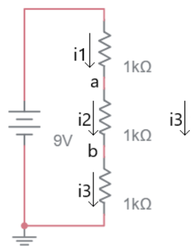
Circuits with resistors, voltage and current sources

Determine all voltages and currents. Round you answer to 2-significant figures and include units. If the circuit does not have the variable asked for in the table, leave that entry blank.



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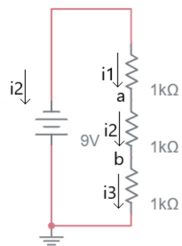

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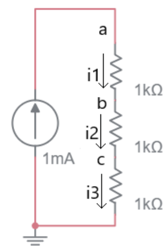

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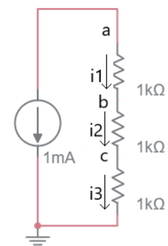

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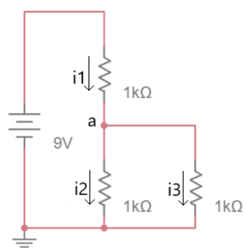

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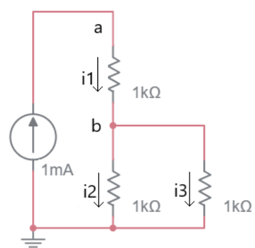

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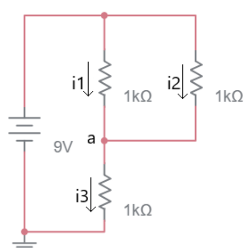

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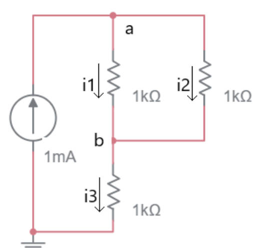

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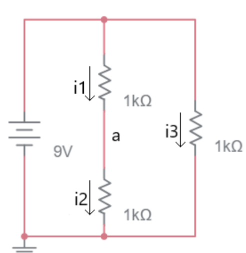

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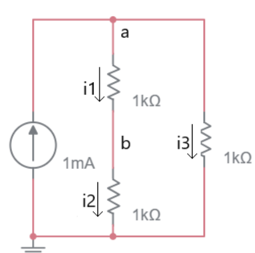

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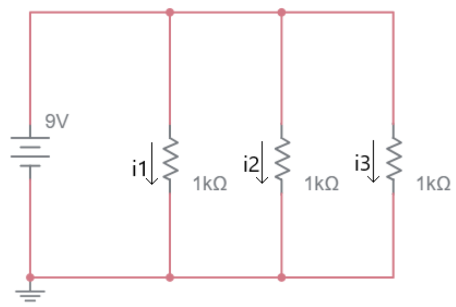

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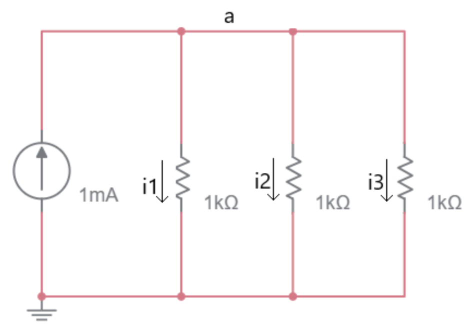

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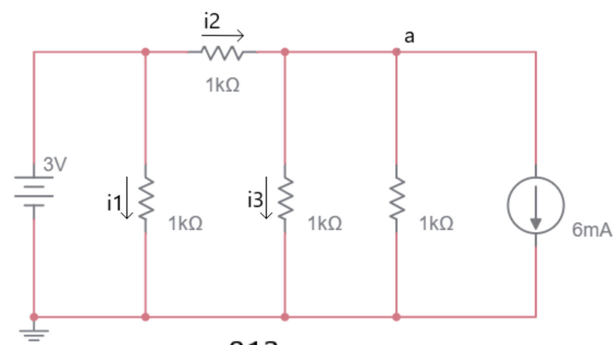


013

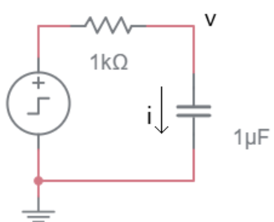
Circuit	a	b	c	i1	i2	i3
001						
002						
003						
004						
005						
006						
007						
008						
009						
010						
011						
012						
013						

Circuits with resistors and capacitors

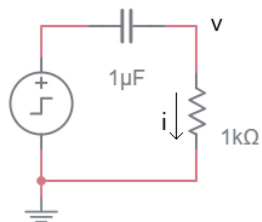
Plot all voltage across the capacitor and the current through the capacitor as a function of time. Assume that the capacitor is initially discharged; in other words, the voltage across the capacitor is 0V at time 0.

