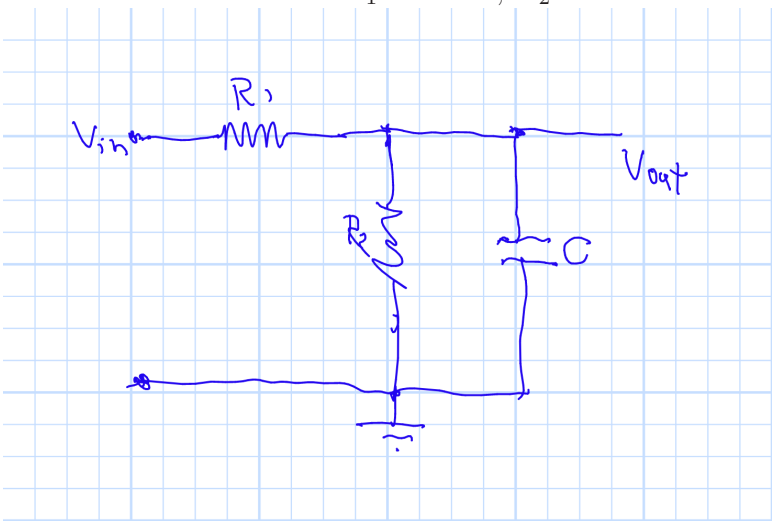
a.What is the impedance of the components in series in the top of this figure?

b. What is the impedance of the components in parallel in the bottom of this figure?



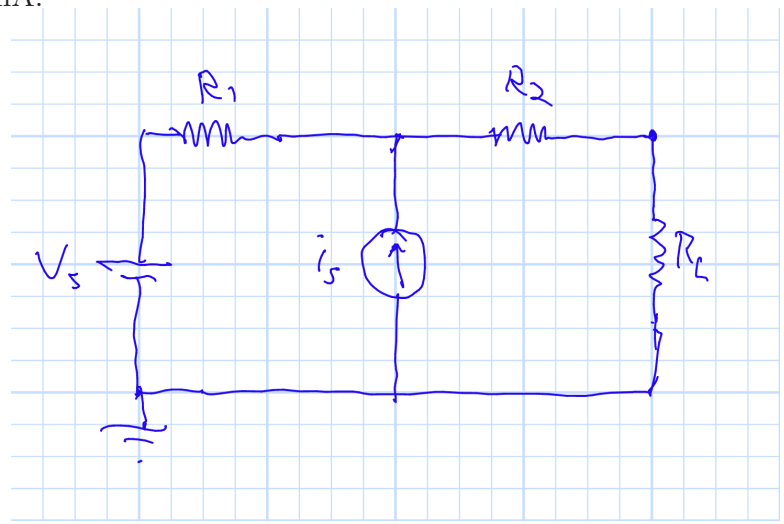
4. Voltage and current Divider

What is v_{out} in the following circuit, if $v_{in} = 2\,\text{Volts} + 3\,\text{Volts} \times \cos \omega t$ at $f = 1\,\text{MHz}$? The values are $R_1 = 10\,\text{k}\Omega$, $R_2 = 3\,\text{k}\Omega$ and $C = 1\,\text{nF}$.



5. Superposition

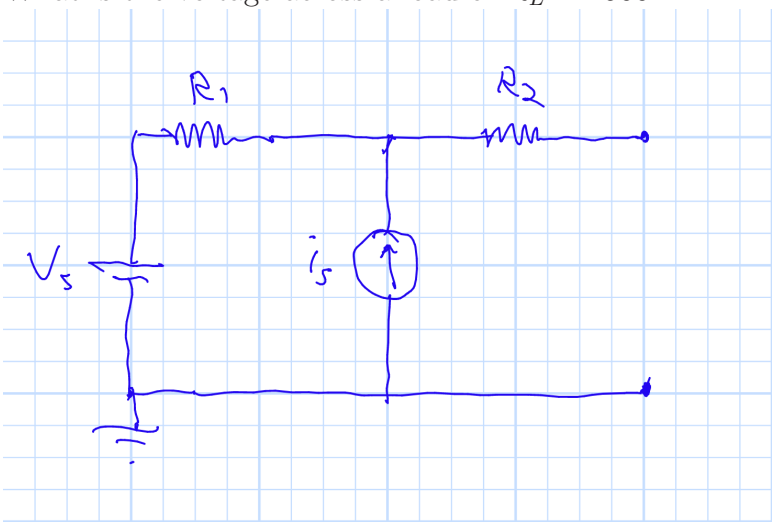
What is the voltage across the load resistor, R_L in the following circuit? $R_1 = 1\,\mathrm{k}\Omega$, $R_2 = 1\,\mathrm{k}\Omega$, $R_L = 500\,\Omega$, The sources are $v_s = 1\,\mathrm{Volt}$ and $i_s = 1\,\mathrm{mA}$.



6. Thévenin Equivalent

What is the Thévenin equivalent circuit of the circuit in the following figure? As in the previous problem, $R_1 = 1\,\mathrm{k}\Omega$ and $R_2 = 1\,\mathrm{k}\Omega$. The sources are $v_s = 1\,\mathrm{Volt}$ and $i_s = 1\,\mathrm{mA}$.

What is the voltage across a load of $R_L = 1500\,\Omega$?

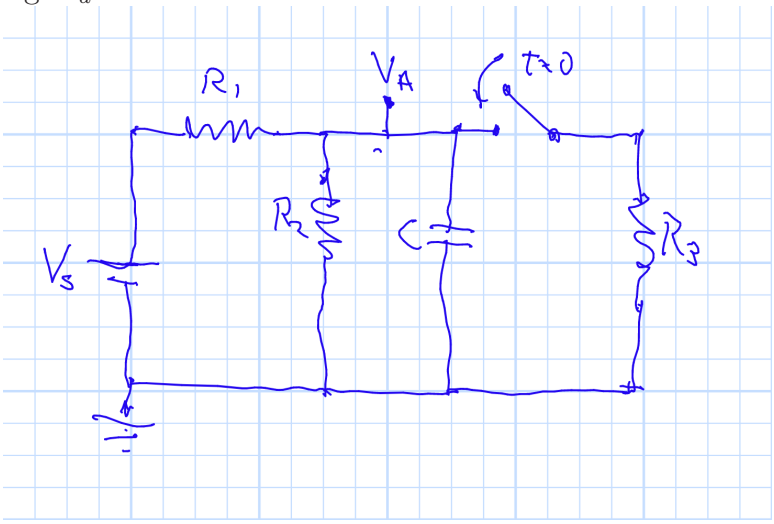


7. Steady State

In the following circuit, the switch is open for a long time. The values are $v_s = 10\,\text{Volts}$, $R_1 = R_2 = R_3 = 20\,\text{k}\Omega$, $C = 10\,\mu\text{F}$.

a. What is the voltage, v_A?

b. The switch is closed at $t = 0$. After waiting a long time, what is the voltage v_a now?



8. Sinuoids

a. What is the transfer function of the following circuit? Write the equation as a function of frequency. $R_1 = 5\,\text{k}\Omega$, $R_2 = 3\,\text{k}\Omega$, $C = 100\,\text{nF}$.

b. What is v_{out} at DC?

c. What is v_{out} as the frequency approaches infinity?

d. What is the cutoff frequency?

