18. A vector is given by x = [4.5 5 –16.12 21.8 10.1 10 –16.11 5 14 –3 3 2]. Using conditional statements and loops, write a program that rearranges the elements of x in order from the smallest to the largest. Do not use MATLAB's built-in function `sort`.

19. The Pythagorean theorem states that $a^2 + b^2 = c^2$. Write a MATLAB program in a script file that finds all the combinations of triples a, b, and c that are positive integers all smaller or equal to 50 that satisfy the Pythagorean theorem. Display the results in a three-column table in which every row corresponds to one triple. The first three rows of the table are:

```
3  4  5
5 12 13
6  8 10
```

20. A twin primes is a pair of prime numbers such that the difference between them is 2 (for example, 17 and 19). Write a computer program that finds all the twin primes between 10 and 500. The program displays the results in a two-column matrix in which each row is a twin prime. Do not use MATLAB's built-in function `isprime`.

21. An isolated prime is a prime number p such that neither $p-2$ nor $p+2$ is prime. For example, 47 is an isolated prime since 45 and 49 are both not primes. Write a computer program that finds all the isolated primes between 50 and 100. Do not use MATLAB's built-in function `isprime`.

23. The Taylor series expansion for $\cos(x)$ is:

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n)!} x^{2n}$$

where x is in radians. Write a MATLAB program that determines $\cos(x)$ using the Taylor series expansion. The program asks the user to type a value for an angle in degrees. Then the program uses a loop for adding the terms of the Taylor series. If a_n is the nth term in the series, then the sum S_n of the n terms is $S_n = S_{n-1} + a_n$. In each pass calculate the estimated error E given by $E = \left| \frac{S_n - S_{n-1}}{S_{n-1}} \right|$. Stop adding terms when $E \le 0.000001$. The program displays the value of $\cos(x)$. Use the program for calculating:

(a) $\cos(35°)$ (b) $\sin(125°)$

Compare the values with those obtained by using a calculator.

24. Write a MATLAB program in a script file that finds a positive integer n such that the sum of all the integers $1 + 2 + 3 + \ldots + n$ is a number between 100 and 1000 whose three digits are identical. As output, the program displays the integer n and the corresponding sum.

30. One numerical method for calculating the cubic root of a number, $\sqrt[3]{P}$ is in iterations. The process starts by choosing a value x_1 as a first estimate of the solution. Using this value, a second, more accurate value x_2 can be calculated with $x_2 = (P/x_1^2 + 2x_1)/3$, which is then used for calculating a third, still more accurate value x_3, and so on. The general equation for calculating the value of x_{i+1} from the value of x_i is $x_{i+1} = (P/x_i^2 + 2x_i)/3$. Write a MATLAB program that calculates the cubic root of a number. In the program use $x_1 = P$ for the first estimate of the solution. Then, by using the general equation in a loop, calculate new, more accurate values. Stop the looping when the estimated relative error E defined by $E = \left|\frac{x_{i+1} - x_i}{x_i}\right|$ is smaller than 0.00001. Use the program to calculate:

(*a*) $\sqrt[3]{100}$ (*b*) $\sqrt[3]{53701}$ (*c*) $\sqrt[3]{19.35}$

33. Solve the following system of three linear equations:

$$\begin{aligned} -4x + 3y + z &= -18.2 \\ 5x + 6y - 2z &= -48.8 \\ 2x - 5y + 4.5z &= 92.5 \end{aligned}$$

34. Solve the following system of five linear equations:

$$\begin{aligned} 2.5a - b + 3c + 1.5d - 2e &= 57.1 \\ 3a + 4b - 2c + 2.5d - e &= 27.6 \\ -4a + 3b + c - 6d + 2e &= -81.2 \\ 2a + 3b + c - 2.5d + 4e &= -22.2 \\ a + 2b + 5c - 3d + 4e &= -12.2 \end{aligned}$$

