ME 1020 Engineering Programming with MATLAB

Chapter 1 Homework Solutions: 1.2, 1.5, 1.8, 1.11, 1.18, 1.23, 1.25, 1.30

Problem 1.2:

2.* Suppose that $x = 2$ and $y = 5$. Use MATLAB to compute the following.

a. $\dfrac{yx^3}{x - y}$ *b.* $\dfrac{3x}{2y}$ *c.* $\dfrac{3}{2}xy$ *d.* $\dfrac{x^5}{x^5 - 1}$

```
%Prob. 1-2 Scott Thomas
x=2;
y=5;
a=y*x^3/(x-y)
b=3*x/(2*y)
c=3/2*x*y
d=x^5/(x^5-1)
```

```
a =

  -13.3333


b =

    0.6000


c =

    15


d =

    1.0323
```

Problem 1.5:

5. Assuming that the variables a, b, c, d, and f are scalars, write MATLAB statements to compute and display the following expressions. Test your statements for the values $a = 1.12$, $b = 2.34$, $c = 0.72$, $d = 0.81$, and $f = 19.83$.

$$x = 1 + \frac{a}{b} + \frac{c}{f^2} \qquad s = \frac{b - a}{d - c}$$

$$r = \frac{1}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}} \qquad y = ab\frac{1}{c}\frac{f^2}{2}$$

```
%Prob. 1-5 Scott Thomas
a=1.12;
b=2.34;
c=0.72;
d=0.81;
f=19.83;
x=1+a/b+c/f^2
s=(b-a)/(d-c)
r=1/(1/a+1/b+1/c+1/d)
y=a*b/c/2*f^2
```

x =

1.4805

s =

13.5556

r =

0.2536

y =

715.6766

Problem 1.8:

8.* Suppose that $x = -7 - 5i$ and $y = 4 + 3i$. Use MATLAB to compute

a. $x + y$ *b.* xy *c.* x/y

```
%Prob. 1-8 Scott Thomas
x=-7-5i;
y=4+3i;
a=x+y
b=x*y
c=x/y
```

a =

-3.0000 - 2.0000i

b =

-13.0000 -41.0000i

c =

-1.7200 + 0.0400i

Problem 1.11:

11. The *ideal gas law* provides one way to estimate the pressure exerted by a gas in a container. The law is

$$P = \frac{nRT}{V}$$

More accurate estimates can be made with the *van der Waals* equation

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

where the term nb is a correction for the volume of the molecules and the term an^2/V^2 is a correction for molecular attractions. The values of a and b depend on the type of gas. The gas constant is R, the *absolute* temperature is T, the gas volume is V, and the number of gas molecules is indicated by n. If $n = 1$ mol of an ideal gas were confined to a volume of $V = 22.41$ L at 0°C (273.2 K), it would exert a pressure of 1 atm. In these units, $R = 0.08206$.

For chlorine (Cl_2), $a = 6.49$ and $b = 0.0562$. Compare the pressure estimates given by the ideal gas law and the van der Waals equation for 1 mol of Cl_2 in 22.41 L at 273.2 K. What is the main cause of the difference in the two pressure estimates, the molecular volume or the molecular attractions?

```
%Prob. 1-11 Scott Thomas
a=6.49;
b=0.0562;
n = 1;
v = 22.41;
t = 273.2;
p = 1;
r = 0.08206;

p_ig = n*r*t/v
p_vdw = n*r*t/(v-n*b)-a*n^2/v^2

volume_correction = n*b
molecular_correction = a*n^2/v^2
```

```
p_ig =

    1.0004


p_vdw =

    0.9900


volume_correction =

    0.0562


molecular_correction =

    0.0129
```

Problem 1.18:

18.* Use MATLAB to find the roots of $13x^3 + 182x^2 - 184x + 2503 = 0$.

```
%Prob. 1-18 Scott Thomas
a=[13,182,-184,2503]
roots(a)
```

```
a =

          13         182        -184        2503


ans =

 -15.6850
   0.8425 + 3.4008i
   0.8425 - 3.4008i
```

Problem 1.23:

23. The Fourier series is a series representation of a periodic function in terms of sines and cosines. The Fourier series representation of the function

