Matlab Sheet 4 - Solution

Conditional Statements and Loops

1. It is desired to compute the sum of the first 10 terms of the series

$$14k^3 - 20k^2 + 5k. \quad k = 1,2,3, \dots$$

Write and run the program to calculate the sum.

The following M-file gives the correct sum:

M-File:

```
total = 0;
for k = 1:10
    total(k+1) =total(k)+ 14*k^3 - 20*k^2 +5*k;
end
disp('The sum for 10 terms is: ')
disp(total(k+1))
```

Command Window:

```
The sum for 10 terms is:

       34925
```

The following M-file would not give the correct sum (why?).

M-File:

```
total = 0;
for k = 1:10
total = 14*k^3 - 20*k^2 +5*k;
end
disp('The sum for 10 terms is: ')
disp(total)
```

Command Window:

```
The sum for 10 terms is:

       12050
```

2. Create Find the results of the following operations by hand and use MATLAB to check your results.

   a. $z = 6 > 3 + 8$

   b. $z = 6 + 3 > 8$

   c. $z = 4 > (2 + 9)$

   d. $z = (4 < 7) + 3$

   e. $z = 4 < 7 + 3$

   f. $z = (4 < 7) - 5$

   g. $z = 4 < (7 * 5)$

   h. $z = 2/5 >= 5$

   The answers are
   (a) z = 0, (b) z = 1, (c) z = 0,
   (d) z = 4, (e) z = 1, (f) z = 5,
   (g) z = 1, (h) z = 0

3. Given: $a = -2, b = 3, c = 5$. Evaluate the following expressions without using MATLAB. Check the answers with MATLAB.

   (a) $y = a - b > a - c < b$

   (b) $y = -4 < a < 0$

   (c) $y = a - c <= b > a + c$

   M-File:
```
clear, clc
a=-2; b=3; c=5;
disp('Part (a)')
y=a-b>a-c<b
disp('Part (b)')
y=-4<a<0
disp('Part (c)')
y=a-c<=b>a+c
disp('Part (d)')
y=3*(c+a~=a/b-b)==(a+c)~=b
```
   Command Window:
```
Part (a)
y =
1
Part (b)
y =
```

```
0
Part (c)
y =
0
Part (d)
y =
1
```

4. For the arrays x and y given below, use MATLAB to find all the elements in x that are greater than the corresponding elements in y.

   $x = [-3\ \ 0\ \ 0\ \ 2\ \ 6\ \ 8]$ $\quad y = [-5\ \ -2\ \ 0\ \ 3\ \ 4\ \ 10]$

   M-File:
   ```
   x = [-3,0,0,2,6,8];
   y = [-5,-2,0,3,4,10];
   n = (x>y)
   z = find(x>y)
   ```
   Command Window:
   ```
   n=
    1   1   0   0   1   0
   z =
   1 2 5
   ```
   Thus the first, second, and fifth elements of x are greater than the corresponding elements
   in y.

5. The arrays $price\_A$ and $price\_B$ given below contain the price in dollars of two stocks over 10 days. Use MATLAB to determine how many days the price of stock A was above the price of stock B.

   $$price\_A = \ [19\ \ 18\ \ 22\ \ 21\ \ 25\ \ 19\ \ 17\ \ 21\ \ 27\ \ 29]$$
   $$price\_B = \ [22\ 17\ \ 20\ \ 19\ \ 24\ \ 18\ \ 16\ \ 25\ \ 28\ \ 27]$$

   M-File:
   ```
   price_A = [19,18,22,21,25,19,17,21,27,29];
   price_B = [22,17,20,19,24,18,16,25,28,27];
   length(find(price_A>price_B))
   ans =
   7
   ```

6. Suppose that x = [-3, 0, 0, 2, 5, 8] and y = [-5, -2, 0, 3, 4, 10]. Find the results of the following operations by hand and use MATLAB to check your results.

