Assignment-2

Problem-1:

When a voltage V = 5 V is applied between terminals a and b of a linear two-terminal circuit 'X', the circuit draws a current I = 2 A as shown in Figure 1 below. When the terminals are shorted, 3 A current flows as shown in Figure 2.

(a) Derive a relationship between I and V.

(b) Draw the relationship found in (a).

(c) If the circuit in Figure 3 is an alternative version of the circuit 'X', determine the voltage V' and the resistance R'.

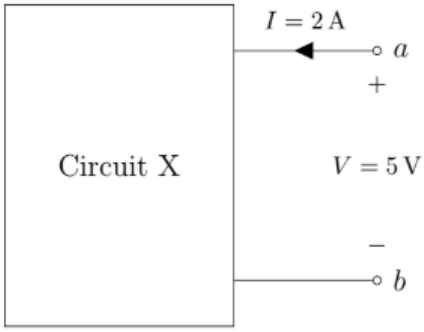


Figure 1

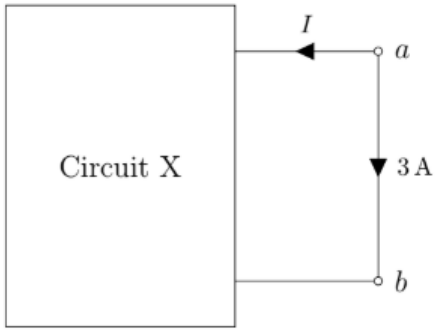


Figure 2

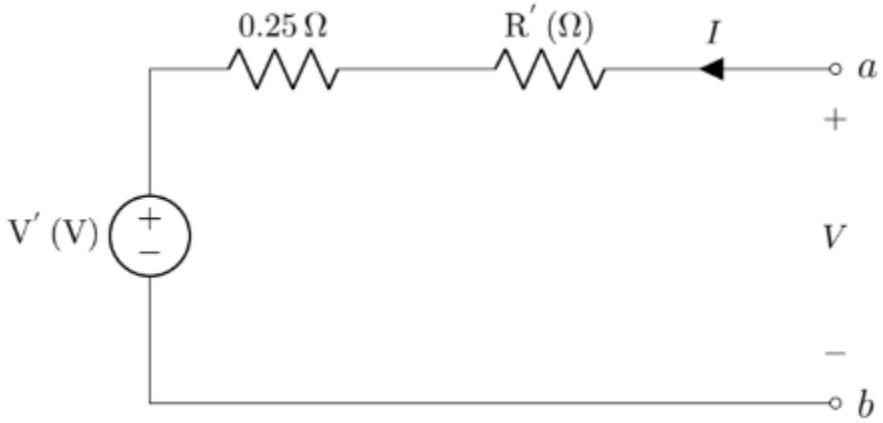
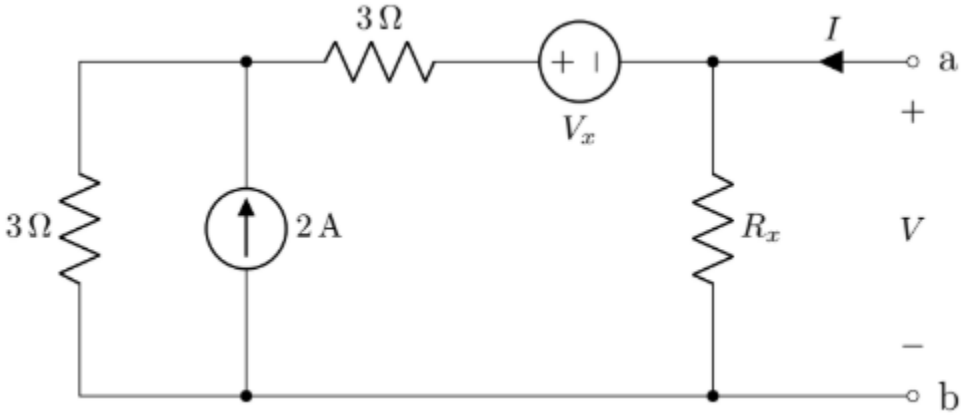


Figure 3

Problem-2:

In the circuit below, all resistors are practical and cannot have negative values. When a voltage of V = 2 V is applied across terminals a and b, the circuit draws a current of I = 3 A. However, if − 6 V is applied, instead of drawing, the circuit supplies 1 A to the terminal a.

