Matlab for Engineers, 5th Edition

Chapter 2 Homework Solutions

```
clear,clc, format shortg
```

You can either solve these problems in the command window, using MATLAB® as an electronic calculator, or you can create an M-file of the solutions. If you are solving these problems as a homework assignment or if you want to keep a record of your work, the best strategy is to use an M-file, divided into cells with the cell divider %%.

Problem 2.1

Predict the outcome of the following MATLAB® calculations. Check your results by entering the calculations into the command window.

```
1 + 3/4
```

```
ans =           1.75
```

```
5*6*4/2
```

```
ans =     60
```

```
5/2*6*4
```

```
ans =     60
```

```
5^2*3
```

```
ans =     75
```

```
5^(2*3)
```

```
ans =         15625
```

```
1 + 3 + 5/5 + 3 + 1
```

```
ans =      9
```

```
(1 + 3 + 5)/(5 + 3 + 1)
```

```
ans =      1
```

Using Variables

Problem 2.2

Identify which name in each of the following pairs is a legitimate MATLAB® variable name. Test your answers by using `isvarname`—for example,

isvarname fred

Remember, `isvarname` returns a 1 if the name is valid and a 0 if it is not. Although it is possible to reassign a function name as a variable name, doing so is not a good idea. Use `which` to check whether the preceding names are function names—for example,

which sin

In what case would MATLAB®tell you that sin is a variable name, not a function name?

The legitimate Matlab names are: fred book_1 Second_Place No_1 vel_5 tan

```
isvarname fred
```

```
ans =    1
```

```
isvarname book_1
```

```
ans =    1
```

```
isvarname Second_Place
```

```
ans =    1
```

```
isvarname No_1
```

```
ans =    1
```

```
isvarname vel_5
```

```
ans =    1
```

```
isvarname tan   %although tan is a function name it can be used as a variable name
```

```
ans =    1
```

```
isvarname fred!  %! is not an allowed character
```

```
ans =    0
```

```
isvarname book-1  % - is not an allowed character
```

```
ans =    0
```

```
isvarname 2ndplace  %variable names must start with a letter
```

```
ans =    0
```

```
isvarname #1  %# is not an allowed character
```

```
ans =    0
```

```
isvarname vel.5  % . is not an allowed character
```

```
ans =    0
```

```
isvarname while  %while is a reserved name
```

```
ans =    0
```

```

which tan  % tan is a function name
```

```
built-in (C:\Program Files\MATLAB\R2016b\toolbox\matlab\elfun\@double\tan)  % double method
```

```
which while  %while is also a function name, but is reserved
```

```
built-in (C:\Program Files\MATLAB\R2016b\toolbox\matlab\lang\while)
```

```

%You can reassign a function name as a variable name
%For example
sin=3
```

```
sin =      3
```

```
%The which function now tells us sin is a variable
which sin
```

```
sin is a variable.
```

```
% Use the clear function to return sin to its function definition
clear sin
which sin
```

```
built-in (C:\Program Files\MATLAB\R2016b\toolbox\matlab\elfun\@double\sin)  % double method
```

Scalar Operations and Order of Operations

Problem 2.3

Create MATLAB® code to perform the following calculations. Check your code by entering it into MATLAB® and performing the calculations on your scientific calculator.

```
5^2
```

```
ans =     25
```

```
(5 + 3)/(5*6)
```

```
ans =       0.26667
```

```
sqrt(4+6^3) % or...
```

```
ans =        14.832
```

```
(4+6^3)^(1/2)
```

```
ans =        14.832
```

```
9*6/12 + 7*5^(3+2)
```

```
ans =         21880
```

```
1 + 5*3/6^2 + 2^(2-4) *1/5.5
```

```
ans =        1.4621
```

Problem 2.4

(a) The area of a circle is πr^2 Define *r* as 5, then find the area of a circle, using MATLAB®.

```
r=5
```

```
r =      5
```

```
area=pi*r^2
```

```
area =         78.54
```