   a. $z = y < \sim x$

   b. $z = x \,\&\, y$

   c. $z = x \mid y$

   M-File:

```
x = [-3, 0, 0, 2, 5, 8]
y = [-5, -2, 0, 3, 4, 10]
z0=~x
z1= y<~x
z2= x&y
z3=x|y
```

   The answers are
   (a) z = [1,1,1,0,0,0], (b) z = [1,0,0,1,1,1]
   (c) z = [1,1,0,1,1,1]

7. Evaluate the following expressions without using MATLAB. Check the answers with MATLAB

   a) -3&3

   b) ~5<4&~0> -3

   c) -2&2>3|8/3

   M-File:

```
clear, clc
disp('Part (a)')
-3&3
disp('Part (b)')
~5<4&~0>-3
disp('Part (c)')
-2&2>3|8/3
disp('Part (d)')
-3<-1<~0|5<4<3
```

   Command Window:

```
Part (a)
ans =
1
Part (b)
ans =
1
```

```
Part (c)
ans =
1
Part (d)
ans =
1
```

8. Create The height and speed of a projectile (such as a thrown ball) launched with a speed of at an angle A to the horizontal are given by

$$h(t) = v_0 t \sin A - 0.5 g t^2$$

$$v(t) = \sqrt{v_0^2 - 2 v_0 g t \sin A + g^2 t^2}$$

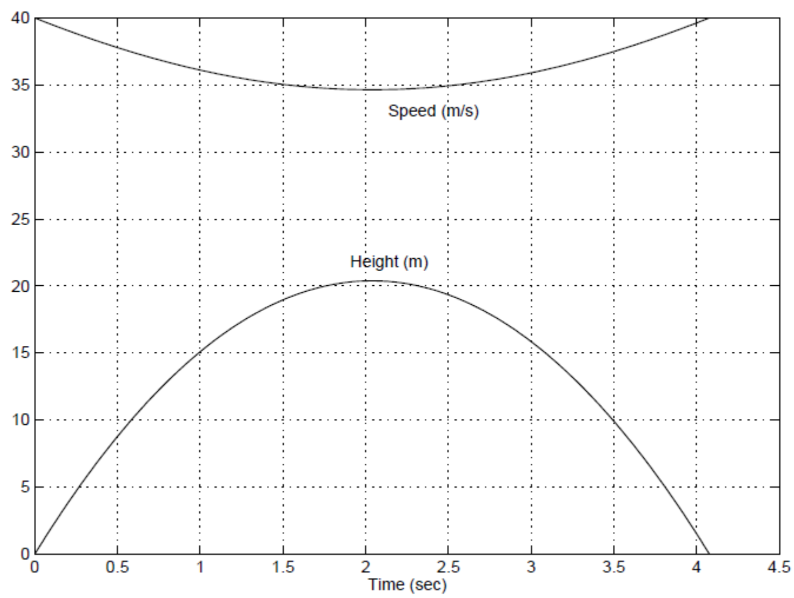
where g is the acceleration due to gravity. The projectile will strike the ground when $h(t) = 0$, which gives the time to hit $t_{hit} = 2(v_0/g)\sin A$. Suppose that $A = 30°$, $v_0 = 40$ m/s, and g =9.8 m/s². Use the MATLAB relational and logical operators to find the times when

a. The height is no less than 15 m.

b. The height is no less than 15 m and the speed is simultaneously no greater than 36 m/s.

c. The height is less than 5 m or the speed is greater than 35 m/s.

It is helpful to plot the height and speed versus time before answering the questions, especially part (c). The plot is shown in the figure.



The rest of the following script file can be used to compute the answers with more precision than can be obtained by reading the plot.

