ME 1020 Engineering Programming with MATLAB

Chapter 4b Homework Solutions: 4.26, 4.31, 4.34, 4.36, 4.41, 4.44

Problem 4.26:

26. Electrical resistors are said to be connected "in series" if the same current passes through each and "in parallel" if the same voltage is applied across each. If in series, they are equivalent to a single resistor whose resistance is given by

$$R = R_1 + R_2 + R_3 + \cdots + R_n$$

If in parallel, their equivalent resistance is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}$$

Write an M-file that prompts the user for the type of connection (series or parallel) and the number of resistors n and then computes the equivalent resistance.

```
% Problem 4.26
clear
clc
disp('Problem 4.26: Scott Thomas')
disp(' ')

n = input('Input number of resistors: ')

for k = 1:n
   R(k) = input('Input resistance: ')
end

disp('Input Resistor Configuration: ')

a = input('for Series, Type 1: ')

if a == 1
    disp('You chose Series')
else
    disp('You chose Parallel')
end

if a == 1
   Rsum = sum(R)
else
    Rsum = (sum(1./R)).^(-1)
end
```

```
Problem 4.26: Scott Thomas

Input number of resistors: 2

n =

     2

Input resistance: 2

R =

     2

Input resistance: 3

R =

     2     3
```

```
R =

     2

Input resistance: 3

R =

     2     3

Input Resistor Configuration:
for Series, Type 1: 1

a =

     1

You chose Series

Rsum =

     5

fx >>
```

```
Problem 4.26: Scott Thomas

Input number of resistors: 2

n =

     2

Input resistance: 2

R =

     2

Input resistance: 3

R =

     2     3
```

```
Input Resistor Configuration:
for Series, Type 1: 2

a =

     2

You chose Parallel

Rsum =

    1.2000

fx >>
```

Problem 4.31:

31. Plot the function $y = 10(1 - e^{-x/4})$ over the interval $0 \leq x \leq x_{max}$, using a `while` loop to determine the value of x_{max} such that $y(x_{max}) = 9.8$. Properly label the plot. The variable y represents force in newtons, and the variable x represents time in seconds.

```
% Problem 4.31
clear
clc
disp('Problem 4.31: Scott Thomas')

xstep = 0.1;
x = 0;y = 0;
while y < 9.8
     y = 10*(1 - exp(-x/4));
    x = x + xstep;
end

xmax = x
x = 0:xstep:xmax;
y = 10*(1 - exp(-x/4));
ymax = y(length(y))
plot(x,y),xlabel('Time (seconds)'), ylabel('Force (N)')
title('Problem 4.31: Scott Thomas', 'FontWeight','bold')
```

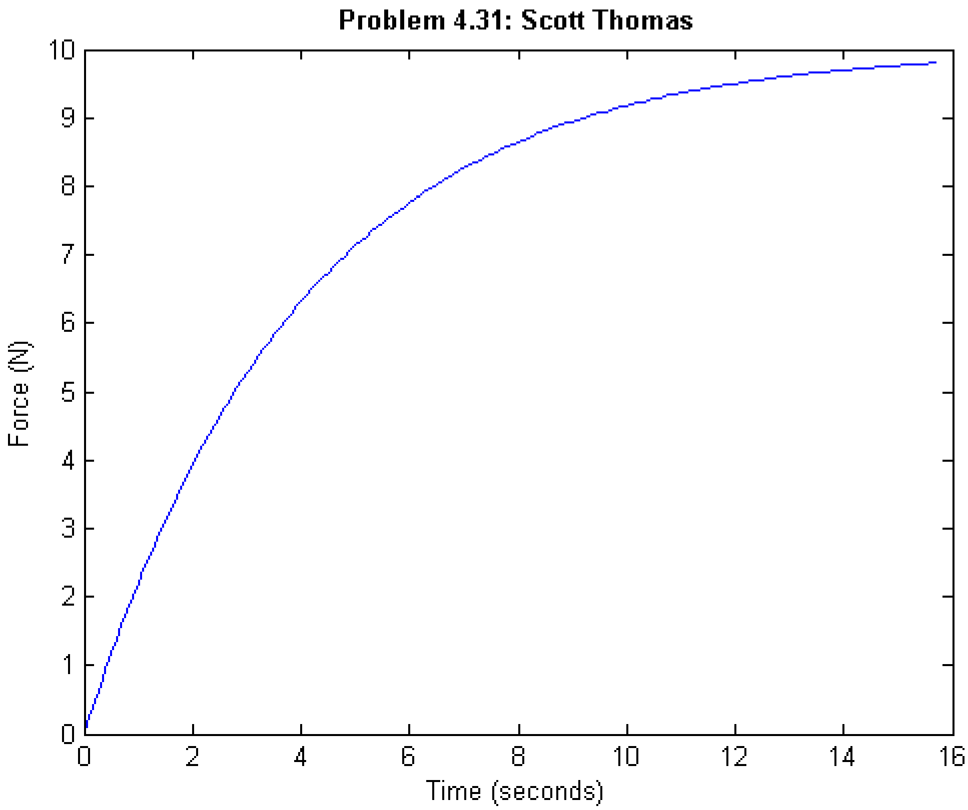
```
Problem 4.31: Scott Thomas

xmax =

   1.5800e+01


ymax =

   9.8026e+00
```



