

N linearly independent equations must be written to solve for the loop currents.

- If current sources are present in the circuit, either of two techniques can be employed. In the first case, one loop current is selected to pass through one of the current sources. The remaining loop currents are determined by open-circuiting the current sources in the circuit and using this modified circuit to select them. In the second case, a current is assigned to each mesh in the circuit.
- Write a constraint equation for each current source— independent or dependent—in the circuit in terms of the

assigned loop currents using KCL. Each constraint equation represents one of the necessary linearly independent equations, and N_f current sources yield N_f linearly independent equations. For each dependent current source, express the controlling variable for that source in terms of the loop currents.

- Use KVL to formulate the remaining $N - N_f$ linearly independent equations. Treat dependent voltage sources like independent voltage sources when formulating the KVL equations. For each dependent voltage source, express the controlling variable in terms of the loop currents.

PROBLEMS

3.1 Find I_1 in the circuit in Fig. P3.1.

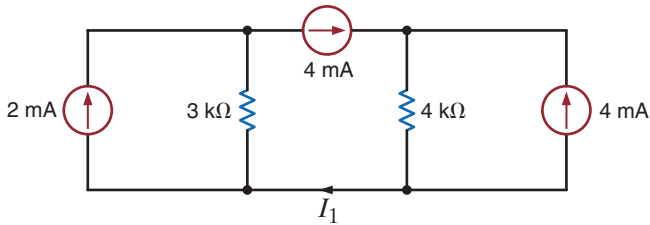


Figure P3.1

3.2 Find I_1 in the network in Fig. P3.2.

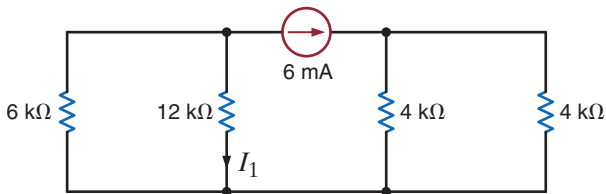


Figure P3.2

3.3 Find I_o in the circuit in Fig. P3.3.

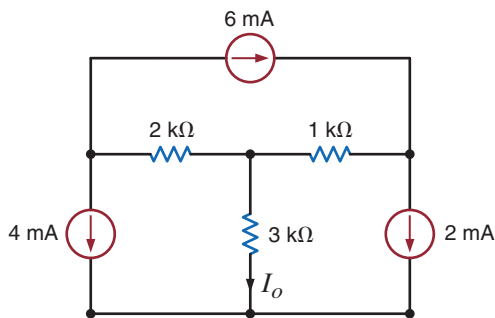


Figure P3.3

3.4 Use nodal analysis to find V_1 in the circuit in Fig. P3.4.

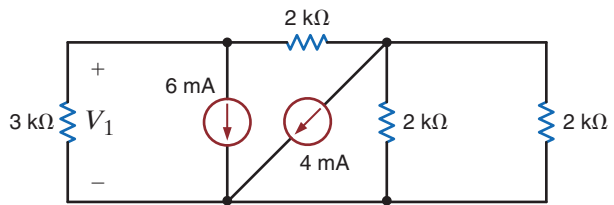


Figure P3.4

3.5 Find V_1 and V_2 in the circuit in Fig. P3.5 using nodal analysis.

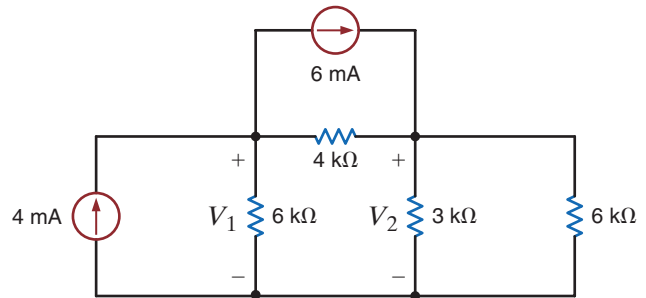


Figure P3.5

3.6 Use nodal analysis to find both V_1 and V_o in the circuit in Fig. 3.6.

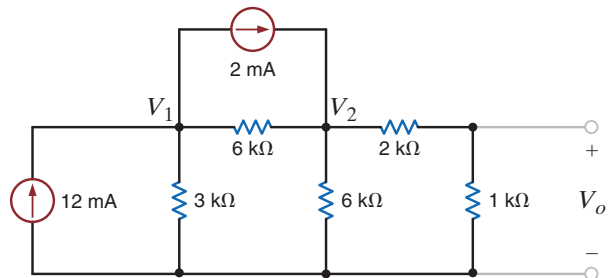


Figure P3.6

3.7 Find I_o in the circuit in Fig. P3.7 using nodal analysis.

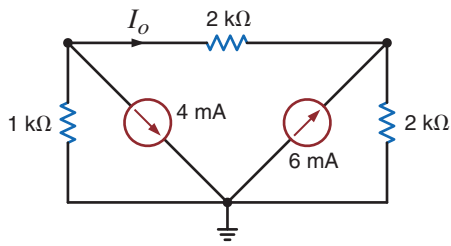


Figure P3.7

3.8 Find I_o in the network in Fig. P3.8 using nodal analysis.

