Chapter 3
Solved Problems

Problem 1

```
>> x=-2:4
x =
    -2    -1     0     1     2     3     4
>> y=x.^3-2*x.^2+x
y =
   -18    -4     0     0     2    12    36
```

Problem 2

```
>> x=-3:3
x =
    -3    -2    -1     0     1     2     3
>> y=(x.^2-2)./(x+4)
y =
    7.0000    1.0000   -0.3333   -0.5000   -0.2000    0.3333
1.0000
```

Problem 3

```
>> x=1:7
x =
     1     2     3     4     5     6     7
>> y=(x-3).*(x.^2+3)./x.^2
y =
   -8.0000   -1.7500         0    1.1875    2.2400    3.2500
4.2449
```

Problem 4

```
>> t=0:8
t =
     0     1     2     3     4     5     6     7     8
>>      y=20*t.^(2/3)./(t+1)-(t+1).^2./exp(0.3*t+5)+2./
(t+1)
y =
     1.9933    10.9800    11.2161    10.8566    10.4286
10.0259    9.6652    9.3455    9.0616
```

Problem 5

Script file

```
h=2; g=9.81;
v=sqrt(2*g*h);
n=1:8;
t=v/g*0.85.^n;
Table=[n' t']
```

Command Window

```
Table =
    1.0000    0.5428
    2.0000    0.4614
    3.0000    0.3922
    4.0000    0.3333
    5.0000    0.2833
    6.0000    0.2408
    7.0000    0.2047
    8.0000    0.1740
```

Problem 6

Script file:

```
g=9.81;
r=0.002;
roal=2700; rog=1260;
V=4*pi*r^3/3;
k=0.0018;
con=sqrt(V*(roal-rog)*g/k);
t=0:0.05:0.35;
v=con*tanh(t*sqrt(V*(roal-rog)*g*k)/(V*roal))
```

Command Window:

```
v =
        0    0.2410    0.3949    0.4669    0.4958    0.5066
0.5106    0.5120
```

Problem 7

Script file:

```
V=120; R=120; L=0.1;
If=V/R;
t99=-L/R*log(1-R*0.99*If/V)
t=linspace(0,t99,10)
i=V/R*(1-exp(-R/L*t))
```

Command Window:

```
t99 =
    0.0038
t =
           0     0.0004     0.0009     0.0013     0.0017
0.0021    0.0026    0.0030    0.0034    0.0038
i =
           0     0.4005     0.6406     0.7846     0.8708
0.9226    0.9536    0.9722    0.9833    0.9900
```

Problem 8

8.a

```
>> ua=[23.5 -17 6];
>> uMa=sqrt(ua(1)^2+ua(2)^2+ua(3)^2)
uMa =
   29.618
```

8.b

```
>> ub=[23.5 -17 6];
>> uMb=sqrt(sum(ua.^2))
uMb =
   29.618
```

Problem 9

```
>> u=[-8 -14 25];
>> un=u./sqrt(sum(u.^2))
un =
   -0.2689   -0.4706    0.8404
```

Problem 10

```
>> v=[3 -2 4];
>> u=[5 3 -1];
>> v.*u
ans =
    15    -6    -4
>> v*u'
ans =
     5
>> v'*u
ans =
    15     9    -3
   -10    -6     2
    20    12    -4
```

Problem 11

```
>> va=[6.5 -5 -4];
>> ua=[-3 8 -2];
>> dotuva=sum(u.*v)
dotuva =
  -51.5000
>> ub=[-3 8 -2];
>> vb=[6.5; -5; -4];
>> ub*vb
ans =
  -51.5000
>> vc=[6.5 -5 -4];
>> uc=[-3 8 -2];
>> dotuvc=dot(vc,uc)
dotuvc =
  -51.5000
```

Problem 12

```
>> v=2:2:10
v =
     2     4     6     8    10
>> a=1./v
a =
    0.5000    0.2500    0.1667    0.1250    0.1000
>> b=1./v.^2
b =
    0.2500    0.0625    0.0278    0.0156    0.0100
>> c=v/2
c =
     1     2     3     4     5
>> d=v./v
d =
     1     1     1     1     1
>>
```