(b) The surface area of a sphere is $4\pi r^2$. Find the surface area of a sphere with a radius of 10 ft.

```
r=10
```

```
r =     10
```

```
surface_area=4*pi*r^2
```

```
surface_area =        1256.6
```

(c) The volume of a sphere is 4/3*pr*2. Find the volume of a sphere with a radius of 2 ft.

```
r=2
```

```
r =      2
```

```
volume=4/3*pi*r^3
```

```
volume =         33.51
```

Problem 2.5

(a) The area of a square is the edge length squared (A = edge2). Define the edge length as 5, then find the area of a square, using MATLAB®.

```
edge=5
```

```
edge =      5
```

```
area=edge^2
```

```
area =     25
```

(b) The surface area of a cube is 6 times the edge length squared (SA = 6 × edge2). Find the surface area of a cube with edge length 10.

```
edge=10
```

```
edge =     10
```

```
surface_area=6*edge^2
```

```
surface_area =    600
```

(c) The volume of a cube is the edge length cubed (*V* = edge3). Find the volume of a cube with edge length 12.

```
edge=12
```

```
edge =     12
```

```
volume=edge^3
```

```
volume =         1728
```

Problem 2.6

Consider the barbell shown in Figure P2.6.

(**a)** Find the volume of the figure, if the radius of each sphere is 10 cm, the length of the bar connecting them is 15 cm, and the diameter of the bar is 1 cm. Assume that the bar is a simple cylinder.

```
r=10; %cm
length=15; %cm
d=1; % cm
% Find the volume of each sphere
volume_sphere=4/3*pi*r^3;
% Find the volume of the bar
volume_bar=pi*(d/2)^2*length;
% Combine the components to get the total volume
total_volume=2*volume_sphere +volume_bar
```

```
total_volume =        8389.4
```

b)Surface Area

(**b)** Find the surface area of the figure.

Find the surface area of each sphere

```
sa_sphere=4*pi*r^2;
% Find the surface area of the bar
```

```
sa_bar=pi*d*length;
% Combine the components to get the total surface area
total_sa=2*sa_sphere + sa_bar
```

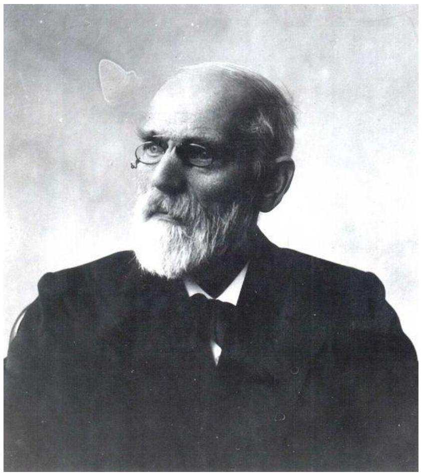
```
total_sa =       2560.4
```

Problem 2.7

The ideal gas law was introduced in Example 2.1. It describes the relationship between pressure (*P*), temperature (*T*), volume (*V*), and the number of moles of gas (*n*).

PV = nRT

The additional symbol, *R*, represents the ideal gas constant. The ideal gas law is a good approximation of the behavior of gases when the pressure is low and the temperature is high. (What constitutes low pressure and high temperature varies with different gases.) In 1873, Johannes Diderik van der Waals, Figure P2.7 proposed a modified version of the ideal gas law that better models the behavior of real gases over a wider range of temperature and pressure.



$$\left(\left(P + \frac{n^2 a}{v^2}\right)(V - \mathrm{nb})\right) = \mathrm{nRT}$$

In this equation the additional variables *a* and *b* represent values characteristic of individual gases.