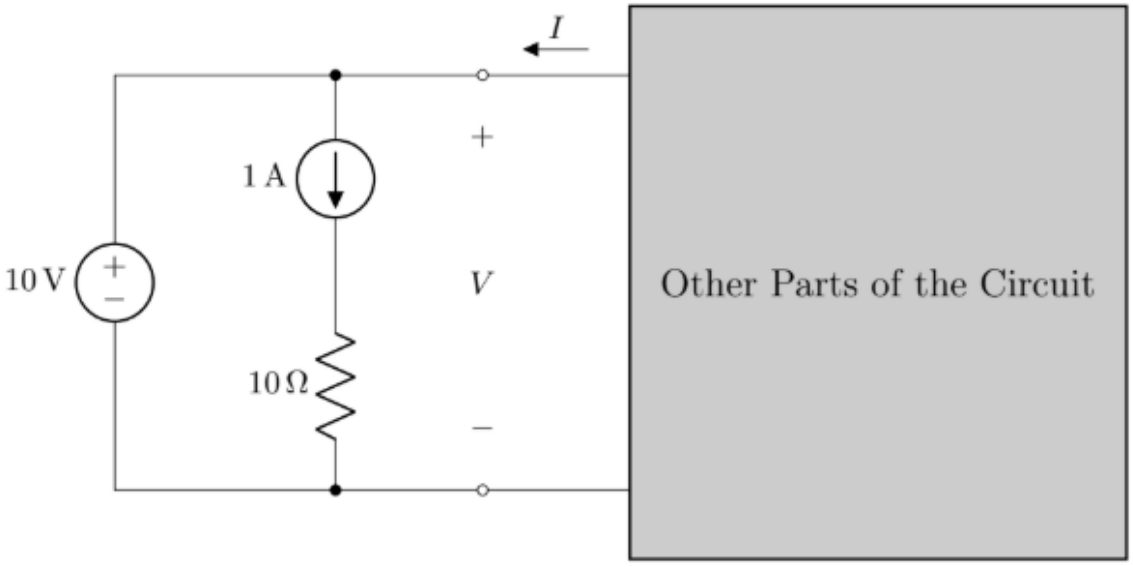


(a) Determine the unknown resistance Rx in the circuit.

(b) Find an equivalent representation of the circuit having the minimum number of elements and determine Vx.

Problem-3:

You break open your phone charger and find the following circuit. The greyed-out part doesn't contain anything interesting, but the left part of the circuit catches your eye.



