Scilab Textbook Companion for A Text Book of Physical Chemistry by K. l. Kapoor[1]

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July 31, 2019

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: A Text Book of Physical Chemistry

Author: K. l. Kapoor

Publisher: Macmillan, India

Edition: 1

Year: 1984

ISBN: 33904222

Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

Chapter 1

Equilibrium between phases

Scilab code Exa 1.5.1 Ex 1

```
clear ;
clc ;
T1 = 234.5 ;// Temperature in K
P = 1 ; // Pressure in atm
rho1 = 14.19 // Density of solid Hg in g/(cm^3)
rho2 = 13.70 // Density of liquid Hg in g/(cm^3)
V = 200.59 // volume of liquid and solid in g/mol
delV = ((V/rho2)-(V/rho1))*(10^-3)// in dm^3/mol
delTdelP = 0.0051 // K/atm
R1 = 8.314 // in J
R2 = 0.082 // in (dm)^3/atm
delH = ((delV*T1)/(delTdelP))*(R1/R2)*10^-3;//molar
   heat of fusion in kJ/mol
printf('delH = %.3f (KJ)/mol',delH)
T2 = 273// in K
delP = (delH*(R2/R1)*(T2-T1))/(delV*T1)*10^3;//
   pressure required to raise melting point to T2 in
    atm
printf('\ndelP = %d atm ',delP)


```

```
19 //Example in page 10
```

Scilab code Exa 1.5.2 Ex 2

```
1  clear;
2  clc;
3  T1=373.15;//in K
4  P=1;//atm
5  Vv=1674;//in cm^3/gm
6  delPdelT=27.12;//in torr/K
7  R1=8.314;//in J
8  R2=0.082;//in atm/(dm)^3
9  delH=((delPdelT)/760)*T1*((Vv*10^-3)*18)*(R1/R2)
10 printf('delH =%d J/mol',delH)
11
12 ////Example in page 15
```

Scilab code Exa 1.5.3 Ex 3

```
1  clear;
2  clc;
3  T1=313.75;//in K
4  P1=59.1;//in torr
5  T2=353.15;//in K
6  P2=298.7;//in torr
7  R=2.303*8.314;//in J/(K*mol)
8  delH=R*log10(P2/P1)*((T2*T1)/(T2-T1))
9  printf('delH=%d J/mol',delH)
```

Scilab code Exa 1.5.4 Ex 4

```
clear
clc
T1=325.15;//in K
T2=338.15;//in K
P2=760;//in torr
DelHm_v=10.5;//
P1=P2/(10^((DelHm_v/2.303)*((T2/T1)-1)));//in torr
printf('P1=%.1f torr',P1)
P=200;//in torr
T=T2/(1+((2.303/10.5)*log10(P2/P)));//in K
printf('\nT=%.1d K',T)
I=log10(P2)-(((DelHm_v*T2)/2.303)*(-1/T2));//
printf('\nI=%.3f',I)

//There are some errors in the solution given in
   textbook
//page 16
```

Scilab code Exa 1.5.5 Ex 5

```
clear;
clc;
P=760;//in torr
dP=52;//in torr
dT=2;//in K
DelH_RTb=10.5;//Trouton rule
Tb=(DelH_RTb*P)/(dP/dT)
printf('Tb=%.1f K',Tb)
R=8.314;//in J/Kmol
DelH_v=(DelH_RTb*R*Tb)
printf('\nDelH_v=%1d J/mol',DelH_v)

//There are some errors in the solution given in
   textbook
//page 17
```

Scilab code Exa 1.5.6 Ex 6

```
clear;
clc;
T1=373.15;//in K
P1=76.0;//in cmHg
P2=77.0;//in cmHg
DelHm_v=2255;//in J/gm
Vm_v=1664;//in cm^3/mol
Vm_l=1;//in cm^3/mol
R=8.314;//in J/Kmol
T2=(1/((1/T1)-((2.303*R/(DelHm_v*18))*log10(P2/P1))))
printf('T2=%.1f K',T2)

//There are some errors in the solution given in
   textbook
//page 18
```