M-File:

```
v0 = 40;g = 9.81;A = 30*pi/180;
t_hit = 2*v0*sin(A)/g;
t = 0:t_hit/100:t_hit;
h = v0*t*sin(A)-0.5*g*t.^2;
v = sqrt(v0^2-2*v0*g*sin(A)*t+g^2*t.^2);
plot(t,h,t,v),xlabel(0Time (sec)0),
gtext(0Height0),gtext(0Speed0),grid
%
% Part (a).
ua = find(h>=15);
t1a = (ua(1)-1)*(t_hit/100)
t2a = ua(length(ua)-1)*(t_hit/100)
%
% Part (b).
ub = find(h>=15&v<=36);
t1b = (ub(1)-1)*(t_hit/100)
t2b = ub(length(ub)-1)*(t_hit/100)
%
% Part (c).
uc = find(~(h<5|v>35));
t1c = (uc(1)-1)*(t_hit/100)
t2c = uc(length(uc)-1)*(t_hit/100)
```

When run, this file produces the results: t1a = 1.0194, t2a = 3.0581, t1b = 1.0601, t2b = 3.0173, t1c = 1.5494, t2c = 2.5280.
Thus the height is no less than 15 meters for $1.0194 \leq t \leq 3.0581$ seconds.
The height is no less than 15 meters and the speed is simultaneously no greater than 36 meters/second for $1.0601 \leq t \leq 3.0173$ seconds.
The height is less than 5 meters or the speed is greater than 35 meters/second for $t \leq 1.5494$ $t \geq 2.528$ seconds.

Part C

time (sec)	h<5	v>35	h<5|v>35	time (sec)	h<5	v>35	h<5|v>35	time (sec)	h<5	v>35	h<5|v>35
0	TRUE	TRUE	TRUE	1.508665	FALSE	TRUE	TRUE	3.017329	FALSE	TRUE	TRUE
0.040775	TRUE	TRUE	TRUE	1.549439	FALSE	FALSE	FALSE	3.058104	FALSE	TRUE	TRUE
0.081549	TRUE	TRUE	TRUE	1.590214	FALSE	FALSE	FALSE	3.098879	FALSE	TRUE	TRUE
0.122324	TRUE	TRUE	TRUE	1.630989	FALSE	FALSE	FALSE	3.139653	FALSE	TRUE	TRUE
0.163099	TRUE	TRUE	TRUE	1.671764	FALSE	FALSE	FALSE	3.180428	FALSE	TRUE	TRUE
0.203874	TRUE	TRUE	TRUE	1.712538	FALSE	FALSE	FALSE	3.221203	FALSE	TRUE	TRUE
0.244648	TRUE	TRUE	TRUE	1.753313	FALSE	FALSE	FALSE	3.261978	FALSE	TRUE	TRUE
0.285423	FALSE	TRUE	TRUE	1.794088	FALSE	FALSE	FALSE	3.302752	FALSE	TRUE	TRUE
0.326198	FALSE	TRUE	TRUE	1.834862	FALSE	FALSE	FALSE	3.343527	FALSE	TRUE	TRUE
0.366972	FALSE	TRUE	TRUE	1.875637	FALSE	FALSE	FALSE	3.384302	FALSE	TRUE	TRUE