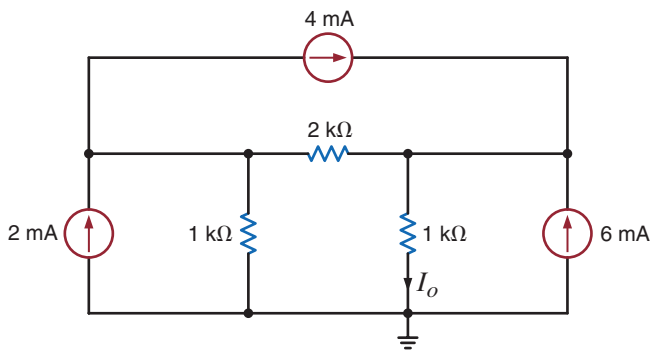


Figure P3.8

3.9 Find I_o in the circuit in Fig. P3.9.

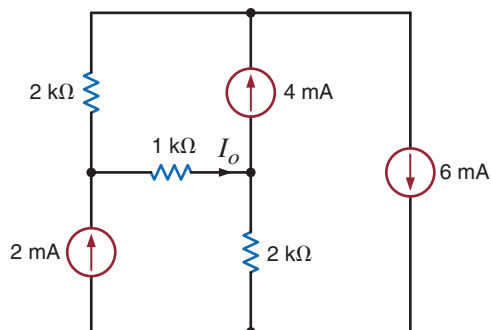


Figure P3.9

3.10 Find I_o in the circuit in Fig. P3.10 using nodal analysis.

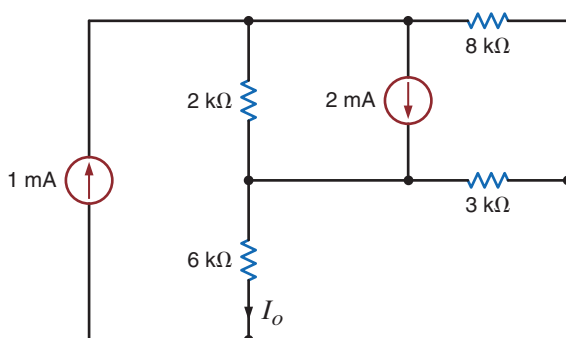


Figure P3.10

3.11 Use nodal analysis to find I_o in the network in Fig. P3.11.

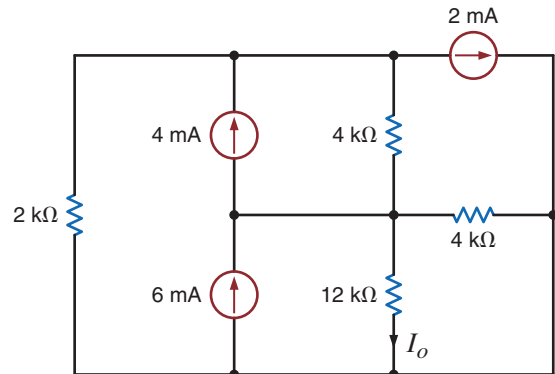


Figure P3.11

3.12 Find V_o in the network in Fig. P3.12 using nodal analysis.

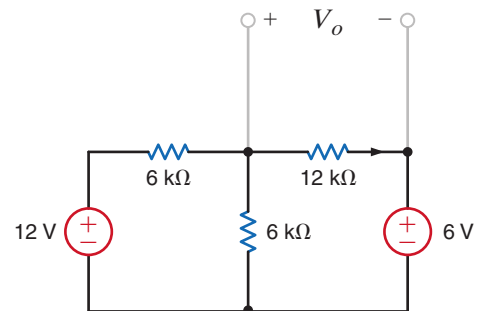


Figure P3.12

3.13 Find V_o in the circuit in Fig. P3.13 using nodal analysis.

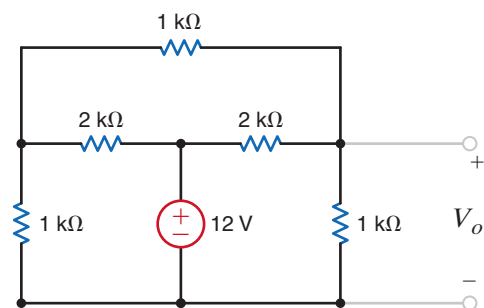


Figure P3.13

3.14 Use nodal analysis to find V_o in the circuit in Fig. P3.14.

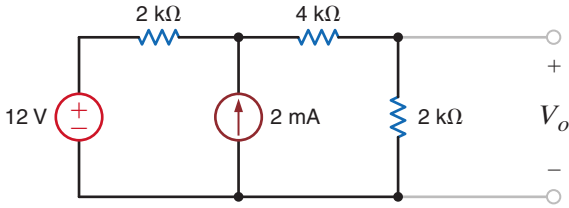


Figure P3.14

3.18 Find V_o in the circuit in Fig. P3.18 using nodal analysis.

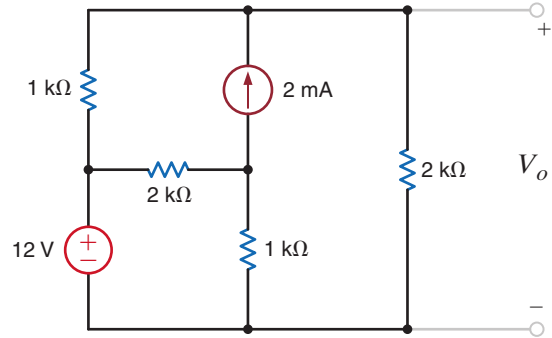


Figure P3.18

3.15 Find I_o in the network in Fig. P3.15 using nodal analysis.

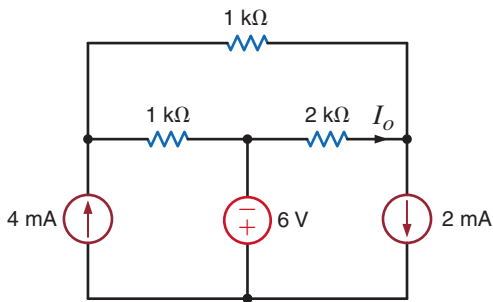


Figure P3.15

3.19 Find I_o in the circuit in Fig. P3.19 using nodal analysis.

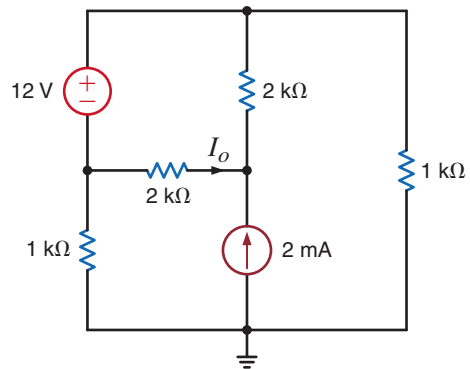


Figure P3.19

3.16 Find I_o in the circuit in Fig. P3.16 using nodal analysis.

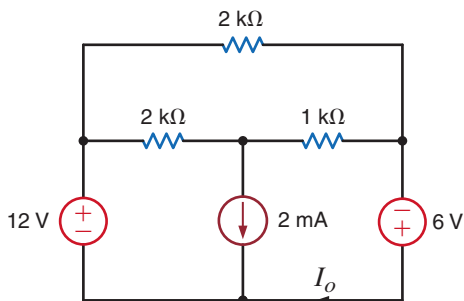


Figure P3.16

3.20 Find V_o in the network in Fig. P3.20 using nodal analysis.

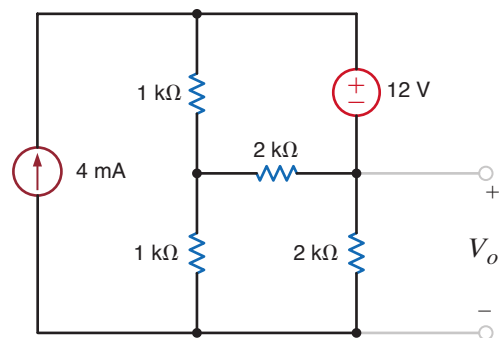


Figure P3.20

3.17 Find V_o in the circuit in Fig. P3.17 using nodal analysis.

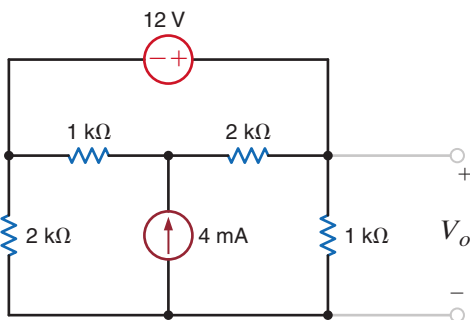


Figure P3.17



3.21 Find V_o in the circuit in Fig. P3.21 using nodal analysis.

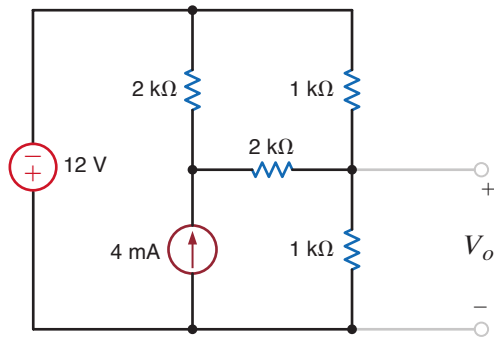


Figure P3.21

3.24 Find I_o in the circuit in Fig. P3.24 using nodal analysis.

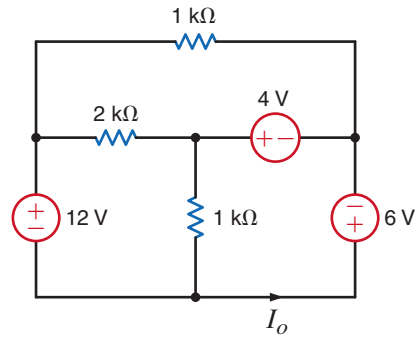


Figure P3.24

3.22 Find V_o in the network in Fig. P3.22 using nodal analysis.

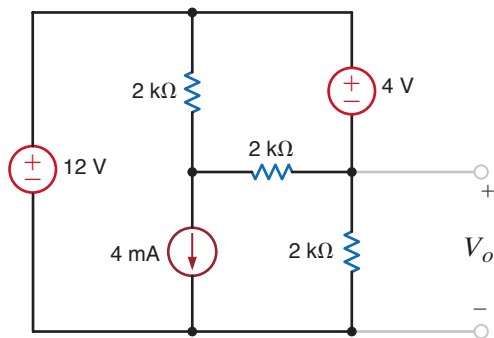


Figure P3.22

3.25 Use nodal analysis to solve for the node voltages in the circuit in Fig. P3.25. Also calculate the power supplied by the 2-mA current source.