Scilab code Exa 1.5.7 Ex 7

```
clear;
clc;
T1=373.15;//in K
P1=76.0;//in cmHg
T2=363.15//in K
DelHm_v=2268;//in J/gm
R=8.314;//in J/Kmol
P2=P1*(10^((DelHm_v*18/(2.303*R))*(1/T1-1/T2)))
printf('P2=%.1f cmHg',P2)

//page 19
```

Scilab code Exa 1.5.8 Ex 8

```
clear
clc
T1=456.15;//boiling temperature of iodine in K
T2=389.65;//vapour pressure temperature of iodine in
    K
P1=760;//pressure in torr
P2=100;//vapour pressure in torr
DelHm_f=15.65;//heat of fusion in kJ/mol
R=8.314;//in J/K
DelHm_v=(2.303*R*log10(P1/P2))/((1/T2)-(1/T1));//
   heat of vapourization in J/mol
DelHm_s=(DelHm_f*1000)+DelHm_v;//heat of sublimation
    in J/mol
T=311.85;//temperature at solid vapour equilibrium
   in K
P=1;//pressure at solid vapour equilibrium in torr
K1=(DelHm_s)/(2.30*R);//
K2=(DelHm_v)/(2.30*R);//
T0=(K1-K2)/((K1*(1/T))-(K2*(1/T2))-log10(P2));//
   triple point temperature in K
printf('\nT0=%.1f K',T0)
P0=10^(K1*((1/T)-(1/T0)));//triple point pressure in
    torr
printf('\nP0=%.2f torr',P0)

//There are some errors in the solution given in
   textbook
//page 19
```

Scilab code Exa 1.5.9 Ex 9

```
clear
clc
K1=5.36;//
K2=4.95;//
T1=-2875;//in K
T2=-2740;//in K
R=8.314;//in J/Kmol
T=(T2-T1)/(K1-K2);//triple point temperature in K
printf('T=%.1f K',T)
P=(10^((T1/T)+K1));//triple point pressure in atm
printf('\nP=%.7f K atm',P)
DelHm_s=2.303*R*(-T1);//molar enthalpy of
   sublimation in J/mol
DelHm_v=2.303*R*(-T2);//molar enthalpy of
   vapourization in J/mol
DelHm_f=DelHm_s-DelHm_v;//molar enthalpy of fusion
   in J/mol
printf('\nDelHm_f=%.1d J/mol',DelHm_f)
DelSm_f=DelHm_f/T;//molar entropy of fusion  in J/
   Kmol
printf('\nDelSm_f=%.2f J/Kmol',DelSm_f)

//There are some errors in the solution given in
   textbook
//page 20
```

Scilab code Exa 1.5.10 Ex 10

```
clear
clc
T=273;//in K
R=8.314;//in J/Kmol
DelHm=T*2.303*R;//in J/mol
printf('DelHm=%.1d J/mol',DelHm)

```

```
8 //page 16
```

Scilab code Exa 1.5.11 Ex 11

```
1  clear;
2  clc;
3  DelG=2866;//in J/mol
4  rhoG=2.25;//in gm/cm^3
5  rhoD=3.52;//in gm/cm^3
6  MC=12;//mass of carbon
7  P1=1;//in atm
8  P2=(-DelG/(MC/rhoD-MC/rhoG))+P1
9  printf('P2=%.1f Jcm^-3',P2)
10 R1=0.082;//in dm^3atm
11 R2=8.314;//in J
12 P21=P2*(R1*1000/R2)
13 printf('\nP21=%.1d atm',P21)
14
15 //There are some errors in the solution given in
      textbook
16 //page 23
```