0.407747	FALSE	TRUE	TRUE	1.916412	FALSE	FALSE	FALSE	3.425076	FALSE	TRUE	TRUE
0.448522	FALSE	TRUE	TRUE	1.957187	FALSE	FALSE	FALSE	3.465851	FALSE	TRUE	TRUE
0.489297	FALSE	TRUE	TRUE	1.997961	FALSE	FALSE	FALSE	3.506626	FALSE	TRUE	TRUE
0.530071	FALSE	TRUE	TRUE	2.038736	FALSE	FALSE	FALSE	3.547401	FALSE	TRUE	TRUE
0.570846	FALSE	TRUE	TRUE	2.079511	FALSE	FALSE	FALSE	3.588175	FALSE	TRUE	TRUE
0.611621	FALSE	TRUE	TRUE	2.120285	FALSE	FALSE	FALSE	3.62895	FALSE	TRUE	TRUE
0.652396	FALSE	TRUE	TRUE	2.16106	FALSE	FALSE	FALSE	3.669725	FALSE	TRUE	TRUE
0.69317	FALSE	TRUE	TRUE	2.201835	FALSE	FALSE	FALSE	3.710499	FALSE	TRUE	TRUE
0.733945	FALSE	TRUE	TRUE	2.24261	FALSE	FALSE	FALSE	3.751274	FALSE	TRUE	TRUE
0.77472	FALSE	TRUE	TRUE	2.283384	FALSE	FALSE	FALSE	3.792049	FALSE	TRUE	TRUE
0.815494	FALSE	TRUE	TRUE	2.324159	FALSE	FALSE	FALSE	3.832824	TRUE	TRUE	TRUE
0.856269	FALSE	TRUE	TRUE	2.364934	FALSE	FALSE	FALSE	3.873598	TRUE	TRUE	TRUE
0.897044	FALSE	TRUE	TRUE	2.405708	FALSE	FALSE	FALSE	3.914373	TRUE	TRUE	TRUE
0.937819	FALSE	TRUE	TRUE	2.446483	FALSE	FALSE	FALSE	3.955148	TRUE	TRUE	TRUE
0.978593	FALSE	TRUE	TRUE	2.487258	FALSE	FALSE	FALSE	3.995923	TRUE	TRUE	TRUE
1.019368	FALSE	TRUE	TRUE	2.528033	FALSE	FALSE	FALSE	4.036697	TRUE	TRUE	TRUE
1.060143	FALSE	TRUE	TRUE	2.568807	FALSE	TRUE	TRUE	4.077472	TRUE	TRUE	TRUE
1.100917	FALSE	TRUE	TRUE	2.609582	FALSE	TRUE	TRUE				
1.141692	FALSE	TRUE	TRUE	2.650357	FALSE	TRUE	TRUE				
1.182467	FALSE	TRUE	TRUE	2.691131	FALSE	TRUE	TRUE				
1.223242	FALSE	TRUE	TRUE	2.731906	FALSE	TRUE	TRUE				
1.264016	FALSE	TRUE	TRUE	2.772681	FALSE	TRUE	TRUE				
1.304791	FALSE	TRUE	TRUE	2.813456	FALSE	TRUE	TRUE				
1.345566	FALSE	TRUE	TRUE	2.85423	FALSE	TRUE	TRUE				
1.38634	FALSE	TRUE	TRUE	2.895005	FALSE	TRUE	TRUE				
1.427115	FALSE	TRUE	TRUE	2.93578	FALSE	TRUE	TRUE				
1.46789	FALSE	TRUE	TRUE	2.976555	FALSE	TRUE	TRUE				