Problem 4.31: Scott Thomas
Force (N)
Time (seconds)
0
1
2
3
4
5
6
7
8
9
10
0
2
4
6
8
10
12
14
16

Problem 4.34:

34.* Use a loop in MATLAB to determine how long it will take to accumulate $1 000 000 in a bank account if you deposit $10 000 initially and $10 000 at the end of each year; the account pays 6 percent annual interest.

```
% Problem 4.34
clear
clc
disp('Problem 4.34: Scott Thomas')

sumk = 10000;
k = 0;
while sumk < 10^6
    sumk = 1.06*sumk;
     sumk = sumk + 10000;
         k = k + 1;
end
k
sumk
```

```
Problem 4.34: Scott Thomas

k =

    33


sumk =

   1.0418e+06
```

Problem 4.36:

36.* In the structure in Figure P36a, six wires support three beams. Wires 1 and 2 can support no more than 1200 N each, wires 3 and 4 can support no more than 400 N each, and wires 5 and 6 can support no more than 200 N each. Three equal weights W are attached at the points shown. Assuming that the structure is stationary and that the weights of the wires and the beams are very small compared to W, the principles of statics applied to a particular beam state that the sum of vertical forces is zero and

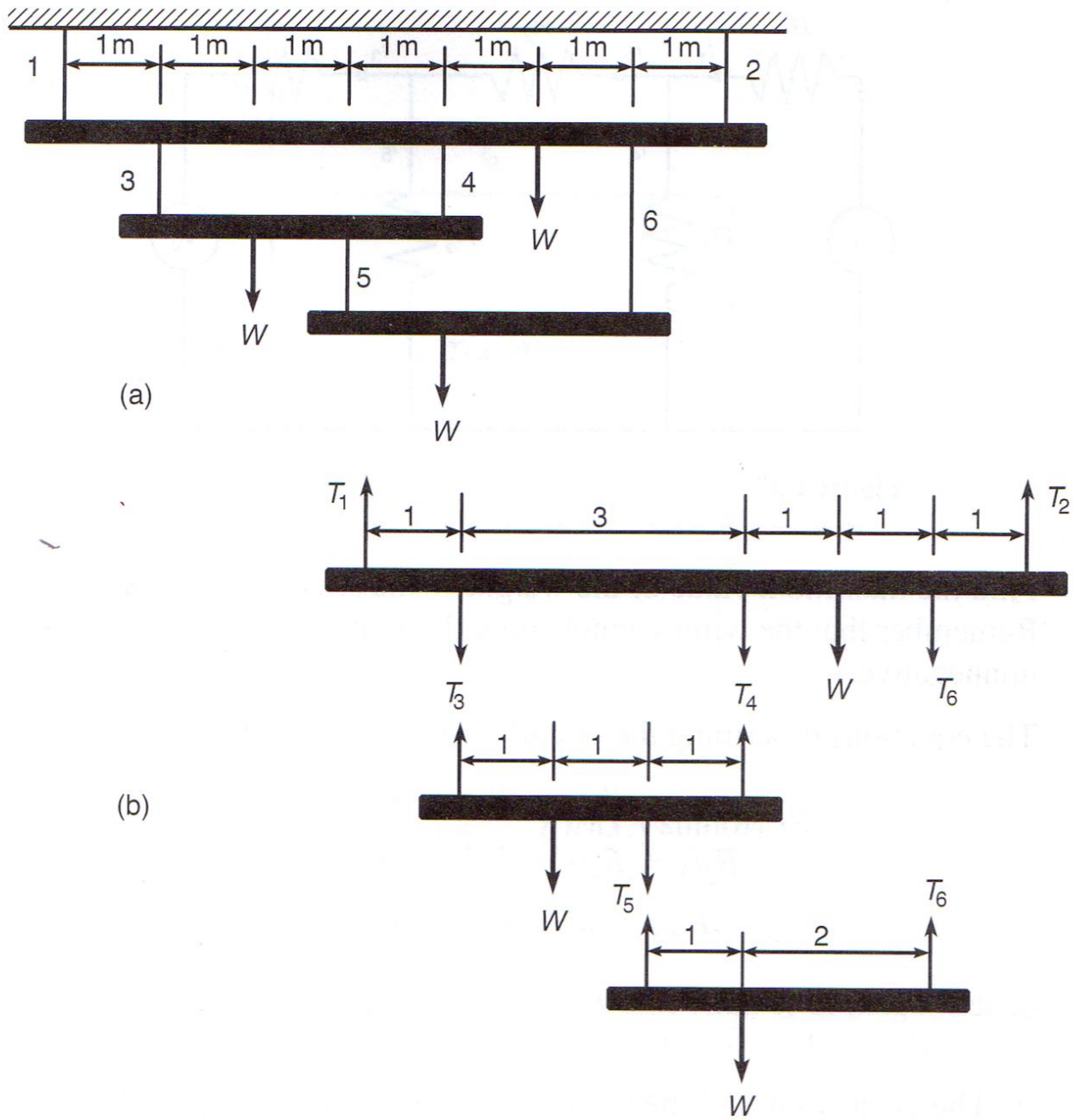


Figure P36