Scilab code Exa 1.5.12 Ex 12

```
1 clear
2 clc
3 rho1=1.21;//in gm^cm-3
4 rho2=1.10;//in gm^cm-3
5 P2=3260;//in atm
6 T2=298.15;//in K
7 P1=2450;//in atm
8 T1=242.15;//in K
9 MI=18;//molar mass of ice in gm/mol
```

```
10 R1=8.314;//in J
11 R2=0.082;//in atm dm^3
12 DelH_Tr=((P2-P1)*(R1/R2)*(MI/rho2-MI/rho1)*T1)/(T2-
      T1)
13 printf('DelH_Tr=%.3f J/mol',DelH_Tr)
14
15 //There is an error in the answer given in the
      textbook
16 //In text book he took (T1-T2)=6,but actually (T1-T2
      )=56
17 //page 23
```

Scilab code Exa 1.5.13 Ex 13

```
1 clear
2 clc
3 DelVm_tr=0.0126;//in cm^3/gm
4 P=1;//in atm
5 Ti=368.65;//in K
6 DelTDelP=0.035;//in K/atm
7 R1=8.314;//in J
8 R2=0.082;//in dm^3atm
9 DelHm_tr=Ti*(DelVm_tr*32/1000)*1/(DelTDelP)*(R1/R2)
10 printf('DelHm_tr=%.1f J/mol',DelHm_tr)
```

Scilab code Exa 1.7.1 Ex 14

```
1 clear
2 clc
3 T=263.15;//in K
4 P2=1.95;//in torr
5 rho=0.920;//in gm/cm^3
6 P=1;//in atm
```

```
R=0.082;//in dm^3atm/(molK)
P1=P2*exp((18/(rho*1000))*(P-(P2/760))/(R*T))
printf('P1=%.3f torr',P1)

//page 29
```

Scilab code Exa 1.7.2 Ex 15

```
clear
clc
P0=100;//in atm
P=1;//in atm
P2=31.82;//in torr
rho=0.996;//in gm/cm^3
R=0.082;//in dm^3atm/(molK)
T=303.15;//in K
P1=P2*(10^(((18/(rho*1000))*(P0-P))/(2.303*R*T)))
printf('P1=%.1f torr',P1)

//page 29
```

Chapter 2

Colligative properties

Scilab code Exa 2.2.1 Ex 1

```
clear
clc
M1=20;//mass of acetic acid in gm
M2=80;//mass of water in gm
mM=60;//molar mass of acetic acid in gm
Vm1=M1/60;//in mol
Vm2=M2/18;//in mol
rho=1.026;//in gm/cm^3
X=Vm1/(Vm1+Vm2);//mole fraction of acetic acid
printf('X=%.3f',X)
B=Vm1/(M2/1000);//molality of acetic acid
printf('\nB=%.3f mol/kg',B)
V=(M1+M2)/rho
C=(Vm1)/(V/1000);//molarity of acetic acid
printf('\nC=%.3f moldm^-3',C)

//There are some errors in the solution given in
   textbook
//In textbook the value of X is given in fraction
//page 36
```

Scilab code Exa 2.2.2 Ex 2

```
clear
clc
C=5;//molarity in mol
mM=100;//molar mass in gm
rho=1.289;//in gm/cm^3
M1=C*mM;//mass of solute
M2=(rho*1000)-M1;//mass of solvent
V=(M2)/18;//volume of water solvent in mol
X=(C)/(V+C);//mole fraction of solute
printf('X=%.4f',X)
B=(C)/(M2/1000)
printf('\nB=%.3f mol/kg',B)

//page 23
```

Scilab code Exa 2.4.1 Ex 3

```
clear
clc
T=303;//in K
m2=10;//mass of solute in gm
m1=80;//mass of solute acetone in gm
P1=271;//in torr
P2=283;//in torr
M1=58;//in gm/mol
M2=((m2*M1)/(((P2-P1)/P2)*m1))-((M1*m2)/m1)
printf('M2=%.1f gm/mol',M2)

//page 39
```