The  symbol is a unit step voltage source that goes from 0V to 1V at time 0.

The  symbol is a unit step current source that goes from 0V to 1mA at time 0.



001



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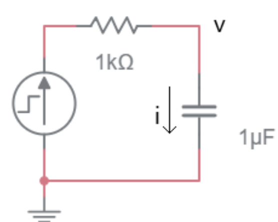
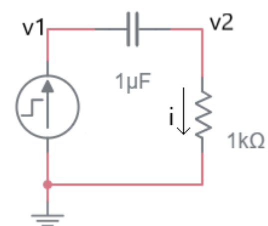


003



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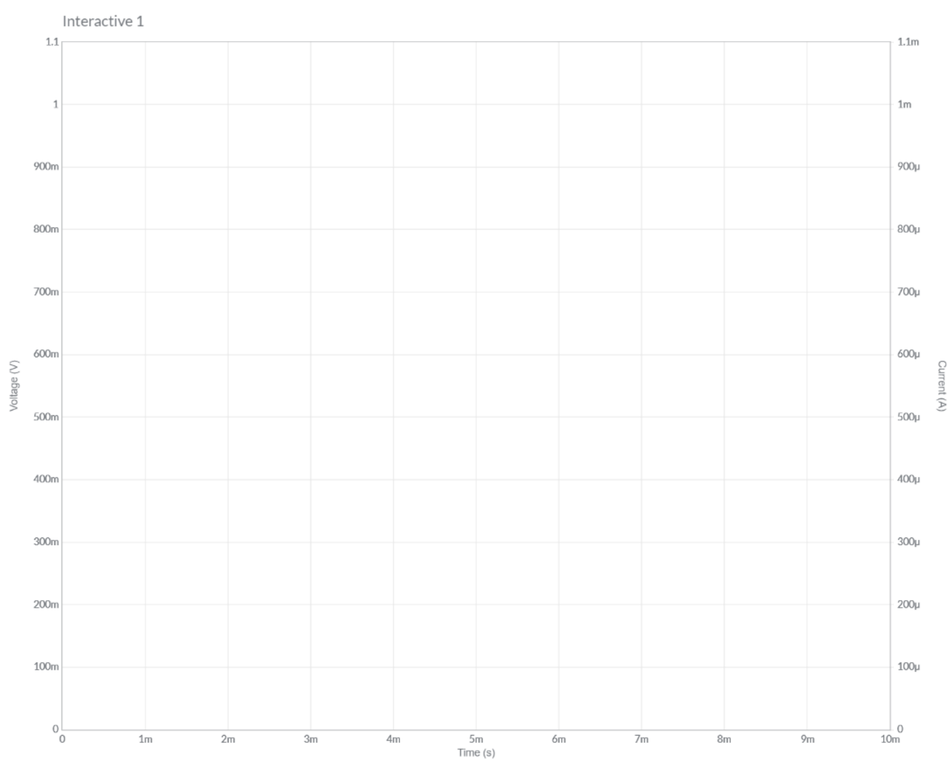
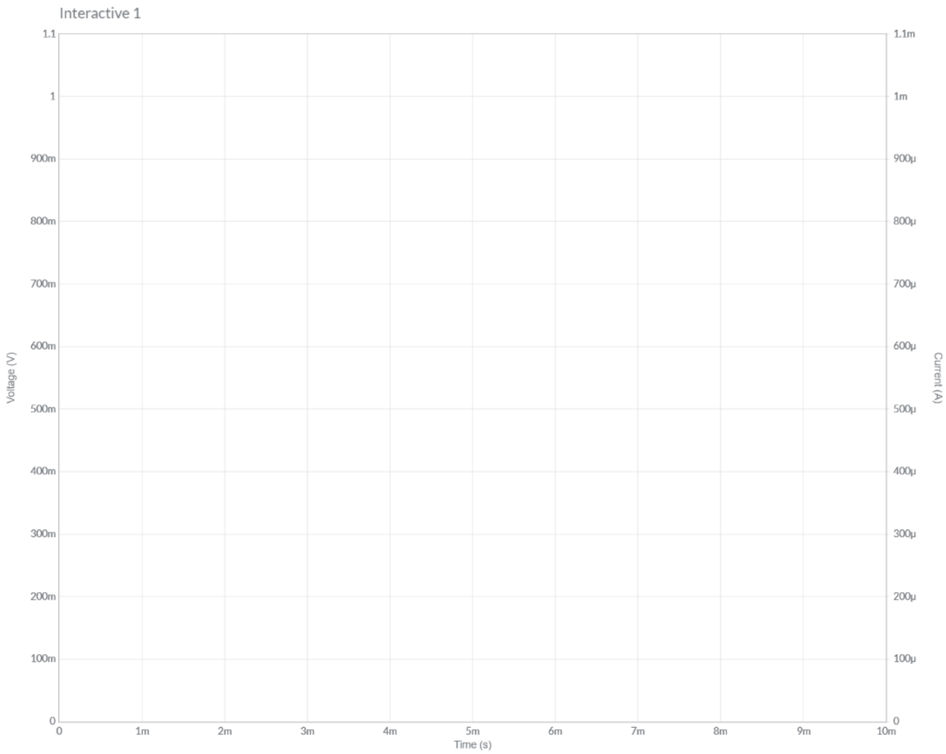
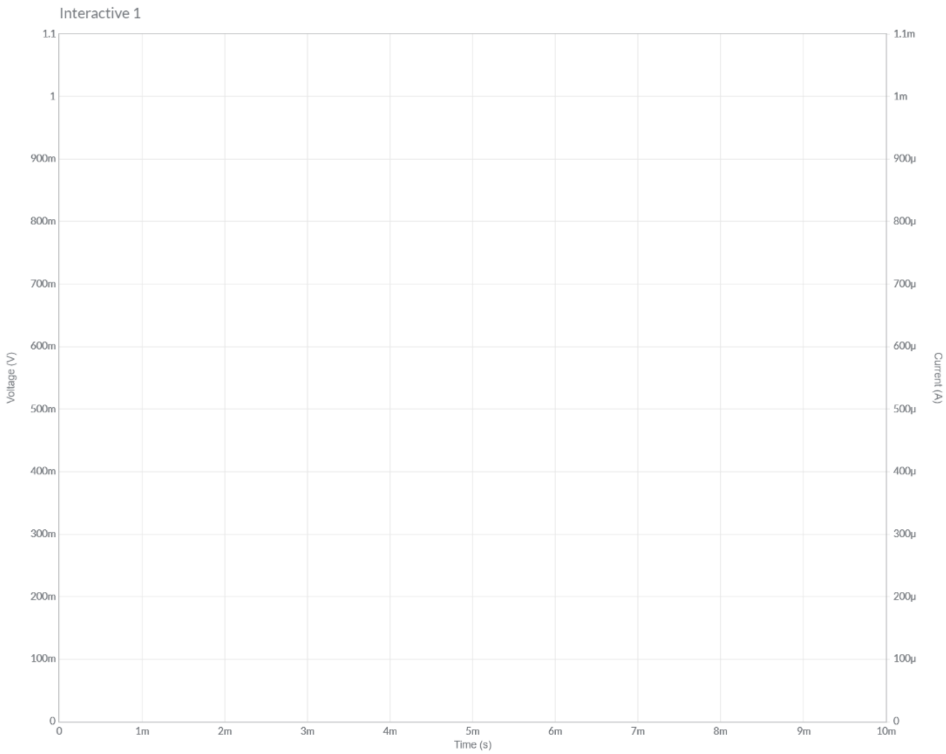


Plot the voltage and current for the circuit labeled 001.