Problem 13

```
>> v=5:-1:1
v =
     5     4     3     2     1
>> a=v.^2
a =
    25    16     9     4     1
>> b=v.^v
b =
        3125         256          27           4
1
>> c=v*5
c =
    25    20    15    10     5
>> d=v-1
d =
     4     3     2     1     0
```

Problem 14

Script file:

```
clear, clc
x=1:2:9;
y=2:3:14;
disp('Part a')
za=x.*y.^2./(x+y)
disp('Part b')
zb=x.*(x.^2-y)-(x-y).^2
```

Command Window:

```
Part a
za =
    1.3333    9.3750   24.6154   47.0556   76.6957
Part b
zb =
    -2     8    76   250   578
```

Problem 15

Script file:

```
clear, clc
p=2.3; w=5.67;
t=1:5;
x=2.8:-0.3:1.6;
y=4:3:17;
disp('Part a')
T=p*(x+y).^2*w./y
disp('Part b')
S=p*(x+y).^2./(w*y)+w*x.*t./(p*y)
```

Command Window:

```
Part a
T =
  150.7540  168.1357  194.1022  222.7102  252.4738
Part b
S =
    6.4149    6.9908    7.6646    8.3687    9.0859
```

Problem 16

Script file:

```
clear, clc
A=[2 0 0]; B=[10 3 0]; C=[4 6 0];
rAB=B-A
rAC=C-A
cross(rAB,rAC);
Area=sqrt(sum(cross(rAB,rAC).^2))
```

Command Window

```
rAB =
     8     3     0
rAC =
     2     6     0
Area =
    42
```

Problem 17

Script file

```
clear, clc
u=[-2 6 5];
v=[5 -1 3];
w=[4 7 -2];
LHS=cross(u,cross(v,w))
RHS=v*dot(u,w)-w*dot(u,v)
```

Command Window:

```
LHS =
   124   -17    70
RHS =
   124   -17    70
```

Problem 18

Script file:

```
clear, clc
r1=[3 -2 1];
r2=[1 2 -4];
Lr1=sqrt(dot(r1,r1));
Lr2=sqrt(dot(r2,r2));
th=acosd(dot(r1,r2)/(Lr1*Lr2))
```

Command Window:

```
th =
  106.9541
```

Problem 19

Script file:

```
clear,clc
g=9.81;  q=70; v0=162;
t=1:5:31;
x=v0*cosd(q)*t;
y=v0*sind(q)*t-g*t.^2/2;
r=sqrt(x.^2+y.^2)
th=atand(y./x)
```

Command Window:

```
r =
  1.0e+003 *
     0.1574     0.8083     1.2410     1.4759     1.5564
1.5773    1.7176
th =
    69.3893    65.7152    60.5858    53.0831    41.6187
24.0270    0.1812
```

Problem 20

Script file:

```
clear, clc
format short g
g=9.81;
vA=560; thA=43;
vB=680; thB=50;
tA=2*vA*sind(thA)/g;
tB=2*vB*sind(thB)/g;
tf=tA;
t=linspace(0,tf,11);
xA=vA*cosd(thA)*t;
yA=vA*sind(thA)*t-0.5*g*t.^2;
xB=vB*cosd(thB)*t;
yB=vB*sind(thB)*t-0.5*g*t.^2;
rABx=xB-xA;
rABy=yB-yA;
Table=[t' rABx' rABy'];
disp(Table)
```

Command Window:

```
         0            0            0
    7.7863       214.42       1082.2
    15.573       428.83       2164.5
    23.359       643.25       3246.7
    31.145       857.66       4328.9
    38.932       1072.1       5411.1
    46.718       1286.5       6493.4
    54.504       1500.9       7575.6
    62.291       1715.3       8657.8
    70.077       1929.7       9740.1
    77.863       2144.2        10822
```

Problem 21

Script file:

```
clear,clc
format long
x=[1.5 1 0.5 0.1 0.01 0.001 0.00001];
y=sin(x)./x
```

Command Window:

```
y =
  0.664996657736036  0.841470984807897  0.958851077208406
0.998334166468282  0.999983333416666  0.999999833333342
0.999999999983333
```

