ME 1020 Engineering Programming with MATLAB

Chapter 3 Homework Solutions: 3.2, 3.4, 3.6, 3.8, 3.10, 3.12, 3.16, 3.18, 3.24

Problem 3.2:

2.* Let $x = -5 - 8i$ and $y = 10 - 5i$. Use MATLAB to compute the following expressions. Hand-check the answers.

a. The magnitude and angle of xy.
b. The magnitude and angle of $\frac{x}{y}$.

```
% Problem 3.2
clear
clc
disp('Problem 3.2: Scott Thomas')

x= -5 - 8i
y = 10 - 5i

disp('Part (a)')
z_a = x*y
mag_a = abs(z_a)
theta_a = angle(z_a)

disp('Part (b)')
z_b = x/y
mag_b = abs(z_b)
theta_b = angle(z_b)
```

```
Problem 3.2: Scott Thomas

x =

  -5.0000 - 8.0000i


y =

  10.0000 - 5.0000i

Part (a)

z_a =

 -90.0000 -55.0000i


mag_a =

  105.4751


theta_a =

   -2.5930
```

```
Part (b)

z_b =

  -0.0800 - 0.8400i


mag_b =

    0.8438


theta_b =

   -1.6657
```

Problem 3.4:

4. For several values of x, use MATLAB to confirm that $\sinh x = (e^x - e^{-x})/2$.

```
% Problem 3.4
clear
clc
disp('Problem 3.4: Scott Thomas')
x=0:10;

sinh_x = sinh(x)

func_x = (exp(x)-exp(-x))/2
```

```
Problem 3.4: Scott Thomas

sinh_x =

   1.0e+04 *

  Columns 1 through 7

         0    0.0001    0.0004    0.0010    0.0027    0.0074    0.0202

  Columns 8 through 11

    0.0548    0.1490    0.4052    1.1013


func_x =

   1.0e+04 *

  Columns 1 through 7

         0    0.0001    0.0004    0.0010    0.0027    0.0074    0.0202

  Columns 8 through 11

    0.0548    0.1490    0.4052    1.1013
```

Problem 3.6:

6. The capacitance of two parallel conductors of length L and radius r, separated by a distance d in air, is given by

$$C = \frac{\pi \epsilon L}{\ln\left[(d - r)/r\right]}$$

where ϵ is the permittivity of air ($\epsilon = 8.854 \times 10^{-12}$ F/m).

Write a script file that accepts user input for d, L, and r and computes and displays C. Test the file with the values $L = 1$ m, $r = 0.001$ m, and $d = 0.004$ m.

```
% Problem 3.6
clear
clc
disp('Problem 3.6: Scott Thomas')

d = input('d = ') %m
L = input('L = ') %m
r = input('r = ') %m

epsilon = 8.854E-12 %F/m

C = pi*epsilon*L/log((d - r)/r)
```

```
Problem 3.6: Scott Thomas
d = .004

d =

    0.0040

L = 1

L =

     1

r = .001

r =

   1.0000e-03


epsilon =

   8.8540e-12


C =

   2.5319e-11

>>
```

Problem 3.8:

8. The output of the MATLAB `atan2` function is in radians. Write a function called `atan2d` that produces an output in degrees.

```
% Problem 3.8
function [theta_degrees] = atan2_degrees(Imag,Real)

theta_radians = atan2(Imag,Real);

theta_degrees = theta_radians*180/pi;
```

```
% Problem 3.8
clear
clc
disp('Problem 3.8: Scott Thomas')

x = -2
y = -2

theta_degrees = atan2_degrees(y,x)
```

```
Problem 3.8: Scott Thomas

x =

    -2


y =

    -2


theta_degrees =

  -135
```

Problem 3.10:

