**Chapter 4: Circuit Theorems**

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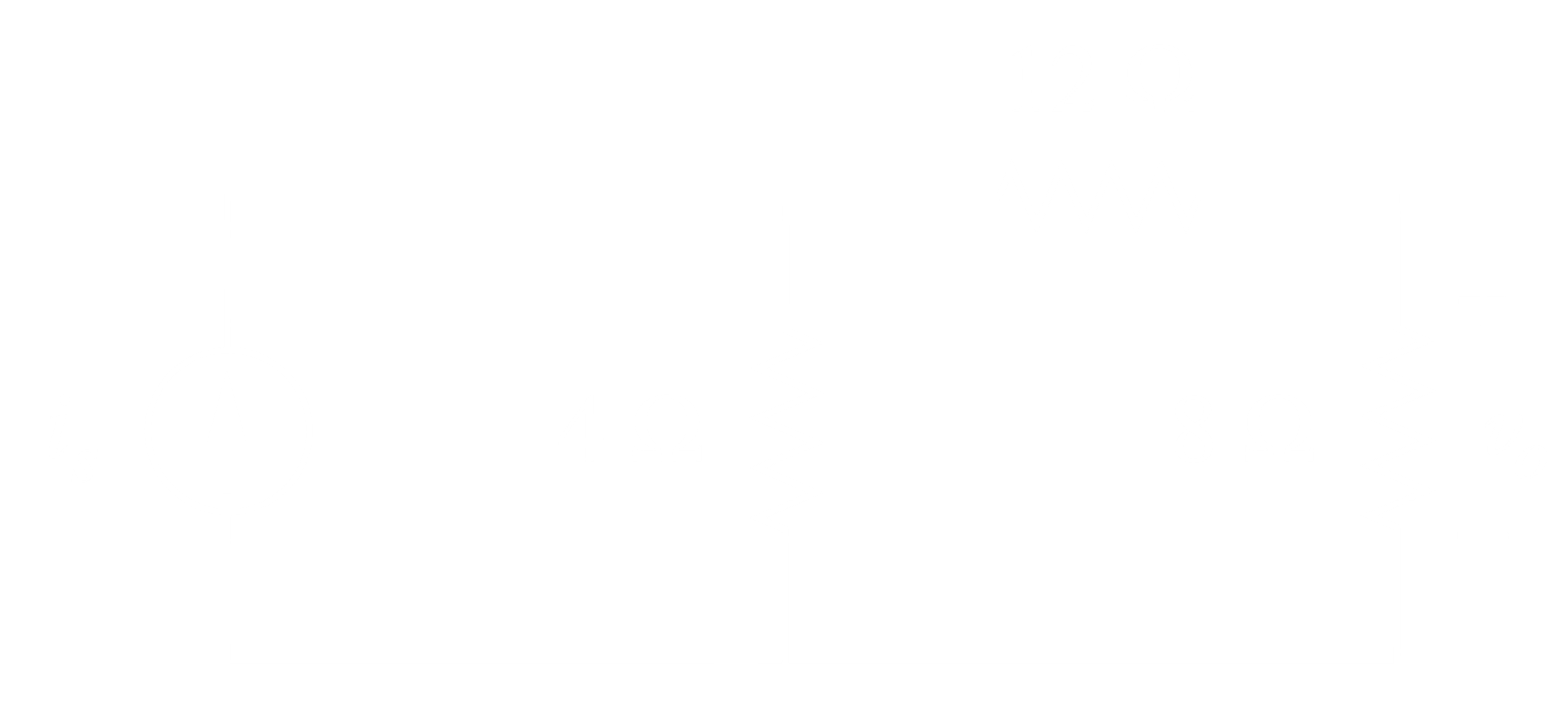
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## 4.2 Linearity Property

transfer or gain =

If the transfer or gain is of first order, then the system is linear. If it is of an order greater than 1, then the system is non-linear.

Practice Problem 4.1



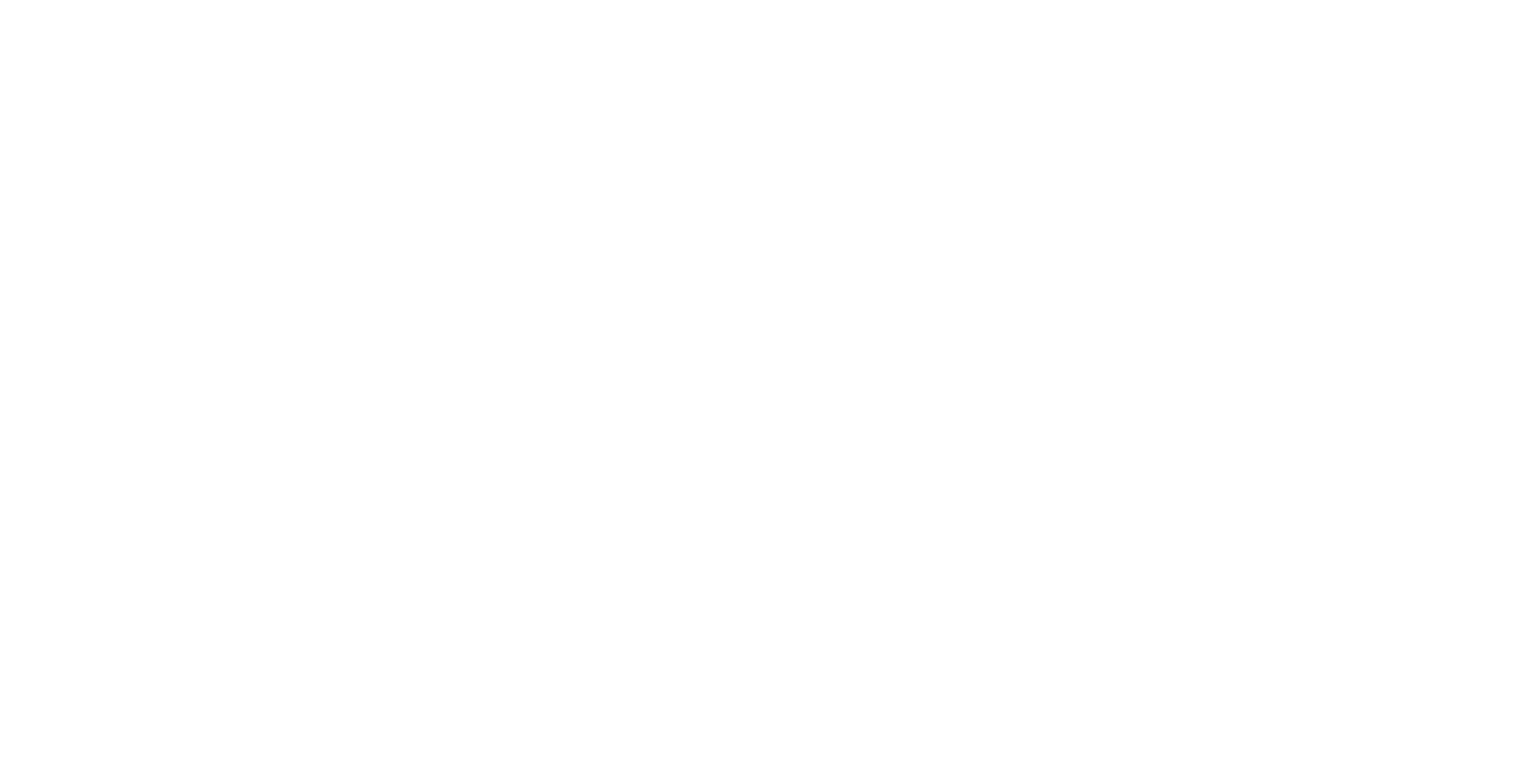
- current divider rule

- voltage divider rule

Thus, it can be seen that the system is linear.

## 4.3 Super Position

If there is more than one source, their effect at the same time on any element is equal to the algebraic sum of the effects of each of the sources on that element.