9. Write a program in a M-File that finds the smallest even integer that is divisible by 13 and by 16 whose square root is greater than 120. Use a loop in the program. The loop should start from 1 and stop when the number is found. The program prints the message "The required number is:" and then prints the number.

M-File:
```
clear, clc
i=0;
s=0;
while s<=120
i=i+1;
if rem(i,2)==0 && rem(i,13)==0 && rem(i,16)==0
s=sqrt(i);
end
end
fprintf('The required number is: %i\n',i)
```

Command Window:

```
The required number is: 14560
```

10. Write a program in a script file that determines the real roots of a quadratic equation. Name the file "quadroots". When the file runs, it asks the user to enter the values of the constants a, b, and c. To calculate the roots of the equation the program calculates the discriminant D, given by:

$$D = b^2 - 4ac$$

If D > 0, the program displays message "The equation has two roots," and the roots are displayed in the next line.

If D = 0, the program displays message "The equation has one root," and the root is displayed in the next line.

If D < 0, the program displays message "The equation has no real roots."

Run the script file in the Command Window three times to obtain solutions to the following three equations:

a. $3x^2 + 6x + 3 = 0$

b. $-3x^2 + 4x - 6 = 0$

c. $-3x^2 + 7x + 5 = 0$

M-File:

```
clear, clc
for k=1:3
disp('For the equation ax^2+bx+c')
a=input('Enter a: ');
b=input('Enter b: ');
c=input('Enter c: ');
D=b^2-4*a*c;
if D<0
fprintf('\nThe equation has no real roots.\n\n')
elseif D==0
root=-b/(2*a);
fprintf('\nThe equation has one root,\n')
fprintf(' %.3f\n\n',root)
else
r1=(-b+sqrt(D))/(2*a);
r2=(-b-sqrt(D))/(2*a);
fprintf('\nThe equation has two roots,\n')
fprintf(' %.3f and %.3f\n\n',r1,r2)
end
end
```

<u>Command Window:</u>

```
For the equation ax^2+bx+c
Enter a: 3
Enter b: 6
Enter c: 3
The equation has one root,
-1.000
For the equation ax^2+bx+c
Enter a: -3
Enter b: 4
Enter c: -6
The equation has no real roots.
For the equation ax^2+bx+c
Enter a: -3
Enter b: 7
Enter c: 5
The equation has two roots,
-0.573 and 2.907
```

11. 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

M-File:

```
clear, clc
id=1;
for k=1:50
for j=k+1:50
for i=j+1:50
if i^2==k^2+j^2
a(id)=k;
b(id)=j;
c(id)=i;
id=id+1;
end
end
end
end
table=[a' b' c']
```

Command Window:

```
table =
3 4 5
5 12 13
6 8 10
7 24 25
8 15 17
9 12 15
9 40 41
10 24 26
12 16 20
12 35 37
14 48 50
15 20 25
15 36 39
16 30 34
18 24 30
20 21 29
21 28 35
```

```
24 32 40
27 36 45
30 40 50
```

12. Rewrite the following statements to use only one if statement.

$if\ x < y$

$\quad if\ z < 10$

$\qquad w = x * y * z$

$\quad end$

end

M-File:

```
if (x<y)&(z<10)
w = x*y*z
end
```

13. Figure 1 shows a mass-spring model of the type used to design packaging systems and vehicle suspensions, for example. The springs exert a force that is proportional to their compression, and the proportionality constant is the spring constant k. The two side springs provide additional resistance if the weight W is too heavy for the center spring. When the weight W is gently placed, it moves through a distance x before coming to rest. From statics, the weight force must balance the spring forces at this new position. Thus

$$W = k_1 x \qquad\qquad if\ x < d$$

$$W = k_1 x + 2k_2(x - d) \quad if\ x \geq d$$

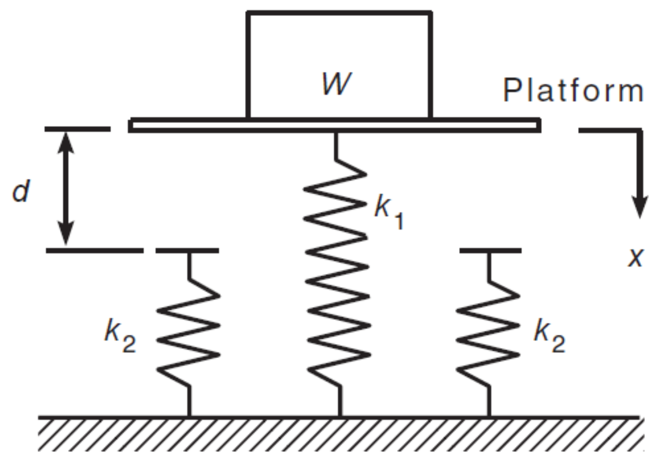


Figure 1.

These relations can be used to generate the plot of x versus W.

a. Create a function file that computes the distance x, using the input parameters W, k_1, k_2, and d. Test your function for the following two cases, using the values k_1 = 10^4 N/m; k_2 = 1.5 × 10^4 N/m; d = 0.1 m.

W = 500 N

W = 2000 N

b. Use your program to plot x versus W for $0 \leq W \leq 3000$ N for the values of k_1, k_2 and d given in part a.

