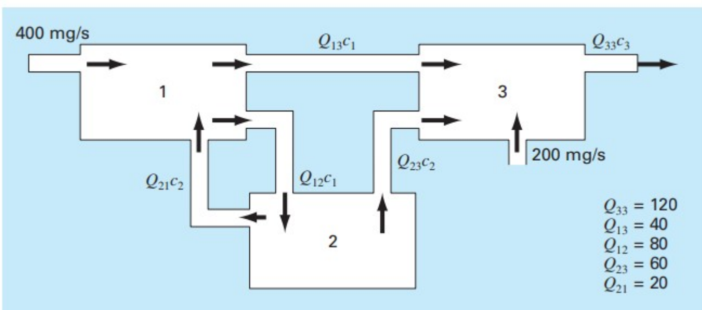
12.13 A civil engineer involved in construction requires 4800, 5810, and 5690 m^3 of sand, fine gravel, and coarse gravel, respectively, for a building project. There are three pits from which these materials can be obtained. The composition of these pits is

	Sand %	Fine Gravel %	Coarse Gravel %
Pit 1	52	30	18
Pit 2	20	50	30
Pit 3	25	20	55

How many cubic meters must be hauled from each pit in order to meet the engineer's needs?

12.6 Figure P12.6 shows three reactors linked by pipes. As indicated, the rate of transfer of chemicals through each pipe is equal to a flow rate (Q, with units of cubic meters per second) multiplied by the concentration of the reactor from which the flow originates (c, with units of milligrams per cubic meter). If the system is at a steady state, the transfer into each reactor will balance the transfer out. Develop mass-balance equations for the reactors and solve the three simultaneous linear algebraic equations for their concentrations.

FIGURE P12.6
Three reactors linked by pipes. The rate of mass transfer through each pipe is equal to the product of flow Q and concentration c of the reactor from which the flow originates.



12.10 An irreversible, first-order reaction takes place in four well-mixed reactors (Fig. P12.10),

$$A \xrightarrow{k} B$$

Thus, the rate at which A is transformed to B can be represented as

$$R_{ab} = kVc$$

The reactors have different volumes, and because they are operated at different temperatures, each has a different reaction rate:

Reactor	V, L	k, h⁻¹
1	25	0.05
2	75	0.1
3	100	0.5
4	25	0.1

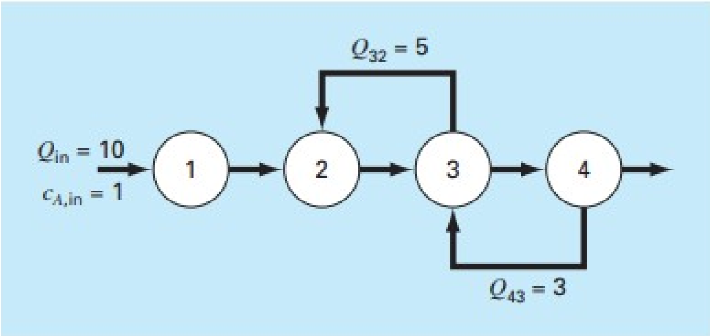
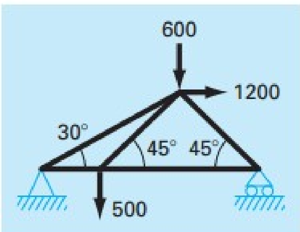


FIGURE P12.10

12.16 Calculate the forces and reactions for the truss in Fig. 12.4

FIGURE P12.14



12.27 Determine the currents for the circuit in Fig. P12.27.

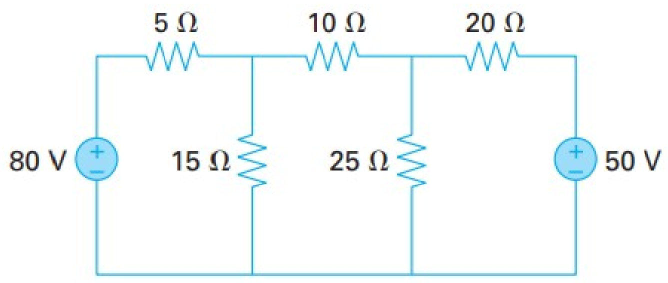


FIGURE P12.27

12.33 Idealized spring-mass systems have numerous applications throughout engineering. Figure P12.33 shows an arrangement of four springs in series being depressed with a force of 2000 kg. At equilibrium, force-balance equations can be developed defining the interrelationships between the springs,

$$k_2(x_2 - x_1) = k_1 x_1$$
$$k_3(x_3 - x_2) = k_2(x_2 - x_1)$$
$$k_4(x_4 - x_3) = k_3(x_3 - x_2)$$
$$F = k_4(x_4 - x_3)$$

where the k's are spring constants. If k_1 through k_4 are 150, 50, 75,

225 N/m

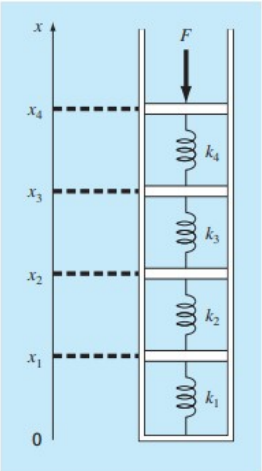


FIGURE P12.33