Current Source Off Open Circuit

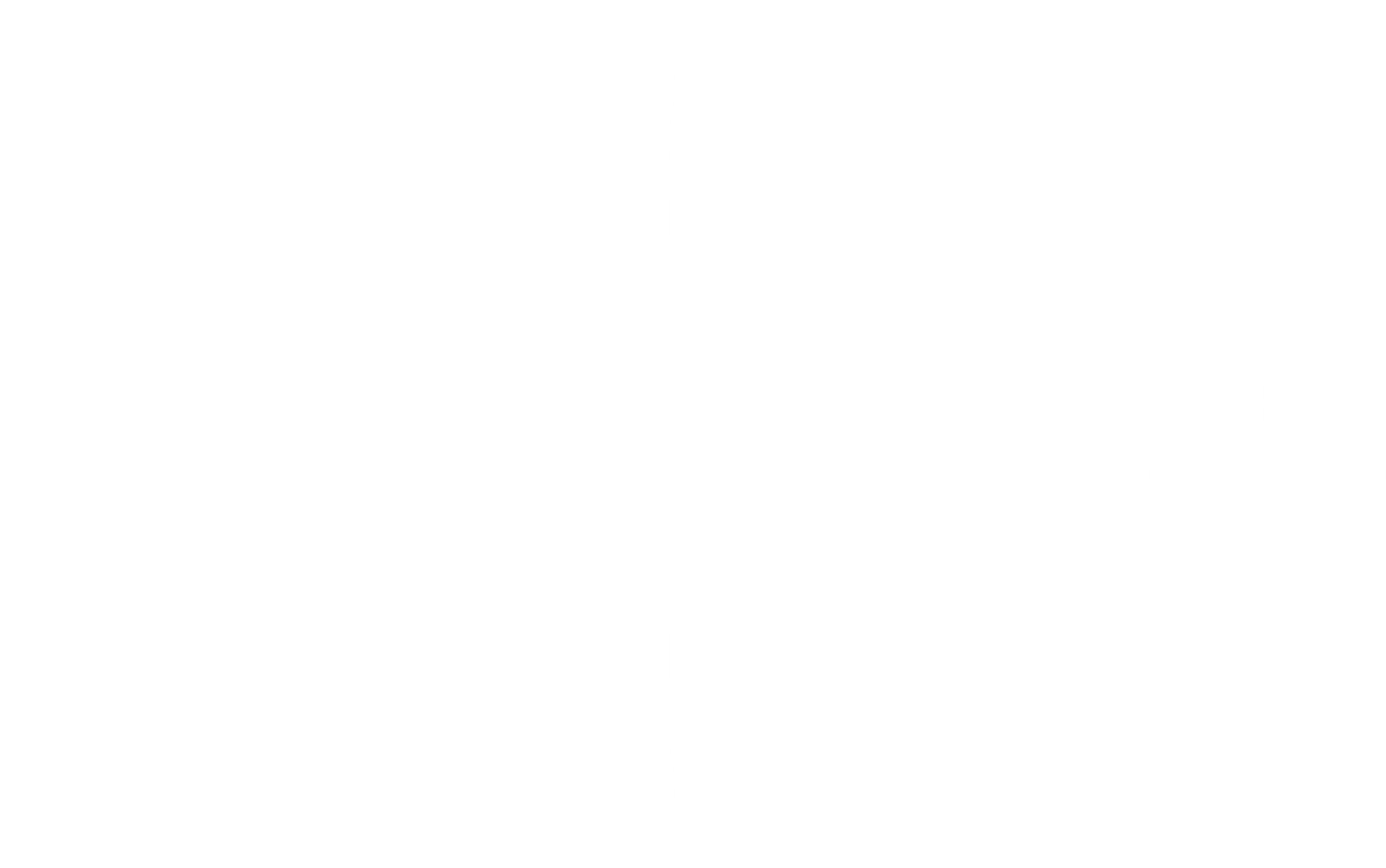
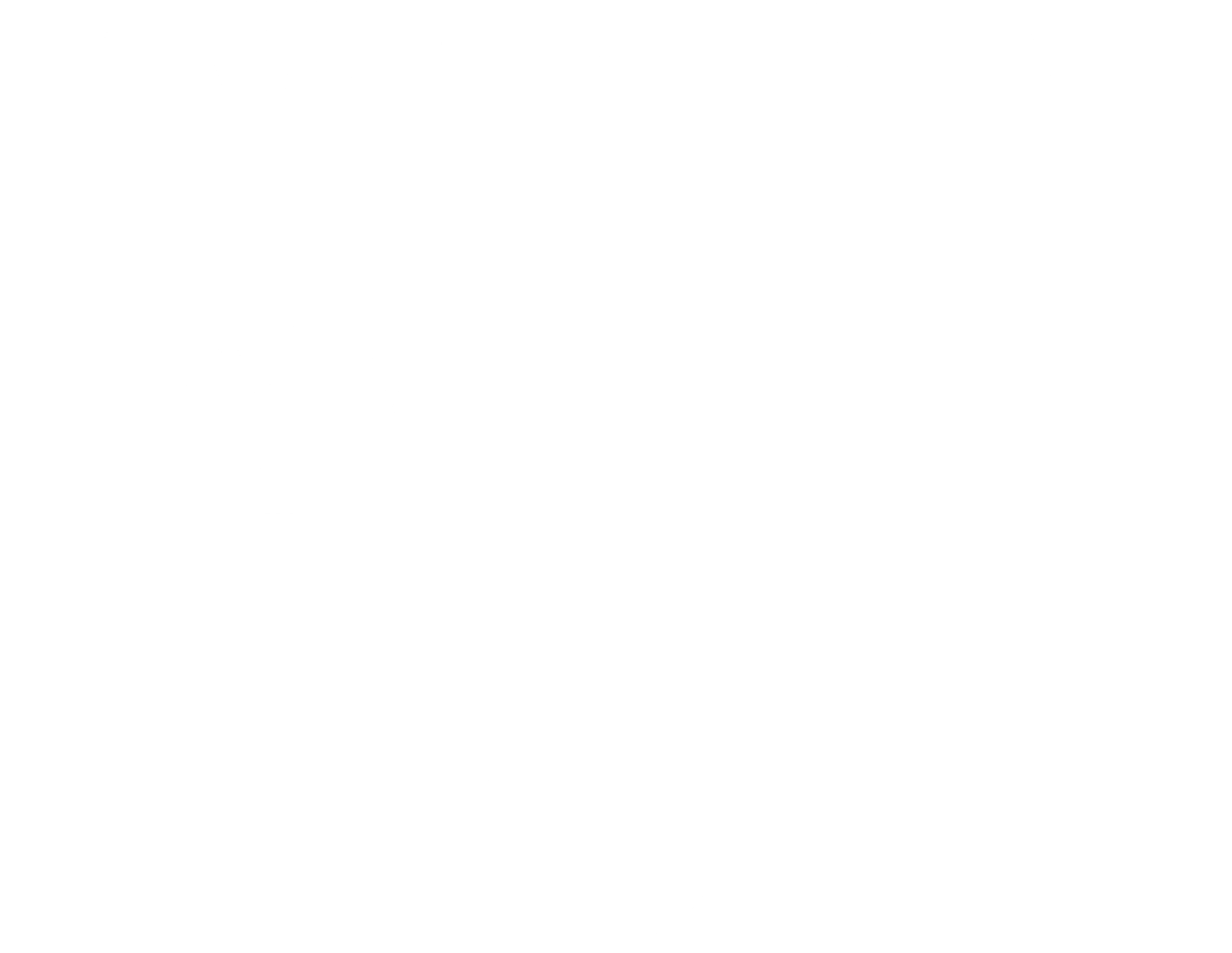
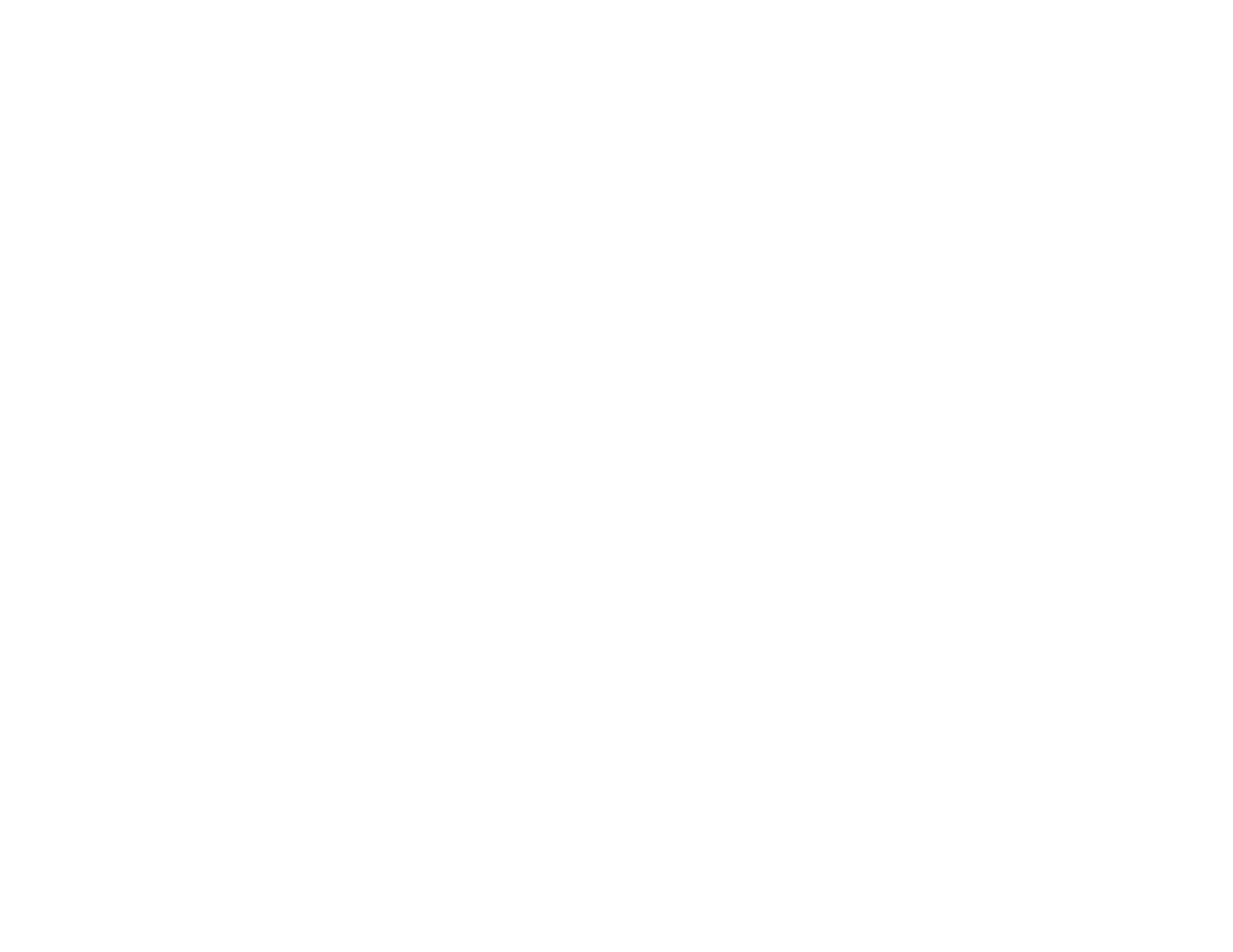
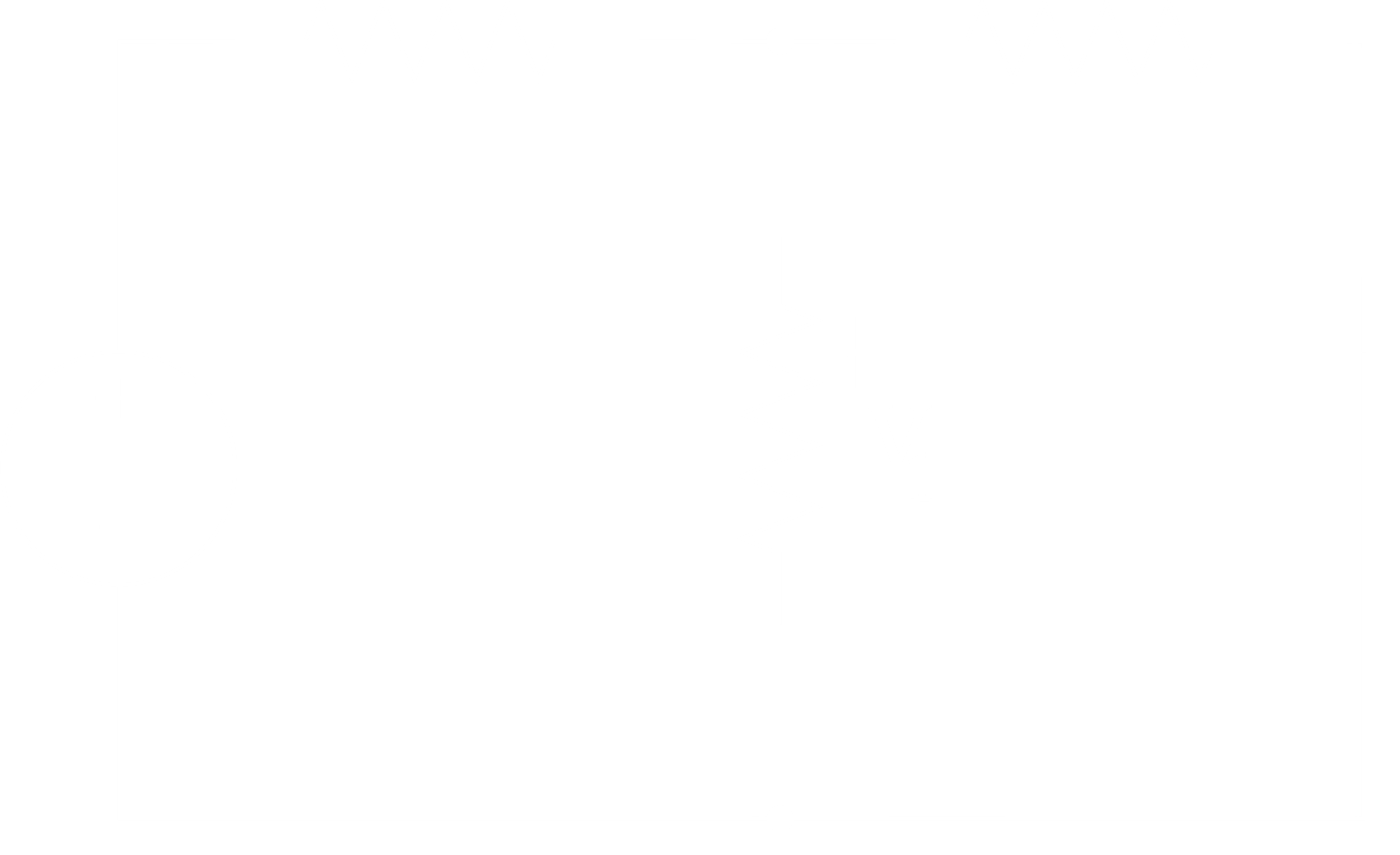
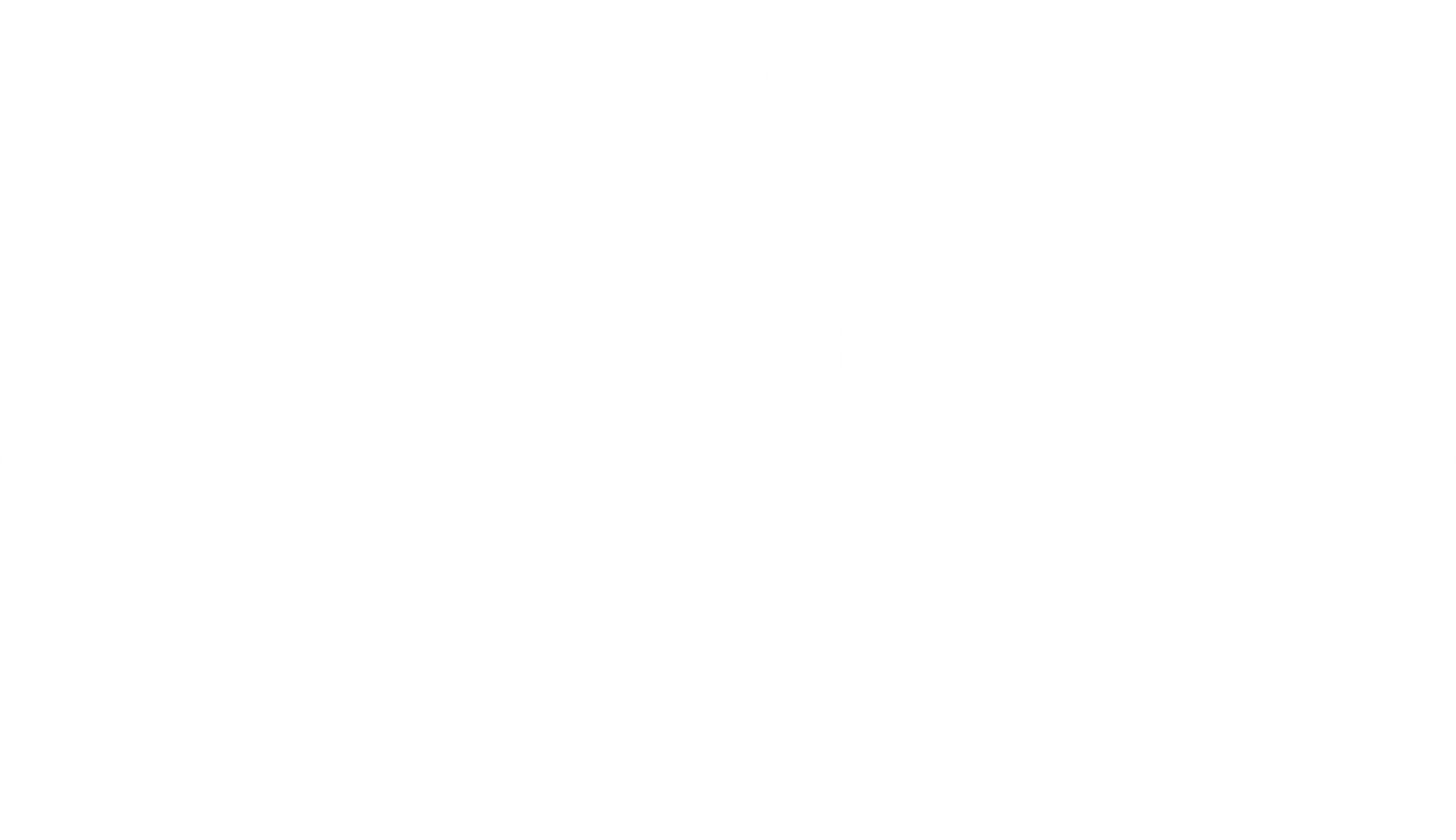
Voltage Source Off Short Circuit