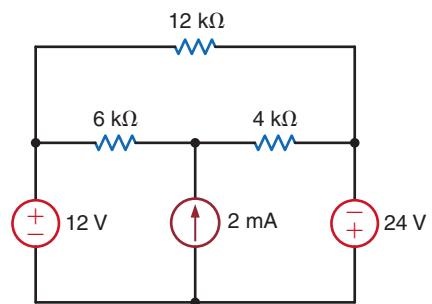


Figure P3.25

3.23 Find I_o in the circuit in Fig. P3.23 using nodal analysis.

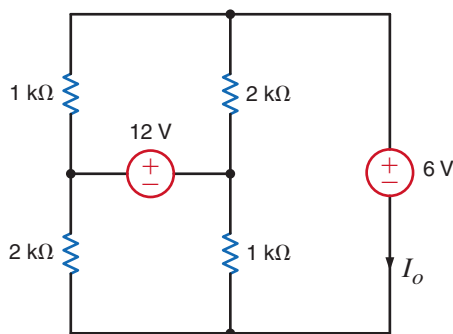


Figure P3.23

3.26 Use nodal analysis to determine the node voltages defined in the circuit in Fig. P3.26.

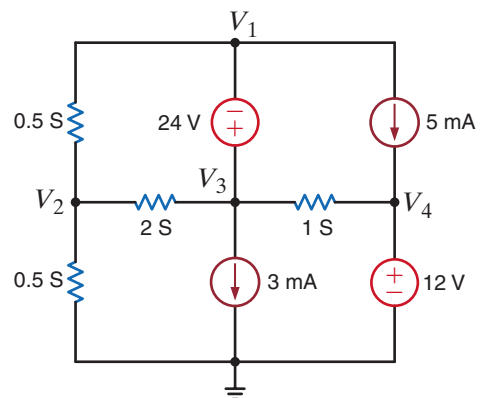


Figure P3.26

3.27 Use nodal analysis to solve for the node voltages in the circuit in Fig. P3.27. Also calculate the power supplied by the 2-mA current source.