<u>M-File:</u>

(a) The function file is

```
function package(W,k1,k2,d);
if W < k1*d
x = W/k1;
```

```
else
x = (W+2*k2*d)/(k1+2*k2);
end
disp('The distance traveled is:')
disp(x)
```

<u>The session is</u>

```
>>package(500,10000,15000,0.1)
'The distance traveled is:'
0.0500
>>package(2000,10000,15000,0.1)
'The distance traveled is:'
0.1250
```

(b) The function file in part (a) must be modified to provide an output variable x and to eliminate the display statements. It is

```
function x = package(W,k1,k2,d);
if W < k1*d
x = W/k1;
else
x = (W+2*k2*d)/(k1+2*k2);
end
```

Note that the inputs must be scalars because of the if statement. Thus the following script file would not give the correct plot. See the text for a discussion of this pitfall.

```
W = 0:5:3000;
plot(W,package(W,10000,15000,0.1)
The correct script file to obtain the plot is the
following.
k1 = 10000;k2 = 15000;d = 0.1;
if k1*d <= 3000
W = [0,k1*d,3000];
x = [package(W(1),k1,k2,d),package(W(2),k1,k2,d),...
package(W(3),k1,k2,d)];plot(W,x,0- 0),...
xlabel('Weight (N)'),ylabel('Distance (m)'),...
title('k1 = 10,000, k2 = 15,000, d = 0.1')
else
W = [0,3000];
x = [package(W(1),k1,k2,d),package(W(2),k1,k2,d)];
plot(W,x,0-0),xlabel('Weight (N)'),...
ylabel('Distance (m)'),title('k1 = 10,000, k2 =
15,000, d = 0.1')
end
```

It is easier to solve this problem using a for loop. The following script file is the solution using such a loop.

```
W = linspace(0,3000,500);
for k = 1:500
x(k) = package(W(k),10000,15000,0.1);
end
plot(W,x)
```

14. Consider the array **A**.

$$\mathbf{A} = \begin{bmatrix} 3 & 5 & -4 \\ -8 & -1 & 33 \\ -17 & 6 & -9 \end{bmatrix}$$

Write a program that computes the array **B** by computing the natural logarithm of all the elements of **A** whose value is no less than 1, and adding 20 to each element that is equal to or greater than 1. Do this in two ways:

a. By using a for loop with conditional statements.

b. By using a logical array as a mask.

a) **M-File:**

```
A = [3, 5, -4; -8, -1, 33; -17, 6, -9];
for m = 1:size(A,1)
for n = 1:size(A,2)
if A(m,n) >= 1
C(m,n) = log(A(m,n));
else
C(m,n) = A(m,n)+20;
end
end
end
A = C
```

b) **M-File:**

```
A = [3, 5, -4; -8, -1, 33; -17, 6, -9]
B = (A >= 1)
A(B) = log(A(B));
A( B) = A( B) + 20;
A
```

15. A company has the choice of producing up to four different products with its machinery, which consists of lathes, grinders, and milling machines. The number of hours on each machine required to produce a product is given in the following table, along with the number of hours available per week on each type of machine. Assume that the company can sell everything it produces. The profit per item for each product appears in the last line of the table.

	Product				
	1	2	3	4	Hours available
Hours required					
Lathe	1	2	0.5	3	40
Grinder	0	2	4	1	30
Milling	3	1	5	2	45
Unit pro t ($)	100	150	90	120	