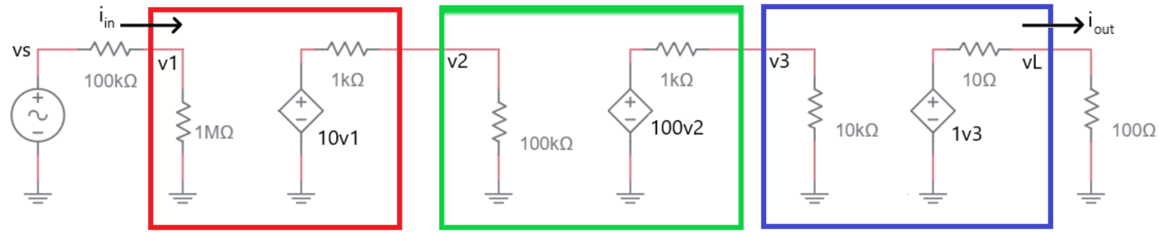
Plot the voltage and current for the circuit labeled 002.

Plot the voltage and current for the circuit labeled 003.



Plot the voltage and current for the circuit labeled 004.

Multistage amplifiers and dependent sources



Determine the voltage gain vL/vs

Step 0

Determine the gain v1/vs by examining the voltage divider formed by the source and the input to the first (red) stage.

Step 1

Determine the gain v2/v1 by examining the voltage divider formed by the output of the first stage (red) and the input to the second stage (green).

Step 2

Determine the gain v3/v2 by examining the voltage divider formed by the output of the second stage (green) and the input to the third stage (blue).

Step 3

Determine the gain vL/v3 by examining the voltage divider formed by the output of the third stage (blue) and the load resistor.

Step 4

Multiply the ratios so that you come out with vL/vs

Determine the current gain $A_i = i_{out}/i_{in}$

Step 1

Using Ohm's law at the input and output

Step 2

Use the step 1 equations to form i_{out}/i_{in}

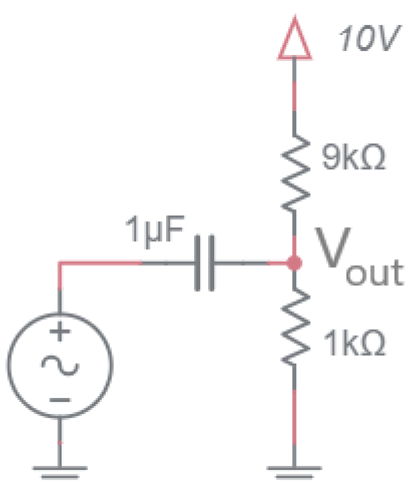
DC and AC simplifications for common circuit elements

As an engineer you will often need to make quick estimate of a circuit's behavior. In these cases, it is completely appropriate to make approximations of component behavior to simplify the analysis.

Element	DC Model	AC Model
Resistor	R	R
Capacitor	Open	C
Inductor	Short	L
Voltage Source	V	Short
Current Source	I	Open

Practical Application – Coupling AC signal on a DC bias

The following circuit is very useful as it allows an AC signal to be DC biased at any level you need. In order to understand how this circuit operates, you will need to invoke the principle of superposition. Superposition dictates that the total response of a system is the sum of the partial response. A partial response is the contributions that one energy source has on the output while all the other energy sources are set to 0. So, in terms of the schematic given the total response is the sum of the partial response due to the AC source (with the 10V supply set to 0V), plus the partial response due to the DC source (with the AC source set to 0).



In this analysis, assume that the AC source is described by 0.5sin(6,280t), a 1V peak to peak 1kHz sine wave.

In the Draw the schematic row, draw the equivalent circuit for each source. For example:

- In the AC Source column draw the schematic with all components replaced by their AC equivalent model from the table in the **DC and AC simplifications for common circuit elements** section and setting the 10V supply to 0V.
- In the DC Source column draw the schematic with all components replaced by their DC equivalent model from the table in the **DC and AC simplifications for common circuit elements** section and setting the AC source to 0V.

In the Vout row, use circuit theory to determine the value of Vout.

In the Total Response row add together the AC and DC contributions.

	AC Source (Set DC source to 0)	DC Source (Set AC source to 0)
Draw the schematic		
Vout		
Total Response		