that the sum of moments about any point is also zero. Applying these principles to each beam using the free-body diagrams shown in Figure P36b, we obtain the following equations. Let the tension force in wire i be T_i. For beam 1

$$T_1 + T_2 = T_3 + T_4 + W + T_6$$

$$-T_3 - 4T_4 - 5W - 6T_6 + 7T_2 = 0$$

For beam 2

$$T_3 + T_4 = W + T_5$$

$$-W - 2T_5 + 3T_4 = 0$$

For beam 3

$$T_5 + T_6 = W$$

$$-W + 3T_6 = 0$$

Find the maximum value of the weight W the structure can support. Remember that the wires cannot support compression, so T_i must be nonnegative.

```
% Problem 4.36
clear
clc
disp('Problem 4.36: Scott Thomas')
T = zeros(1,6);
W = 0;
dW = 1E-2;
while T(1) < 1200 & T(2) < 1200 & T(3) < 400 & T(4) < 400 ...
        & T(5) < 200 & T(6) < 200
    T(6) = W/3;
    T(5) = W - T(6);
    T(4) = (W + 2*T(5))/3;
    T(3) = W + T(5) - T(4);
    T(2) = (T(3) + 4*T(4) + 5*W + 6*T(6))/7;
    T(1) = -T(2) + T(3) + T(4) + T(6) + W;
   W = W + dW;
end

W = W - 2*dW
 T(6) = W/3;
    T(5) = W - T(6);
    T(4) = (W + 2*T(5))/3;
    T(3) = W + T(5) - T(4);
    T(2) = (T(3) + 4*T(4) + 5*W + 6*T(6))/7;
    T(1) = -T(2) + T(3) + T(4) + T(6) + W;

    T
```

```
Problem 4.36: Scott Thomas

W =

   3.0000e+02


T =

   4.2857e+02   4.7143e+02   2.6667e+02   2.3333e+02   2.0000e+02   1.0000e+02
```

Problem 4.41:

41. The following table gives the approximate values of the static coefficient of friction μ for various materials.

Materials	μ
Metal on metal	0.20
Wood on wood	0.35
Metal on wood	0.40
Rubber on concrete	0.70

To start a weight W moving on a horizontal surface, you must push with a force F, where $F = \mu W$. Write a MATLAB program that uses the `switch` structure to compute the force F. The program should accept as input the value of W and the type of materials.

```
% Problem 4.41
clear
clc
disp('Problem 4.41: Scott Thomas')

disp('Friction Force Computer')
W = input('Input Weight (N): ')
disp('For Metal on Metal, Type 1')
disp('For Wood on Wood, Type 2')
disp('For Metal on Wood, Type 3')
disp('For Rubber on Concrete, Type 4')

mu = input('Input Surfaces: ');
switch mu
    case 1
        disp('Metal on Metal')
        mu = 0.20
    case 2
        disp('Wood on Wood')
        mu = 0.35
    case 3
        disp('Metal on Wood')
        mu = 0.40
    case 4
        disp('Rubber on Concrete')
        mu = 0.70
    otherwise
        disp('Incorrect Response')
end

force = mu*W
```

```
Problem 4.41: Scott Thomas
Friction Force Computer
Input Weight (N): 100

W =

   100

For Metal on Metal, Type 1
For Wood on Wood, Type 2
For Metal on Wood, Type 3
For Rubber on Concrete, Type 4
Input Surfaces: 4
Rubber on Concrete

mu =

    0.7000


force =

    70

fx >>
```

Problem 4.44:

44. Engineers often need to estimate the pressures and volumes of a gas in a container. The *van der Waals* equation is often used for this purpose. It is

$$P = \frac{RT}{\hat{V} - b} - \frac{a}{\hat{V}^2}$$

where the term b is a correction for the volume of the molecules and the term $a/\hat{V}^2$ is a correction for molecular attractions. The gas constant is R, the *absolute* temperature is T, and the gas specific volume is $\hat{V}$. The value of R is the same for all gases; it is $R = 0.08206$ L-atm/mol-K. The values of a and b depend on the type of gas. Some values are given in the following table. Write a user-defined function using the `switch` structure that computes the pressure P on the basis of the van der Waals equation. The function's input arguments should be T, $\hat{V}$, and a string variable containing the name of a gas listed in the table. Test your function for chlorine (Cl_2) for $T = 300$ K and $\hat{V} = 20$ L/mol.

Gas	a (L^2-atm/mol^2)	b (L/mol)
Helium, He	0.0341	0.0237
Hydrogen, H_2	0.244	0.0266
Oxygen, O_2	1.36	0.0318
Chlorine, Cl_2	6.49	0.0562
Carbon dioxide, CO_2	3.59	0.0427

```
% Problem 4.44
clear
clc
disp('Problem 4.44: Scott Thomas')

disp('Pressure Calculator using van der Waals Function')
T = input('Input Temperature (K): ');
v = input('Input Molar Specific Volume (L/mol: ');
R = 0.08206;%(L-atm/mol-K)

response = input('Helium, Hydrogen, Oxygen, Chlorine, Carbon_Dioxide:', 's');
response = lower(response);
switch response
    case 'helium'
        disp('Helium')
        a = 0.0341; b = 0.0237;
    case 'hydrogen'
        disp('Hydrogen')
        a = 0.244; b = 0.0266;
    case 'oxygen'
        disp('Oxygen')
        a = 1.36; b = 0.0318;
    case 'chlorine'
        disp('Chlorine')
        a = 6.49; b = 0.0562;
    case 'carbon_dioxide'
        disp('Carbon Dioxide')
        a = 3.59; b = 0.0427;
    otherwise
        disp('Incorrect Response')
end

pressure = R*T/(v - b) - a/v^2
```

```
Problem 4.44: Scott Thomas
Pressure Calculator using van der Waals Function
Input Temperature (K): 300
Input Molar Specific Volume (L/mol: 20
Helium, Hydrogen, Oxygen, Chlorine, Carbon_Dioxide:carbon_dioxide
Carbon Dioxide

pressure =

    1.2246

>>
```