SUMMARY

- Linearity: This property requires both additivity and homogeneity. Using this property, we can determine the voltage or current somewhere in a network by assuming a specific value for the variable and then determining what source value is required to produce it. The ratio of the specified source value to that computed from the assumed value of the variable, together with the assumed value of the variable, can be used to obtain a solution.
- In a linear network containing multiple independent sources, the principle of superposition allows us to compute any current or voltage in the network as the algebraic sum of the individual contributions of each source acting alone.
- Superposition is a linear property and does not apply to nonlinear functions such as power.
- Using Thévenin's theorem, we can replace some portion of a network at a pair of terminals with a voltage source V_{oc} in series with a resistor R_{Th}. V_{oc} is the open-circuit voltage at the terminals, and R_{Th} is the Thévenin equivalent resistance obtained by looking into the terminals with all independent sources made zero.
- Using Norton's theorem, we can replace some portion of a network at a pair of terminals with a current source I_{sc} in parallel with a resistor R_{Th}. I_{sc} is the short-circuit current at the terminals, and R_{Th} is the Thévenin equivalent resistance.
- Source transformation permits us to replace a voltage source V in series with a resistance R by a current source $I = V/R$ in parallel with the resistance R. The reverse is also true. This is an interchange relationship between Thévenin and Norton equivalent circuits.
- Maximum power transfer can be achieved by selecting the load R_L to be equal to R_{Th} found by looking into the network from the load terminals.