Use both the ideal gas law and van der Waals' equation to calculate the temperature of water vapor (steam), given the following data.

```
P=220;
n=2;
V=1;
a=5.536;
b=0.03049;
R=0.08314472;
% Find the temperature using the ideal gas law
T_ideal=P*V/(n*R)
```

```
T_ideal =         1323
```

```
% Find the temperature using Van der Waal's equation
T_VW=(P+n^2*a/V^2)*(V-n*b)/(n*R)
```

```
T_VW =        1367.4
```

Problem 2.8

(a) The volume of a cylinder is *pr2h*. Define *r* as 3 and *h*as the matrix

`h = [1, 5, 12]`

Find the volume of the cylinders (see Figure P2.8a).

```
r=3;
h=[1,5,12];
volume = pi*r^2.*h
```

```
volume =        28.274       141.37       339.29
```

```
%We need to use the .* operator because h is an array
```

(b) The area of a triangle is 1/2 the length of the base of the triangle, times the height of the triangle. Define the base as the matrix

`b = [2, 4, 6]`

and the height *h* as 12, and find the area of the triangles

```
b=[ 2, 4, 6];
h=12;
area=1/2*b.*h
```

```
area =     12     24     36
```

```
%Although you don't have to use the .* operator for both
%multiplications and the ./ for the division it won't hurt if you do
area=1./2.*b.*h
```

```
area =     12     24     36
```

(c) The volume of any right prism is the area of the base of the prism, times the vertical dimension of the prism. The base of the prism can be any shape—for example, a circle, a rectangle, or a triangle. Find the volume of the prisms created from the triangles of part (b). Assume that the vertical dimension of these prisms is 6

```
h=6;
volume=h.*area
```

```
volume =     72    144    216
```

Problem 2.9

The response of circuits containing resistors, inductors and capacitors depends upon the relative values of the resistors and the way they are connected. An important intermediate quantity used in describing the response of such circuits is *s*. Depending on the values of *R*, *L*, and *C*, the values of *s* will be either both real values, a pair of complex values, or a duplicated value.

The equation that identifies the response of a particular series circuit (Figure P2.9) is

$$S = \frac{-R}{2L} \pm \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}}$$

(a) Determine the values of *s* for a resistance of 800 Ω.

```
R=800 %ohms
```

```
R =    800
```

```
L=100e-3 %H
```

```
L =           0.1
```

```
C=1e-6 %F
```

```
C =         1e-06
```

```
s(1)= -R/(2*L)+sqrt((R/(2*L))^2 - 1/(L*C))
```

```
s =       -1550.5
```

```
s(2)= -R/(2*L)-sqrt((R/(2*L))^2 - 1/(L*C))
```

```
s =       -1550.5      -6449.5
```

(b) Create a vector of values for *R* ranging from 100 to 1000 Ω and evaluate *s*. Refine your values of *R* until you find the approximate size of resistor that yields a pure real value of *s*. Describe the effect on *s* as *R*increases in value.

Hint:

1 µF = 1e-6F

1 mH = 1e-3H

```
R=100:100:1000;
s_plus = -R./(2*L)+sqrt((R./(2*L)).^2 - 1/(L*C))
```

```
s_plus =          -500 +      3122.5i         -1000 +         3000i          -1500 +      2783.9i          -2000
```

```
s_minus = -R./(2*L)-sqrt((R./(2*L)).^2 - 1/(L*C))
```

```
s_minus =          -500 -      3122.5i         -1000 -         3000i          -1500 -      2783.9i          -200(
```

```
table_values = [R',s_plus',s_minus']
```

```
table_values =
          100 +           0i          -500 -      3122.5i          -500 +      3122.5i
          200 +           0i         -1000 -        3000i         -1000 +        3000i
          300 +           0i         -1500 -      2783.9i         -1500 +      2783.9i
```

```
        400 +          0i         -2000 -     2449.5i        -2000 +     2449.5i
        500 +          0i         -2500 -     1936.5i        -2500 +     1936.5i
        600 +          0i         -3000 -       1000i        -3000 +       1000i
        700 +          0i         -2000 +          0i        -5000 +          0i
        800 +          0i       -1550.5 +          0i      -6449.5 +          0i
        900 +          0i       -1298.4 +          0i      -7701.6 +          0i
       1000 +          0i         -1127 +          0i        -8873 +          0i
```

```
% Repeat for R between 600 and 700
R=600:10:700;
s_plus = -R./(2*L)+sqrt((R./(2*L)).^2 - 1/(L*C))
```

```
s_plus =         -3000 +        1000i          -3050 +      835.16i          -3100 +       624.5i          -3150
```

```
s_minus = -R./(2*L)-sqrt((R./(2*L)).^2 - 1/(L*C))
```

```
s_minus =         -3000 -        1000i          -3050 -      835.16i          -3100 -       624.5i          -315
```

```
table_values = [R',s_plus',s_minus']
```

```
table_values =
        600 +          0i         -3000 -       1000i        -3000 +       1000i
        610 +          0i         -3050 -     835.16i        -3050 +     835.16i
        620 +          0i         -3100 -      624.5i        -3100 +      624.5i
        630 +          0i         -3150 -     278.39i        -3150 +     278.39i
        640 +          0i       -2710.1 +          0i      -3689.9 +          0i
        650 +          0i         -2500 +          0i        -4000 +          0i
        660 +          0i       -2356.6 +          0i      -4243.4 +          0i
        670 +          0i       -2244.3 +          0i      -4455.7 +          0i
        680 +          0i         -2151 +          0i        -4649 +          0i
        690 +          0i       -2070.7 +          0i      -4829.3 +          0i
        700 +          0i         -2000 +          0i        -5000 +          0i
```

Problem 2.10

The equation that identifies the response parameter, *s*, of the parallel circuit shown in Figure P2.10 is

$$S = -\frac{1}{2RC} \pm \sqrt{\left(\frac{1}{2RC}\right)^2 - \frac{1}{LC}}$$

(a) Determine the values of *s* for a resistance of 200 Ω.

```
R=200;
C=1e-6;
L=0.64
```

```
L =         0.64
```

```
s_plus=-1/(2*R*C) + sqrt((1/(2*R*C))^2 - 1/(L*C))
```

```
s_plus =      -334.94
```

```
s_minus=-1/(2*R*C) - sqrt((1/(2*R*C))^2 - 1/(L*C))
```

```
s_minus =      -4665.1
```

(b) Create a vector of values for *R* ranging from 100 to 1000 Ω and evaluate *s*. Refine your values of *R* until you find the size of resistor that yields a pure real value of *s*. Describe the effect on *s* as *R* decreases.

```
R=100:100:1000;
s_plus=-1./(2*R*C) + sqrt((1./(2*R*C)).^2 - 1/(L*C));
s_minus=-1./(2*R*C) - sqrt((1./(2*R*C)).^2 - 1/(L*C));
table_values = [R',s_plus',s_minus']
```

```
table_values =
         100 +          0i       -158.77 +          0i       -9841.2 +          0i
         200 +          0i       -334.94 +          0i       -4665.1 +          0i
         300 +          0i       -564.27 +          0i       -2769.1 +          0i
         400 +          0i         -1250 +          0i         -1250 +          0i
         500 +          0i         -1000 -       750i         -1000 +       750i
         600 +          0i       -833.33 -    931.69i       -833.33 +    931.69i
         700 +          0i       -714.29 -    1025.8i       -714.29 +    1025.8i
         800 +          0i          -625 -    1082.5i          -625 +    1082.5i
         900 +          0i       -555.56 -    1119.8i       -555.56 +    1119.8i
        1000 +          0i          -500 -    1145.6i          -500 +    1145.6i
```

```
%  Refine the R values
R=400:10:500;
s_plus=-1./(2*R*C) + sqrt((1./(2*R*C)).^2 - 1/(L*C));
s_minus=-1./(2*R*C) - sqrt((1./(2*R*C)).^2 - 1/(L*C));
table_values = [R',s_plus',s_minus']
```

```
table_values =
         400 +          0i         -1250 +          0i         -1250 +          0i
         410 +          0i       -1219.5 -    274.39i       -1219.5 +    274.39i
         420 +          0i       -1190.5 -    381.14i       -1190.5 +    381.14i
         430 +          0i       -1162.8 -    458.71i       -1162.8 +    458.71i
         440 +          0i       -1136.4 -    520.75i       -1136.4 +    520.75i
         450 +          0i       -1111.1 -    572.65i       -1111.1 +    572.65i
         460 +          0i         -1087 -    617.27i         -1087 +    617.27i
         470 +          0i       -1063.8 -    656.33i       -1063.8 +    656.33i
         480 +          0i       -1041.7 -    690.96i       -1041.7 +    690.96i
         490 +          0i       -1020.4 -    721.99i       -1020.4 +    721.99i
         500 +          0i         -1000 -       750i         -1000 +       750i
```