Redraw each of the following:

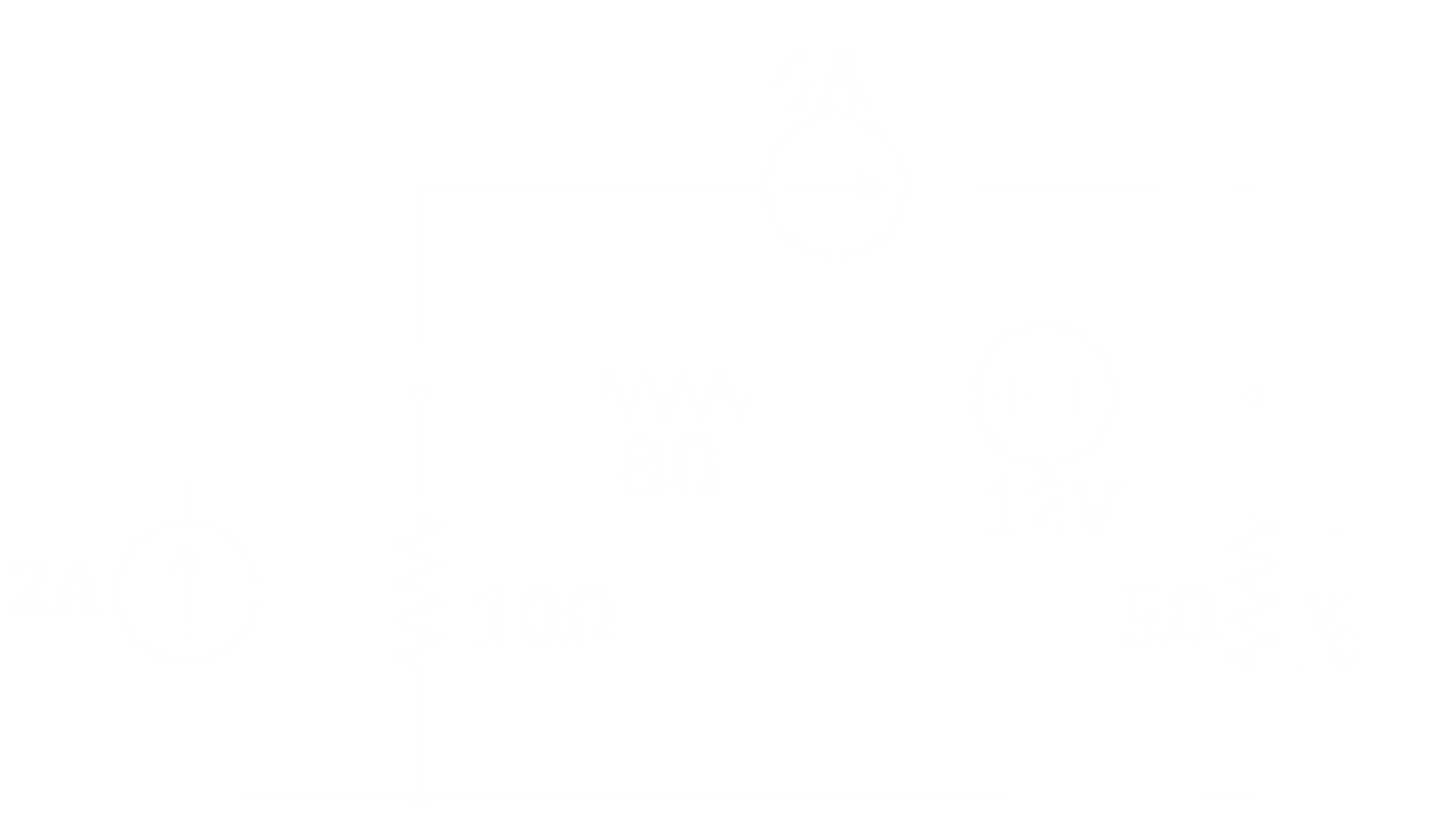
and are turned off. The circuit is shorted at those points. can be found.