10.* An object thrown vertically with a speed v_0 reaches a height h at time t, where

$$h = v_0 t - \frac{1}{2} g t^2$$

Write and test a function that computes the time t required to reach a specified height h, for a given value of v_0. The function's inputs should be h, v_0, and g. Test your function for the case where $h = 100$ m, $v_0 = 50$ m/s, and $g = 9.81$ m/s^2. Interpret both answers.

```
% Problem 3.10
function [time1, time2] = height_function(height,initial_speed,accel_g)
a = -0.5*accel_g;
b = initial_speed;
c = -height;

time1 = (-b + sqrt(b^2 - 4*a*c))/(2*a);
time2 = (-b - sqrt(b^2 - 4*a*c))/(2*a);
```

```
% Problem 3.10
clear
clc
disp('Problem 3.10: Scott Thomas')

height = 100.0
initial_speed = 50.0
accel_g = 9.81

[t1,t2] = height_function(height, initial_speed, accel_g)
```

```
Problem 3.10: Scott Thomas

height =

   100


initial_speed =

    50


accel_g =

    9.8100


t1 =

    2.7324
```

```
t2 =

    7.4612
```

The ball reaches 100 m twice: Once on the way up, and once on the way down.

Problem 3.12:

12. A fence around a field is shaped as shown in Figure P12. It consists of a rectangle of length L and width W, and a right triangle that is symmetrical about the central horizontal axis of the rectangle. Suppose the width W is known (in meters) and the enclosed area A is known (in square meters). Write a user-defined function file with W and A as inputs. The outputs are the length L required so that the enclosed area is A and the total length of fence required. Test your function for the values $W = 6$ m and $A = 80$ m^2.

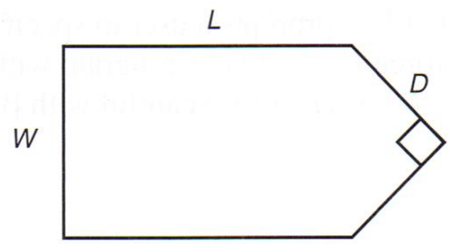


Figure P12

Problem setup:

$$A = LW + \frac{1}{2}D^2$$

$$D^2 + D^2 = W^2$$

$$2D^2 = W^2$$

$$D = \frac{W}{\sqrt{2}}; \qquad \frac{1}{2}D^2 = \frac{1}{4}W^2$$

$$A = LW + \frac{1}{4}W^2$$

$$L = \frac{1}{W}\left(A - \frac{1}{4}W^2\right)$$

$$L_{\text{total}} = W + 2L + 2D$$

```
% Problem 3.12: Scott Thomas

function [L,L_total] = fence_length(A,W)
disp('fence_length(A,W): A = Input fence area (m^2); W = fence width (m)')
%Calculate Fence Side Length L (m)
L = (A-W^2/4)/W;
D = sqrt(W^2/2);
L_total = W + 2*L + 2*D;
```

```
% Problem 3.12
clear
clc
disp('Problem 3.12: Scott Thomas')

A = 80 % m^2
W = 6 %m
[L,L_total] = fence_length(A,W)
```

```
Problem 3.12: Scott Thomas

A =

    80


W =

     6

fence_length(A,W): A = Input fence area (m^2); W = fence width (m)

L =

   11.8333


L_total =

   38.1519
```

Problem 3.16:

16. A torus is shaped like a doughnut. If its inner radius is a and its outer radius is b, its volume and surface area are given by

$$V = \frac{1}{4}\pi^2(a + b)(b - a)^2 \qquad A = \pi^2(b^2 - a^2)$$

a. Create a user-defined function that computes V and A from the arguments a and b.