3. Use MATLAB to solve the following problems.

a.
$$\begin{aligned} -2x + y &= -5 \\ -2x + y &= 3 \end{aligned}$$

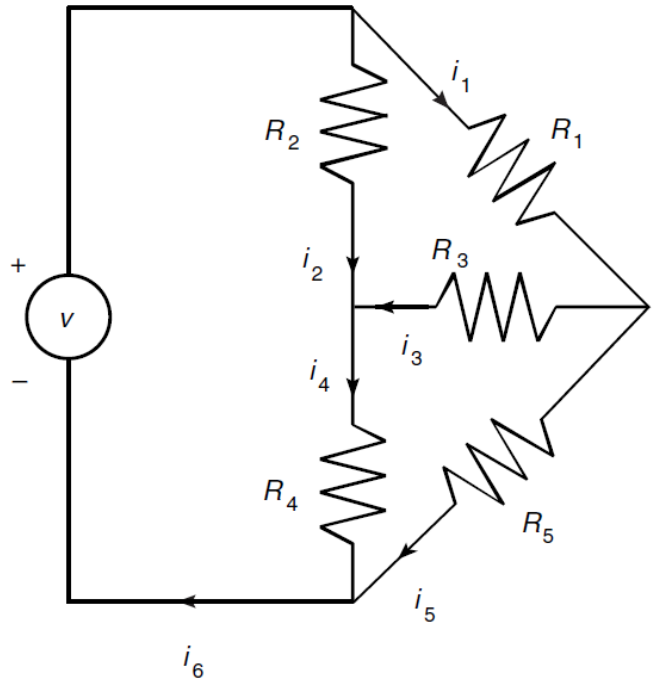
b.
$$\begin{aligned} -2x + y &= 3 \\ -8x + 4y &= 12 \end{aligned}$$

c.
$$\begin{aligned} -2x + y &= -5 \\ -2x + y &= -5.00001 \end{aligned}$$

d.
$$\begin{aligned} x_1 + 5x_2 - x_3 + 6x_4 &= 19 \\ 2x_1 - x_2 + x_3 - 2x_4 &= 7 \\ -x_1 + 4x_2 - x_3 + 3x_4 &= 30 \\ 3x_1 - 7x_2 - 2x_3 + x_4 &= -75 \end{aligned}$$

4. The circuit shown in Figure P4 has ve resistances and one applied voltage. Kirchhoff's voltage law applied to each loop in the circuit shown gives

$$\begin{aligned} v - R_2 i_2 - R_4 i_4 &= 0 \\ -R_2 i_2 + R_1 i_1 + R_3 i_3 &= 0 \\ -R_4 i_4 - R_3 i_3 + R_5 i_5 &= 0 \end{aligned}$$



Conservation of charge applied at each node in the circuit gives

$$\begin{aligned} i_6 &= i_1 + i_2 \\ i_2 + i_3 &= i_4 \\ i_1 &= i_3 + i_5 \\ i_4 + i_5 &= i_6 \end{aligned}$$

a. Write a MATLAB script le that uses given values of the applied voltage v and the values of the ve resistances and solves for the six currents.

b. Use the program developed in part *a* to nd the currents for the case where $R_1 = 1$, $R_2 = 5$, $R_3 = 2$, $R_4 = 10$, $R_5 = 5$ kΩ, and $v = 100$ V. (1 kΩ = 1000 Ω.)

5.* *a.* Use MATLAB to solve the following equations for x, y, and z as functions of the parameter c.

$$x - 5y - 2z = 11c$$
$$6x + 3y + z = 13c$$
$$7x + 3y - 5z = 10c$$

b. Plot the solutions for x, y, and z versus c on the same plot, for $-10 \leq c \leq 10$.

11.* Solve the following equations:

$$7x + 9y - 9z = 22$$
$$3x + 2y - 4z = 12$$
$$x + 5y - z = -2$$

16. *a.* Use MATLAB to find the coefficients of the quadratic polynomial $y = ax^2 + bx + c$ that passes through the three points $(x, y) = (1, 4)$, $(4, 73)$, $(5, 120)$.

b. Use MATLAB to find the coefficients of the cubic polynomial $y = ax^3 + bx^2 + cx + d$ that passes through the three points given in part *a*.

14.* Use MATLAB to solve the following problem:

$$x - 3y = 2$$
$$x + 5y = 18$$
$$4x - 6y = 20$$

15.* Use MATLAB to solve the following problem:

$$x - 3y = 2$$
$$x + 5y = 18$$
$$4x - 6y = 10$$