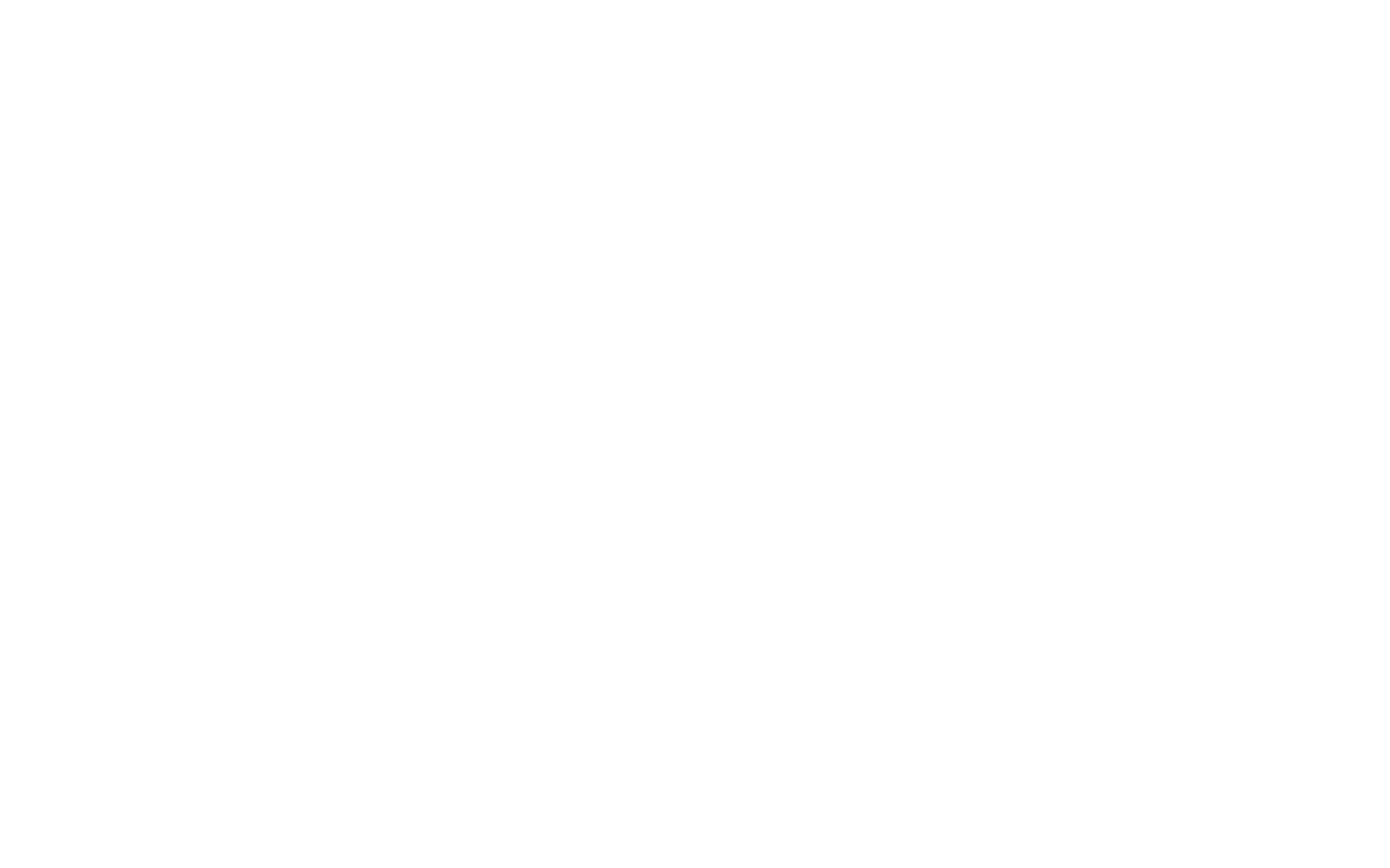
and are turned off. is shorted and is left open. can be found.

and are turned off. is left open and is shorted. can be found.