Problem 22

Script file:

```
clear, clc
format long
x=[5 3 2 1.5 1.1 1.001 1.00001];
y=(x.^2-1)./(x-1)
```

Command Window:

```
y =
          6.000000000000000          4.000000000000000
3.000000000000000                    2.500000000000000
2.100000000000000                    2.000999999999918
2.000010000000827
```

Problem 23

Script file:

```
clear,clc
na = 1:10;
ya = 1./2.^na;
disp('Part a')
Sa = sum(ya)
aPercentError=abs(1-Sa)*100
nb = 1:20;
yb = 1./2.^nb;
disp('Part b')
Sb = sum(yb)
bPercentError=abs(1-Sb)*100
nc = 1:30;
yc = 1./2.^nc;
disp('Part c')
Sc = sum(yc)
cPercentError=abs(1-Sc)*100
nd = 1:40;
yd = 1./2.^nb;
disp('Part d')
Sd = sum(yd)
dPercentError=abs(1-Sc)*100
```

Command Window:

```
Part a
Sa =
   0.999023437500000
aPercentError =
   0.097656250000000
Part b
Sb =
   0.999999046325684
bPercentError =
    9.536743164062500e-005
Part c
Sc =
   0.999999999068677
```

```
cPercentError =
    9.313225746154785e-008
Part d
Sd =
   0.999999046325684
dPercentError =
    9.313225746154785e-008
```

Problem 24

Script file:

```
clear,clc
na = 0:10;
ya = (-3).^(-na)./(2*na+1);
disp('Part a')
Sa = sqrt(12)*sum(ya)
aPercentError=abs((pi-Sa)/pi)*100
nb = 0:20;
yb = (-3).^(-nb)./(2*nb+1);
disp('Part b')
Sb = sqrt(12)*sum(yb)
bPercentError=abs((pi-Sb)/pi)*100
nc = 0:30;
yc = (-3).^(-nc)./(2*nc+1);
disp('Part c')
Sc = sqrt(12)*sum(yc)
cPercentError=abs((pi-Sc)/pi)*100
```

Command Window:

```
Part a
Sa =
   3.141593304503081
aPercentError =
    2.071921346691696e-005
Part b
Sb =
   3.141592653595635
bPercentError =
    1.859564303762336e-010
```

```
Part c
Sc =
   3.141592653589794
cPercentError =
    2.827159716856460e-014
>>
```

Problem 25

Script file:

```
clear,clc
clear,clc
Lmax=58; K=0.45; tau=0.65;
t=0:5;
L=Lmax*(1-exp(-K*(t+tau)))
```

Command Window:

```
L =
    14.7091    30.3965    40.3992    46.7772    50.8441
53.4372
```

Problem 26

Script file:

```
clear, clc
th=75; v=110; g=9.81;
a=g/(2*v^2*(cosd(th))^2);
b=-tand(th);
c=200;
d=sqrt(b^2-4*a*c);
x1=(-b+d)/(2*a);
x2=(-b-d)/(2*a);
xp=linspace(0,x1,100);
y=tand(th).*xp-g/(2*v^2*(cosd(th))^2)*xp.^2;
plot(xp,y)
[hm, xm]=max(y);
hmax=hm
```

```
xhmax=xp(xm)
```

Command Window:

```
hmax =
  575.3948
xhmax =
  309.6821
```

Problem 27

```
>> A=[2 4 -1; 3 1 -5; 0 1 4];
>> B=[-2 5 0; -3 2 7; -1 6 9];
>> C=[0 3 5; 2 1 0; 4 6 -3];
```

27*a*

```
>> A+B
ans =
     0     9    -1
     0     3     2
    -1     7    13
>> B+A
ans =
     0     9    -1
     0     3     2
    -1     7    13
```

27.*b*

```
>> A+(B+C)
ans =
     0    12     4
     2     4     2
     3    13    10
>> (A+B)+C
ans =
     0    12     4
     2     4     2
     3    13    10
```

27.*c*

```
>> 5*(A+C)
ans =
    10    35    20
```

```
    25    10   -25
    20    35     5
>> 5*A+5*C
ans =
    10    35    20
    25    10   -25
    20    35     5
```