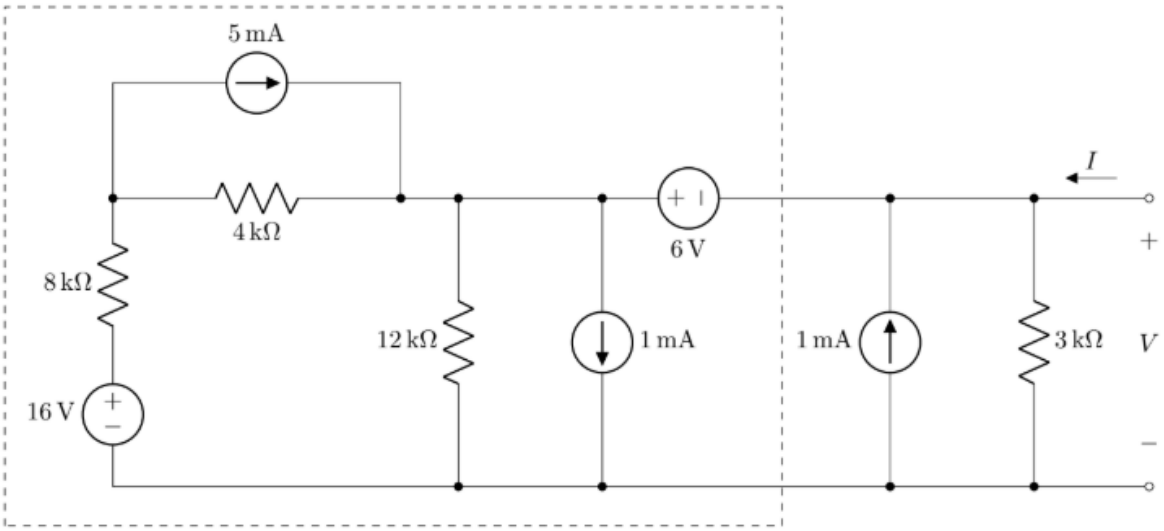
(a) (i) Determine I − V characteristics of the left part of the circuit. i.e. Write an equation that will always hold irrespective of what is inside the greyed-out box.

Hint: The equation cannot have any variables other than V and/or I. Everything else should just be a number.

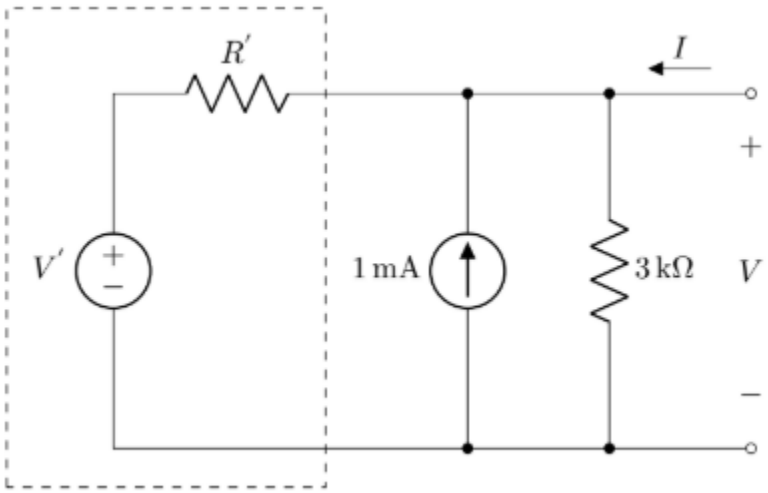
(ii) Based on your answer in (i), plot the I −V characteristics of the subcircuit.

(b) You notice that the left part of the circuit can actually be replaced with one single equivalent circuit element. Redraw the reduced equivalent circuit.

Problem-4:



Circuit 1



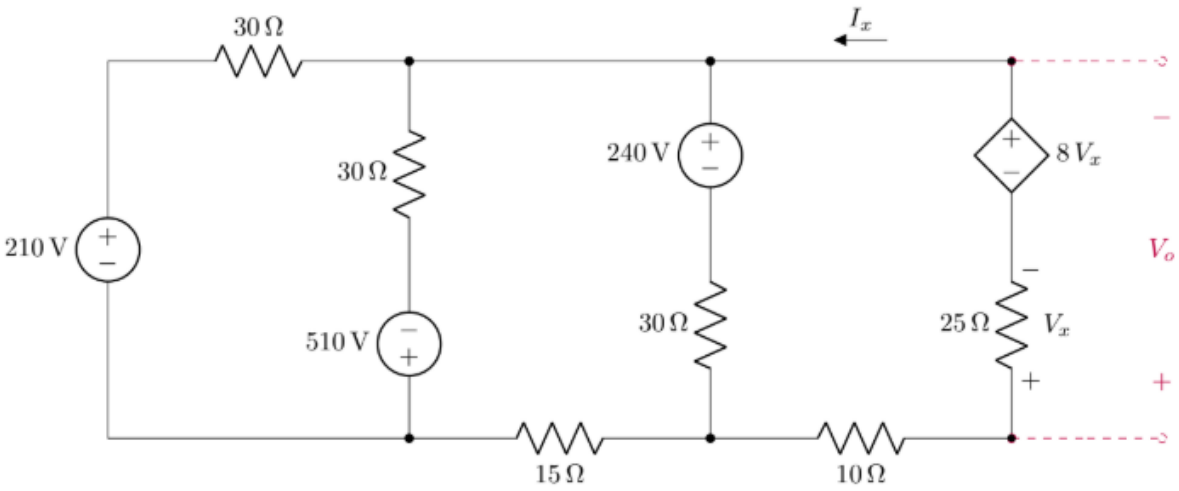
Circuit 2

For the circuits shown above,

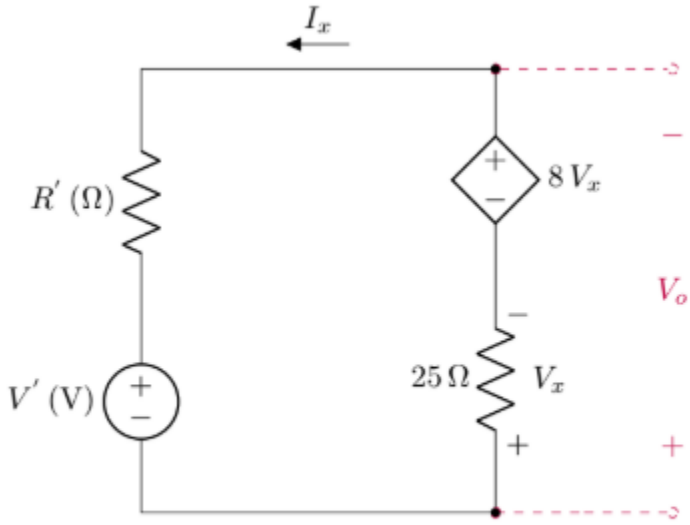
(a) Apply Source Transformation to reduce the dashed boxed portion of the Circuit 1 to a single voltage source in series with a resistor as shown in Circuit 2. What are the values of V′ and R′?

(b) Derive a Current-Voltage Relationship from Circuit 2. The I −V equation cannot contain any variables other than I and V pointed out in the diagram. Plot the I − V relation

Problem-5:



Circuit 1



Circuit 2

Apply Source Transformation to answer the following queries–

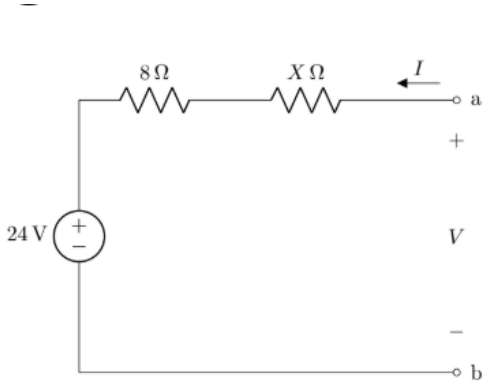
(a) Reduce the Circuit 1 so that it takes the form of Circuit 2. Determine the values of V' and R'.

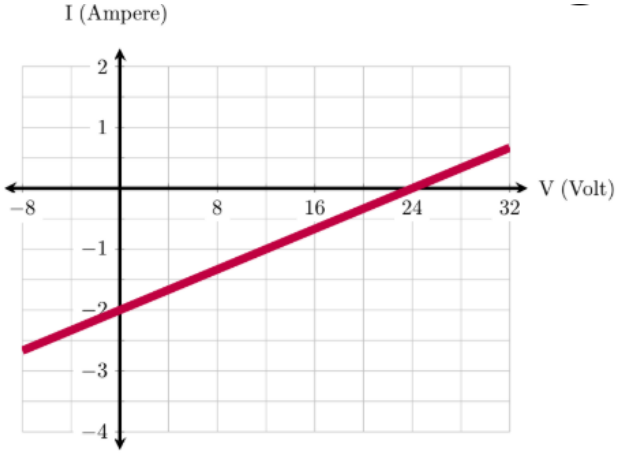
(b) Determine the values of Vx and Ix.