Practice Problem 4.4

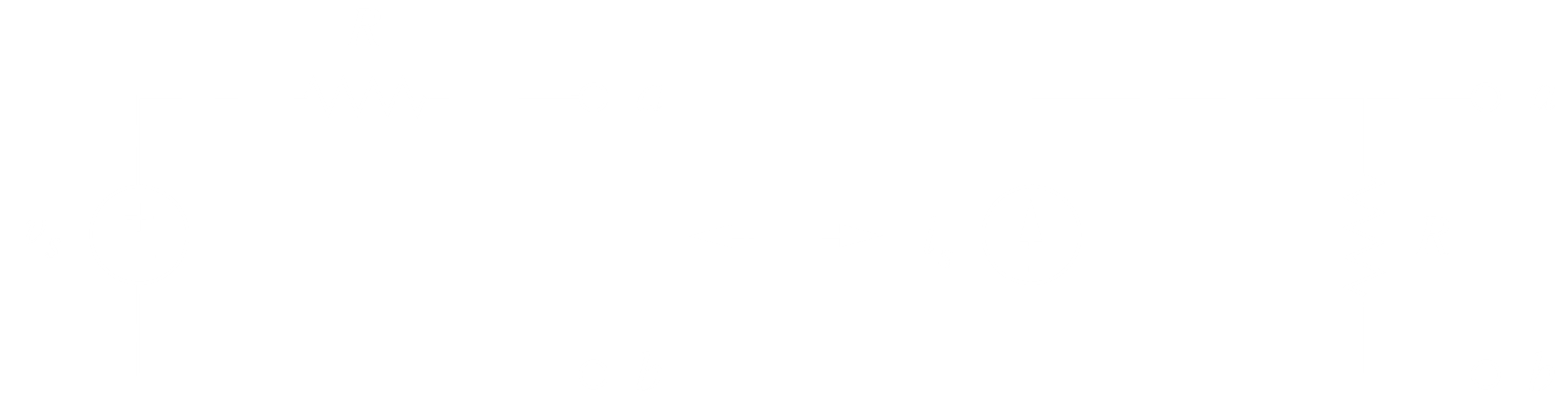


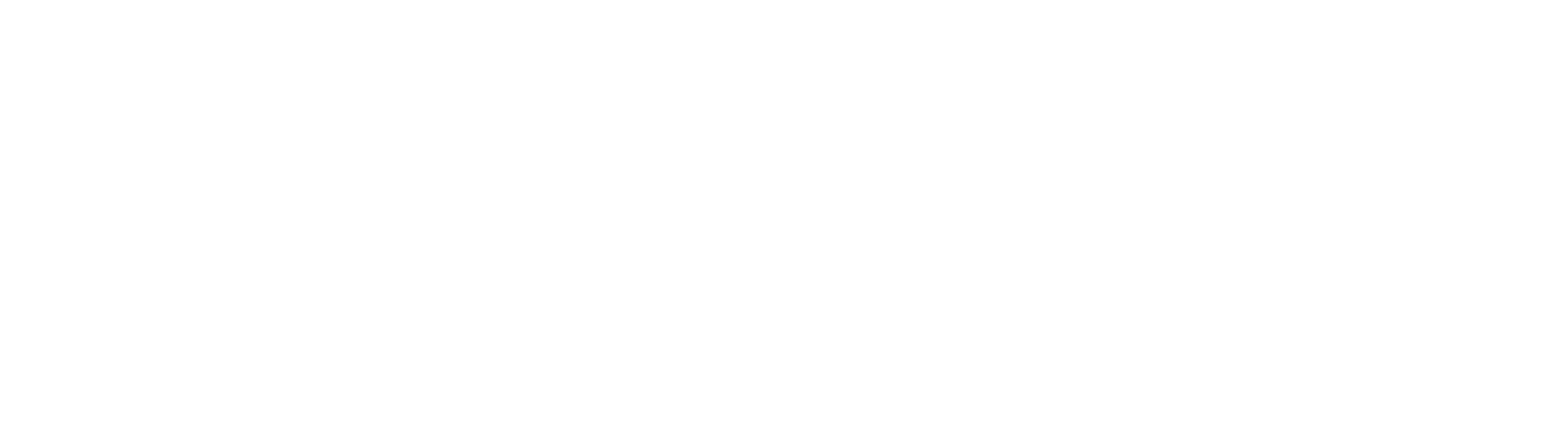




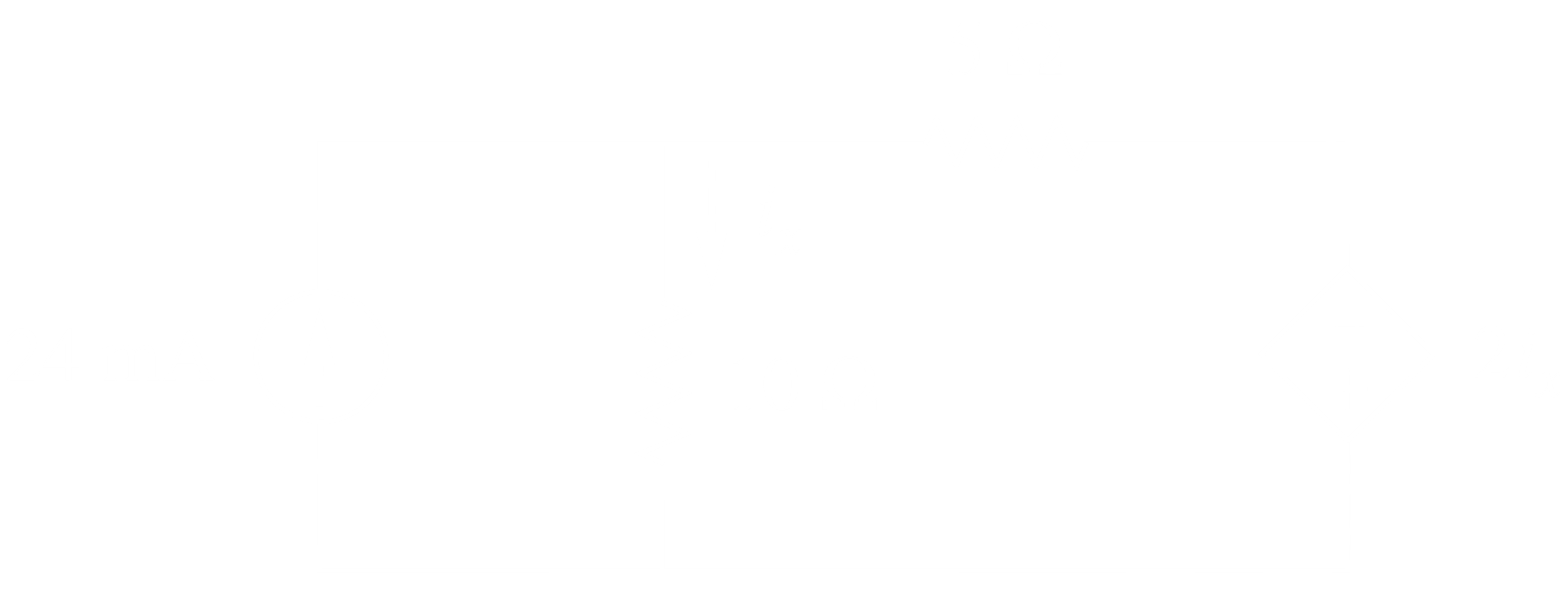


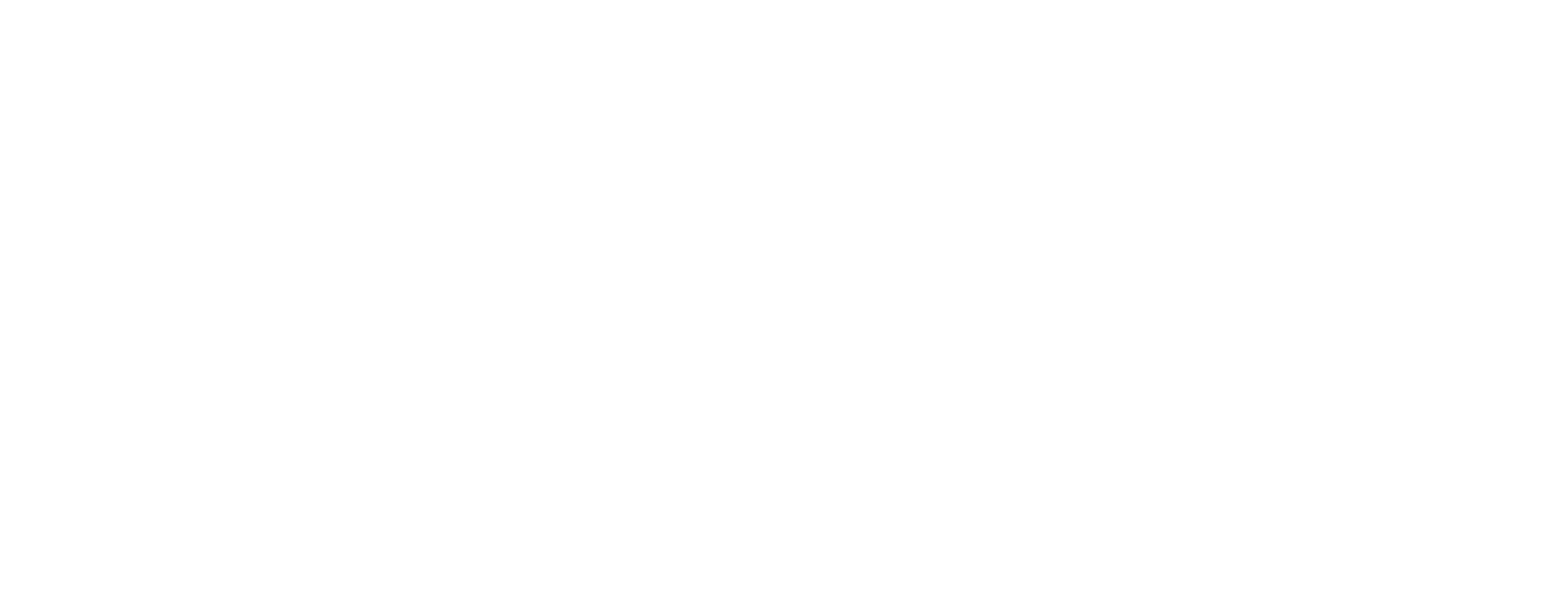
## 4.4 Source Transformation





Practice Problem 4.7





## 4.5 Thevenin’s Theorem

Any complex circuit can be replaced by a series voltage source () and a series resistor ().

Assuming all sources are independent,

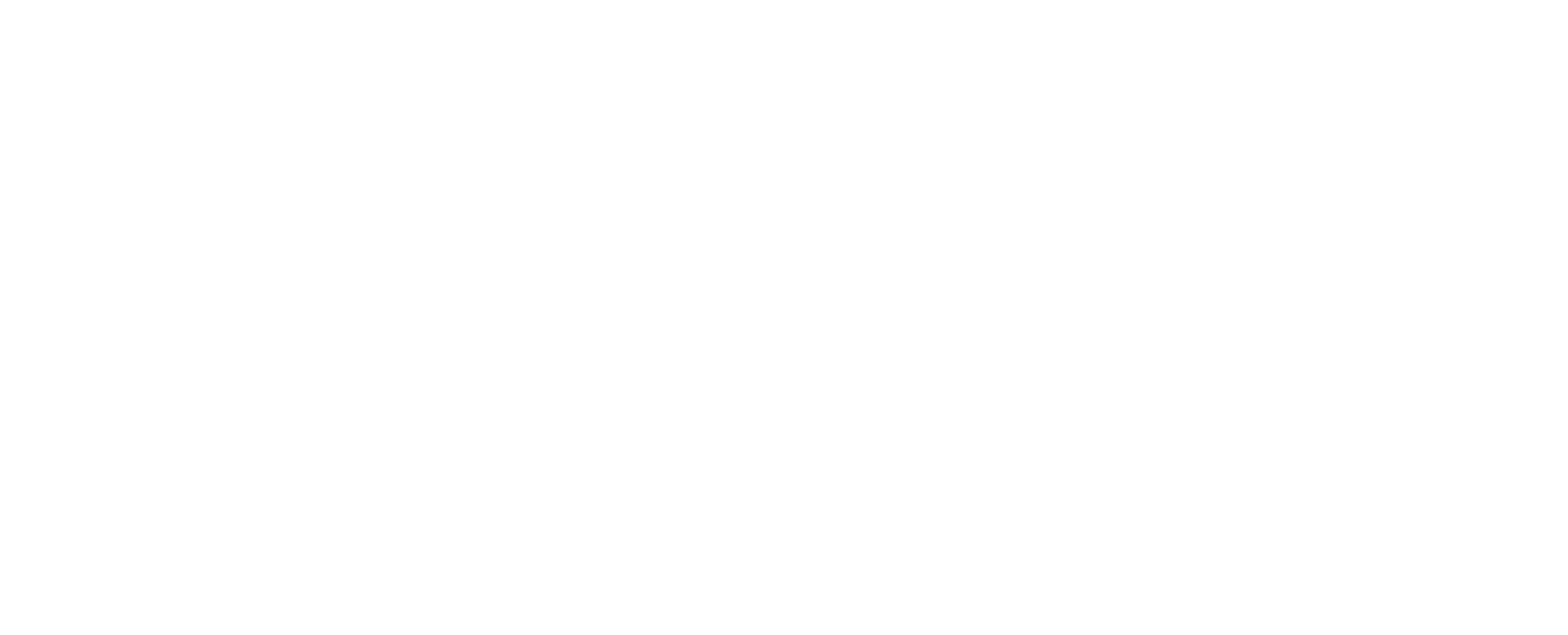
Step 1. Switch off all independent sources.

Step 2. Find the terminal open circuit voltage. This is .

Thevenin’s Theorem with Dependent Sources

* For , the process is the same as before. The open circuit voltage at the terminal or at the load is found.
* For :
  + Switch off the independent sources, but not the dependent ones.
  + Connect at extra voltage source or current source at the terminal and find the current from the voltage source or voltage across the terminal respectively.