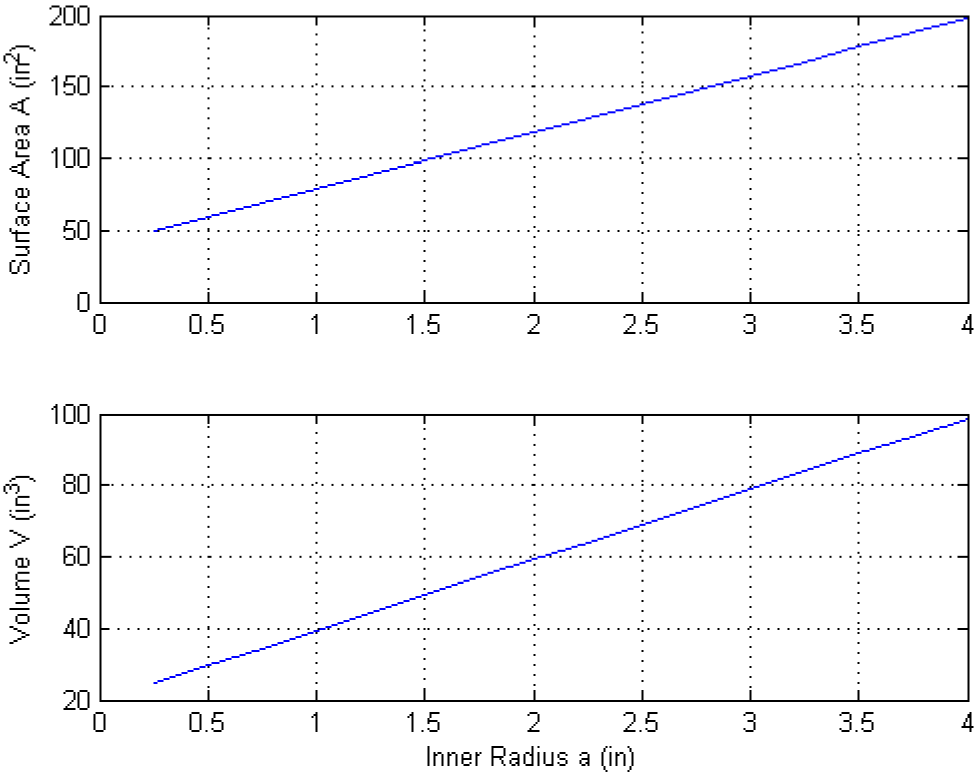
b. Suppose that the outer radius is constrained to be 2 in. greater than the inner radius. Write a script file that uses your function to plot A and V versus a for $0.25 \le a \le 4$ in.

```
% Problem 3.16: Scott Thomas
function [V,A] = torus(a,b)
disp('torus(a,b): a = inner radius (in); b = outer radius (in)')

a;
b;

%Calculate Torus Volume (in^3)
V = pi^2/4*(a + b).*(b - a).^2;

%Calculate Torus Surface Area (in^2)
A = pi^2*(b.^2 - a.^2);
```

```
>> [V,A] = torus(1,2)
torus(a,b): a = inner radius (in); b = outer radius (in)

a =

     1


b =

     2


V =

    7.4022


A =

   29.6088

fx >> |
```

```
% Problem 3.16
clear
clc
disp('Problem 3.16: Scott Thomas')

a = 0.25:0.25:4;
b = a + 2;

[V,A] = torus(a,b);

subplot(2,1,1), plot(a,A), ylabel('Surface Area A (in^2)'), grid on
subplot(2,1,2), plot(a,V),xlabel('Inner Radius a (in)'),...
    ylabel('Volume V (in^3)'), grid on
```

```
Problem 3.16: Scott Thomas
torus(a,b): a = inner radius (in); b = outer radius (in)
```