Problem 2.11

Burning one gallon of gasoline in your car produces 19.4 pounds of CO2. Calculate the amount of CO2 emitted during a year for the following vehicles, assuming they all travel 12,000 miles per year. The reported fuel-efficiency numbers were extracted from the U.S. Department of Energy website, www.fueleconomy.gov, and reflect the combined city and highway estimates.

```
%Create a matrix of mpg values
mpg=[107, 35, 35, 46, 56, 32];
% Calculate the emissions
Mass_CO2=(12000./mpg*19.4)'
```

```
Mass_CO2 =
      2175.7
      6651.4
      6651.4
      5060.9
      4157.1
```

```
        7275
```

```
% Notice that I transposed the result so that it is easier to read
```

Problem 2.12

(a) Create an evenly spaced vector of values from 1 to 20 in increments of 1.

```
a=1:20
```

```
a =      1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16
```

(b) Create a vector of values from zero to 2*p* in increments of *p*/10.

```
b=0:pi/10:2*pi
```

```
b =             0     0.31416     0.62832     0.94248      1.2566      1.5708       1.885       2.
```

(c) Create a vector containing 15 values, evenly spaced between 4 and 20. (*Hint:* Use the `linspace` command. If you can't remember the syntax, type `help linspace`.)

```
c=linspace(4,20,15)
```

```
c =             4      5.1429      6.2857      7.4286      8.5714      9.7143      10.857
```

(d) Create a vector containing 10 values, spaced logarithmically between 10 and 1000. (*Hint:* Use the `logspace` command.)

```
d=logspace(1,3,4)
```

```
d =            10      46.416      215.44        1000
```

Problem 2.13

(a) Create a table of conversions from feet to meters. Start the feet column at 0, increment it by 1, and end it at 10 feet. (Look up the conversion factor in a textbook or online.)

```
feet=0:1:10;
meters=feet./3.28;
[feet',meters']
```

```
ans =
           0            0
           1      0.30488
           2      0.60976
           3      0.91463
           4       1.2195
           5       1.5244
           6       1.8293
           7       2.1341
           8        2.439
           9       2.7439
          10       3.0488
```

(b) Create a table of conversions from radians to degrees. Start the radians column at 0 and increment by 0.1*p*radian, up to *p* radians. (Look up the conversion factor in a textbook or online.)

```
radians=0:0.1*pi:pi;
degrees=radians*180/pi;
[radians',degrees']  % Or we could also give this table a name
```

```
ans =
          0           0
    0.31416          18
    0.62832          36
    0.94248          54
     1.2566          72
     1.5708          90
      1.885         108
     2.1991         126
     2.5133         144
     2.8274         162
     3.1416         180
```

```
conversion_table=[radians',degrees']
```

```
conversion_table =
          0           0
    0.31416          18
    0.62832          36
    0.94248          54
     1.2566          72
     1.5708          90
      1.885         108
     2.1991         126
     2.5133         144
     2.8274         162
     3.1416         180
```