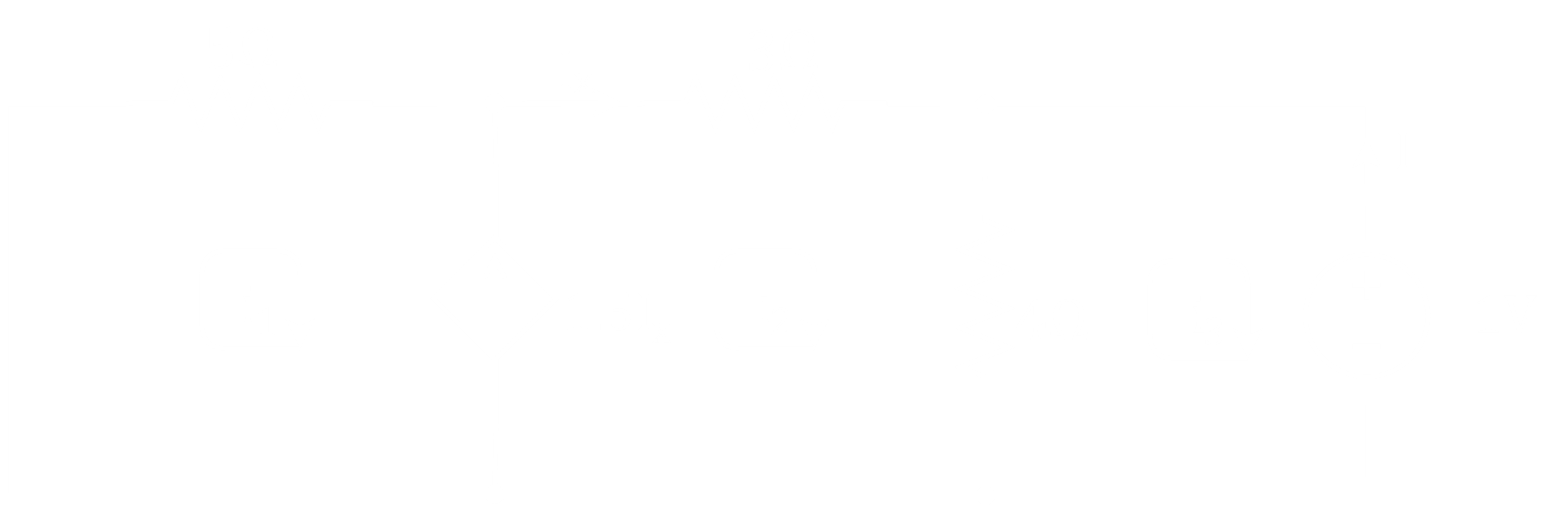
Practice Problem 4.9



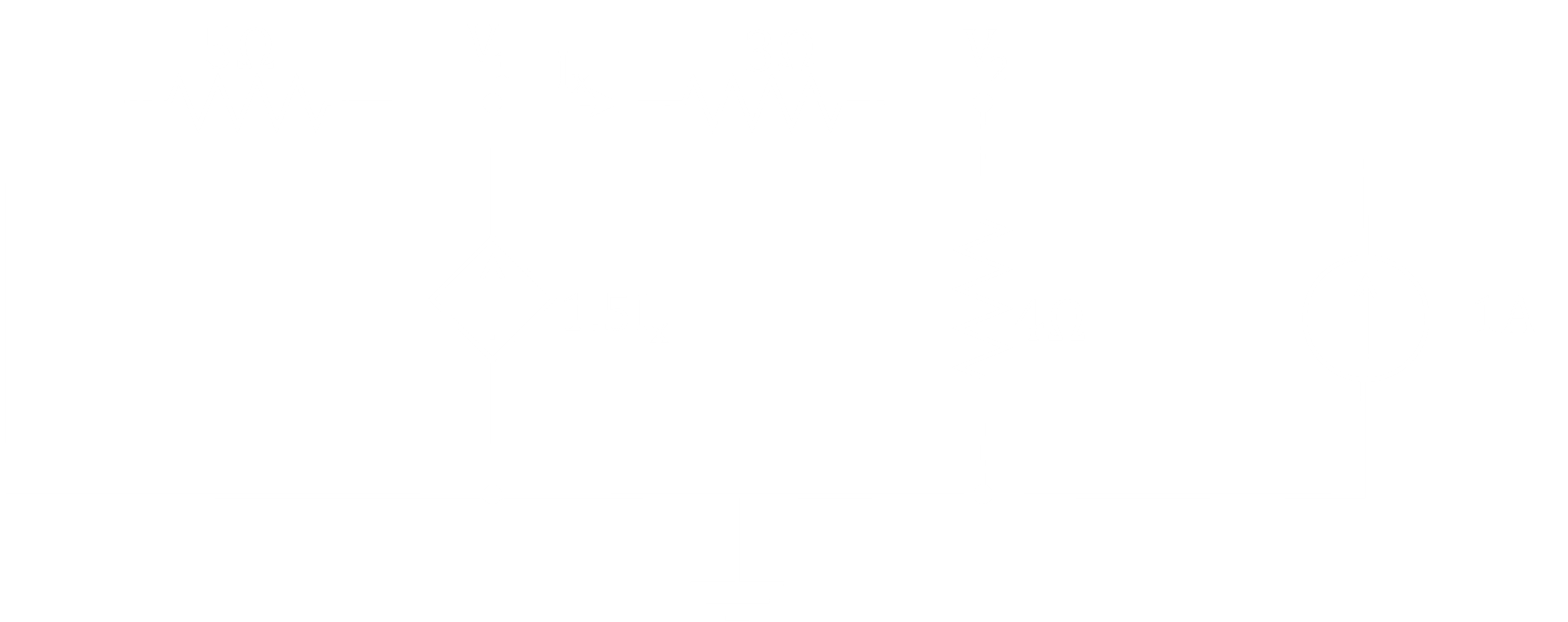
Using Mesh Analysis,

For ,

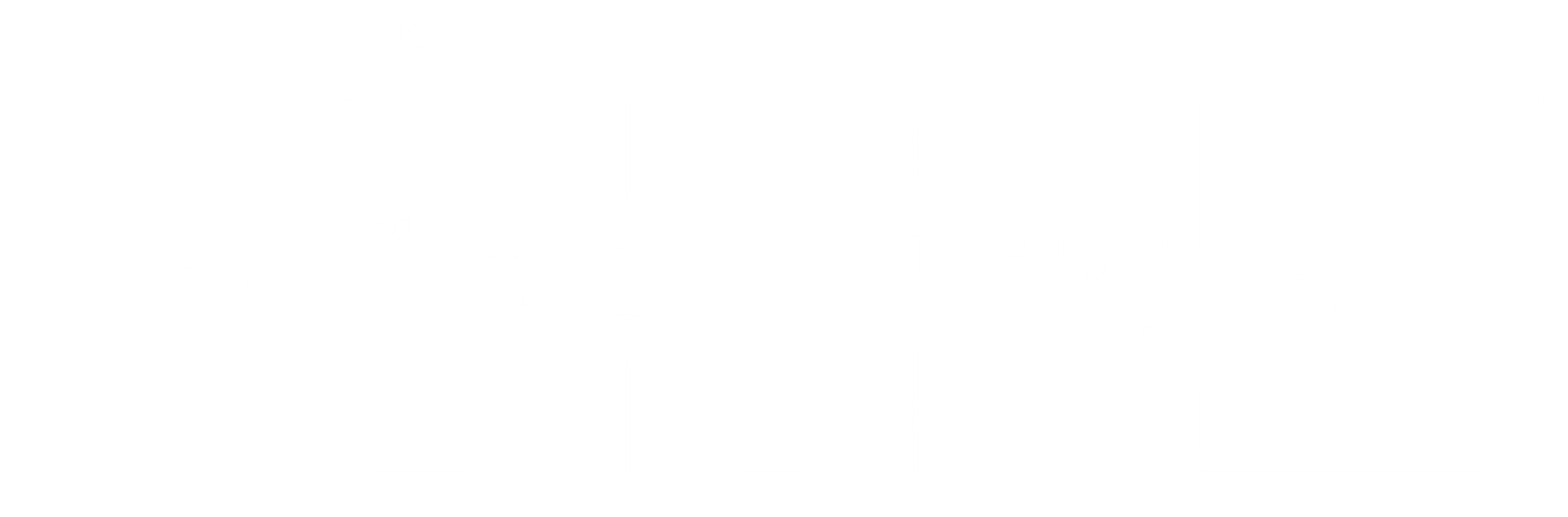
Assuming voltage source is connected (any voltage can be connected),