PROBLEMS

5.1 Use linearity and the assumption that $V_o = 1$ V to find the actual value of V_o in Fig. P5.1.

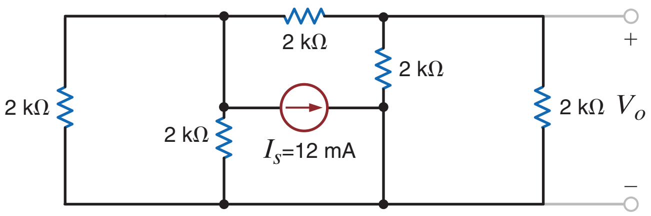

Figure P5.1

5.2 Using linearity and the assumption that $I_o = 1$ mA, find the actual value of I_o in the network use Fig. P5.2.

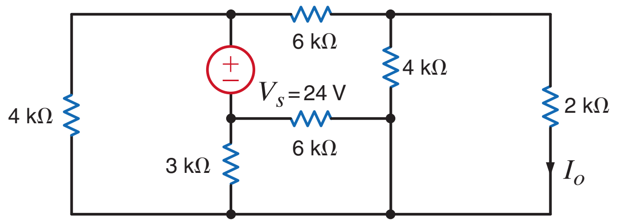

Figure P5.2

5.3 Find I_o in the network in Fig. P5.3 using linearity and the assumption that $I_o = 1$ mA.

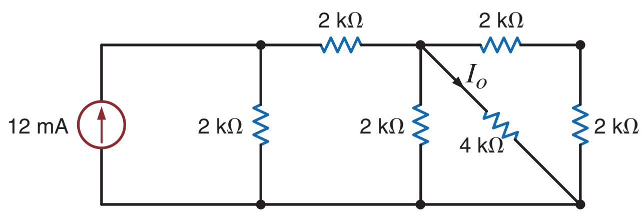

Figure P5.3

5.4 Find I_o in the circuit in Fig. P5.4 using linearity and the assumption that $I_o = 1$ mA.

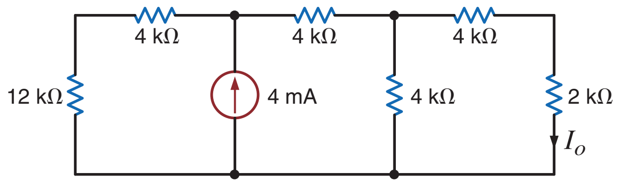

Figure P5.4

5.5 Find V_o in the network in Fig. P5.5 using linearity and the assumption that $V_o = 1$ V.

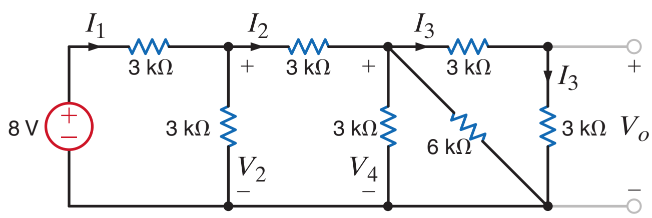

Figure P5.5

5.6 Find I_o in the network in Fig. P5.6 using superposition.

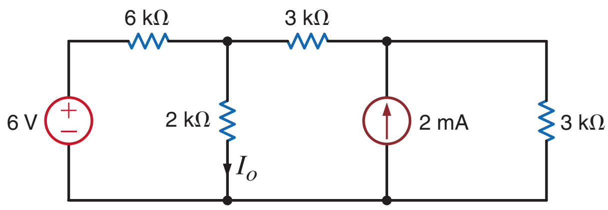

Figure P5.6

5.7 In the network in Fig. P5.7 find I_o using superposition.

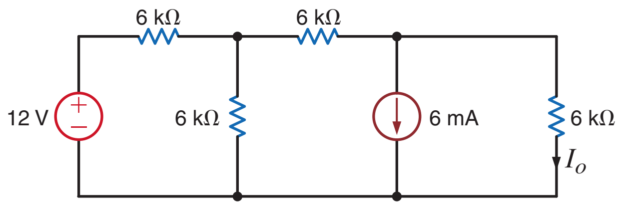

Figure P5.7

5.8 Find V_o in the network in Fig. P5.8 using superposition.

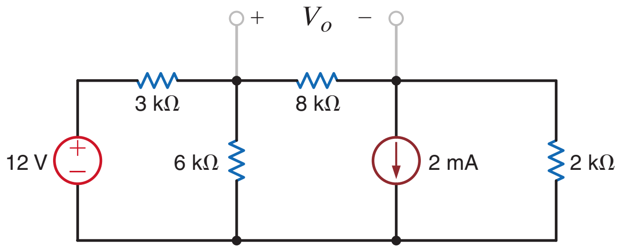

Figure P5.8

5.9 Find V_o in the network in Fig. P.5.9 using superposition.

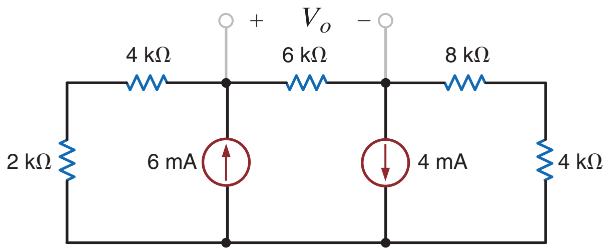

Figure P5.9

5.10 Find V_o in the network in Fig. P5.10 using superposition.

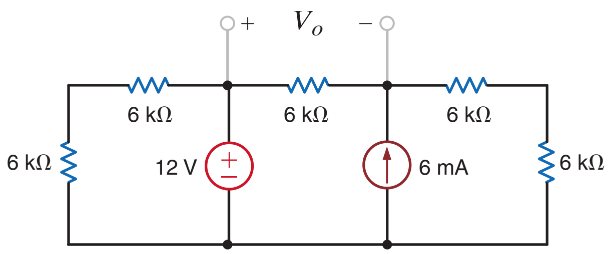

Figure P5.10

5.11 Find I_o in the network in Fig. P5.11 using superposition.

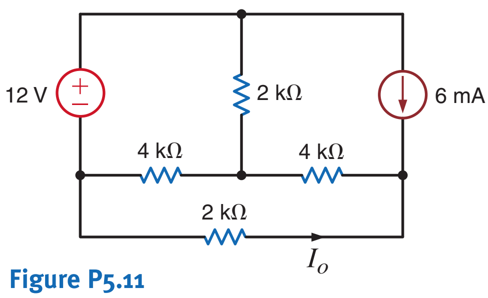

Figure P5.11

5.12 Find V_o in the circuit in Fig. P5.12 using superposition.

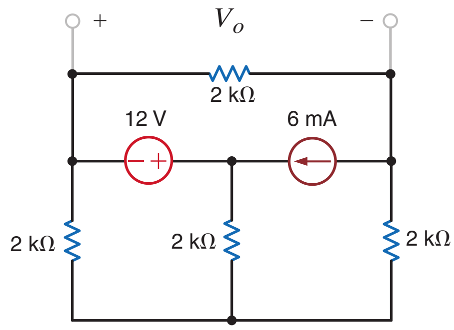

Figure P5.12

5.13 Find V_o in the circuit in Fig. P5.13 using superposition.

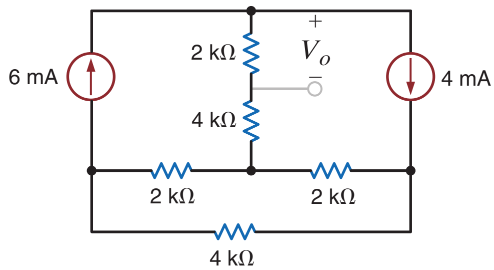

Figure P5.13

5.14 Find I_o in the circuit in Fig. P5.14 using superposition.

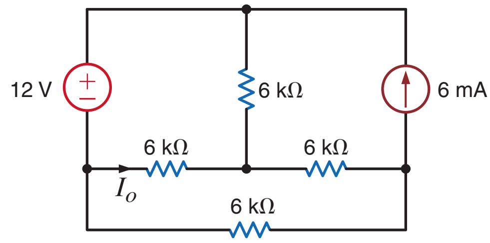

Figure P5.14

5.15 Find V_o in the circuit in Fig. P5.15 using superposition.

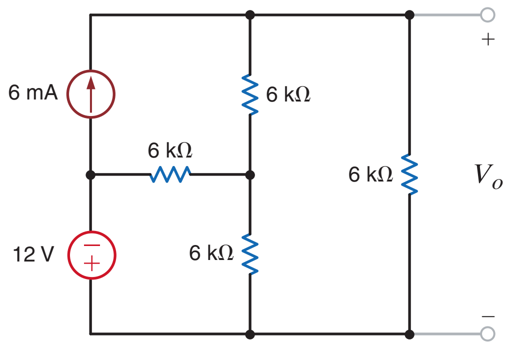

Figure P5.15

5.16 Find I_o in the circuit in Fig. P5.16 using superposition.

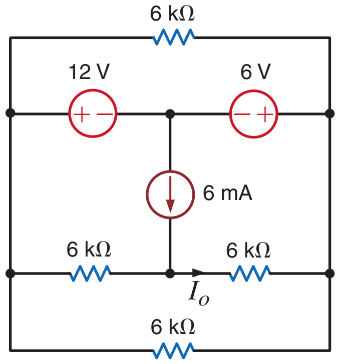

Figure P5.16

5.17 Use superposition to find I_o in the circuit in Fig. P5.17.

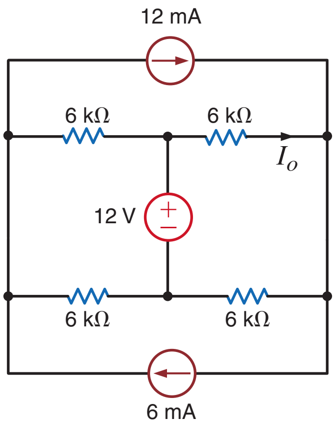

Figure P5.17

5.18 Use superposition to find I_o in the network in Fig. P5.18.

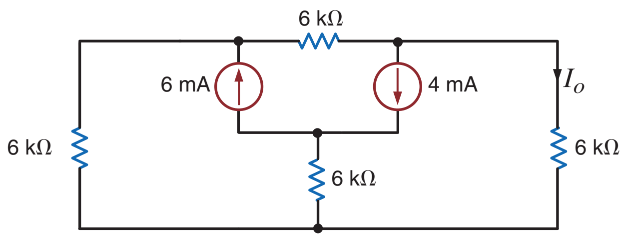

Figure P5.18

5.19 Use superposition to find V_o in the circuit in Fig. P5.19.

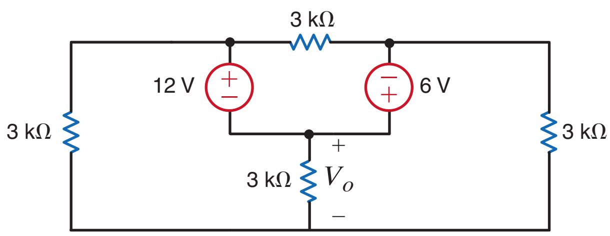

Figure P5.19

5.20 Use superposition to find V_o in the network in Fig. P5.20.

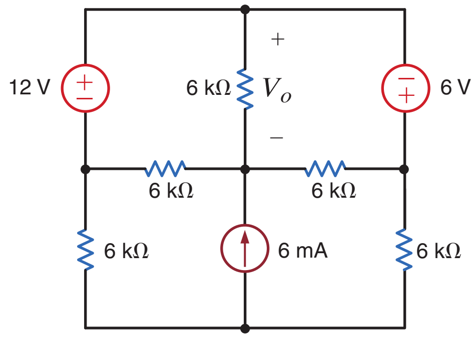

Figure P5.20

5.21 Use superposition to find I_o in the circuit in Fig. P5.21.

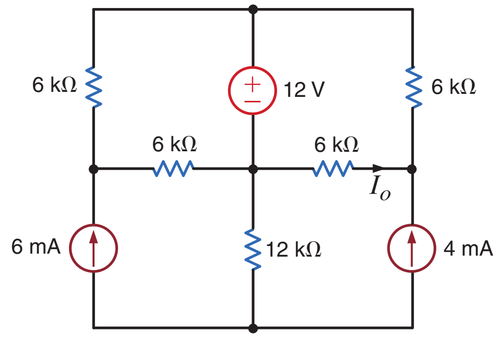

Figure P5.21

5.22 Use superposition to find I_o in the network in Fig. P5.22.

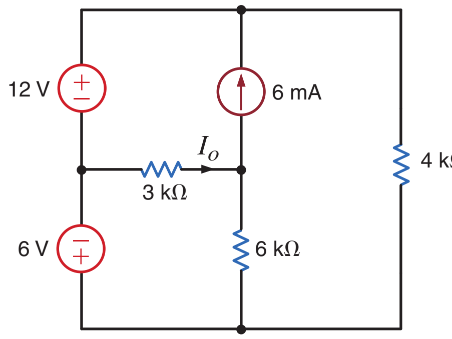

Figure P5.22

5.23 Use superposition to find V_o in the circuit in Fig. P5.23.

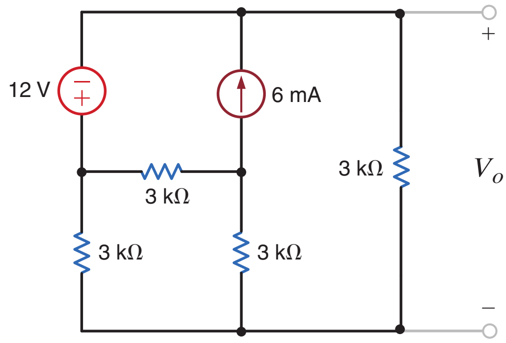

Figure P5.23

5.24 Find V_A in Fig. P5.24 using superposition.

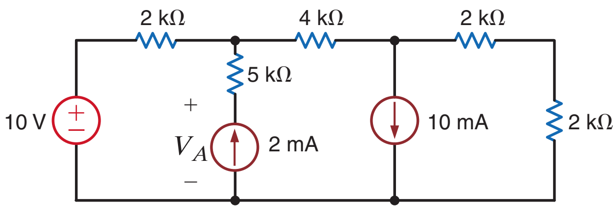

Figure P5.24

5.25 Find I_1 in Fig. P5.25 using superposition.