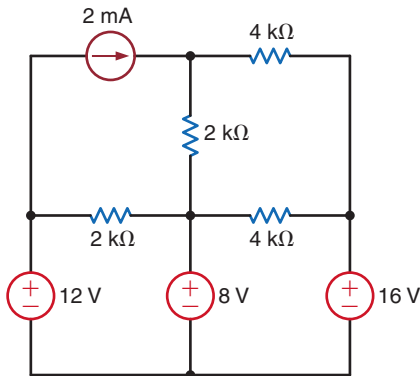


Figure P3.27

3.28 Use nodal analysis to find V_o in the network in Fig. P3.28.

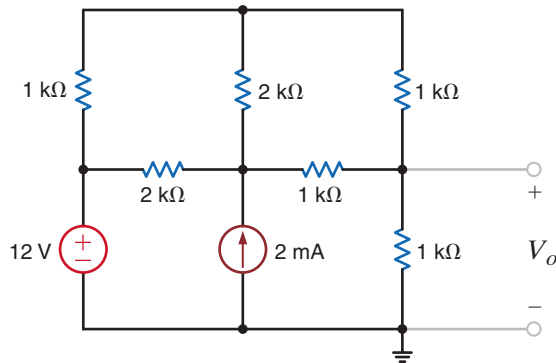


Figure P3.28

3.29 Use nodal analysis to find V_o in the circuit in Fig. P3.29.

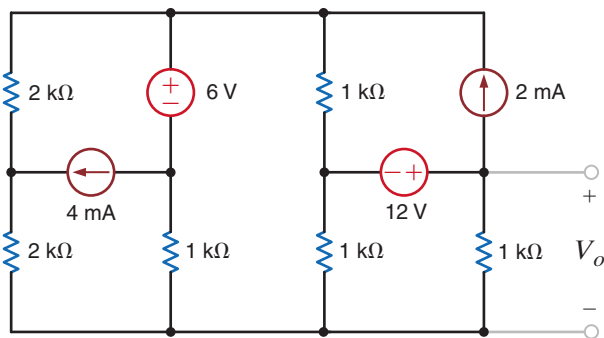


Figure P3.29

3.30 Use nodal analysis to find V_o in the circuit in Fig. P3.30.

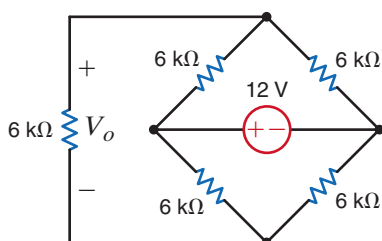


Figure P3.30

3.31 Find V_o in the network in Fig. P3.31.

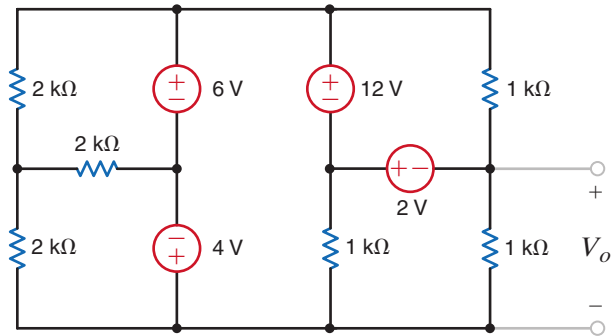


Figure P3.31

3.32 Find I_o in the network in Fig. P3.32 using nodal analysis.

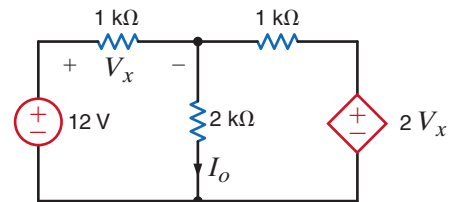


Figure P3.32

3.33 Find I_o in the network in Fig. P3.33 using nodal analysis.

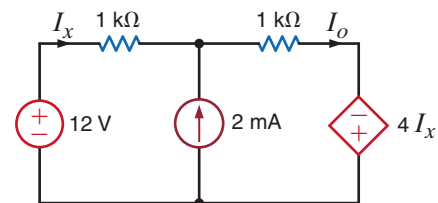


Figure P3.33

3.34 Find V_o in the network in Fig. P3.34 using nodal analysis.

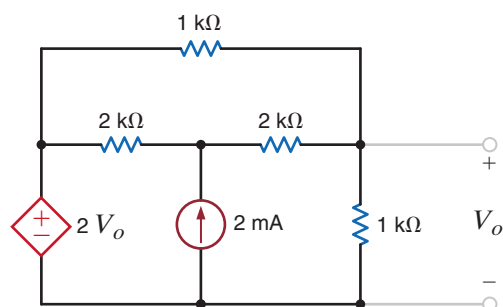


Figure P3.34

3.35 Find V_o in the circuit in Fig. P3.35 using nodal analysis.

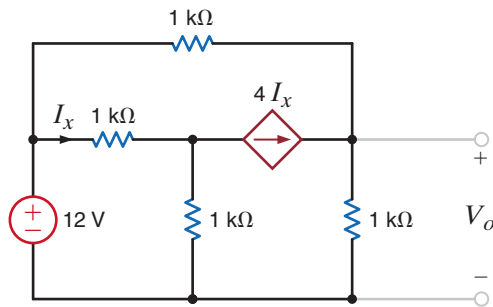


Figure P3.35

3.38 Find I_o in the network in Fig. P3.38 using nodal analysis.

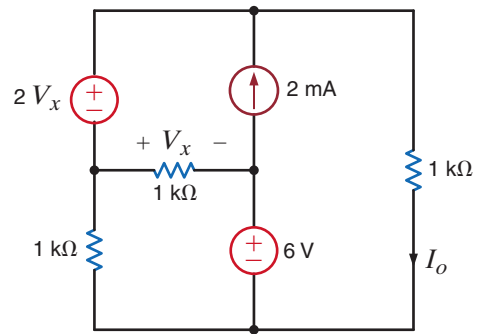


Figure P3.38

3.36 Find V_o in the network in Fig. P3.36 using nodal analysis.

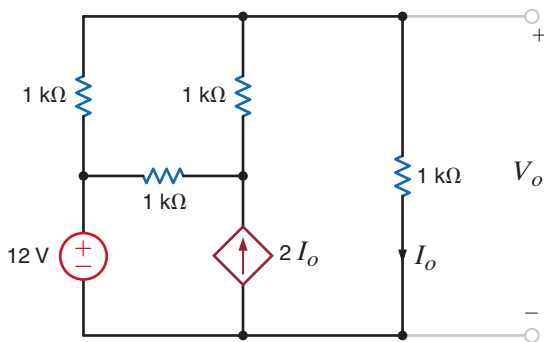


Figure P3.36

3.39 Find V_o in the network in Fig. P3.39 using nodal analysis.

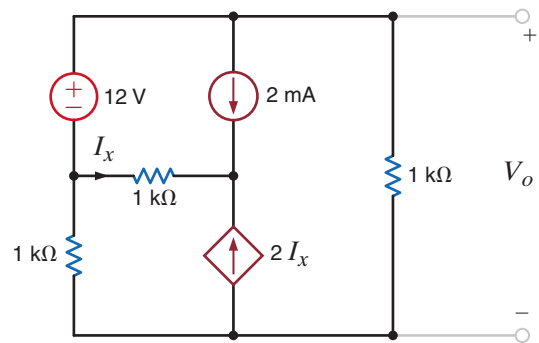


Figure P3.39

3.40 Use nodal analysis to find V_o in the circuit in Fig. P3.40.

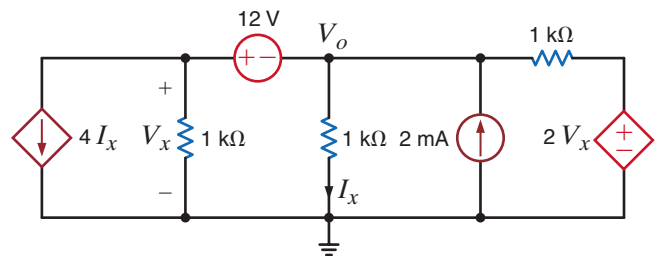


Figure P3.40

3.37 Find I_o in the network in Fig. P3.37 using nodal analysis.

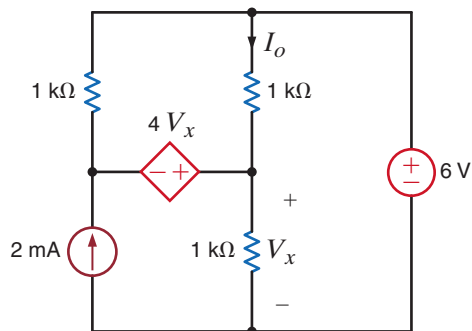


Figure P3.37

3.41 Use nodal analysis to find V_o in the circuit in Fig. P3.41.

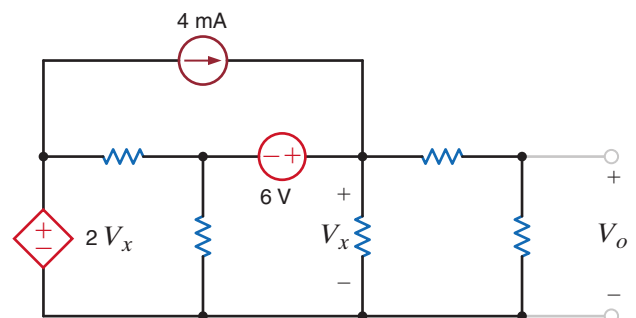


Figure P3.41

3.42 Use nodal analysis to find V_o in the network in Fig. P3.42.

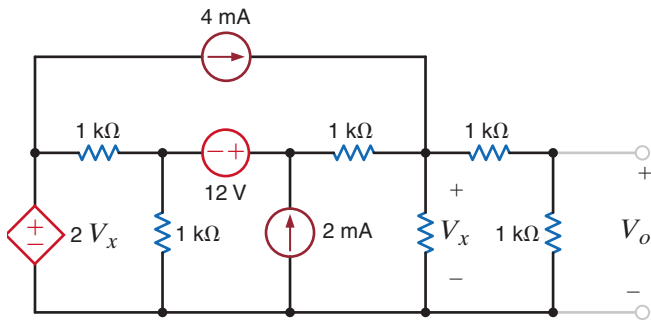


Figure P3.42

3.43 Use nodal analysis to find V_o in the circuit in Fig. P3.43.

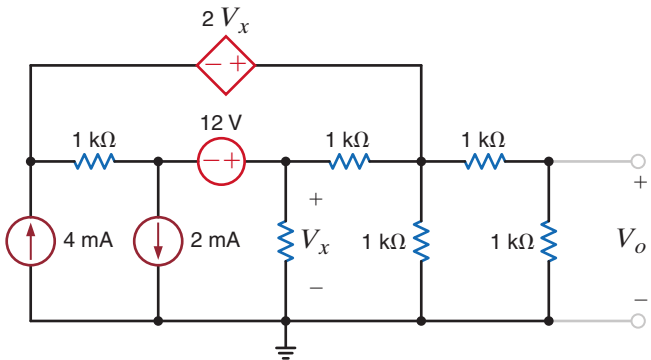


Figure P3.43

3.44 Use nodal analysis to find I_o in the circuit in Fig. P3.44.

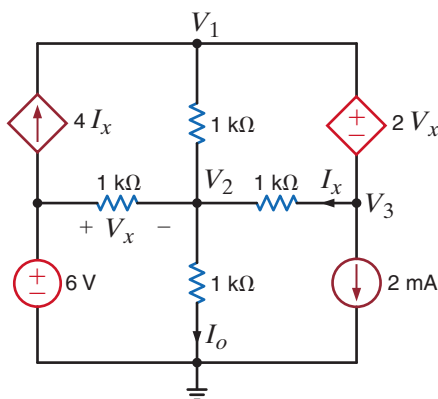


Figure P3.44

3.45 Find I_o in the circuit in Fig. P3.45 using nodal analysis.

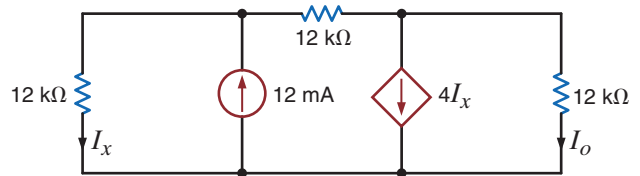


Figure P3.45

3.46 Find V_o in the circuit in Fig. P3.46.

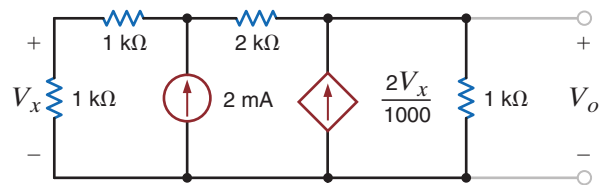


Figure P3.46

3.47 Use nodal analysis to find V_o in the circuit in Fig. P3.47. In addition, find all branch currents and check your answers using KCL at every node.