Assuming current source

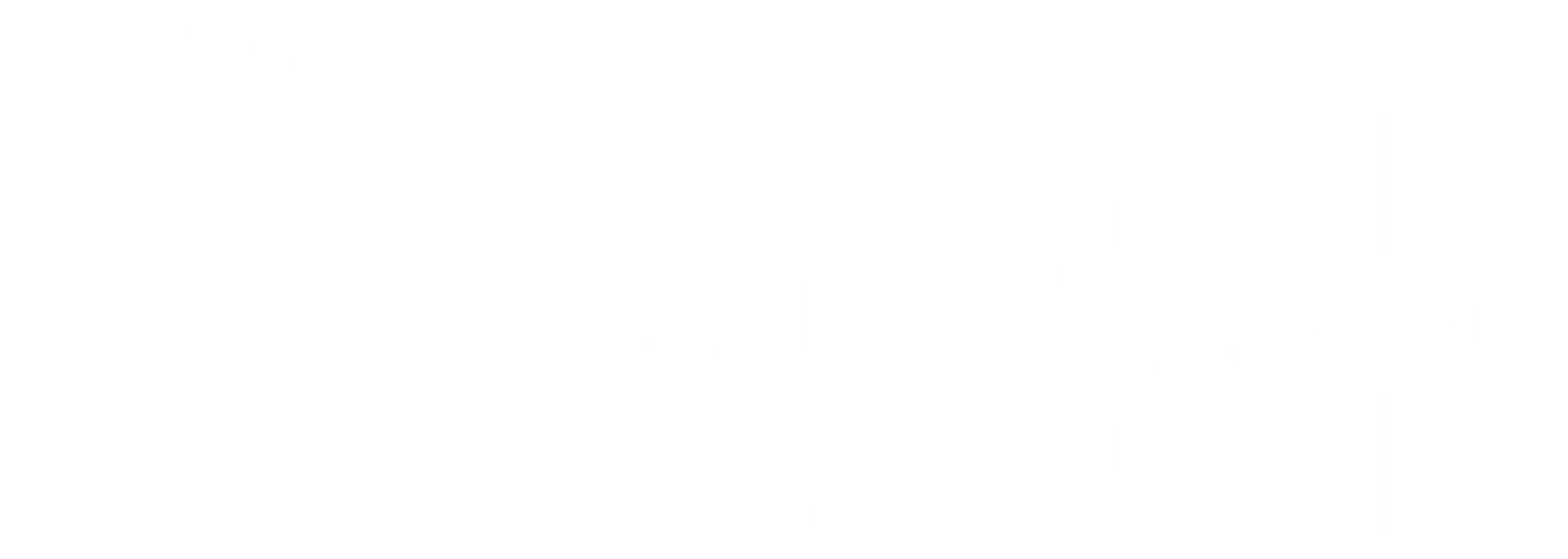


Exercise 4.54

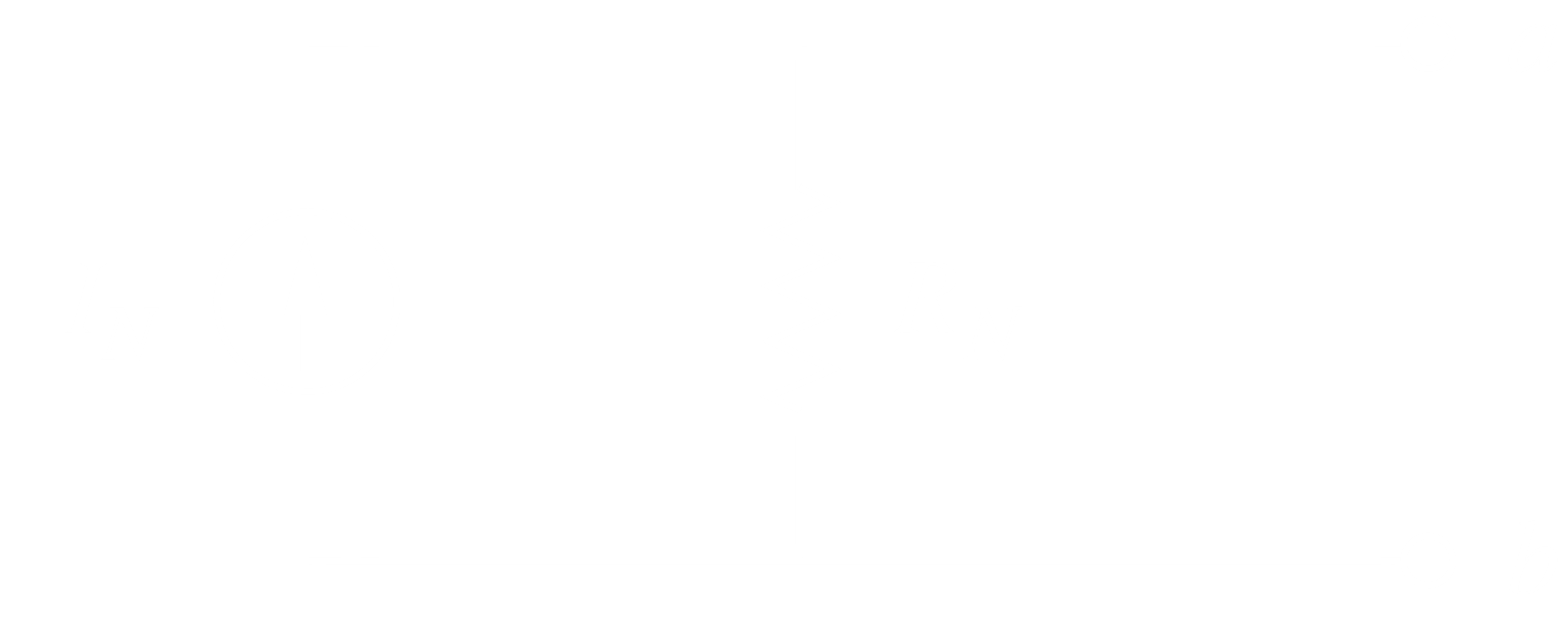


For ,

Adding current source,



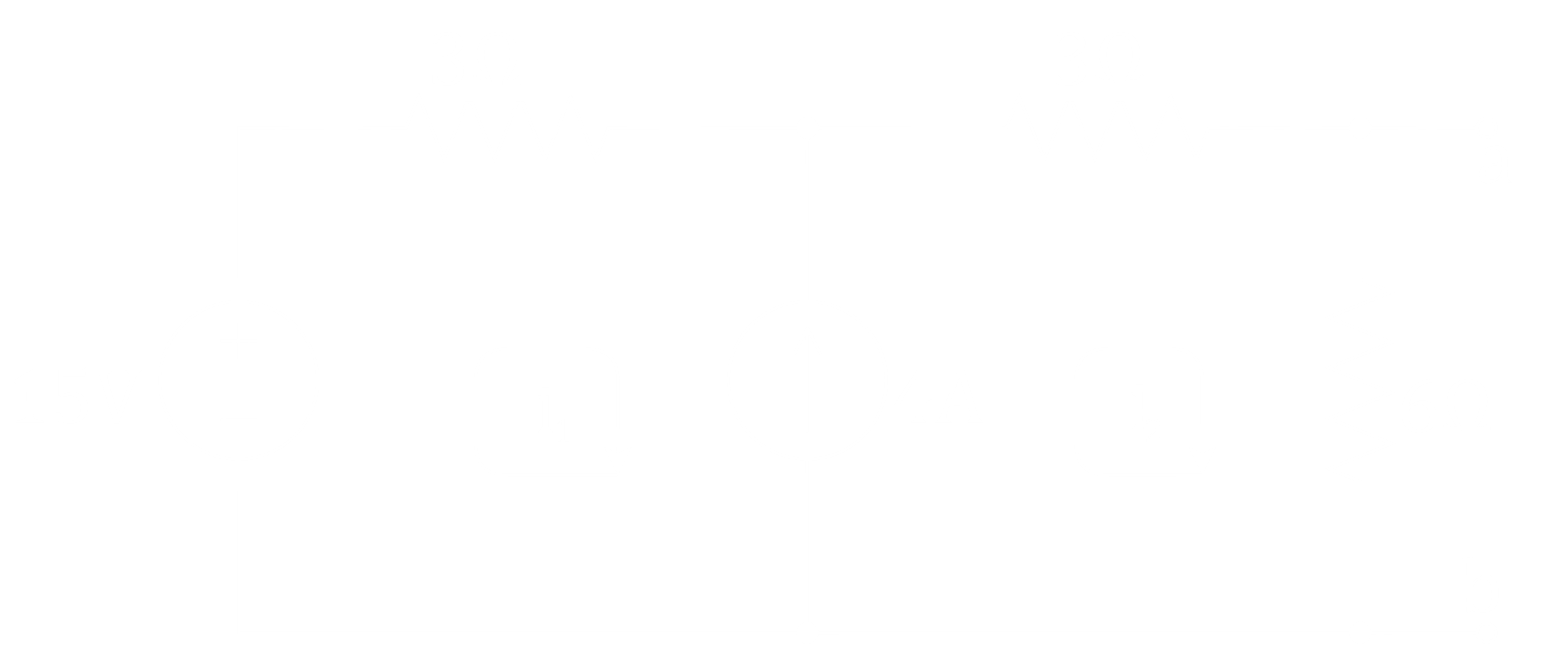
## 4.6 Norton’s Theorem

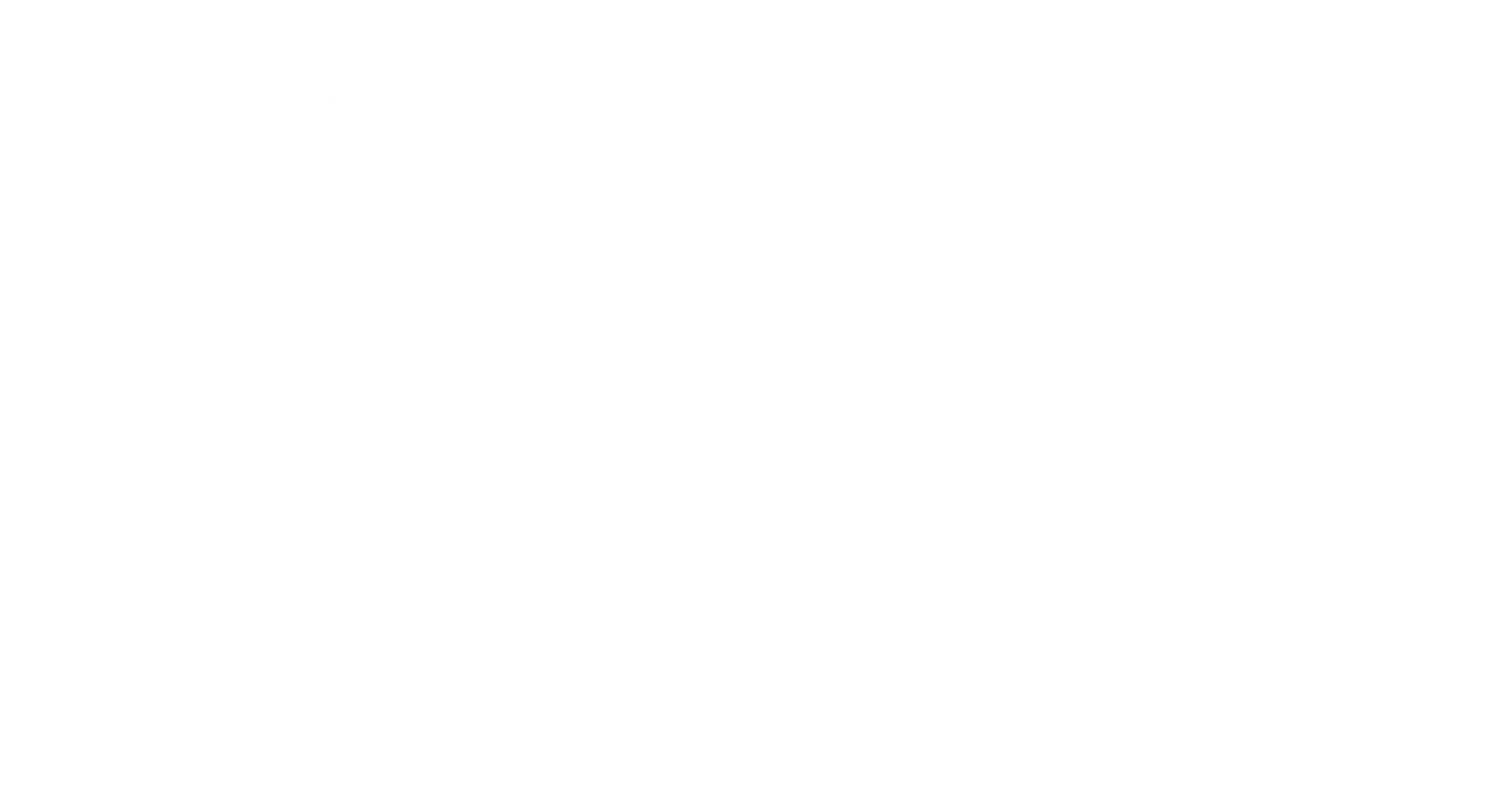


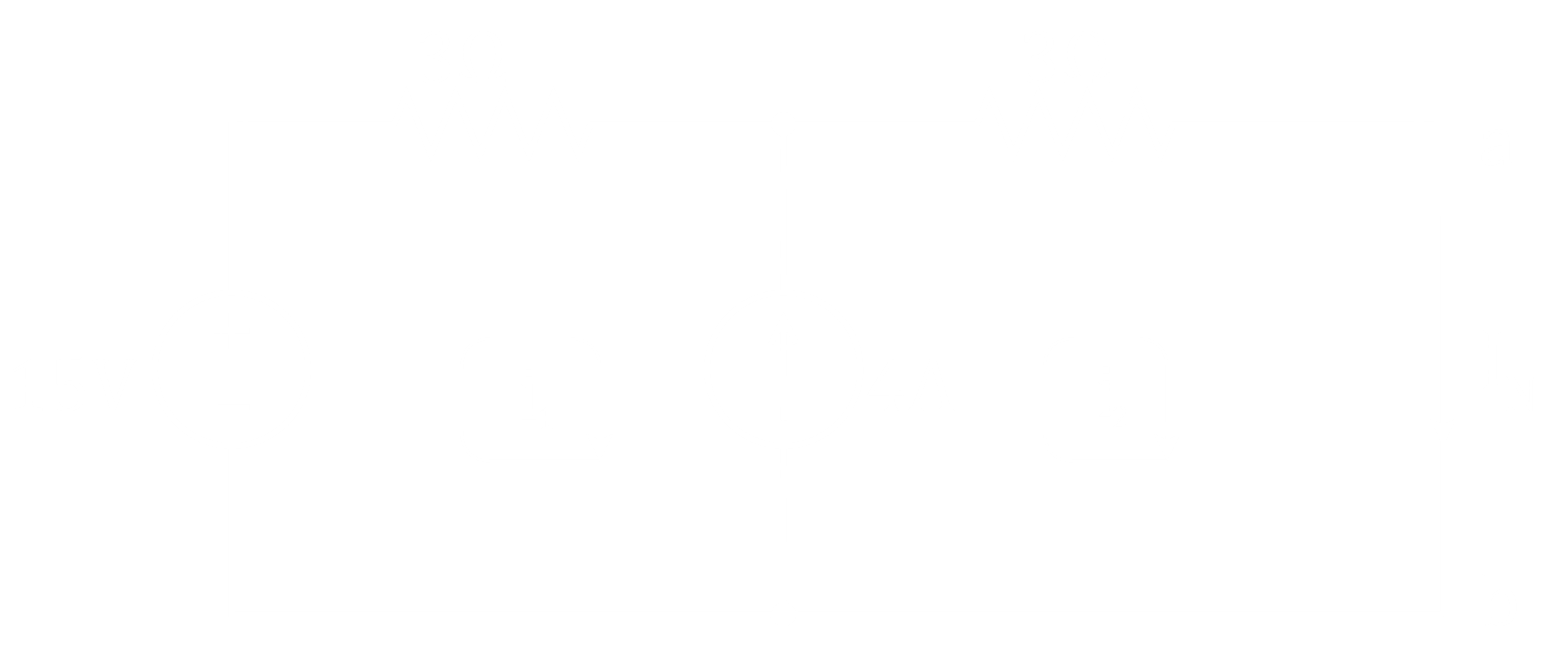
Any complex circuit can be replaced by a series current sources ) and a parallel resistor ().