Scilab code Exa 2.4.2 Ex 4

```
clear
clc
P1=74.01;//in torr
P2=74.66;//in torr
m2=2;//in gm
m1=100;//in gm
M1=78;//in gm
M2=((m2*M1)/(((P2-P1)/P2)*m1))-((M1*m2)/m1)
printf('M2=%.1f gm/mol',M2)
nCH=94.4/5.6;//mass ratio of C and H
N=nCH*(1/12);//atomic ratio
printf('\nN=%.1f',N)

//atomic ratio is 7:5 (here N is showed decimals)

EM=(12*7)+(1*5);//empirical mass
K=M2/EM;//No. of units C7H5
printf('\nK=%1f',K)

//Approximately equal to 2, Molecular Formula C14H10
//There are some errors in the solution given in
   textbook
//page 40
```

Scilab code Exa 2.4.3 Ex 5

```
clear
clc
m1=100;//amount of water in gm
M1=18;//in gm
```

```
5 m2=1;//amount of urea in gm
6 M2=60;//in gm
7 m3=2;//amount of sucrose in gm
8 M3=342;//in gm
9 X=(m1/M1)/((m1/M1)+(m2/M2)+(m3/M3));//mole fraction
    of solvent
10 P2=23.756;//in torr
11 T=298;//in K
12 P1=P2*X;//vapour pressure of solution intorr
13 printf('P1=%.2f torr',P1)
14
15 //There are some errors in the solution given in
    textbook
16 //page 39
```

Scilab code Exa 2.7.3 Ex 6

```
1 clear
2 clc
3 m1=0.5126;//in dissolved mass in gm
4 mM1=128.2;//molar mass of napthalene in gm
5 m0=50;//mass of solvent in gm
6 B=(m1/mM1)/(m0/1000);//Molality of solution in mol/
    kg
7 printf('B=%.5f mol/kg',B)
8 delTb=0.402;//change in tempereature of napthalene
    in K
9 Kb=delTb/B;
10 delTbs=0.647//chamge in temp for unknown solution in
    K
11 m2=0.6216;//mass of unknown solute
12 M=(Kb*m2*1000)/(delTbs*m0);//molar mass of unknown
    solute
13 printf('\nM=%.2f gm/mol',M)
14
```

```
15 //page 51
```

Scilab code Exa 2.7.4 Ex 7

```
1  clear
2  clc
3  P0=100;//vapour pressure in torr
4  P2=760;//in torr
5  T2=353.15;//in K
6  T1=300.15;// in K
7  DelSm_v=87.03;//entropy in J/Kmol
8  R=8.314;//in J/Kmol
9  P1=P2/(10^((DelSm_v*(T2-T1))/(2.303*R*T1)))
10 printf('P1=%.1f torr',P1)
11 X=(P1-P0)/P1;//Mole fraction of solute
12 printf('\nX=%.4f',X)
13 T0=(1/T2)+((R*log(1-X))/(DelSm_v*T2))
14 Tb=1/T0;//Boiling point of solution
15 printf('\nTb=%.1f K',Tb)
16
17 //page 52
```

Scilab code Exa 2.7.5 Ex 8

```
1 clear
2 clc
3 M1=76;//molar mass of CS2 in gm
4 w2=3.795;//weight of S in 100gm of CS2 in gm
5 w1=100;//weight of CS2
6 R=8.314;//in J/Kmol
7 Tb=319.81;//boiling point of CS2 in K
8 Tbp=319.45;//boiling point of pure CS2 in K
9 DelHm_v=351.87;//enthalpy of vaporization in J/gm
```

```
10 M2=(w2*M1*R*(Tb^2))/(w1*(Tb-Tbp)*DelHm_v*76)
11 printf('M2=%.1f gm/mol',M2)
12 N=M2/32;//no. of s atoms
13 printf('\nN=%.1f',N)
14
15 //Molecular formula S8
16 //There are some errors in the solution given in
      textbook
17 //page 53
```