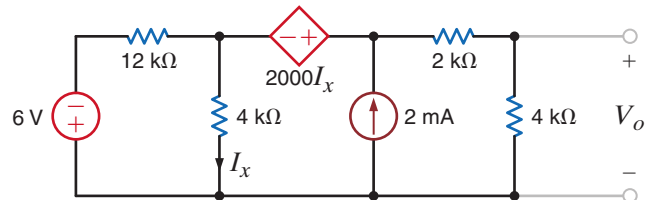


Figure P3.47

3.48 Determine V_o in the network in Fig. P3.48 using nodal analysis.

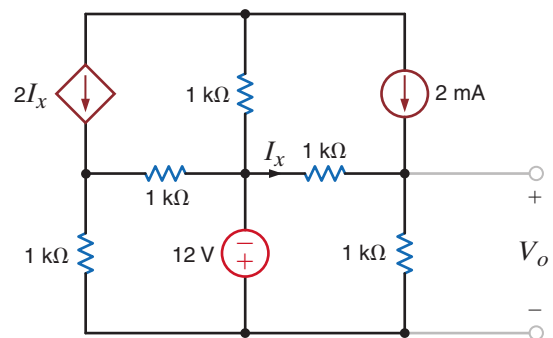


Figure P3.48

3.49 Use nodal analysis to find V_1 , V_2 , V_3 , and V_4 in the circuit in Fig. P3.49.

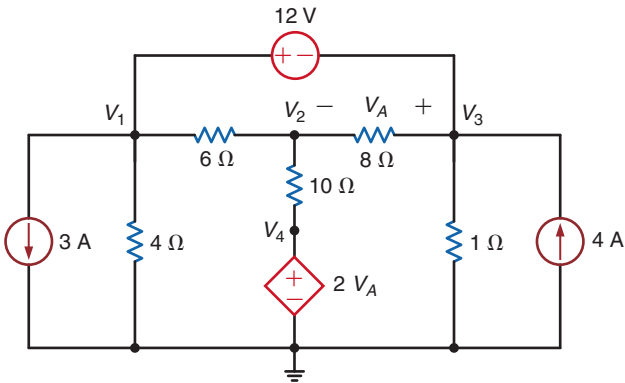


Figure P3.49

3.52 Use nodal analysis to determine the node voltages defined in the circuit in Fig. P3.52.

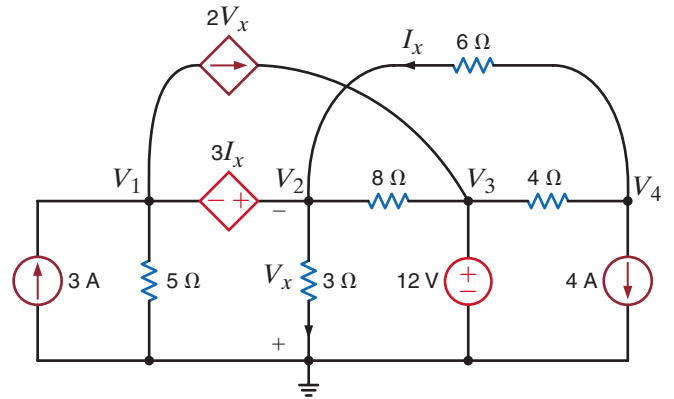


Figure P3.52

3.50 Use nodal analysis to determine the node voltages defined in the circuit in Fig. P3.50.

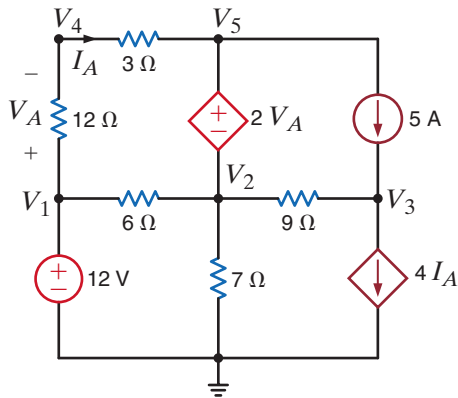


Figure P3.50

3.53 Find I_o in the network in Fig. P3.53 using mesh analysis.

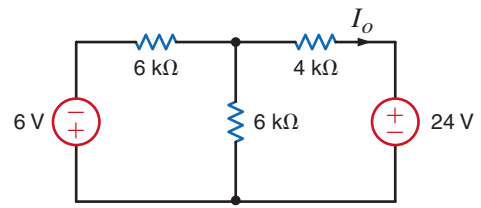


Figure P3.53

3.51 Use nodal analysis to determine the node voltages defined in the circuit in Fig. P3.51.

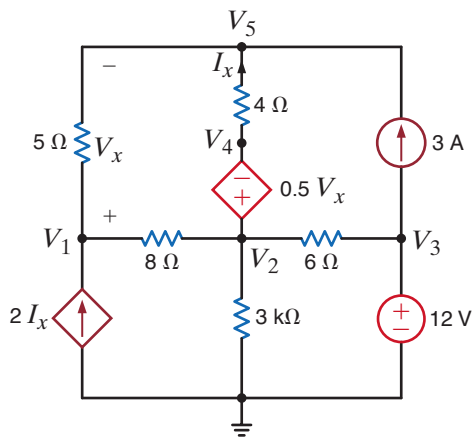


Figure P3.51

3.54 Find I_o in the circuit in Fig. P3.54.

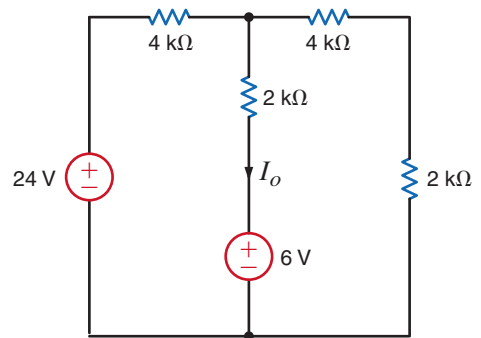


Figure P3.54

3.55 Find V_o in the network in Fig. P3.55 using mesh analysis.

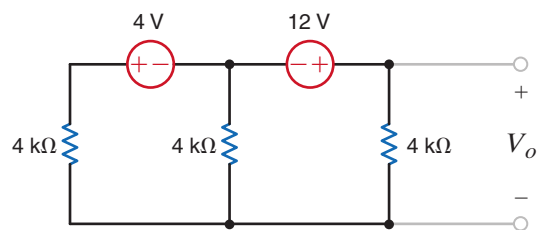


Figure P3.55

3.56 Find I_o in the circuit in Fig. P3.56.

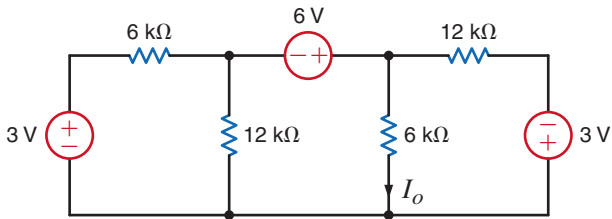


Figure P3.56

3.57 Use mesh analysis to find the power dissipated in the 6-kΩ resistor in Fig. P3.57.

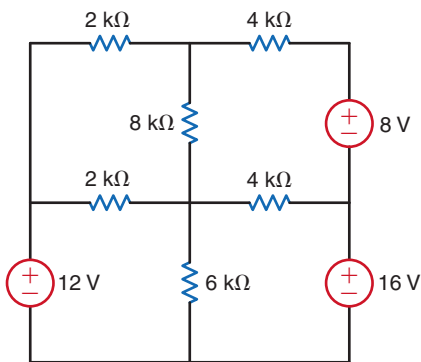


Figure P3.57

3.58 Find V_o in the circuit in Fig. P3.58 using mesh analysis.

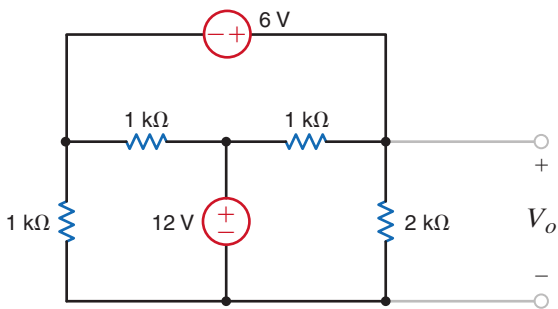