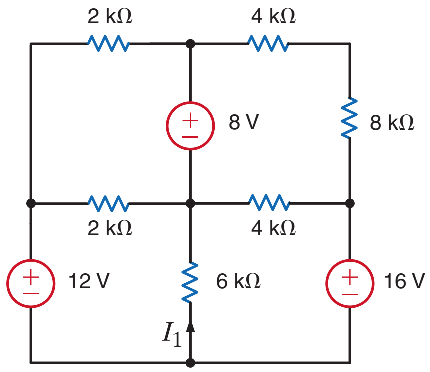

Figure P5.25

5.26 Use superposition to calculate I_x in Fig. P5.26.

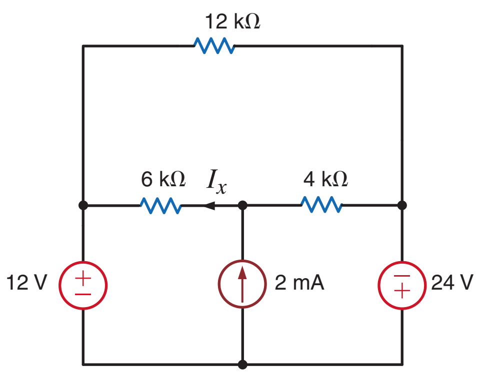

Figure P5.26

5.27 Calculate V_o in Fig. P5.27 using superposition.

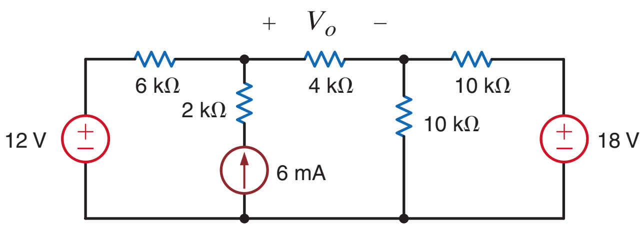

Figure P5.27

5.28 Find V_o in the circuit in Fig. P5.28 using superposition.

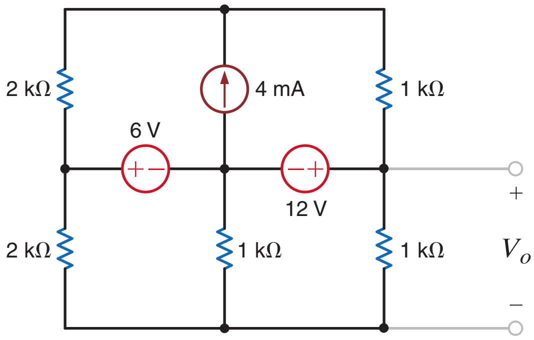

Figure P5.28

5.29 Use superposition to find I_o in the network in Fig. P5.29.

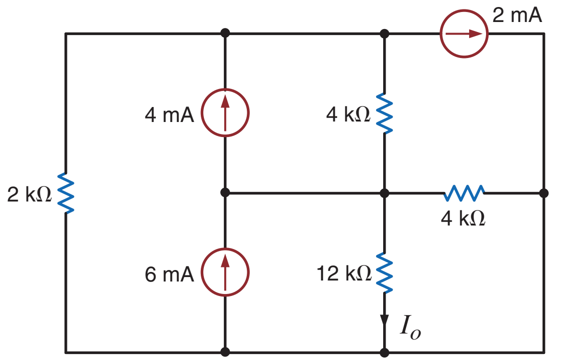

Figure P5.29

5.30 Use superposition to find I_o in the circuit in Fig. P5.30.

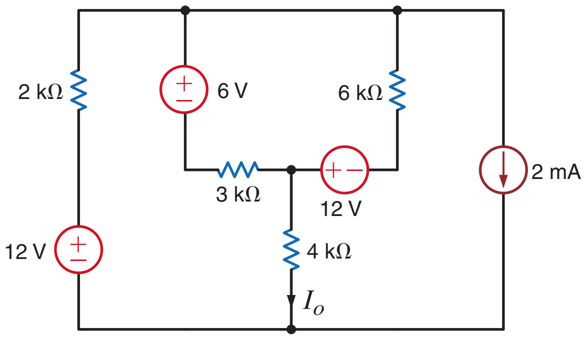

Figure P5.30

5.31 Use superposition to find I_o in the circuit in Fig. P5.31.

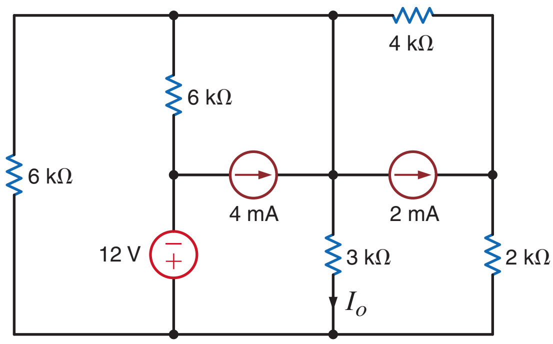

Figure P5.31

5.32 Use Thévenin's theorem to find V_o in the network in Fig. P5.32.

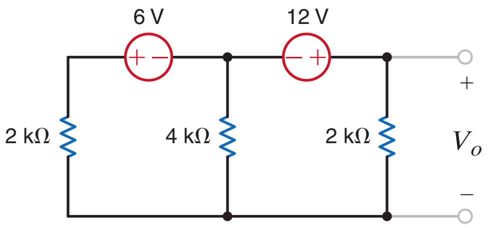

Figure P5.32

5.33 Use Thévenin's theorem to find I_o in the circuit using Fig. P5.33.

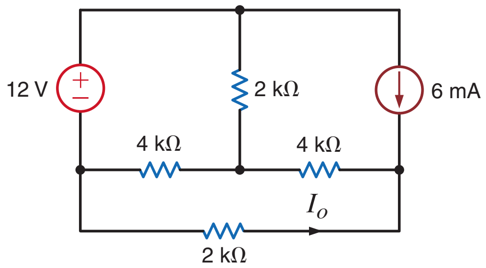

Figure P5.33

5.34 Use Thévenin's theorem to find V_o in the circuit using Fig. P5.34.

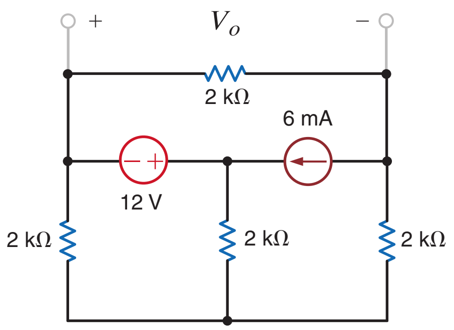

Figure P5.34

5.35 Use Thévenin's theorem to find V_o in the circuit in Fig. P5.35.

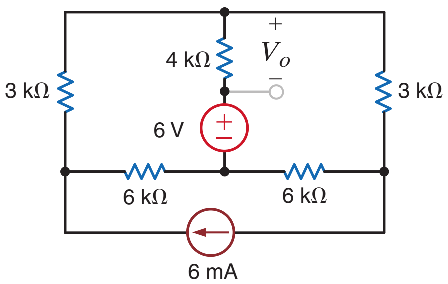

Figure P5.35

5.36 Use Thévenin's theorem to find I_o in the network in Fig. P5.36.

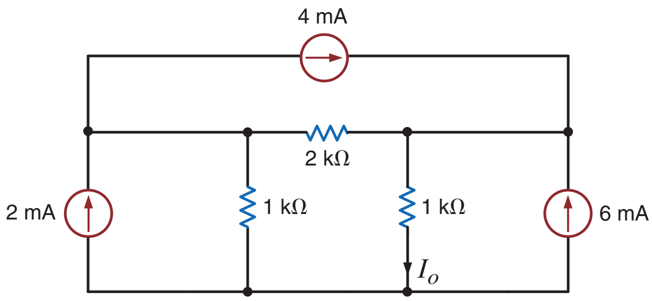

Figure P5.36

5.37 Find I_o in the network in Fig. P5.37 using Thevenin's theorem.

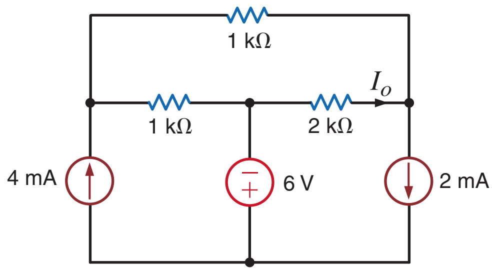

Figure P5.37

5.38 Find V_o in the circuit in Fig. P5.38 using Thévenin's theorem.

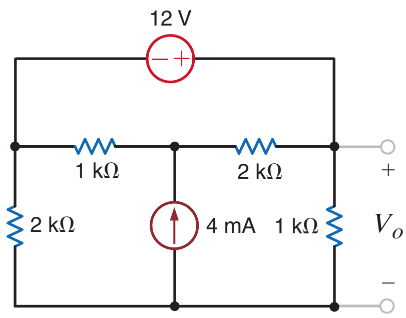

Figure P5.38

5.39 Find V_o in the circuit in Fig. P5.39 using Thévenin's theorem.

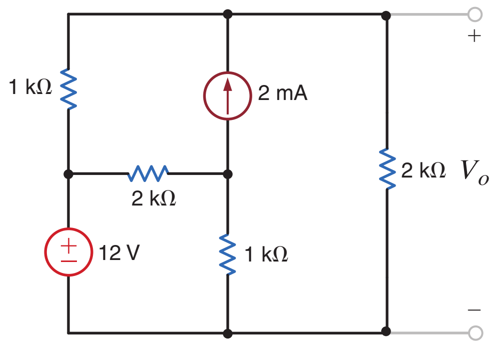

Figure P5.39

5.40 Find I_o in the circuit in Fig. P5.40 using Thévenin's theorem.

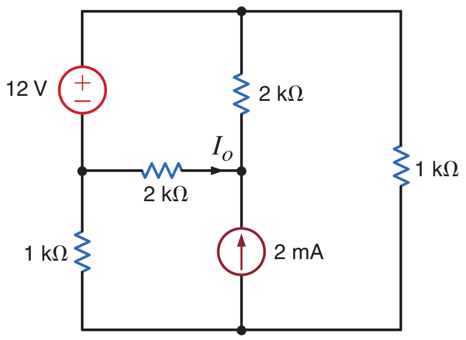

Figure P5.40

5.41 Find V_o in the network in Fig. P5.41 using Thévenin's theorem.

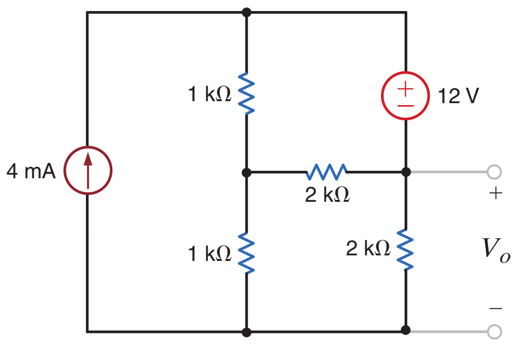

Figure P5.41

5.42 Find I_o in the network in Fig. P5.42 using Thévenin's theorem.

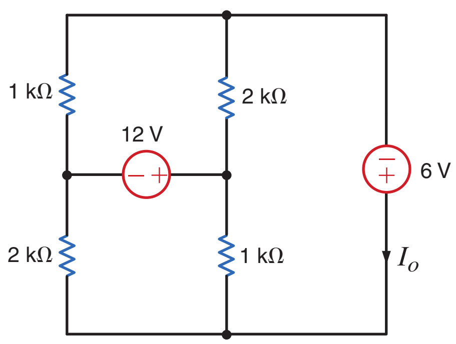

Figure P5.42

5.43 Use Thévenin's theorem to find I_o in Fig. P5.43.

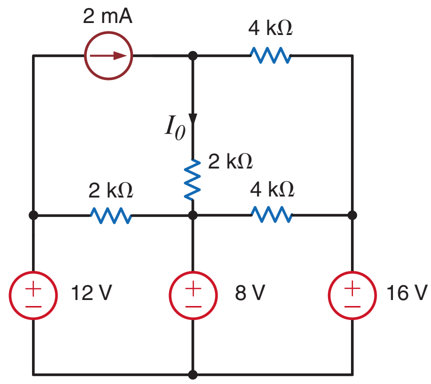

Figure P5.43

5.44 Calculate I_x in Fig. P5.44 using Thévenin's theorem.

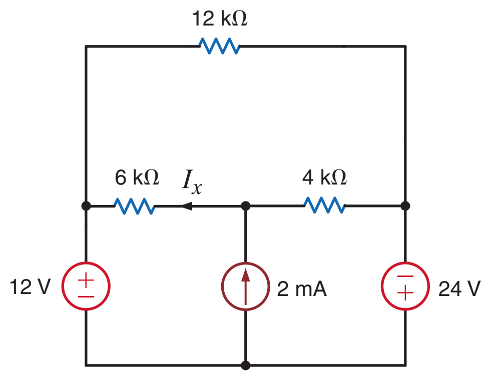

Figure P5.44

5.45 Find I_o in the network in Fig. P5.45 using Thévenin's theorem.

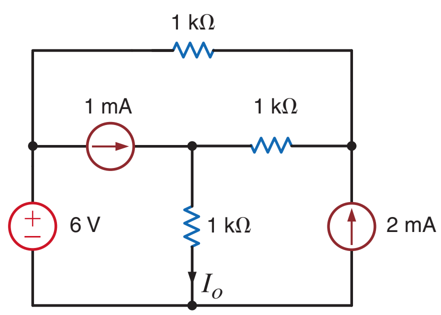

Figure P5.45

5.46 Find V_o in the network in Fig. P5.46 using Thévenin's theorem.

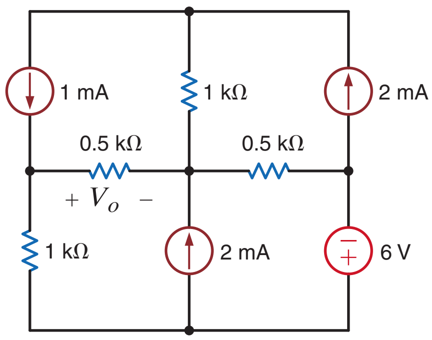

Figure P5.46

5.47 Use Thévenin's theorem to find I_o in the network in Fig. P5.47.

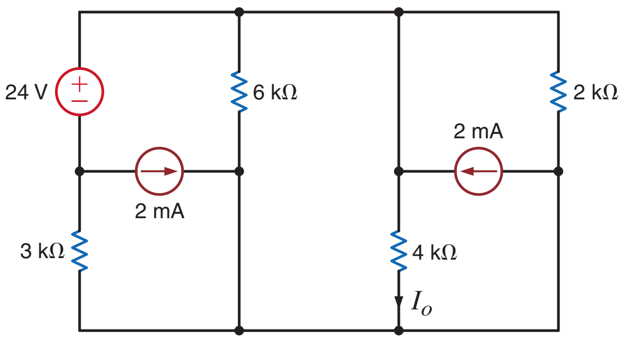

Figure P5.47

5.48 Use Thévenin's theorem to find I_o in the circuit in Fig. P5.48.

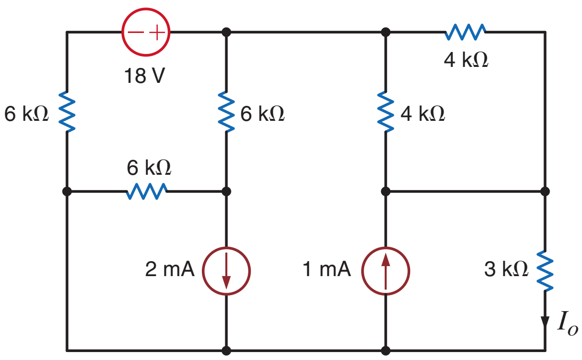

Figure P5.48

5.49 Given the linear circuit in Fig. P5.49, it is known that when a 2-kΩ load is connected to the terminals A–B, the load current is 10 mA. If a 10-kΩ load is connected to the terminals, the load current is 6 mA. Find the current in a 20-kΩ load.

