<u>Homework 1</u>

P1.1.7 Seven circuit elements are interconnected as shown in Figure P1.1.7. The assigned positive directions of voltage drops and currents are indicated. Based on these assigned positive directions, which elements absorb power and which deliver power? If the values of the currents and voltages are as listed in Table P1.1.7, which elements actually absorb power and which deliver power? How much is the total power absorbed, and how much is the total power delivered? Are they equal? Verify your results using PSpice; simulate power absorbing elements with resistors and power delivering elements with sources.

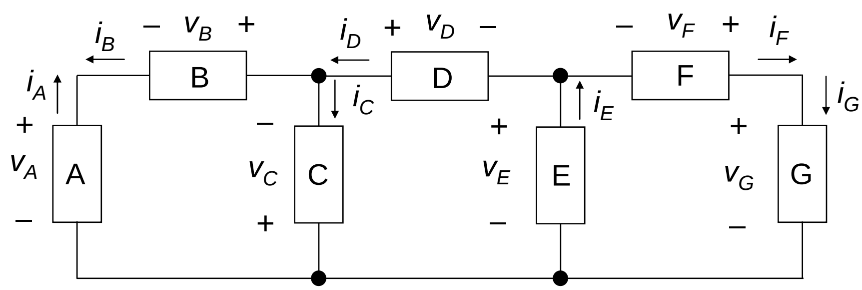

Figure P1.1.7

Table P1.1.7

Element	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Voltage, V	5	−3	−2	5	−3	7	4
Current, A	3	−3	1	−2	−1	1	1

<u>Solution P1.1.7</u>

According to the assigned positive directions, the direction of power flow is indicated in the second row of the table below, where D denotes power delivered and A denotes power absorbed. The signed

Element	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Power flow	D	A	D	D	D	D	A
Voltage, V	5	−3	−2	5	−3	7	4
Current, A	3	−3	1	−2	−1	1	1
Power delivered, W	15	−9	−2	−10	3	7	−4
Power Absorbed, W	−15	9	2	10	−3	−7	4

product of the voltage and current for each element is entered in the fifth row if there is a D in the second row, or is entered in the last row if there is an A in the second row. The remaining entries in the fifth and last rows are made so that they have opposite signs in a given column. The sum of the positive quantities in each of the fifth and last rows is 25 and the sum of the negative quantities is also 25. Thus, the total power delivered is 25 W and the total power absorbed is 25 W.

P1.2.4 Determine V_{SRC} in Figure P1.2.4.

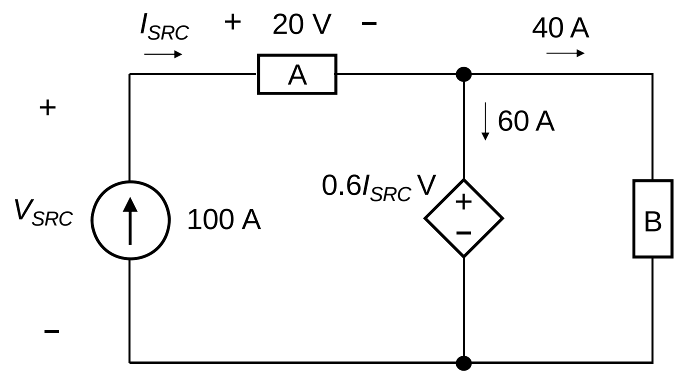

Figure P1.2.4

<u>Solution P1.2.4</u>

I_{SRC} = 100A, as determined by the current source.

Voltage across voltage source and B is $0.6\times100 = 60$ V.

Power absorbed by voltage source is $60\times60 = 3600$ W.

Power absorbed by B is $60\times40 = 2400$ W.

Power absorbed by A is $20\times100 = 2000$ W.

Hence, power delivered by current source is $3600 + 2400 + 2000 = 8000 = V_{SRC}\times100$, so V_{SRC} = 80 V.

P1.2.5 Determine V_B in Figure P1.2.5.

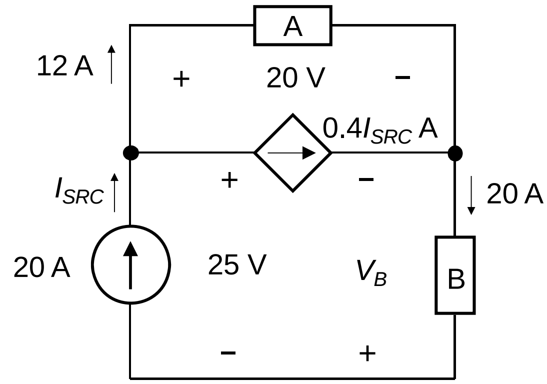

Figure P1.2.5

<u>Solution P1.2.5</u>

I_{SRC} = 20 A, as determined by the current source.

Power delivered by independent current source is

$25 \times 20 = 500$ W.

Power absorbed by A is $20 \times 12 = 240$ W.

Power absorbed by dependent current source is

$20 \times 0.4 \times 20 = 160$ W.

Hence, B must absorb 500 – 240 – 160 = 100 W.

It follows that $(-V_B) \times 20 = 100$, so V_B = -5 V.

P1.2.7 A and B are identical circuit elements connected as in Figure P1.2.7. The *v-i* relation of either element is: $v = 2i^2$ V, where i is in amperes. Determine I, the power absorbed by each element, and that delivered by the source. Note that power is conserved although the elements are nonlinear, because conservation of energy applies to all systems, linear or nonlinear.

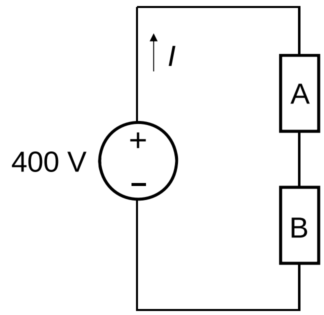

Figure P1.2.7

Solution P1.2.7

Power absorbed by each element is $2I^2 \times I = 2I^3$ W.

Total power absorbed by A and B is $4I^3$ W.

Power delivered by source is $400 \times I$ W. Hence, $400I = 4I^3$, so I = 10 A, since I should be positive for power delivery by the source.

Alternatively, we can say that since A and B are identical, the voltage each of them is 200 V.

Hence, $I = \sqrt{\dfrac{200}{2}} = 10$ A.

The power delivered by the source is, therefore, $400 \times 10 \equiv 4$ kW, whereas each element absorbs $2 \times (10)^3 \equiv 2$ kW, which is also half the power delivered by the source.

P1.2.8 The elements of P1.2.7 are connected as in Figure P1.2.8. Determine I_{SRC}, the power absorbed by each element, and that delivered by the source.

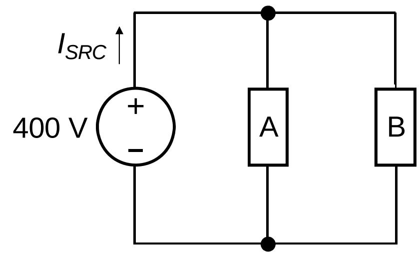

Figure P1.2.8

Solution P1.2.8

Since the voltage across each element is 400 V, the current through each element is $\sqrt{\frac{400}{2}} = 10\sqrt{2}$ A. The power absorbed by each element is, therefore, $400 \times 10\sqrt{2} \equiv 4\sqrt{2}$ kW. The total power delivered by the source is $8000\sqrt{2}$ = $400I_{SRC}$ W. It follows that $I_{SRC} = 20\sqrt{2}$ A.