

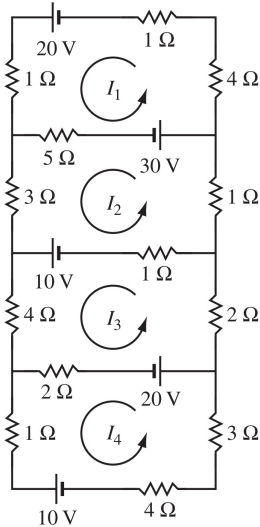
1.10 More Applications

Electrical Networks; Kirchhoff's Voltage Law

Kirchhoff's Voltage Law

The sum of the R/I voltage drops in one direction around a loop equals the sum of the voltage sources in the same direction around the loop.

Example 1 Write a matrix equation that explains the loop currents using Kirchhoff's law, $V = RI$, where V is the voltage in *volts*, R is the resistance in ohms, Ω , and I is the current in *amperes* (or *amps*).



Difference Equations

Example 2 Suppose demographic studies determined that 3% of the population of a city moves to the suburbs, and 2% of suburbanites move to the cities each year. Find a transition matrix, or migration matrix, modeling the flow of population. If the population of the city is 200,000 in 2016, and the population in the suburbs is 500,000 in 2016, find the respective populations in 2017, 2018, 2019, and 2020. Estimate the equilibrium populations.

Example 3 One serving of Shredded Wheat supplies 160 calories, 5 grams of protein, 6 g of fiber, and 1 g of fat. One serving of Crispix supplies 110 calories, 2 grams of protein, 0.1 g fiber, and 0.4 g of fat.

a) Set up a matrix B and a vector \mathbf{u} such that $B\mathbf{u}$ gives the amounts of calories, protein, fiber, and fat contained in a mixture of three servings of Shredded Wheat and two servings of Crispix.

b) Suppose you want a cereal with more fiber than Crispix but fewer calories than Shredded Wheat. Is it possible for a mixture of the two cereals to supply 130 calories, 3.2 g protein, 2.46 g fiber, and 0.64 g fat?