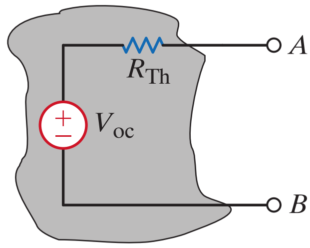

Figure P5.49

5.50 If an 8-kΩ load is connected to the terminals of the network in Fig. P5.50, $V_{AB} = 16$ Ω. If a 2-kΩ load is connected to the terminals, $V_{AB} = 8$ V. Find V_{AB} if a 20-kΩ load is connected to the terminals.

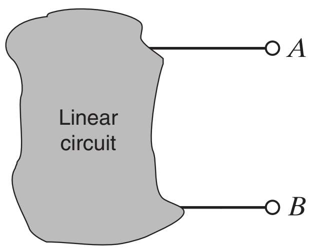

Figure P5.50

5.51 Find I_o in the network in Fig. P5.51 using Norton's theorem.

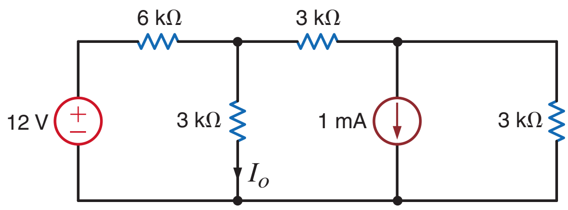

Figure P5.51

5.52 Use Norton's theorem to find I_o in the circuit in Fig. P5.52.

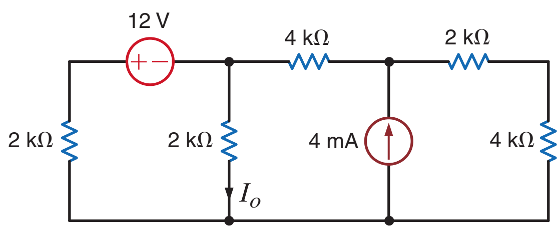

Figure P5.52

5.53 Find I_o in the network in Fig. P5.53 using Norton's theorem.

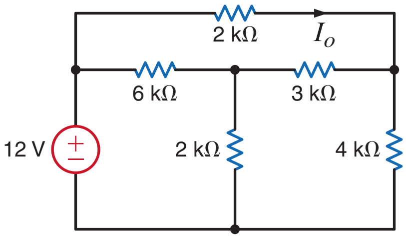

Figure P5.53

5.54 Use Norton's theorem to find V_o in the network in Fig. P5.54.

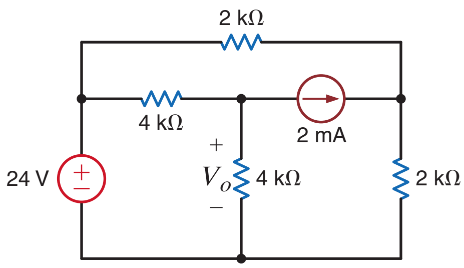

Figure P5.54

5.55 Use Norton's theorem to find I_o in the circuit in Fig. P5.55.

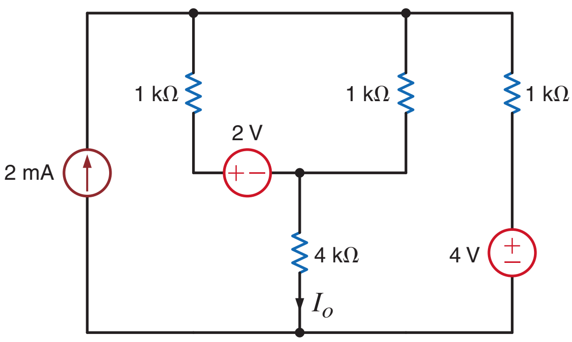

Figure P5.55

5.56 Find V_o in the circuit in Fig. P5.56 using Norton's theorem.

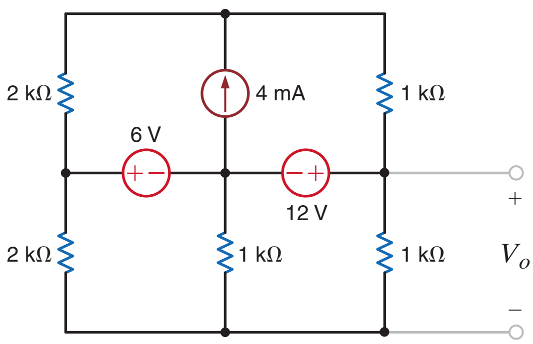

Figure P5.56

5.57 Use Norton's theorem to find I_o in the network in Fig. P5.57.

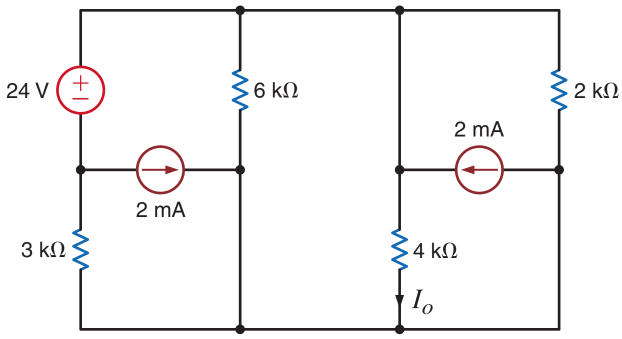

Figure P5.57

5.58 Use Norton's theorem to find I_o in the circuit in Fig. P5.58.

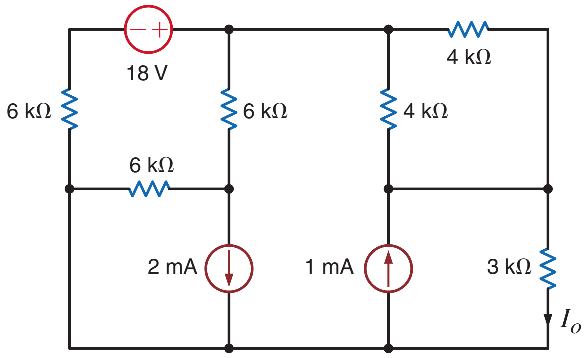

Figure P5.58

5.59 Find V_o in the network in Fig. P5.59 using Thévenin's theorem.

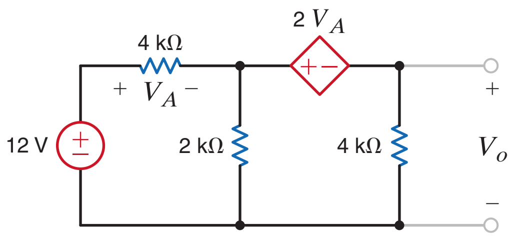

Figure P5.59

5.60 Use Thévenin's theorem to find V_o in the circuit in Fig. P5.60.

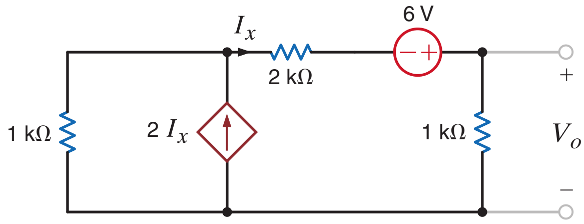

Figure P5.60

5.61 Use Thévenin's theorem to find I_o in the circuit in Fig. P5.61.

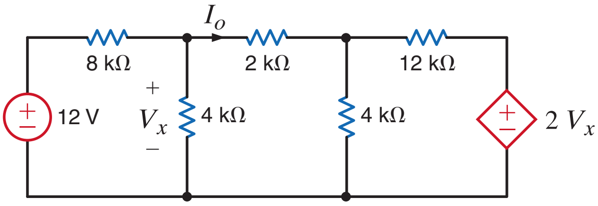

Figure P5.61

5.62 Use Thévenin's theorem to find V_o in the circuit in Fig. P5.62.

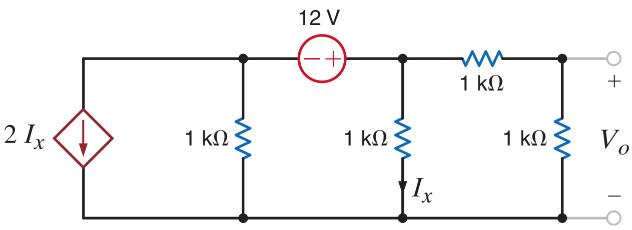

Figure P5.62

5.63 Find I_o in the circuit in Fig. P5.63 using Thévenin's theorem.

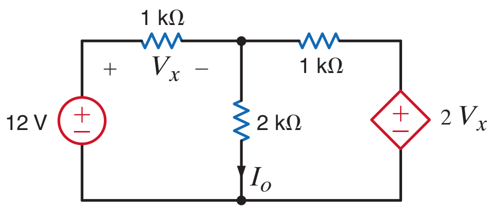

Figure P5.63

5.64 Find V_o in the network in Fig. P5.64 using Thévenin's theorem.

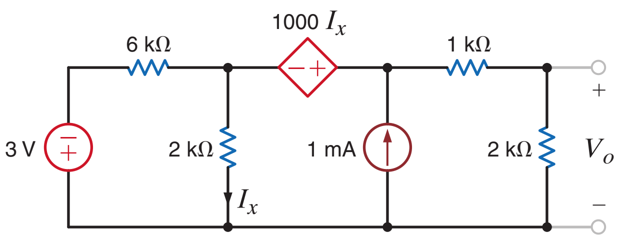