M-File:

```
unit_profit = [100, 150, 90, 120];
hours = [1,2,0.5,3;0,2,4,1;3,1,5,2];
p = [0,0,0,0];
max_profit = 0;
another = [];
P = [];
for p1 = 0:15
for p2 = 0:15
for p3 = 0:8
for p4 = 0:14
p = [p1,p2,p3,p4];
if hours*p0 <= [40, 30, 45]0
profit = unit_profit*p0;
else
profit = 0;
end
if profit > max_profit
max_profit = profit;
production = [p1,p2,p3,p4];
elseif (max_profit - profit)<=1
another = [another;p];
P = [P,profit];
end
end
end
end
end
```

```
end
disp(0Optimal production is:0)
disp(production)
disp(0The profit is:0)
disp(max_profit)
[m,n] = size(another);
if m>1
disp(0The number of answers giving the same profit
is:0)
disp(m-1)
disp(0The other possible answers are:0)
disp(another(2:m,:))
disp(0Other profit:0)
disp(P(2:m)0)
else
disp(0There is only one solution.0)
end
```

The results are that the optimal production is given by the vector [10 15 0 0]. Thus we should manufacture 10 units of product 1, 15 units of product 2, and no units of products 3 and 4. The profit is $3250. There is only one solution.
(b) If we produce 9, 14, 0, and 0 units of each product, the profit would be 9(100) + 14(150) = $3000. If we produce 11, 16, 1, and 1 units of each product, the profit would be 11(100) + 16(150) + 1(90) + 1(120) = $3710, but this would require 46.5 hours on the lathe, 37 hours on the grinder, and 56 hours on the milling machine, which is more than the available hours.

16. Create Use a while loop to determine how many terms in the series 2^k, k = 1, 2, 3, . . . , are required for the sum of the terms to exceed 2000. What is the sum for this number of terms?

M-File:

```
sum = 0;k = 0;
while sum <= 2000
k = k + 1;
sum = sum + 2^k;
end
k
sum
The answers are k = 10 and sum = 2046.
```

17. Compute 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.

M-File:

```
amt = 10000;
k = 0;
while amt < 1e+6
k = k+1;
amt = amt*1.06 +10000;
end
amt
k
```

The result is amt = 1.0418e+006 and k = 33. Thus, after 33 years, the amount will be
$1,041,800.

18. 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 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. $\sqrt[3]{19.35}$

M-File:

```
clear, clc
n=[100 53701 19.35];
for j=1:3
P=n(j);
x=P;
E=1;
while E>.00001
x_old=x;
x=(P/x^2+2*x)/3;
E=abs((x-x_old)/x_old);
end
fprintf('The cube root of %.0f is %.1f\n',P,x)
end
```

Command Window:

```
The cube root of 100 is 4.6
The cube root of 53701 is 37.7
The cube root of 19 is 2.7
```

19. The overall grade in a course is determined from the grades of 6 quizzes, 3 midterms, and a final exam, using the following scheme: Quizzes: Quizzes are graded on a scale from 0 to 10. The grade of the lowest quiz is dropped and the average of the 5 quizzes with the higher grades constitutes 30% of the course grade. Midterms and final exam: Midterms and final exams are graded on a scale from 0 to 100. If the average of the midterm scores is higher than the score on the final exam, the average of the midterms constitutes 50% of the course grade and the grade of the final exam constitutes 20% of the course grade. If the final grade is higher than the average of the midterms, the average of the midterms constitutes 20% of the course grade and the grade of the final exam constitutes 50% of the course grade.

    Write a computer program in a script file that determines the course grade for a student. The program first asks the user to enter the six quiz grades (in a vector), the three midterm grades (in a vector), and the grade of the final. Then the program calculates a numerical course grade (a number between 0 and 100). Finally, the program assigns a letter grade according to the following key: A for $Grade \geq 90$, B for $80 \leq Grade < 90$, C for $70 \leq Grade < 80$, D for $60 \leq Grade < 70$, and E for a grade lower than 60. Execute the program for the following cases:

    (a) Quiz grades: 6, 10, 6, 8, 7, 8. Midterm grades: 82, 95, 89. Final exam: 81.

    (b) Quiz grades: 9, 5, 8, 8, 7, 6. Midterm grades: 78, 82, 75. Final exam: 81.