(c) Create a table of conversions from mi/h to ft/s. Start the mi/h column at 0 and end it at 100 mi/h. Print 15 values in your table. (Look up the conversion factor in a textbook or online.)

```
mph=linspace(0,100,15);
ft_per_sec=mph*5280/3600;
vel_conversion=[mph',ft_per_sec']
```

```
vel_conversion =
          0           0
     7.1429      10.476
     14.286      20.952
     21.429      31.429
     28.571      41.905
     35.714      52.381
     42.857      62.857
         50      73.333
     57.143       83.81
     64.286      94.286
     71.429      104.76
     78.571      115.24
     85.714      125.71
     92.857      136.19
        100      146.67
```

(d) The acidity of solutions is generally measured in terms of *p*H. The *p*H of a solution is defined as –log10 of the concentration of hydronium ions. Create a table of conversions from concentration of hydronium ion to *p*H, spaced logarithmically from .001 to .1 mol/liter with 10 values. Assuming that you have named the concentration of hydronium ions `H_conc`, the syntax for calculating the negative of the logarithm of the concentration (and thus the *p*H) is

`pH = –log10(H_conc)`

```
%d
H_conc=logspace(-3,-1,10);
pH=-log10(H_conc);
pH_table=[H_conc',pH']
```

```
pH_table =
        0.001            3
    0.0016681       2.7778
    0.0027826       2.5556
    0.0046416       2.3333
    0.0077426       2.1111
     0.012915       1.8889
     0.021544       1.6667
     0.035938       1.4444
     0.059948       1.2222
          0.1            1
```

Problem 2.14

The general equation for the distance that a freely falling body has traveled (neglecting air friction) is

$$d = \frac{1}{2}gt^2$$

Assume that *g* =9.8 m > s2. Generate a table of time versus distance traveled for values of time from 0 to 100 seconds. Choose a suitable increment for your time vector. (*Hint:* Be careful to use the correct operators; *t*2 is an array operation!)

```
g=9.8;
t=0:10:100;
d=1/2*g*t.^2;
table_values=[t',d']
```

```
table_values =
            0            0
           10          490
           20         1960
           30         4410
           40         7840
           50        12250
           60        17640
           70        24010
           80        31360
           90        39690
          100        49000
```

Problem 2.15

In direct current applications, electrical power is calculated using Joule's law as

$P = VI$

where P is power in watts

V is the potential difference, measured in volts

I is the electrical current, measured in amperes

Joule's law can be combined with Ohm's law

$V = IR$

to give

$$P = I^2R$$

where R is resistance measured in ohms.

The resistance of a conductor of uniform cross section (a wire or rod for example) is

$$R = \rho \frac{l}{A}$$

where

ρ is the electrical resistivity measured in ohm-meters

l is the length of the wire

A is the cross-sectional area of the wire

This results in the equation for power

$$P = I^2\rho \frac{l}{A}$$

Electrical resistivity is a material property that has been tabulated for many materials. For example

```
rho = [1.59e-8; 1.68e-8; 2.44e-8; 2.82e-8; 1.0e-7];
```

Calculate the power that is dissipated through a wire with the following dimensions for each of the materials listed.

diameter 0.001 m

length 2.00 m

Assume the wire carries a current of 120 amps.

```
d=0.001; %meters
area = pi*d^2/4;
length = 2; %meters

I=120; %amps
P=I.^2.*rho.*length./area
```

```
P =
       583.04
       616.04
```

```
894.73
1034.1
3666.9
```

Problem 2.16

Repeat the previous problem for 10 wire lengths, from 1 m to 1 km. Use logarithmic spacing.

```
length=logspace(1,3,10)
```

```
length =           10       16.681       27.826       46.416       77.426       129.15       215.44
```

```
P_silver=I.^2.*rho(1).*length./area
```

```
P_silver =       2915.2       4862.9       8111.7        13531        22571        37651        62806
```

```
P_copper=I.^2.*rho(2).*length./area
```

```
P_copper =       3080.2       5138.1       8570.9        14297        23849        39783        66361
```

```
P_gold = I.^2.*rho(3).*length./area
```

```
P_gold =       4473.7       7462.5        12448        20765        34638        57779        96382   1
```

```
P_al = I.^2.*rho(4).*length./area
```

```
P_al =       5170.4       8624.7        14387        23999        40032        66778   1.1139e+05   1.8
```

```
P_Fe = I.^2.*rho(5).*length./area
```

```
P_Fe =        18335        30584        51017        85102   1.4196e+05    2.368e+05   3.9501e+05   6.5
```