Scilab code Exa 2.8.2 Ex 9

```
1  clear
2  clc
3  M1=152.2;//molar mass of carbon in gm
4  T1=451.55;//melting point temp in K
5  T2=433.85;//melting point temp in K(for unknown
      compound)
6  w2=0.0386;//mass of unknown compound in gm
7  w1=0.522;//mass of camphor in solution in gm
8  R=8.314;//J/Kmol
9  DelHm_f=6.844;//in KJ
10 Kf=(((R*T1^2)/(DelHm_f*10^3))*(M1/1000))
11 printf('Kf=%.1f',Kf)
12 DelT_f=(T1-T2);
13 B=(DelT_f/Kf);//molality of the solution in mol/kg
14 printf('\nB=%.2f mol/kg',B)
15 M2=(w2/B)*(1000/w1);
16 printf('\nM2=%.1f gm/mol',M2)
17 Z=92.3/7.7;//mass ratio of wC and wH
18 N0=1/12;//atomic ratio of H and C
19 K=(Z*N0);
20 printf('\nK=%.1f',K)
21
22 //Clearly we get K=1.0 implies empirical formula is
```

```
    CH
Me=13;//empirical mass in gm
N=(M2/Me);//no. of units of CH
printf('\nN=%.1f',N)

//Taking approximately equal to 12 Molecular formula
    is C12H12
//There are some errors in the solution given in
    textbook
//page 58
```

Scilab code Exa 2.8.3 Ex 10

```
clear
clc
n1=0.1;//amount of napthalene in mol
n2=0.9;//amount of benzene in mol
Tf=278.5;//freezing temperature of C6H6 in K
Tb=353;//boiling temperature of C6H6 in K
P1=670;//vapour pressure in torr
P2=760;//in torr
R=8.314;//in J/Kmol
M1=78;//atomic mass of C6H6
DelHm_f=10.67;//in KJ
X1=(P2-P1)/P2;//
nT=(n1/X1);//
nb=(nT-n1);//
Kfb=((R*Tf^2)/(DelHm_f*1000))*(M1/1000);//
printf('Kfb=%.3f Kg/mol',Kfb)
B=(n1/(nb*M1)*1000);//molality of the solution
printf('\nB=%.3f mol/kg',B)
DelTf=(Kfb*B);//in K
T=(Tf-DelTf);//in K
printf('\nT=%.2f K',T)

```

```
23 //There are some errors in the solution given in
      textbook
24 //page 59
```

Scilab code Exa 2.9.1 Ex 11

```
1  clear
2  clc
3  x1=[0.0200,0.0150,0.0100,0.0075,0.0050,0.00025]
4  y2=[0.104,0.101,0.099,0.098]
5  x2=[0.0200,0.0150,0.0100,0.0050]
6  y1=[0.585,0.440,0.300,0.230,0.18,0.140]
7  plot(x1,y1,'go-',x2,y2,'ro-')
8  [m1,c1]=reglin(x1,y1)
9  [m2,c2]=reglin(x2,y2)
10 R=82.0;//in cm^2atm/Kmol
11 T=298;//in K
12 M=R*T/c2;//molar mass of polyisobutylene in gm/mol
13 printf('M=%.1d gm/mol',M)
14
15 //There is some error in the solution given in
      textbook
16 //There are some errors in the solution given in
      textbook
17 //page 68
```