(c) Determine the value of Vo.

Problem-6:

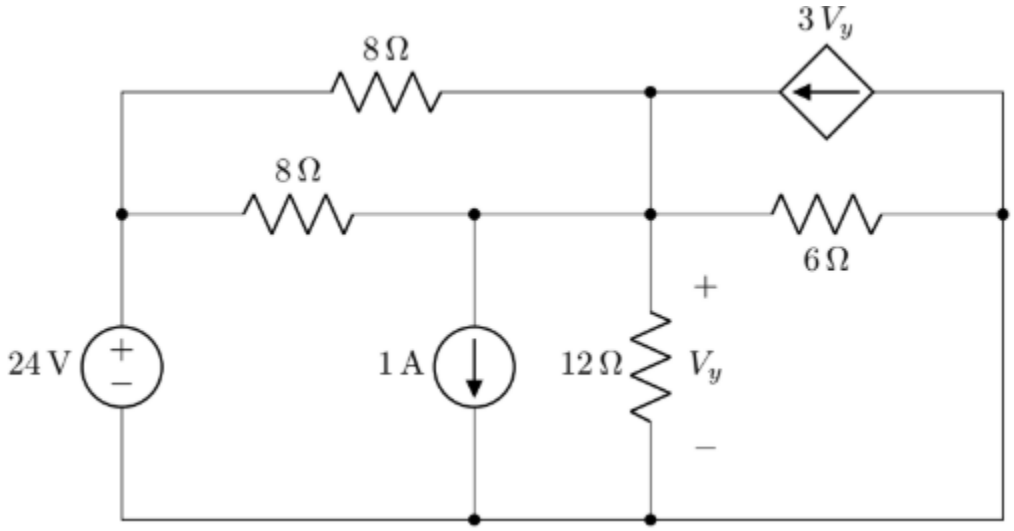
For the following circuit, if the I vs. V has the relationship shown, determine the value of the unknown resistance X.