27.*d*

```
>> A*(B+C)
ans =
   -11    16    32
   -22   -33    -8
    11    51    31
>> A*B+A*C
ans =
   -11    16    32
   -22   -33    -8
    11    51    31
```

Problem 28

```
>> A=[2 4 -1; 3 1 -5; 0 1 4];
>> B=[-2 5 0; -3 2 7; -1 6 9];
>> C=[0 3 5; 2 1 0; 4 6 -3];
```

28.*a*

```
>> A*B
ans =
   -15    12    19
    -4   -13   -38
    -7    26    43
>> B*A
ans =
    11    -3   -23
     0    -3    21
    16    11     7
```

Answer: No, A*B does not equal B*A

28.*b*

```
>> A*(B*C)
ans =
   100    81  -132
  -178  -253    94
```

```
   224   263  -164
>> (A*B)*C
ans =
   100    81  -132
  -178  -253    94
   224   263  -164
```

Answer: Yes, A*(B*C) does equal (A*B)*C

28.*c*

```
>> (A*B)'
ans =
   -15    -4    -7
    12   -13    26
    19   -38    43
>> B'*A'
ans =
   -15    -4    -7
    12   -13    26
    19   -38    43
```

Answer: Yes, $(A*B)^t$ does equal B^t*A^t

28.*d*

```
>> (A+B)'
ans =
     0     0    -1
     9     3     7
    -1     2    13
>> A'+B'
ans =
     0     0    -1
     9     3     7
    -1     2    13
```

Answer: Yes, $(A+B)^t$ does equal A^t+B^t

Problem 29

```
>> A=randi(10,4)
A =
     9     7    10    10
    10     1    10     5
     2     3     2     9
    10     6    10     2
```

29.*a*

```
>> A*A
ans =
   271   160   280   235
   170   131   180   205
   142    77   144    71
   190   118   200   224
```

Matrix multiplication.

29.*b*

```
>> A.*A
ans =
    81    49   100   100
   100     1   100    25
     4     9     4    81
   100    36   100     4
```

Each of element in A is squared.

29.*c*

```
>> A\A
ans =
    1.0000         0         0         0
         0    1.0000         0         0
         0         0    1.0000         0
         0         0    0.0000    1.0000
```

Solution for *I* of *A*I=A*

29.*d*

```
>> A.\A
ans =
     1     1     1     1
     1     1     1     1
```

```
     1     1     1     1
     1     1     1     1
```

Each element of A is divided by itself.

29.*e*

```
>> det(A)
ans =
  -484
```

Determinant of *A*.

29.*f*

```
>> inv(A)
ans =
   -1.0000    0.1198    0.8884    0.7025
    0.0000   -0.1777    0.0620    0.1653
    1.0000   -0.0207   -0.9463   -0.6901
    0.0000    0.0372    0.1033   -0.0579
```

Inverse of *A*.

Problem 30

Script file:

```
u=0:.05:1;
k=.25;
p=k*u.*(1-u)./(k+u);
pmax05 = max(p)
u=0:.01:1;
p=k*u.*(1-u)./(k+u);
pmax01 = max(p)
E = abs((pmax01-pmax05)/pmax01)*100
```

Command Window:

```
>> format long
pmax05 =
   0.095454545454545
pmax01 =
```

```
   0.095491071428571
E =
   0.038250669386692
```

Problem 31

```
>> A=[3 -2 5; -4.5 2 3; 5 1 -2.5];
>> C=[7.5;5.5;4.5];
>> x=A\C
x =
    1.2692
    2.8113
    1.8630
```

Problem 32

```
>> A=[3 1.5 1 0.5 4; -2 1 4 -3.5 2; 6 -3 2 2.5 1; 1 4 -
3 0.5 -2; 3 2 -1 1.5 -3];
>> C=[-11.75; 19; -23; -1.5; -3.5];
>> x=A\C
x =
   -4.0000
    2.5000
    4.0000
    1.0000
   -2.0000
```