Figure P3.58

3.59 Use loop analysis to find V_o in the network in Fig. P3.59.

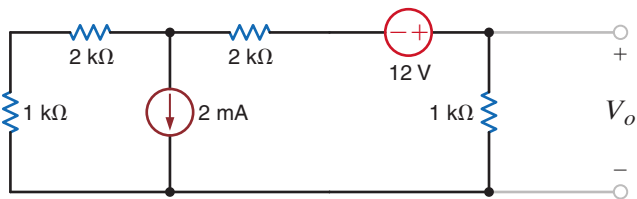


Figure P3.59

3.60 Use mesh analysis to find V_o in the network in Fig. P3.60.

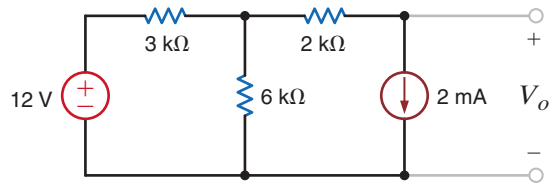


Figure P3.60

3.61 Find V_o in the network in Fig. P3.61 using loop analysis.

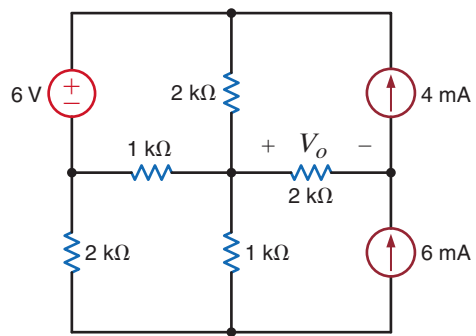


Figure P3.61

3.62 Find V_o in the circuit in Fig. P3.62 using loop analysis.

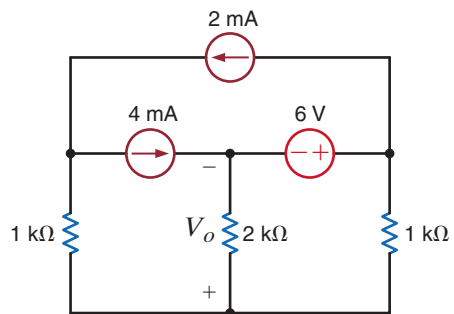


Figure P3.62

3.63 Find I_o in the circuit in Fig. P3.63 using loop analysis.

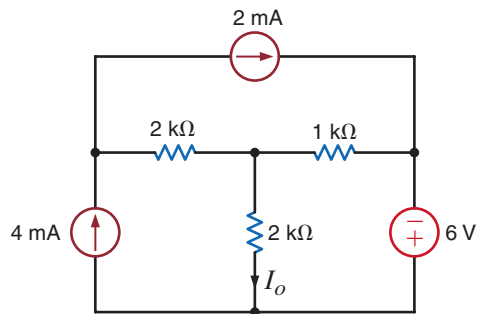


Figure P3.63

3.64 Find I_o in the network in Fig. P3.64 using loop analysis.

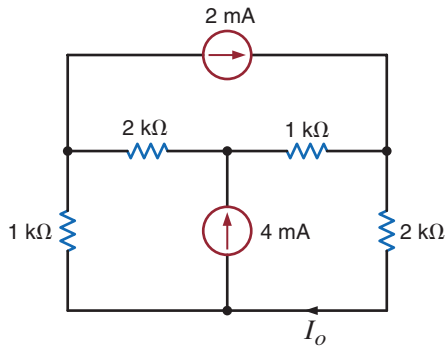


Figure P3.64

3.65 Find V_o in the network in Fig. P3.65 using loop analysis.

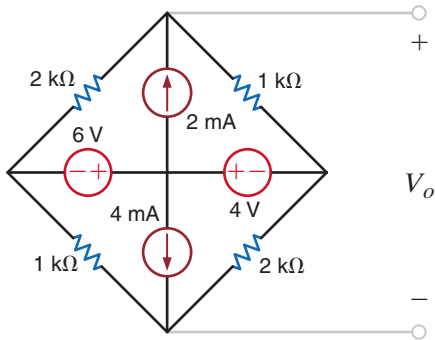


Figure P3.65

3.66 Find V_o in the circuit in Fig. P3.66 using loop analysis.

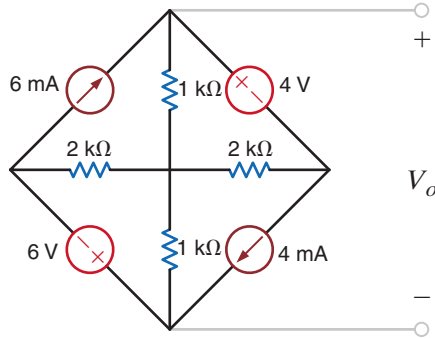


Figure P3.66

3.67 Find I_o in the network in Fig. P3.67 using loop analysis.

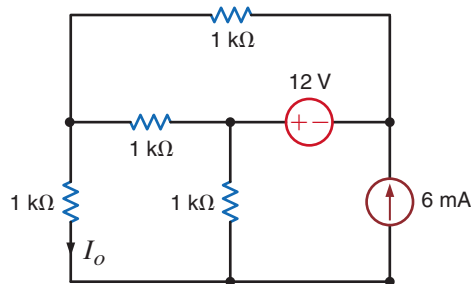


Figure P3.67

3.68 Find I_o in the network in Fig. P3.68 using loop analysis.

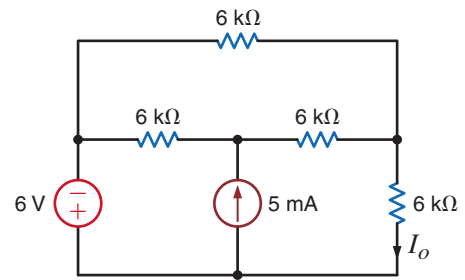


Figure P3.68

3.69 Use loop analysis to find V_o in the circuit in Fig. P3.69.

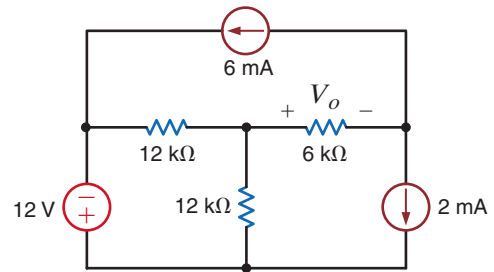


Figure P3.69

3.70 Using loop analysis, find V_o in the network in Fig. P3.70.

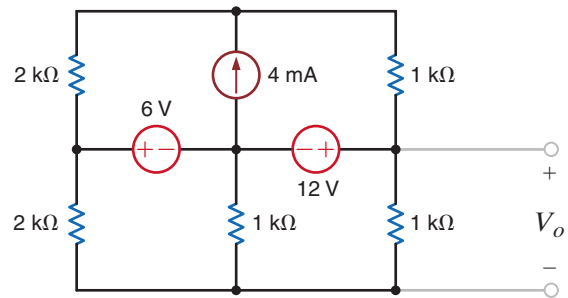