Problem 2.17

Newton’s law of universal gravitation tells us that the force exerted by one particle on another is

$$F = G\frac{m_1 m_2}{r^2}$$

where the universal gravitational constant *G* is found experimentally to be

G = *6.673* × 10^{-11} N m2/kg2

The mass of each particle is *m*1and *m*2, respectively, and *r* is the distance between the two particles. Use Newton’s law of universal gravitation to find the force exerted by the earth on the moon, assuming that

the mass of the earth is approximately 6 ×10^{24} kg,

the mass of the moon is approximately 7.4 × 10^{22} kg, and

the earth and the moon are an average of 3.9 × 10^{8}m apart.

```
G=6.673e-11;
m_earth=6e24;
m_moon=7.4e22;
r=3.9e8;
F=G*m_earth*m_moon/r^2
```

```
F =    1.9479e+20
```

Problem 2.18

We know that the earth and the moon are not always the same distance apart. Based on the equation in the previous problem, find the force the moon exerts on the earth for 10 distances between 3.8 $\times 10^8$ m and 4.0 $\times 10^8$ m. Be careful when you do the division to use the correct operator.

```
r=linspace(3.8e8,4.0e8,10);
F=G*m_earth*m_moon./r.^2;  %Notice the .^ and ./ operators
[r',F']
```

```
ans =
      3.8e+08   2.0518e+20
   3.8222e+08    2.028e+20
   3.8444e+08   2.0046e+20
   3.8667e+08   1.9817e+20
   3.8889e+08   1.9591e+20
   3.9111e+08   1.9369e+20
   3.9333e+08   1.9151e+20
   3.9556e+08   1.8936e+20
   3.9778e+08   1.8725e+20
        4e+08   1.8518e+20
```

Problem 2.19

Recall from Problem 2.7 that the ideal gas law is:

PV =nRT

and that the Van der Waals modification of the ideal gas law is

$$\left(\left(P + \frac{n^2 a}{v^2}\right)(V - \mathrm{nb})\right) = \mathrm{nRT}$$

Using the data from Problem 2.7, find the value of temperature (*T*), for

(a) 10 values of pressure from 0 bar to 400 bar for volume of 1 L

```
%a
P=linspace(0,400,10);
n=2;
V=1;
a=5.536;
b=0.03049;
R=0.08314472;
% Find the temperature using the ideal gas law
T_ideal=P*V/(n*R)
```

```
T_ideal =          0     267.27     534.54     801.81     1069.1     1336.4     1603.6
```

```
% Find the temperature using Van der Waal's equation
T_VW=(P+n^2*a/V^2)*(V-n*b)/(n*R)
```

```
T_VW =     125.04     376.02     626.99     877.97     1128.9     1379.9     1630.9
```

```
% It would be easier to compare the calculated values if they are listed in
% a table
[T_ideal',T_VW']
```

```
ans =
             0       125.04
        267.27       376.02
        534.54       626.99
        801.81       877.97
        1069.1       1128.9
        1336.4       1379.9
        1603.6       1630.9
        1870.9       1881.9
        2138.2       2132.8
        2405.4       2383.8
```