Problem 33

x Gallons oforange blend
y Gallons of pineapple blend
z Gallons of mango blend

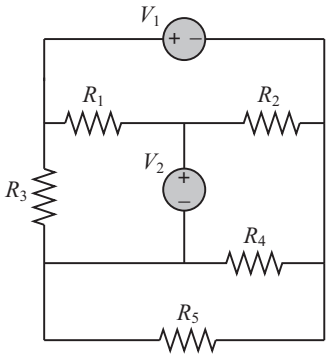
$$3 \cdot 0.25x + 0.25y + 0.5 \cdot 0.25z = 7600$$
$$0.75 \cdot 0.25x + 2.5 \cdot 0.25y + 0.5 \cdot 0.25z = 4900$$
$$0.25 \cdot 0.25x + 0.5 \cdot 0.25y + 3 \cdot 0.25z = 3500$$

Command window:

```
>> A=0.25*[3 1 0.5; 0.75 2.5 0.5; 0.25 0.5 3];
>> C=[7600; 4900; 3500];
>> x=A\C
x =
  1.0e+003 *
    8.0000
    4.8000
    3.2000
```

8000 Gallons oforange blend
4800 Gallons of pineapple blend
3200 Gallons of mango blend

Problem 34



Script file:

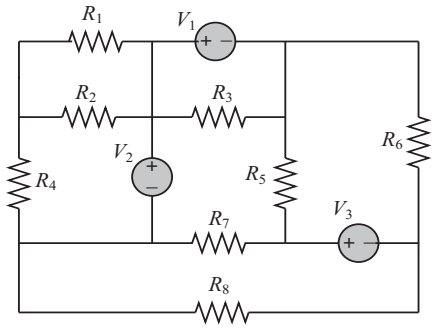
```
clear, clc
V1=12; V2=24;
R1=20; R2=12; R3=8; R4=6;
R5=10;
A=[-(R1+R2) R1 R2 0
R1 -(R1+R3) 0 0
R2 0 -(R2+R4) R4
0 0 R4 -(R4+R5)]
B=[V1; V2; -V2; 0]
I=A\B
% A table with the value of the current in each resistor
RI=[1 abs(I(1)-I(2))
    2 abs(I(1)-I(3))
    3 abs(I(2))
    4 abs(I(3)-I(4))
    5 abs(I(4))]
```

Command Window:

```
A =
   -32    20    12     0
    20   -28     0     0
    12     0   -18     6
     0     0     6   -16
B =
    12
    24
   -24
     0
I =
   -1.2667
   -1.7619
    0.5587
    0.2095
RI =
    1.0000    0.4952
    2.0000    1.8254
    3.0000    1.7619
```

```
4.0000    0.3492
5.0000    0.2095
```

Problem 35



Script file:

```
V1=18; V2=30; V3=18;
R1=10; R2=20; R3=8; R4=16;
R5=14; R6=24; R7=20; R8=12;
A=[(R1+R2) 0 -R2 0 0 0
0 R3 0 -R3 0 0
-R2 0 (R2+R4) 0 0 0
0 -R3 0 (R3+R5+R7) -R5 -R7
0 0 0 -R5 (R5+R6) 0
0 0 0 -R7 0 (R7+R8)]
B=[0; -V1; -V2; V2; V3; -V3]
I=A\B
% A table with the value of the current in each resistor
RI=[1 abs(I(1))
    2 abs(I(1)-I(3))
    3 abs(I(2)-I(4))
    4 abs(I(3))
    5 abs(I(4)-I(5))
    6 abs(I(5))
    7 abs(I(4)-I(6))
    8 abs(I(6))]
```

Command Window:

```
A =
    30     0   -20     0     0     0
     0     8     0    -8     0     0
   -20     0    36     0     0     0
     0    -8     0    42   -14   -20
     0     0     0   -14    38     0
     0     0     0   -20     0    32
B =
     0
   -18
   -30
    30
    18
   -18
```

```
I =
   -0.8824
   -1.7983
   -1.3235
    0.4517
    0.6401
   -0.2802
RI =
    1.0000    0.8824
    2.0000    0.4412
    3.0000    2.2500
    4.0000    1.3235
    5.0000    0.1884
    6.0000    0.6401
    7.0000    0.7319
    8.0000    0.2802
```