is the short circuit current through the terminal.

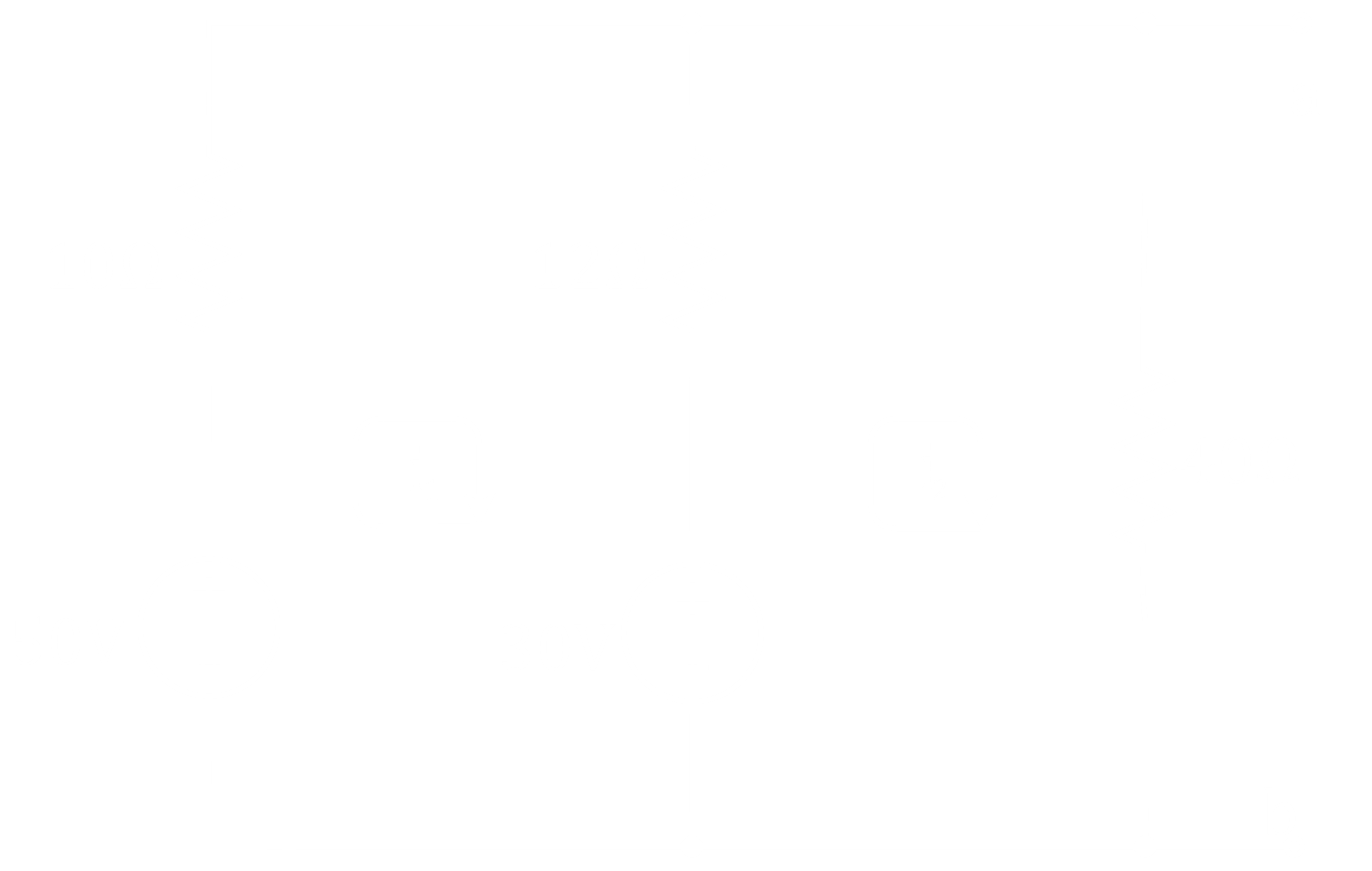
For circuits with dependent sources, the process for finding remains the same, while the process for finding is the same as that for Thevenin’s Theorem.



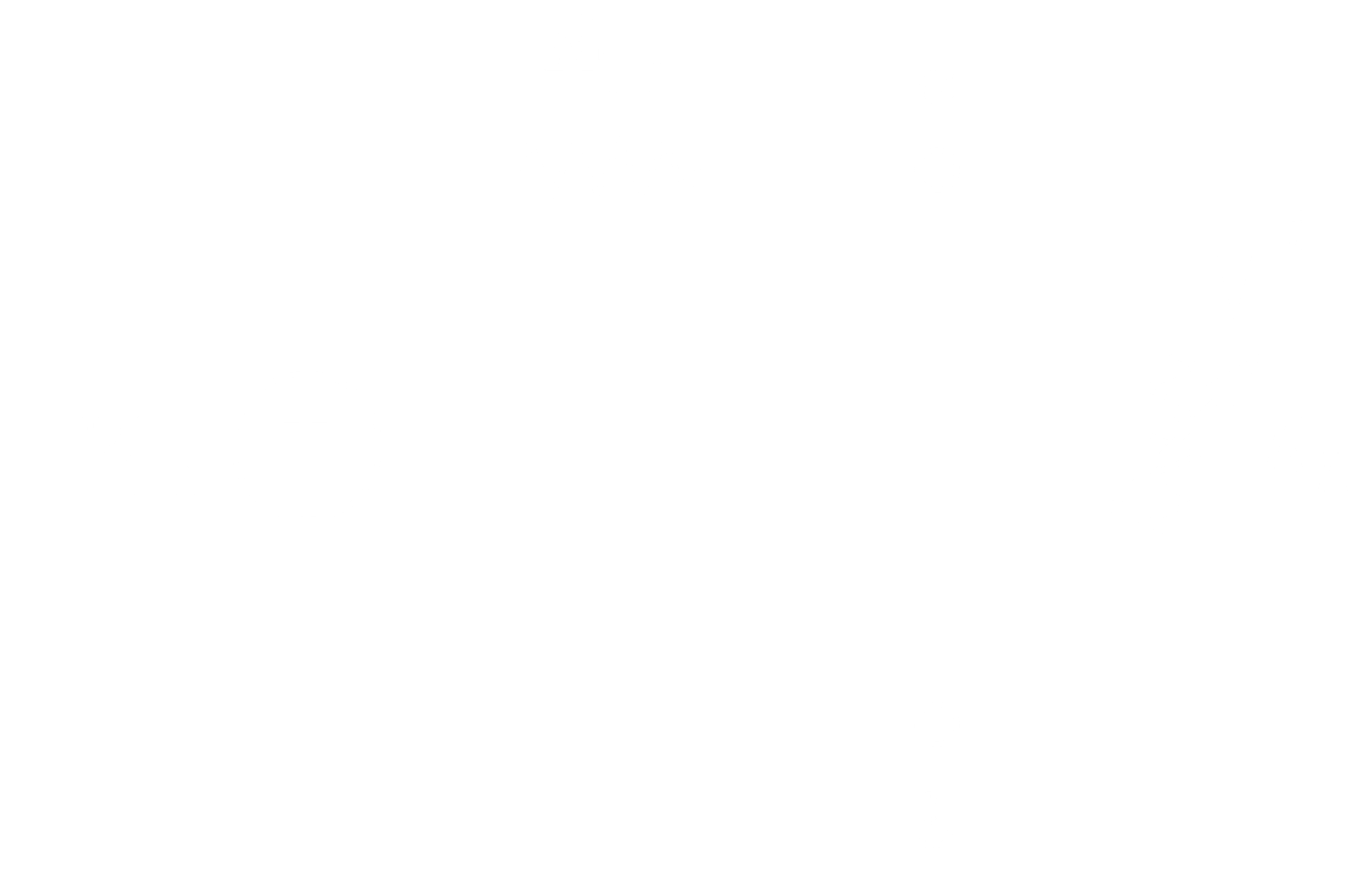




Exercise 4.36



## 4.8 Maximum Power Transfer



Exercise 4.67