Figure P5.64

5.65 Use Norton's theorem to find V_o in the network in Fig. P5.65.

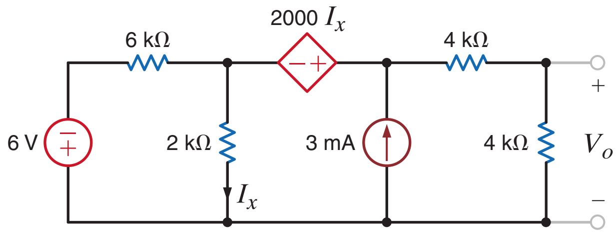

Figure P5.65

5.66 Find V_o in the circuit in Fig. P5.66 using Thévenin's theorem.

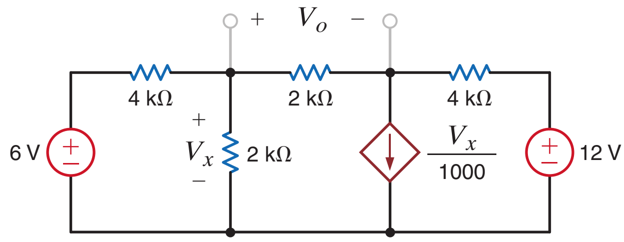

Figure P5.66

5.67 Find V_o in the network in Fig. P5.67 using Thévenin's theorem.

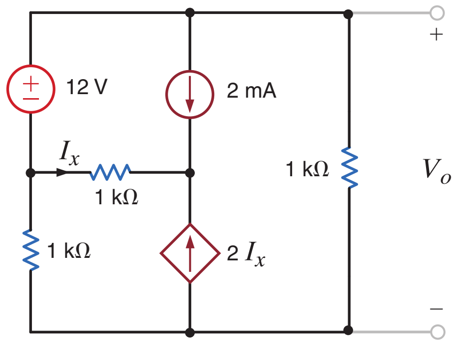

Figure P5.67

5.68 Use Thévenin's theorem to find V_o in the circuit in Fig. P5.68.

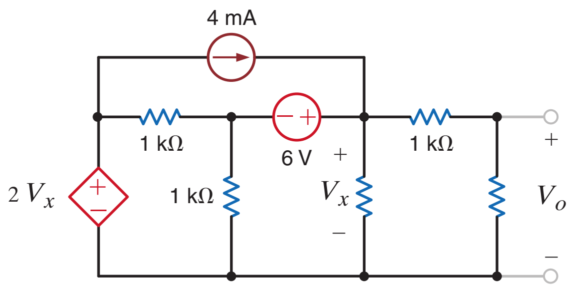

Figure P5.68

5.69 Use Thévenin's theorem to find V_o in the circuit in Fig. P5.69.

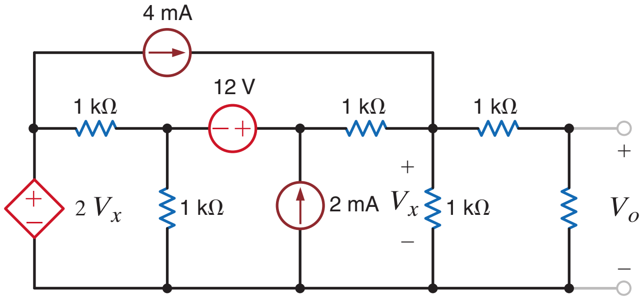

Figure P5.69

5.70 Use Thévenin's theorem to find V_o in the network in Fig. P5.70.

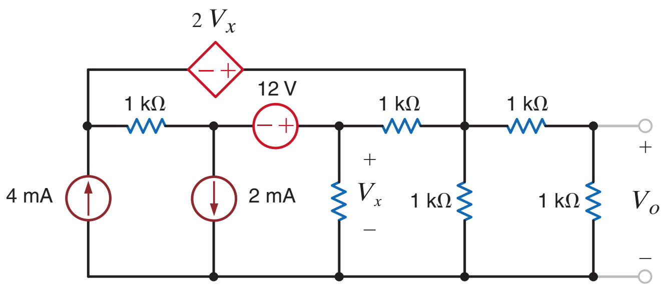

Figure P5.70

5.71 Find V_o in the network in Fig. P5.71 using Norton's theorem.

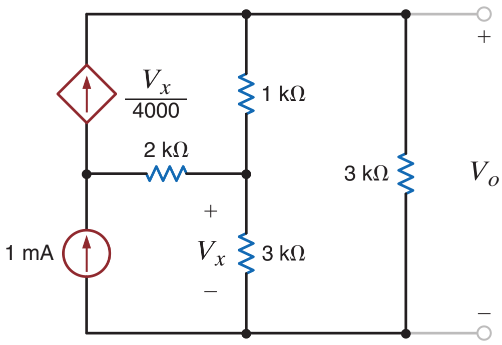

Figure P5.71

5.72 Find I_o in the network in Fig. P5.72 using Thévenin's theorem.

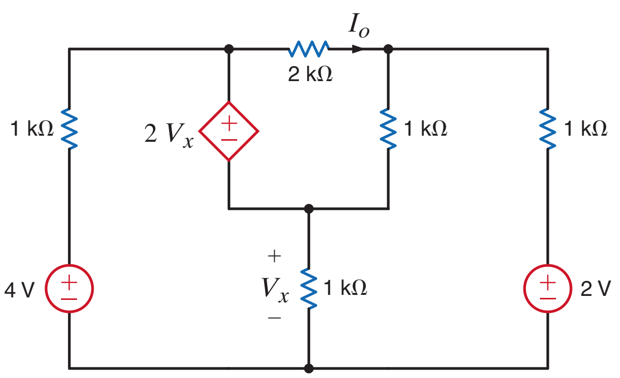

Figure P5.72

5.73 Find V_o in the circuit in Fig. P5.73 using Thévenin's theorem.

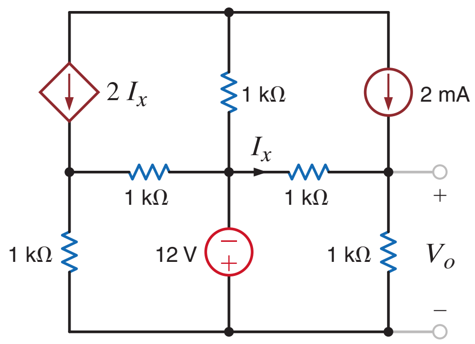

Figure P5.73

5.74 Find V_o in the network in Fig. P5.74 using Thévenin's theorem.

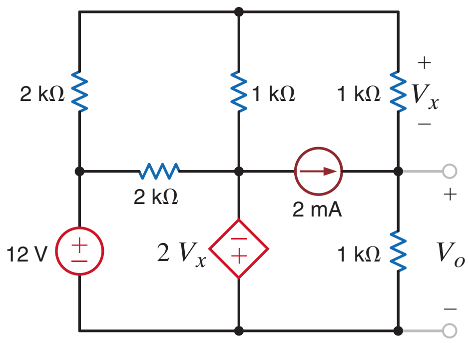

Figure P5.74

5.75 Find V_o in the network of Fig. P5.75 using Thévenin's theorem.

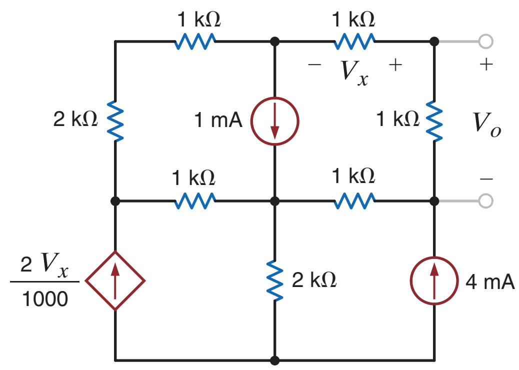

Figure P5.75

5.76 Use Thévenin's theorem to find I_2 in the circuit in Fig. P5.76.

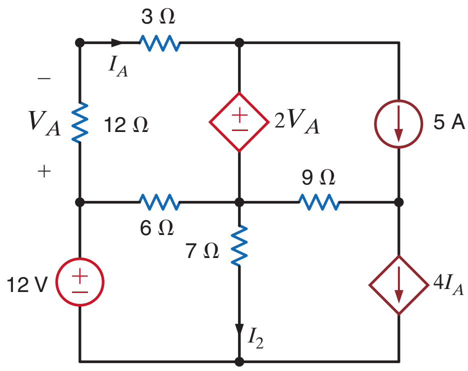

Figure P5.76

5.77 Use Thévenin's theorem to find V_o in the circuit in Fig. P5.77.

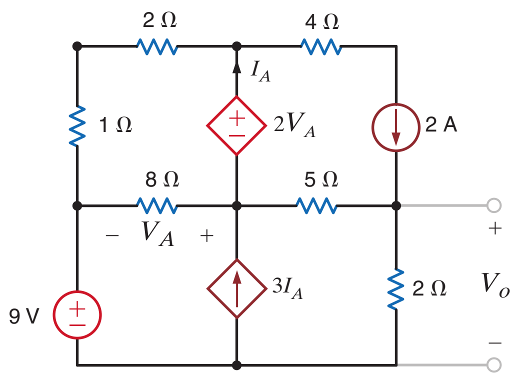

Figure P5.77

5.78 Use Thévenin's theorem to find I_o in the network in Fig. P5.78.

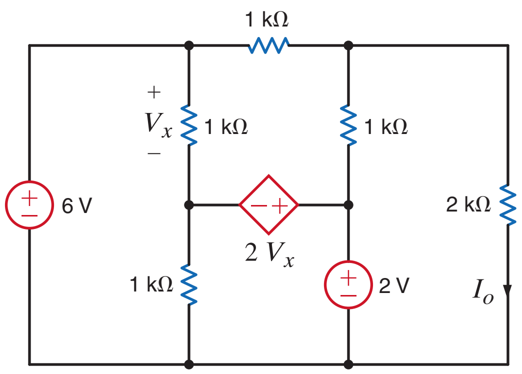

Figure P5.78

5.79 Use Thévenin's theorem to find V_o in the network in Fig. P5.79.

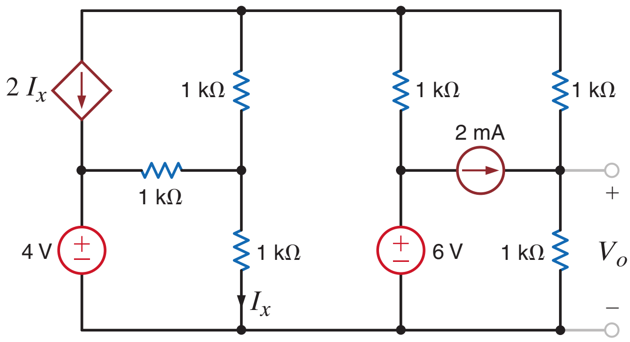

Figure P5.79

5.80 Find the Thévenin equivalent of the network in Fig. P5.80 at the terminals *A*–*B*.

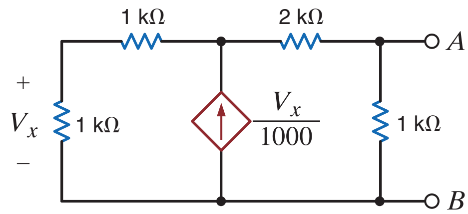