Figure P3.70

3.71 Find I_o in the circuit in Fig. P3.71.

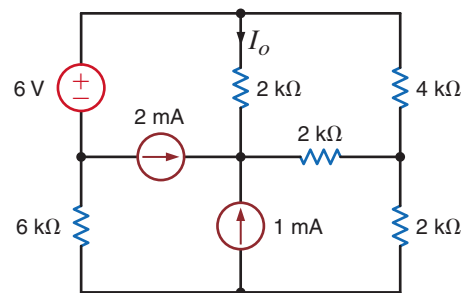


Figure P3.71

3.72 Use loop analysis to find I_o in the network in Fig. P3.72.

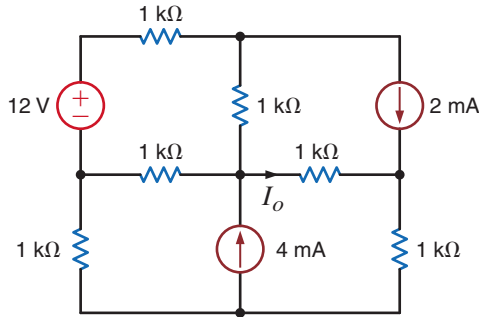


Figure P3.72

3.73 Find I_o in the circuit in Fig. P3.73 using loop analysis.

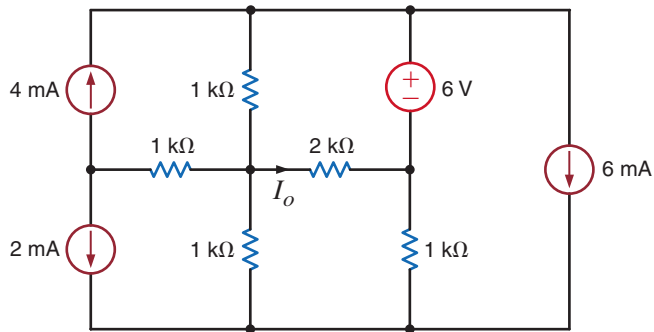


Figure P3.73

3.76 Using loop analysis, find I_o in the circuit in Fig. P3.76.

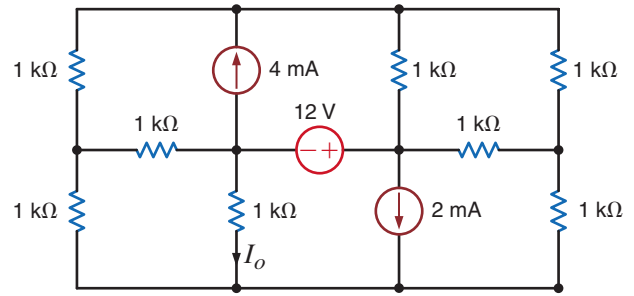


Figure P3.76

3.77 Find the mesh currents in the network in Fig. P3.77.

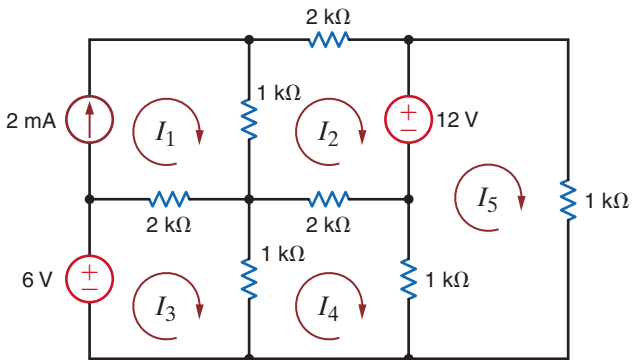


Figure P3.77

3.74 Find I_o in the network in Fig. P3.74 using loop analysis.

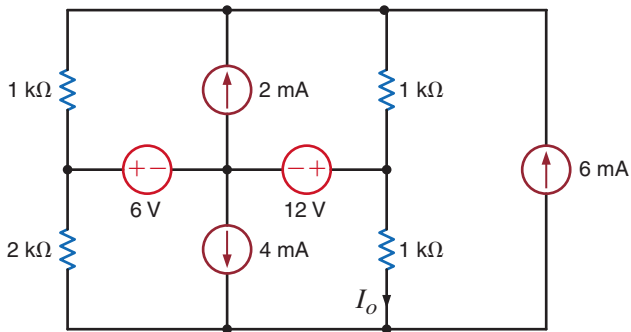


Figure P3.74

3.78 Use loop analysis to find V_o in the network in Fig. P3.78.

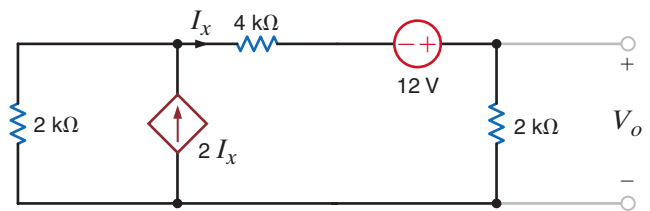


Figure P3.78

3.75 Find V_o in the circuit in Fig. P3.75 using loop analysis.

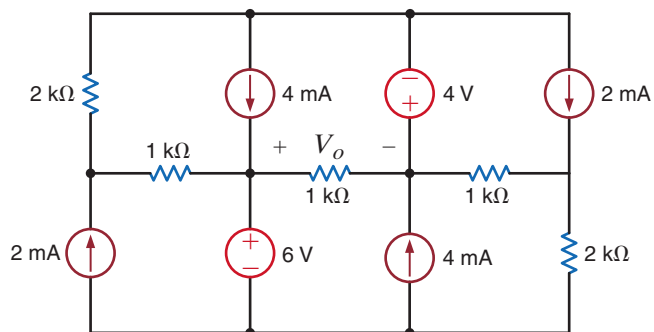


Figure P3.75

3.79 Find V_o in the circuit in Fig. P3.79 using nodal analysis.

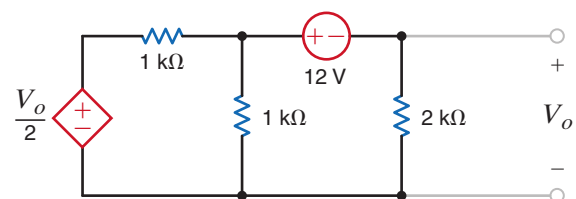


Figure P3.79

3.80 Use nodal analysis to find V_o in Fig. P3.80.

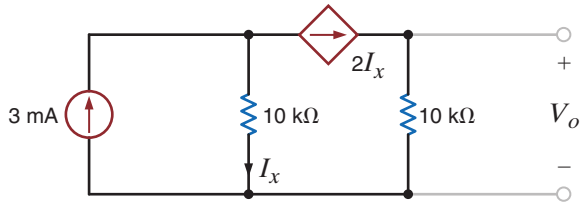


Figure P3.80

3.84 Find V_o in the network in Fig. P3.84 using nodal analysis.

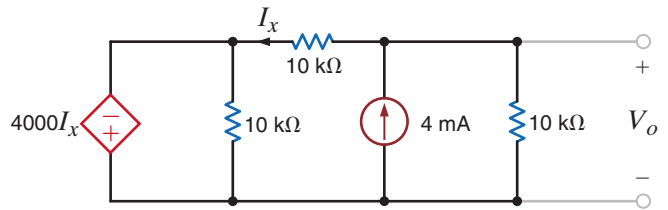


Figure P3.84

3.81 Find the power supplied by the 2-A current source in the network in Fig. P3.81 using loop analysis.