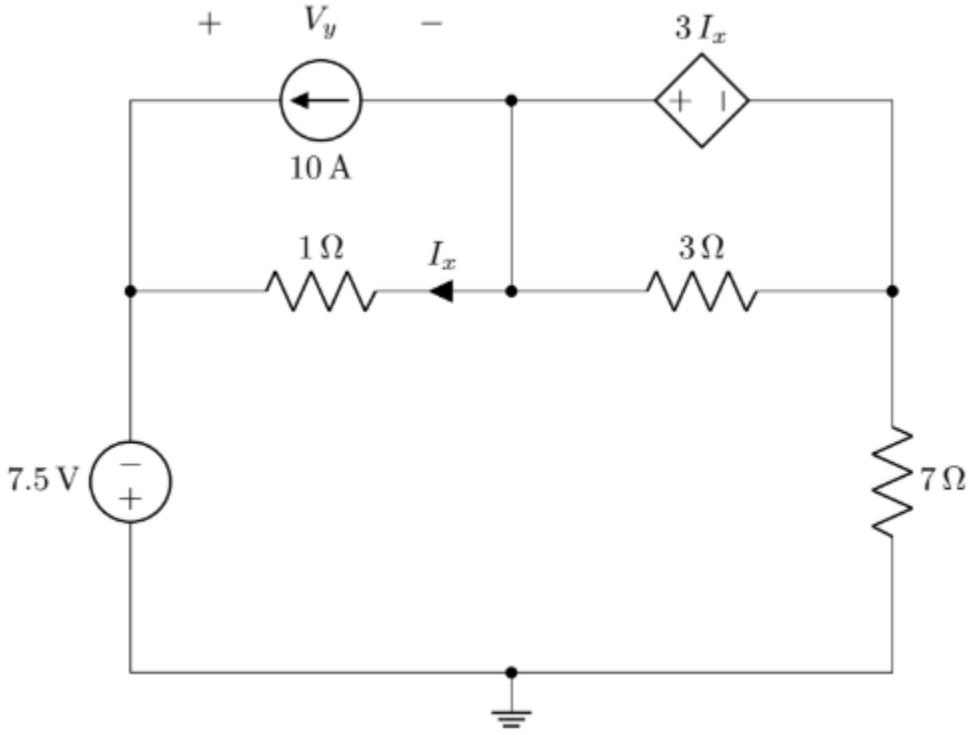


Problem-7:

Apply Superposition Principle in the following circuit to determine the voltage Vy.



Problem-8:



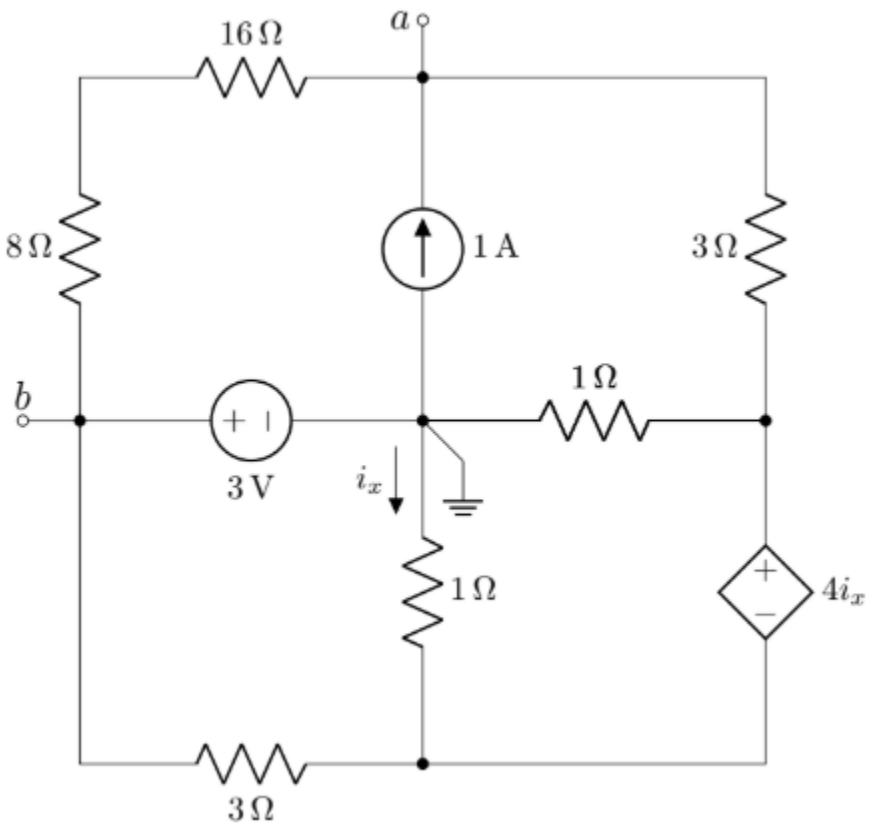
From the above circuit, answer the following questions-

(a) Find Vy using Superposition principle. After applying Superposition principle you may use any analysis technique you prefer (Nodal, Mesh, Src Tx etc.).

(b) Find the power consumed/supplied by the current source (with proper ± sign and unit).

Problem-9:

Consider the following circuit with open terminals a and b. Currently, no load is connected to the terminals.



Find i_x using Superposition principle.

Problem-10:

Apply Superposition Principle and/or Source Transformation to determine the voltage v_y in the following circuit.