Figure P5.80

5.81 Find the Thévenin equivalent of the network in Fig. P5.81 at the terminals *A*–*B*.

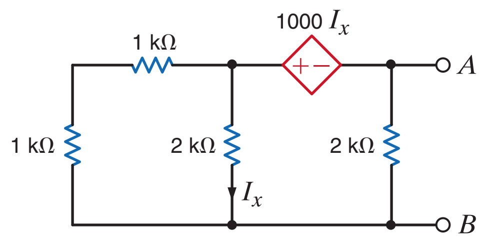

Figure p5.81

5.82 Find the Thévenin equivalent circuit of the network in Fig. P5.82 at the terminals *A*–*B*.

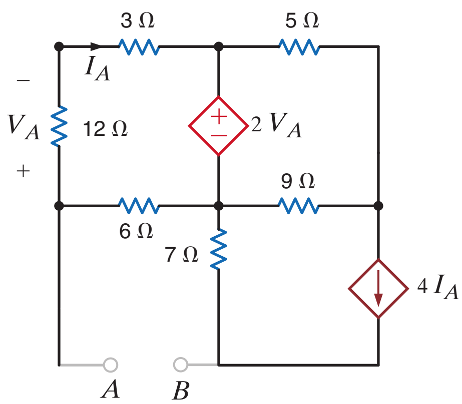

Figure P5.82

5.83 Find the Thévenin equivalent of the network below at the terminals *A*-*B* in Fig. P5.83.

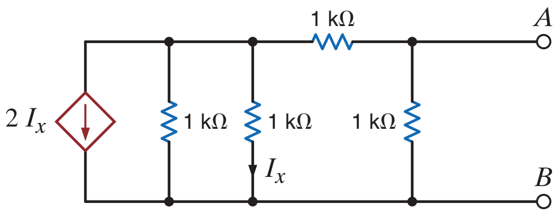

Figure P5.83

5.84 Find I_o in the network in Fig. P5.84 using Thévenin's theorem.

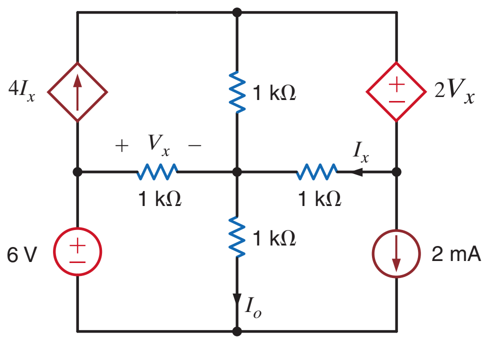

Figure P5.84

5.85 Use source transformation to find V_o in the network in Fig. P5.85.

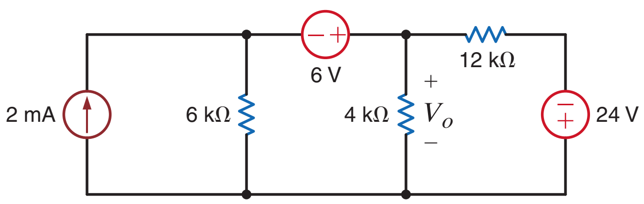

Figure P5.85

5.86 Find I_o in the network in Fig. P5.86 using source transformation.

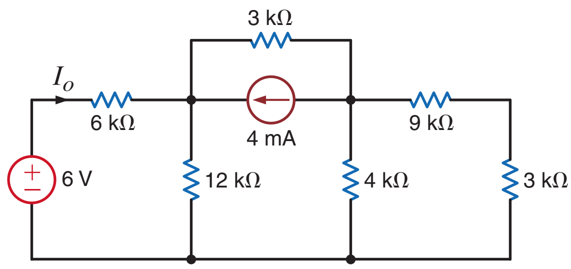

Figure P5.86

5.87 Find V_o in the network in Fig. P5.87 using source transformation.

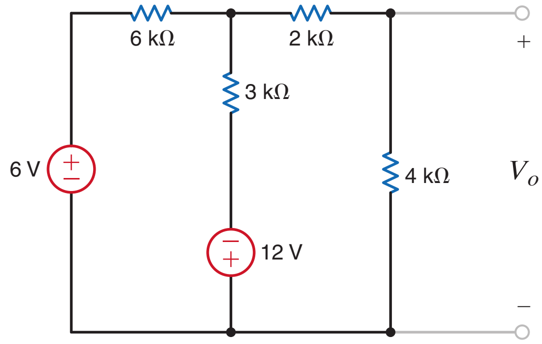

Figure P5.87

5.88 Use source transformation to find I_o in the network in Fig. P5.88.

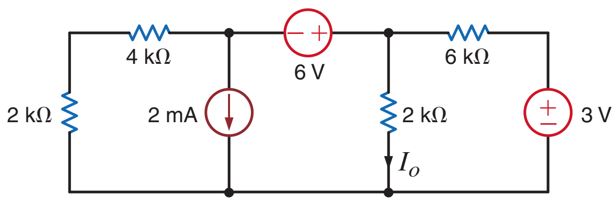

Figure P5.88

5.89 Find V_o in the network in Fig. P5.89 using source transformation.

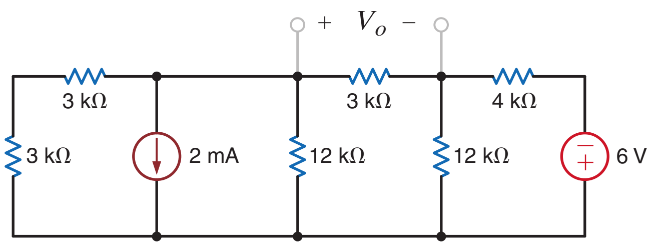

Figure P5.89

5.90 Find I_o in the network in Fig. P5.90 using source transformation.

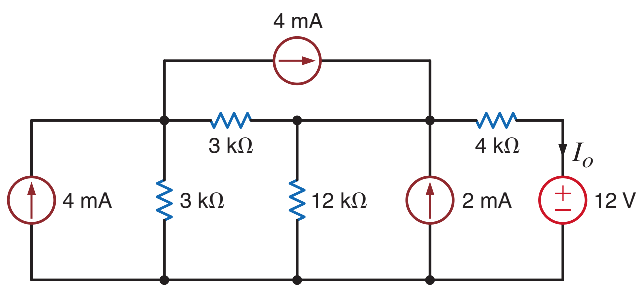

Figure P5.90

5.91 Find I_o in the circuit in Fig. P5.91 using source transformation.

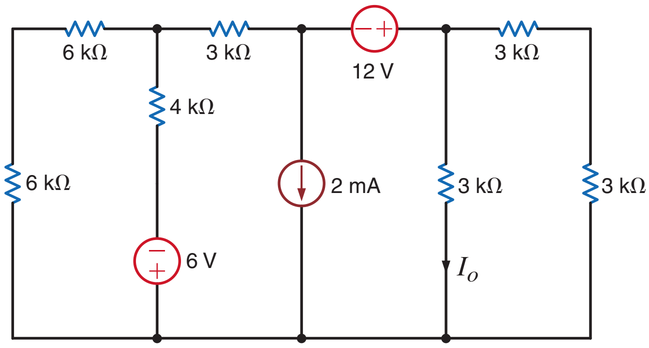

Figure P5.91

5.92 Use source exchange to find I_o in the network in Fig. P5.92.

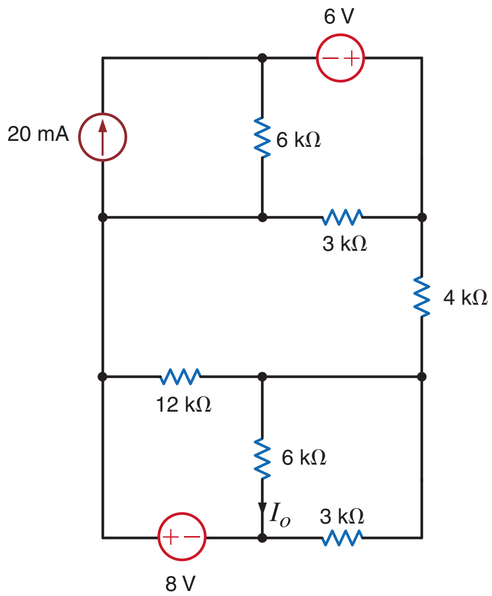

Figure P5.92

5.93 Use a combination of Y–Δ transformation source transformation to find I_o in the circuit in Fig. P5.93.

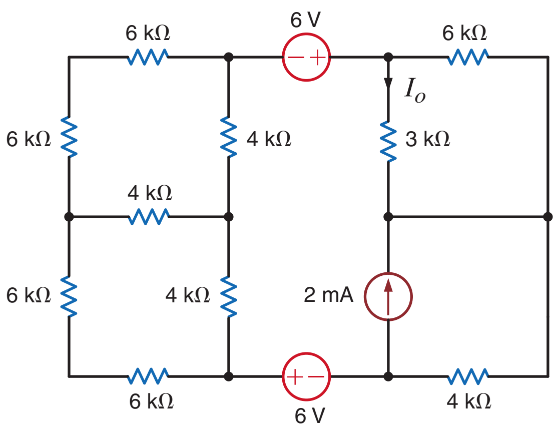

Figure P5.93

5.94 Find V_o in the network in Fig. P5.94 using source exchange.

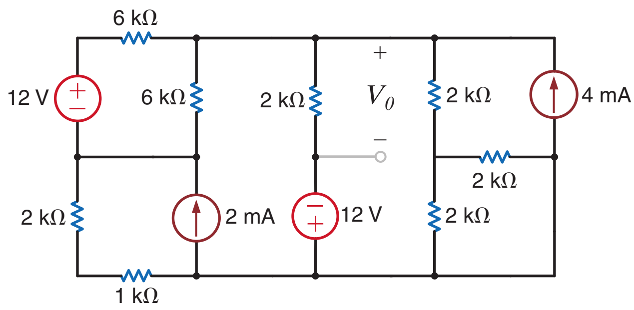

Figure P5.94

5.95 Use source exchange to find I_o in the circuit in Fig. P5.95.

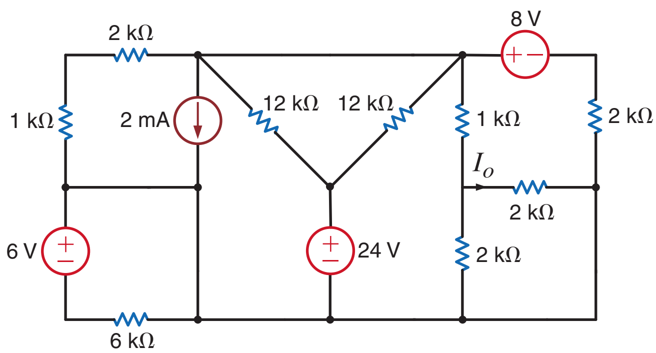

Figure P5.95