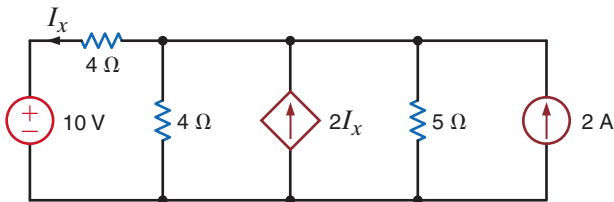


Figure P3.81

3.85 Find I_o in the circuit in Fig. P3.85 using loop analysis.

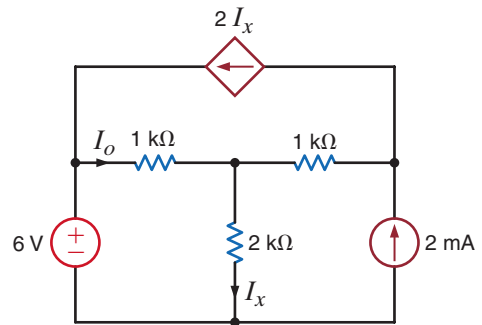


Figure P3.85

3.82 Find I_o in the network in Fig. P3.82.

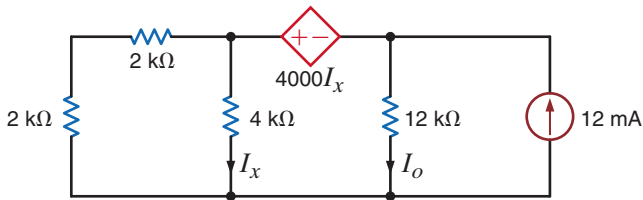


Figure P3.82

3.86. Use mesh analysis to find V_o in the circuit in Fig. P3.86.

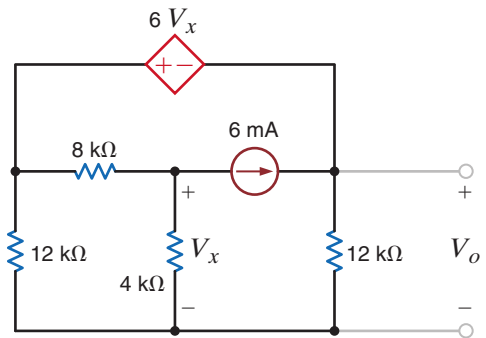


Figure P3.86

3.83 Find V_o in the circuit in Fig. P3.83 using loop analysis.

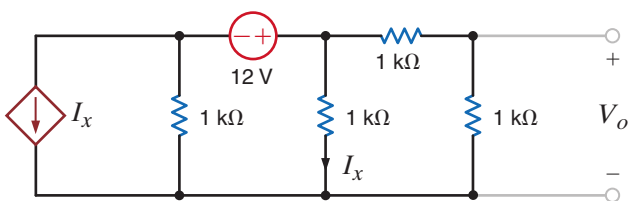


Figure P3.83

3.87 Using mesh analysis, find V_o in the circuit in Fig. P3.87.

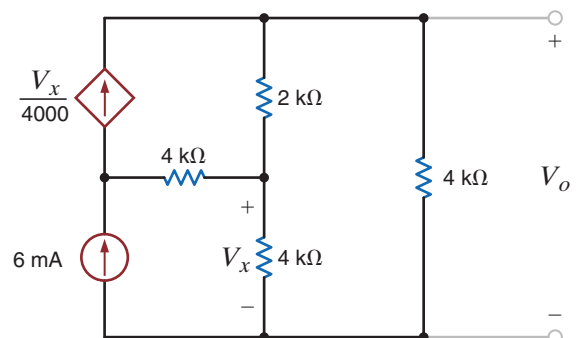


Figure P3.87

3.88 Find V_o in the network in Fig. P3.88.

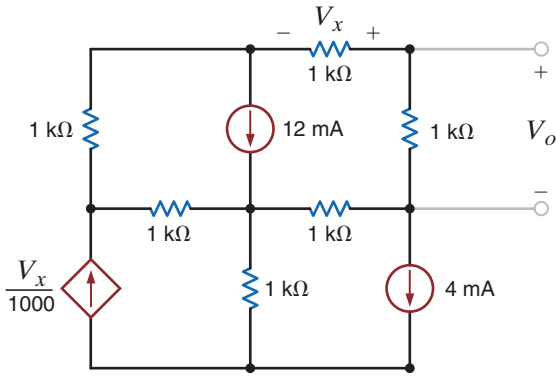


Figure P3.88

3.92 Using loop analysis, find V_o in the circuit in Fig. P3.92.

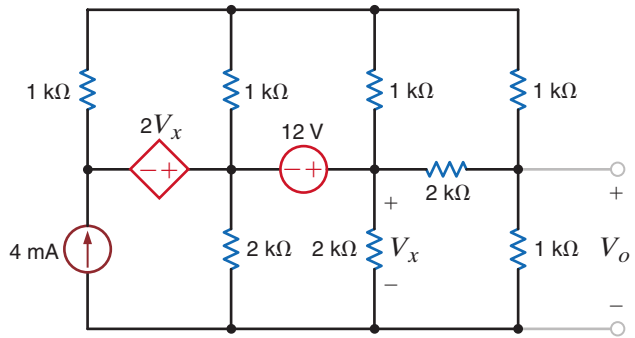


Figure P3.92

3.89 Using loop analysis, find V_o in the circuit in Fig. P3.89.

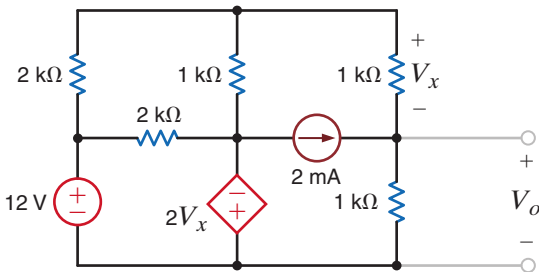


Figure P3.89

3.93 Using loop analysis, find I_o in the network in Fig. P3.93.

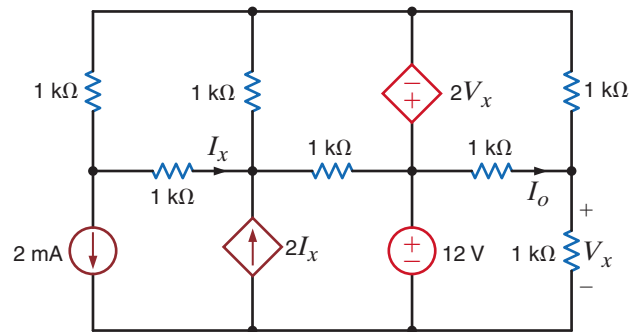


Figure P3.93

3.90 Using loop analysis, find V_o in the circuit in Fig. P3.90.

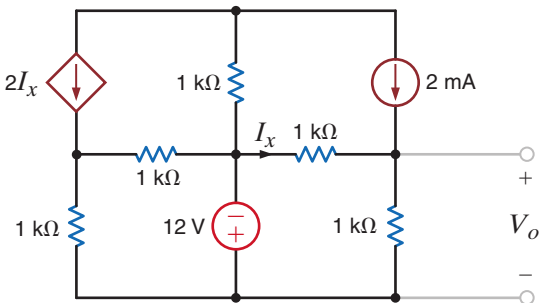


Figure P3.90

3.94 Use loop analysis to find I_o in the circuit in Fig. P3.94.

3.91 Using loop analysis, find V_o in the network in Fig. P3.91.

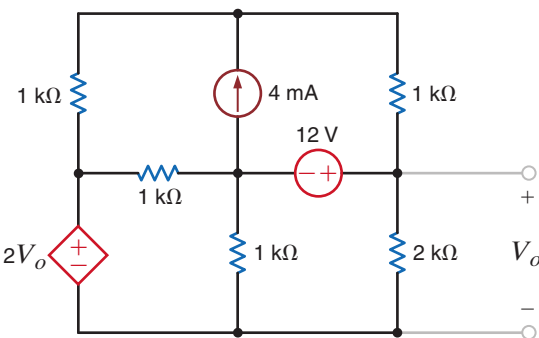


Figure P3.91

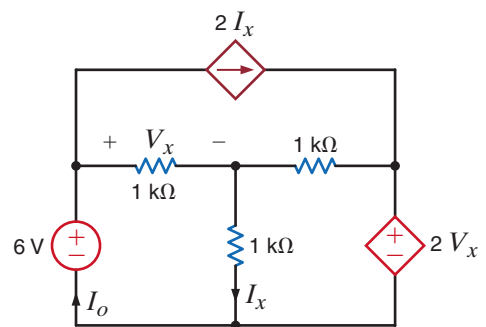


Figure P3.94