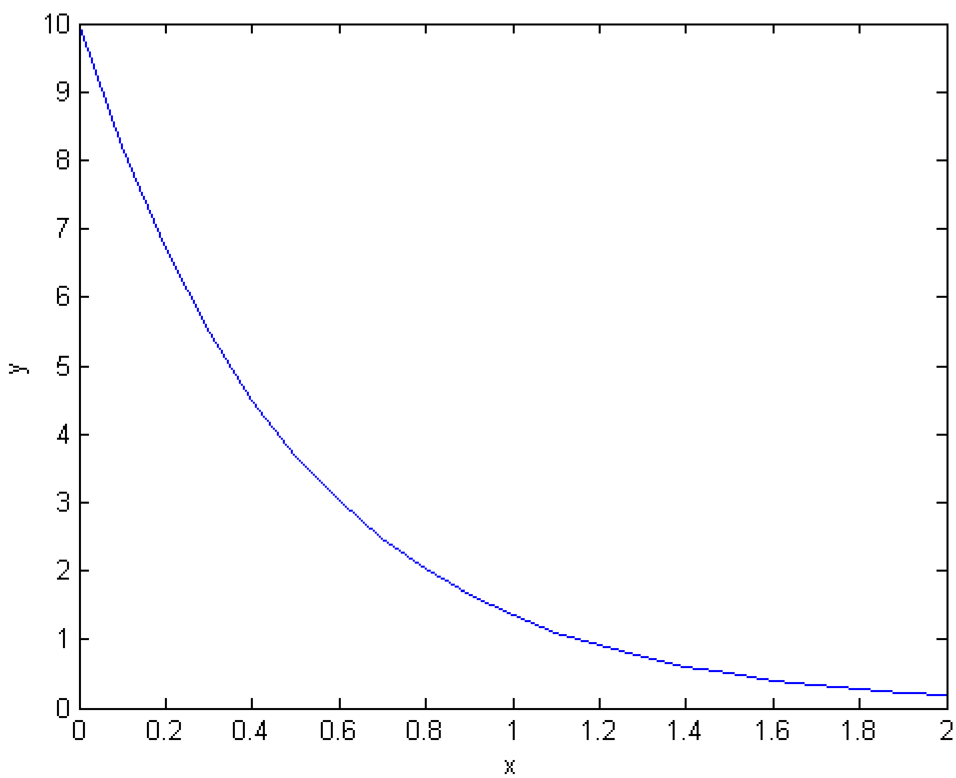


Problem 3.18:

18. Create an anonymous function for $10e^{-2x}$ and use it to plot the function over the range $0 \le x \le 2$.

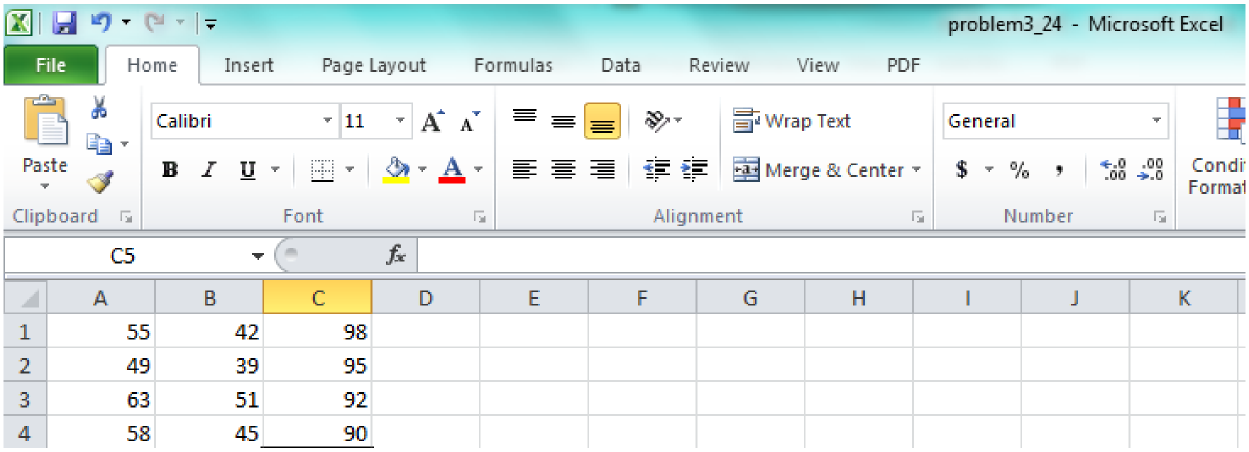
```
% Problem 3.18
clear
clc
disp('Problem 3.18: Scott Thomas')

anonfun_318 = @(x) 10*exp(-2.*x);

x = 0:0.1:2;

y = anonfun_318(x);

plot(x,y), xlabel('x'), ylabel('y')
```

```
Problem 3.18: Scott Thomas
```



Problem 3.24:

24. Enter and save the data given in Problem 23 in a spreadsheet. Then import the spreadsheet file into the MATLAB variable A. Use MATLAB to compute the sum of each column.



	A	B	C	D	E	F	G	H	I	J	K
1	55	42	98								
2	49	39	95								
3	63	51	92								
4	58	45	90								

```
% Problem 3.24
clear
clc
disp('Problem 3.24: Scott Thomas')

A = xlsread('problem3_24')

col_sum_1 = sum(A(:,1))
col_sum_2 = sum(A(:,2))
col_sum_3 = sum(A(:,3))
```

```
Problem 3.24: Scott Thomas

A =

    55    42    98
    49    39    95
    63    51    92
    58    45    90


col_sum_1 =

   225


col_sum_2 =

   177


col_sum_3 =

   375
```