5.96 Use source exchange to find I_o in the network in Fig. P5.96.

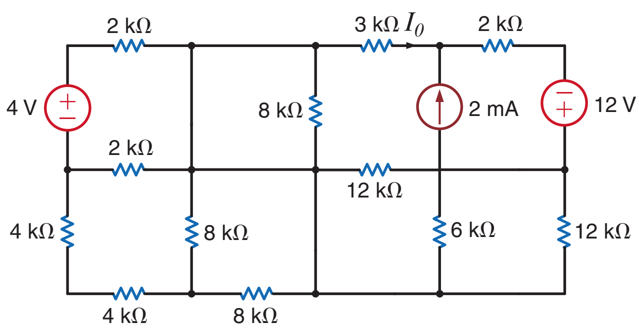

Figure P5.96

5.97 Use source exchange to find I_o in the network in Fig. P5.97.

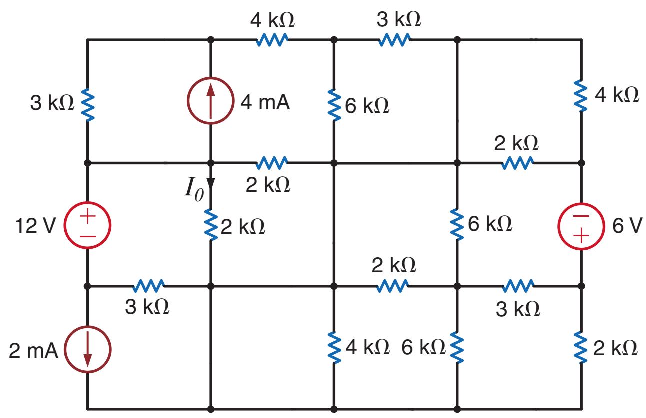

Figure P5.97

5.98 Use source transformation to find I_o in the network in Fig. P5.98.

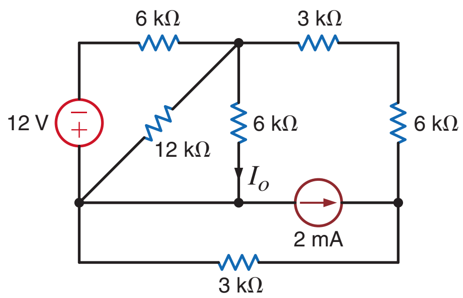

Figure P5.98

5.99 Using source transformation, find V_o in the circuit in Fig. P5.99.

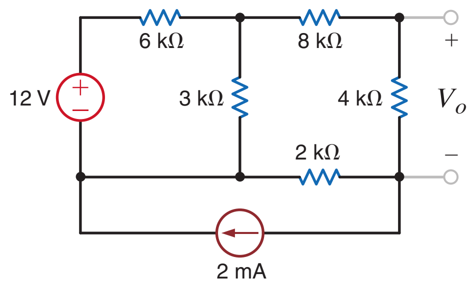

Figure P5.99

5.100 Using source transformation, find I_o in the circuit in Fig. P5.100.

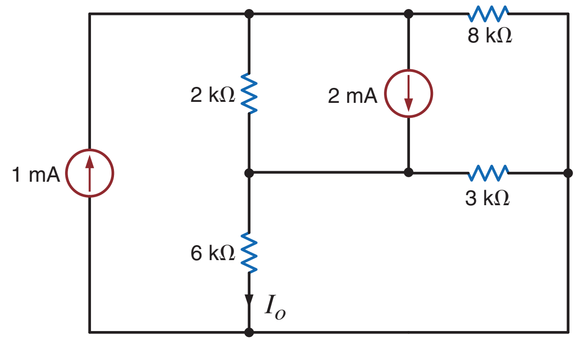

Figure P5.100

5.101 Use source transformation to find I_o in the circuit in Fig. P5.101.

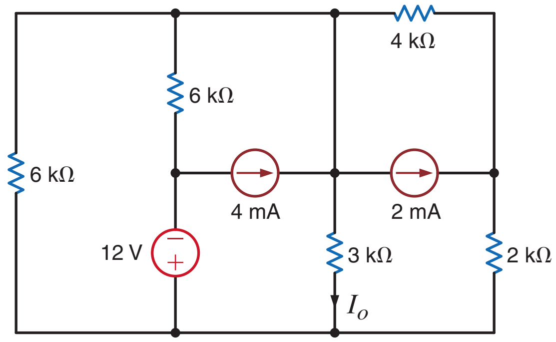

Figure P5.101

5.102 Using source transformation, find I_o in the network in Fig. P5.102.

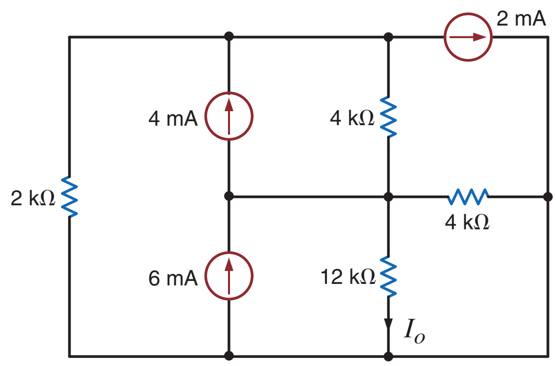

Figure P5.102

5.103 Use source transformation to find I_o in the circuit in Fig. P5.103.

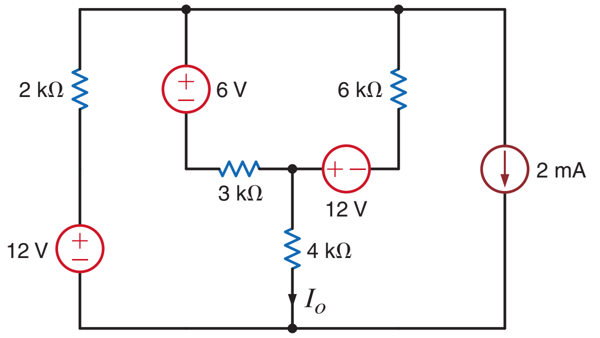

Figure P5.103

5.104 Use source transformation to find I_o in the circuit in Fig. P5.104.

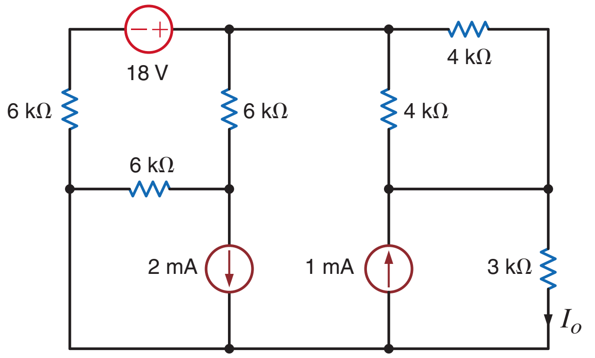

Figure P5.104

5.105 Using source transformation, find I_o in the circuit in Fig. P5.105.

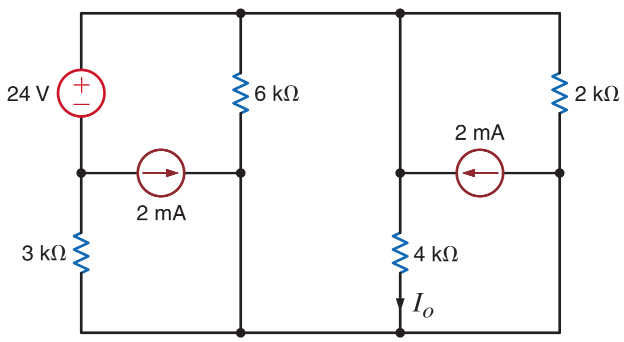

Figure P5.105

5.106 Find R_L in the network in Fig. P5.106 in order to achieve maximum power transfer.

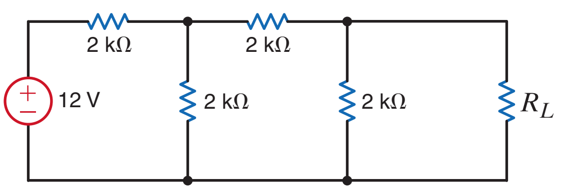

Figure P5.106

5.107 In the network in Fig. P5.107 find R_L for maximum power transfer and the maximum power transferred to this load.

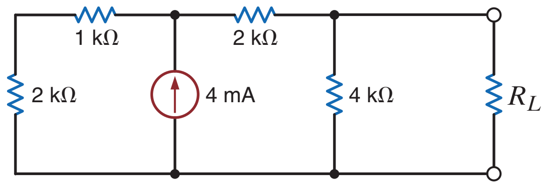

Figure P5.107

5.108 Find R_L for maximum power transfer and the maximum power that can be transferred to the load in Fig. P5.108.

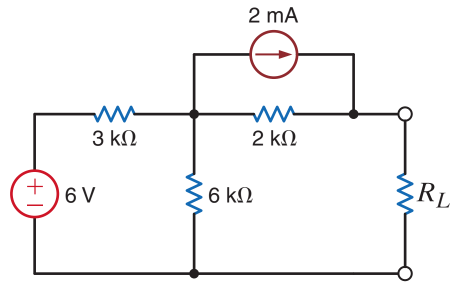

Figure P5.108

5.109 Calculate the maximum power that can be transferred to R_L in Fig. P5.109.

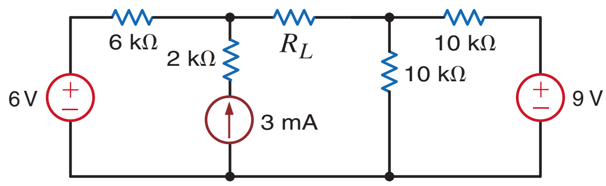

Figure P5.109

5.110 Find the value of R_L in Fig. P5.110 for maximum power transfer and the maximum power that can be dissipated in R_L.