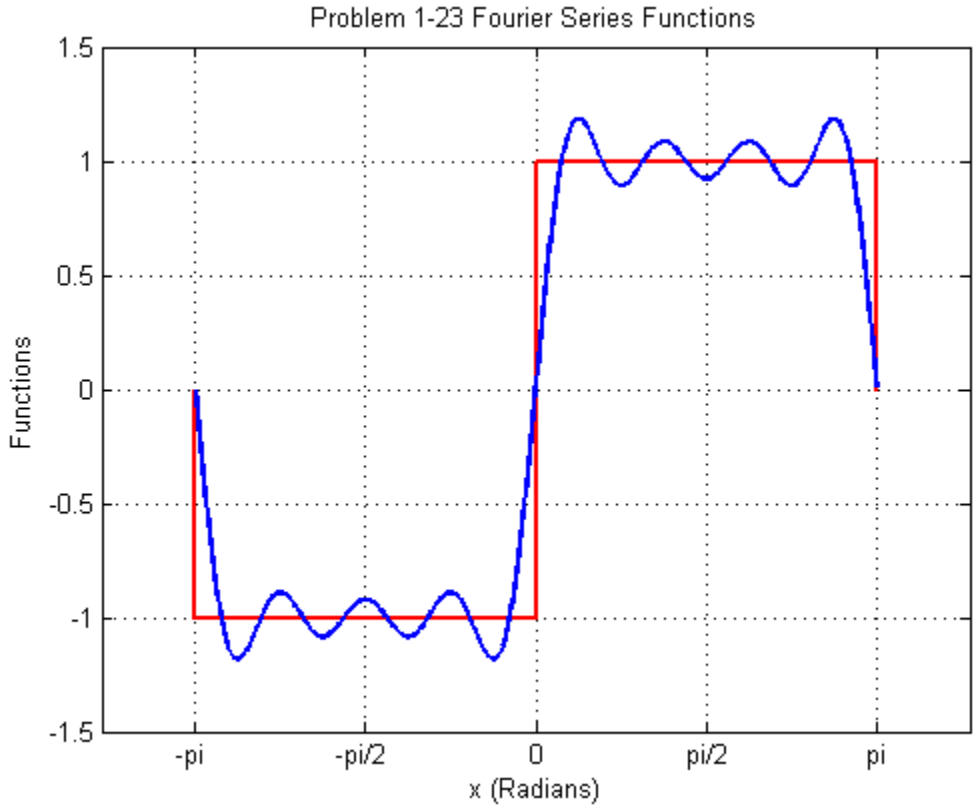
$$f(x) = \begin{cases} 1 & 0 < x < \pi \\ -1 & -\pi < x < 0 \end{cases}$$

is

$$\frac{4}{\pi}\left(\frac{\sin x}{1} + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + \frac{\sin 7x}{7} + \cdots\right)$$

Plot on the same graph the function $f(x)$ and its series representation, using the four terms shown.

```
%Prob. 1-23 Scott Thomas
x1=[-pi, -pi,  0, 0, pi, pi];
y1=[  0,  -1, -1, 1,  1,  0];
x2=-pi:0.01:pi;
y2=4/pi*(sin(x2)/1+sin(3*x2)/3+sin(5*x2)/5+sin(7*x2)/7);
plot(x1,y1,'r',x2,y2,'LineWidth',2)
grid
set(gca,'XTick',-pi:pi/2:pi)
set(gca,'XTickLabel',{'-pi','-pi/2','0','pi/2','pi'})
title('Problem 1-23 Fourier Series Functions');
xlabel('x (Radians)');
ylabel('Functions');
```



Problem 1.25:

25. A fence around a field is shaped as shown in Figure P25. It consists of a rectangle of length L and width W and a right triangle that is symmetric 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 MATLAB script file in terms of the given variables W and A to determine the length L required so that the enclosed area is A. Also determine the total length of fence required. Test your script for the values $W = 6$ m and $A = 80$ m^2.

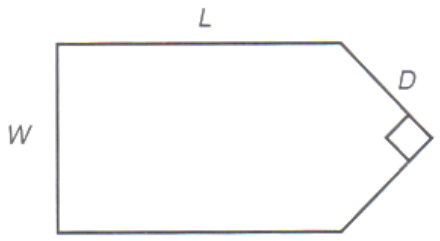


Figure P25

```
%Prob. 1-25 Scott Thomas
A = 80 %m^2
W = 6 %m
D = W/sqrt(2)
L = (A-D^2/2)/W
Length = W + 2*L + 2*D
```

```
A =

    80

W =

     6

D =

    4.2426

L =

   11.8333

Length =

   38.1519
```

Problem 1.30:

30. *a.* With what initial speed must you throw a ball vertically for it to reach a height of 20 ft? The ball weighs 1 lb. How does your answer change if the ball weighs 2 lb?

b. Suppose you want to throw a steel bar vertically to a height of 20 ft. The bar weighs 2 lb. How much initial speed must the bar have to reach this height? Discuss how the length of the bar affects your answer.

```
%Prob. 1-30 Scott Thomas
g=32.2 %ft/s^2
h=20 %ft
vi=sqrt(2*g*h) %ft/s
```

```
g =

   32.2000


h =

    20


vi =

   35.8887
```