M-File:

```
clear, clc
for j=1:2
quiz=input('Please enter the quiz grades as a vector [x
x x x x x]: ');
mid=input('Please enter the midterm grades as a vector
[x x x]: ');
final=input('Please enter the final exam grade: ');
q_c=(sum(quiz)-min(quiz))/5;
if mean(mid)>final
grade=3*q_c + 0.5*mean(mid) + 0.2*final;
else
grade=3*q_c + 0.2*mean(mid) + 0.5*final;
```

```
end
if grade>=90
letter='A';
elseif grade>=80
letter='B';
elseif grade>=70
letter='C';
elseif grade>=60
letter='D';
else
letter='E';
end
fprintf('\nThe overall course grade is %.1f for a
letter grade of
%s\n\n',grade,letter)
end
```

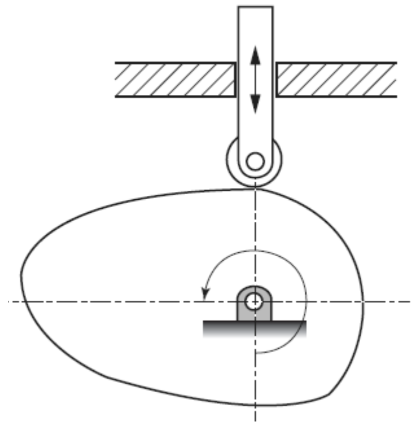
Command Window:

```
Please enter the quiz grades as a vector [x x x x x x]:
[6 10 6 8 7 8]
Please enter the midterm grades as a vector [x x x]:
[82 95 89]
Please enter the final exam grade: 81
The overall course grade is 83.9 for a letter grade of
B
Please enter the quiz grades as a vector [x x x x x x]:
[9 5 8 8 7 6]
Please enter the midterm grades as a vector [x x x]:
[78 82 75]
Please enter the final exam grade: 81
The overall course grade is 79.0 for a letter grade of

C
```

20. Given Cam is a mechanical device that transforms rotary motion into linear motion. The shape of the disc is designed to produce a specified displacement profile. A displacement profile is a plot of the displacement of the follower as a function of the angle of rotation of the cam. The motion of a certain cam is given by the following equations:

$$y = 6[2\theta - 0.5\sin\theta]/\pi \quad \text{for} \quad 0 \le \theta \le \pi/2$$
$$y = 6 \quad \text{for} \quad \pi/2 \le \theta \le 2\pi/3$$
$$y = 6 - 3\left[1 - 0.5\cos\left(3\left(\theta - 2\frac{\pi}{3}\right)\right)\right] \quad \text{for} \quad 2\pi/3 \le \theta \le 4\pi/3$$
$$y = 3 \quad \text{for} \quad 4\pi/3 \le \theta \le 3\pi/2$$
$$y = 3 - 1.5\left(\frac{\theta - 3(\pi/2)}{\pi/4}\right)^2 \quad \text{for} \quad 3\pi/2 \le \theta \le 7\pi/4$$
$$y = 0.75 - 0.75\left(1 - \frac{t - 7(\pi/4)}{\pi/4}\right)^2 \quad \text{for} \quad 7\pi/4 \le \theta \le 2\pi$$



M-File:

```
theta=linspace(0,2*pi,100)
for k=1:100
if theta(k)<=pi/2
y(k)=6*(2*theta(k)-0.5*sin(theta(k)))/pi;
elseif theta(k)<=2*pi/3
y(k)=6;
elseif theta(k)<=4*pi/3
y(k)=6-3*(1-0.5*cos(3*(theta(k)-2*pi/3)));
elseif theta(k)<=3*pi/2
y(k)=3;
elseif theta(k)<=7*pi/4
y(k)=3-1.5*((theta(k)-3*pi/2)/(pi/4))^2;
else
y(k)=0.75-0.75*(1-(theta(k)-7*pi/4)/(pi/4))^2;
end
end
plot(theta,y)
title('Cam Performance')
xlabel('Rotation Angle, rad')
ylabel('Follower Displacement, cm')
```

<u>Figure Window:</u>