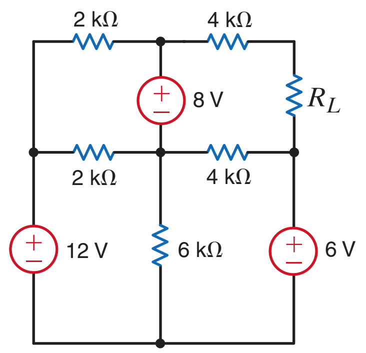

Figure P5.110

5.111 Determine the value of R_L in Fig. P5.111 for maximum power transfer. In addition, calculate the power dissipated in R_L under these conditions.

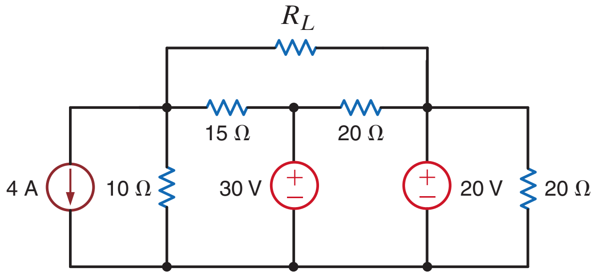

Figure P5.111

5.112 Determine the value of R_L in the network in Fig. P5.112 for maximum power transfer.

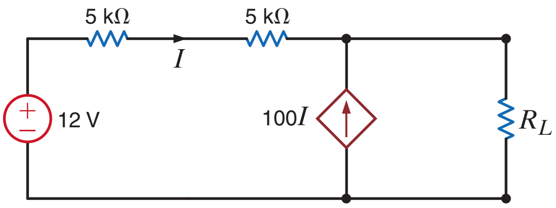

Figure P5.112

5.113 Find R_L for maximum power transfer and the maximum power that can be transferred to the load in Fig. P5.113.

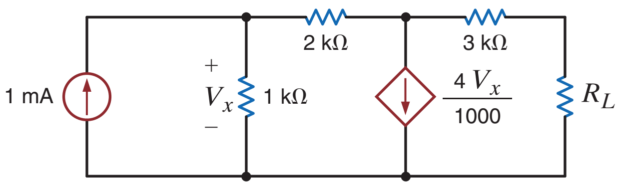

Figure P5.113

5.114 Find the value of R_L in the network in Fig. P5.114 for maximum power transfer.

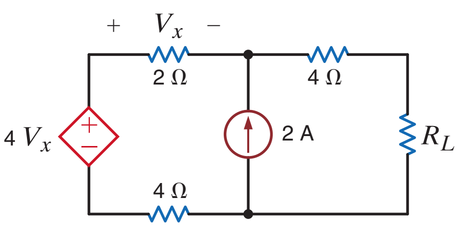

Figure P5.114

5.115 Find the value of R_L in Fig. P5.115 for maximum power transfer and the maximum power that can be transferred to R_L.

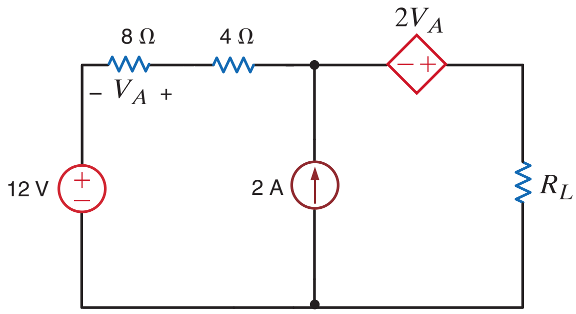

Figure P5.115

5.116 Find the value of R_l in Fig. P5.116 for maximum power transfer and the maximum power that can be dissipated in R_L.

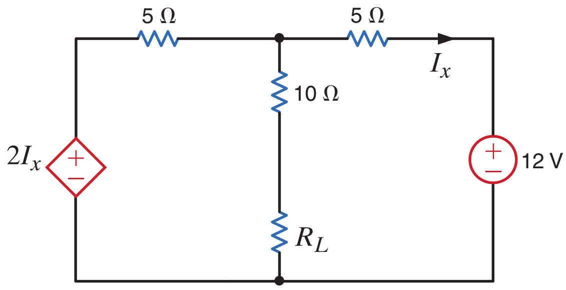

Figure P5.116

5.117 Find the value of R_L in Fig. P5.117 for maximum power transfer. In addition, calculate the power dissipated in R_L under these conditions.

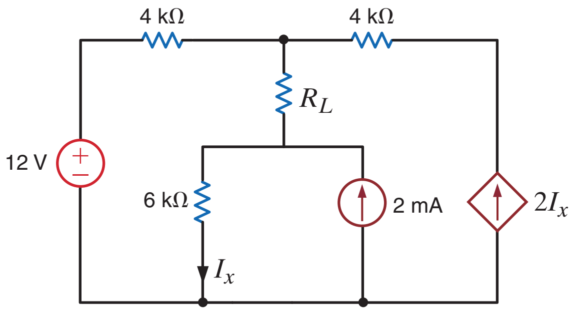

Figure P5.117

5.118 Find the value of R_L in Fig. P5.118 for maximum power transfer. In addition, calculate the power dissipated in R_L under these conditions.

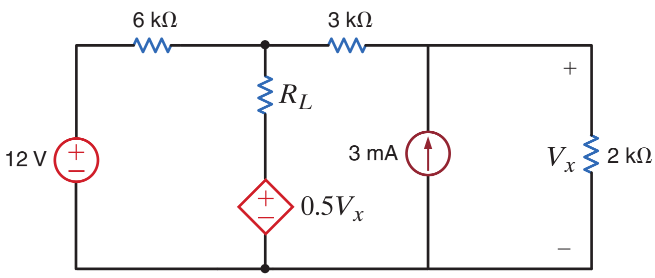

Figure P5.118

5.119 Calculate the maximum power that can be transferred to R_L in the circuit in Fig. P5.119.

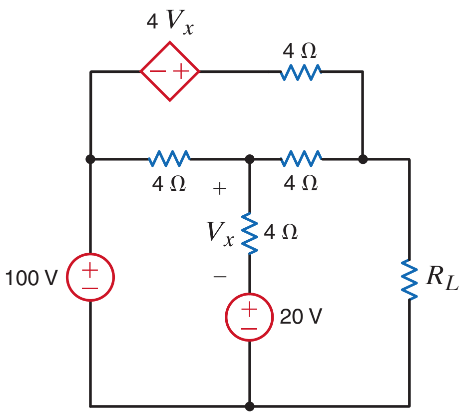

Figure P5.119

5.120 Find R_L for maximum power transfer and the maximum power that can be transferred in the network in Fig. P5.120.

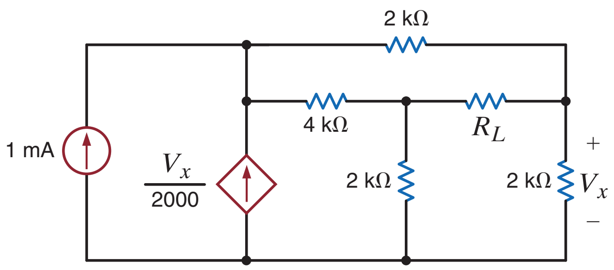

Figure P5.120

5.121 Find the value of R_L in Fig. P5.121 for maximum power transfer and the maximum power that can be dissipated in R_L.

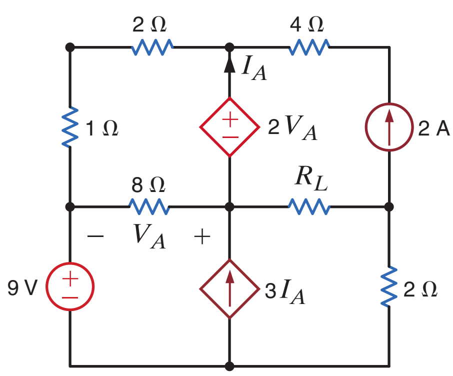

Figure P5.121

5.122 Solve the remaining problems using computational methods. Find I_o in the network in Fig. P5.122.

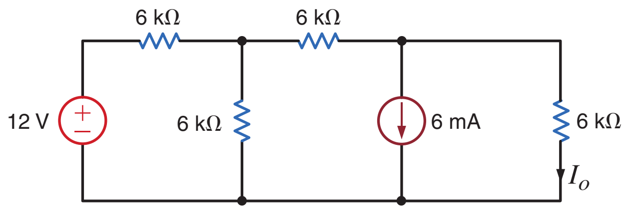

Figure P5.122

5.123 Find V_o in the network in Fig. P5.123.

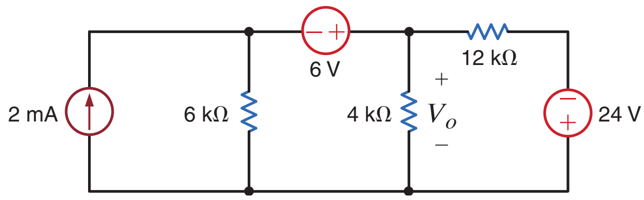

Figure P5.123

5.124 Find I_o in the circuit in Fig. P5.124.

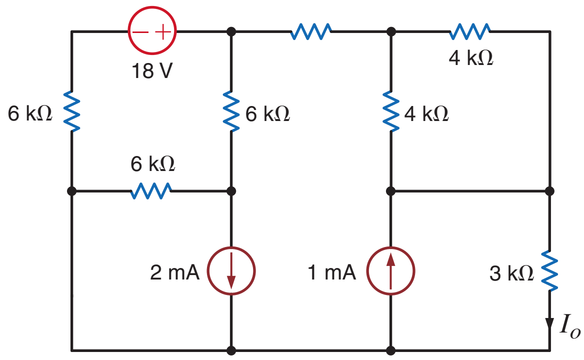

Figure P5.124

5.125 Find V_o in the network in Fig. P5.125.

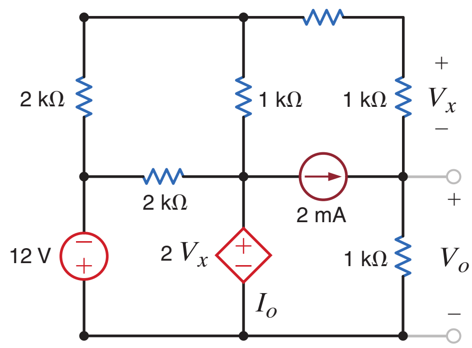

Figure P5.125