(b) 10 values of volume from 0.1 L to 10 L for a pressure of 220 bar

```
V=linspace(0.1,10,10);
P=220;
% Find the temperature using the ideal gas law
T_ideal=P*V/(n*R)
```

```
T_ideal =      132.3     1587.6     3042.9     4498.2     5953.5     7408.8     8864.1
```

```
% Find the temperature using Van der Waal's equation
T_VW=(P+n^2*a./V.^2).*(V-n*b)/(n*R)
```

```
T_VW =     571.23     1612.2     3018.6       4456       5902     7351.6     8803.1
```

```
% It would be easier to compare the calculated values if they are listed in
% a table
[T_ideal',T_VW']
```

```
ans =
         132.3       571.23
        1587.6       1612.2
        3042.9       3018.6
        4498.2         4456
        5953.5         5902
        7408.8       7351.6
        8864.1       8803.1
         10319        10256
         11775        11709
         13230        13163
```

c

You might interpret this probem to mean that the 10 values of pressure

and ten values of volume should be used in the same calculation

```
V=linspace(0.1,10,10);
P=linspace(0,400,10);
% Find the temperature using the ideal gas law
T_ideal=P.*V/(n*R)
```

```
T_ideal =            0       320.73       1229.4       2726.2       4810.9       7483.6        10744
```

```
% Find the temperature using Van der Waal's equation
T_VW=(P+n^2*a./V.^2).*(V-n*b)/(n*R)
```

```
T_VW =       519.61       409.76       1253.2       2715.7       4774.9       7425.6        10666
```

```
% It would be easier to compare the calculated values if they are listed in
% a table
[T_ideal',T_VW']
```

```
ans =
            0       519.61
       320.73       409.76
       1229.4       1253.2
       2726.2       2715.7
       4810.9       4774.9
       7483.6       7425.6
        10744        10666
        14593        14496
        19030        18914
        24054        23921
```

Number Display

Problem 2.20

Create a matrix **a**equal to [−1**/**3, 0, 1/3, 2/3], and use each of the built-in format options to display the results:

format short (which is the default)

format long

format bank

format short e

format long e

format short eng

format long eng

format short g

format long g

format +

format rat

```
a=[-1/3,0,1/3,2/3]  %displays as format short automatically
```

```
a =      -0.33333            0      0.33333      0.66667
```

```
format long
a
```

```
a =   -0.333333333333333                   0   0.333333333333333   0.666666666666667
```

```
format bank
a
```

```
a =          -0.33              0          0.33          0.67
```

```
format short e
a
```

```
a =   -3.3333e-01            0   3.3333e-01   6.6667e-01
```

```
format long e
a
```

```
a =     -3.333333333333333e-01                         0     3.333333333333333e-01     6.66666666666666
```

```
format short eng
a
```

```
a =   -333.3333e-003     0.0000e+000   333.3333e-003   666.6667e-003
```

```
format long eng
a
```

```
a =    -333.333333333333e-003    0.00000000000000e+000    333.333333333333e-003    666.666666666667e-00
```

```
format short g
a
```

```
a =      -0.33333            0      0.33333      0.66667
```

```
format long g
a
```

```
a =         -0.333333333333333                         0         0.333333333333333         0.6666666666
```

```
format +
a
```

```
a = - ++
```

```
format rat
a
```

```
a =       -1/3            0              1/3            2/3
```

```
format shortg  %This is my favorite
a
```

```
a =      -0.33333            0      0.33333      0.66667
```

Saving Your Work in Files

Problem 2.21

```
D=0:10:180;
R=D*pi/180;
D_to_R=[D',R']
```

```
D_to_R =
           0            0
          10      0.17453
          20      0.34907
          30       0.5236
          40      0.69813
          50      0.87266
          60       1.0472
          70       1.2217
          80       1.3963
          90       1.5708
         100       1.7453
         110       1.9199
         120       2.0944
         130       2.2689
         140       2.4435
         150        2.618
         160       2.7925
         170       2.9671
         180       3.1416
```

```
save degrees.dat -ascii D_to_R
%Check your current directory to confirm that the file
%was saved
clear
load degrees.dat
degrees
```

```
degrees =
           0            0
          10      0.17453
          20      0.34907
          30       0.5236
          40      0.69813
          50      0.87266
          60       1.0472
          70       1.2217
          80       1.3963
          90       1.5708
         100       1.7453
         110       1.9199
         120       2.0944
         130       2.2689
         140       2.4435
```

```
     150        2.618
     160       2.7925
     170       2.9671
     180       3.1416
```