Scilab code Exa 2.9.2 Ex 12

```
1 clear
2 clc
3 h=3.9;//height in mm
4 rho=1.0;//density of solution
5 g=980.7;//acceleration due to gravity in cm/s^2
```

```
6  P=((h/10)*rho*g);//osmotic pressure in gm/(cms^2)
7  V=1000;//volume in cm^3
8  T=25;//temperatur in C
9  w2=1;//weight of serum albumin
10 R=8.314;//in J/Kmol
11 M2=(w2*(R*10^7)*(T+273))/(P*V);//molar mass of serum
       albumin
12 printf('M2=%.3f *10^4 g/mol',M2/10^4)
13
14 //The above result is in CGS units
15
16 //The following results are in SI units
17 p=(P/10);//osmotic pressure in N/m^2
18 m2=(M2/10^3);//molar mass of serum albumin
19 printf('\nm2=%.2f Kg/mol',m2)
20
21 //page 67
```

Scilab code Exa 2.9.3 Ex 13

```
1  clear
2  clc
3  w1=1;//amount of glucose C6H12O6 in gm
4  w2=1;//amount of sucrose C12H12022 in gm
5  n=(w1/180)+(w2/342);//amount of solute
6  R=8.314;//in J/Kmol
7  T=25;//in C
8  V=1000;//volume of water in gm
9  P=(n*R*(T+273))/(V*10^-6);//osmotic pressure of
       solution
10 printf('P=%.3f *10^4 N/m^2',P/10^4)
11 w=(w1+w2);//weight of solute
12 M=(w*R*(T+273))/(P*(V*10^-3));//molar mass of solute
13 printf('\nM=%.4f kg/mol',M)
14 Mn=((w1*10^-3)+(w2*10^-3))/(n);//average molar mass
```

```
    in Kg/mol
15 printf('\nMn=%.4f kg/mol',Mn)
16
17 //page 67
```

Scilab code Exa 2.10.1 Ex 14

```
1  clear
2  clc
3  P=2.47;//osmotic pressure in atm
4  DelHm_v=539*18;//in cal/mol
5  R=0.082;//in litreatm
6  Vm=18.1;//molar volume of water
7  T=303;//in K
8  Tb=373;//boiling point temperature in K
9  DelTb=(P*Vm*10^-3*(Tb^2))/(DelHm_v*(R/1.987)*T)
10 printf('DelTb=%.4f K',DelTb)
11
12 //The above calculations are done in CGS units
13
14 //To convert them into SI units the following
       changes are done
15 R=8.314;//in J/Kmol
16 P=2.47*101325;//in N/m^2
17 Vm=18.1*10^-6;//in m^3/mol
18
19 //Both answers come out be same
20 //page 70
```

Scilab code Exa 2.10.2 Ex 15

```
1  clear
2  clc
```

```
rho=1.59;//density of CCl4 in kg/dm^3
M1=154;//molar mass of CCl4 in kg/mol
DelTb=0.60;//boiling point of CCl4 in K
Kb=5.03;//in Kkg/mol
m=DelTb/Kb;
m2=3;//amount added to CCl4 in gm
m1=100;//amount of CCl4 in gm
M2=(m2*10^-3)/(m1*10^-3*m);//molar mass of substance
printf('M2=%.3f kg/mol',M2)
Kf=31.8;//freezing point depression in Kkg/mol
DelTf=Kf*m
printf('\nDelTf=%.3f K',DelTf)
P=(m2*10^-3/M2)/(((m2*10^-3)/M2)+((m1*10^-3)/(M1
   *10^-3)));//relative vapour pressure DelP/P1
printf('\nP=%.5f',P)
V1m=m1*10^-3/(rho);//volume in dm^3
R=0.082;//in dm^3atm/Kmol
T=298;//Temperature in K
P0=((m2/250)*R*T)/V1m;//osmotic pressure in atm
printf('\nP0=%.3f atm',P0)

//There are some errors in the solution given in
   textbook
//page 71
```

Scilab code Exa 2.11.1 Ex 16

```
clear
clc
w2=0.122;//amount of benzoic acid in kg
w1=1;//amount of benzene in kg
Tb1=353;//boiling point of benzene in K
Tb2=354.5;//boiling point at which actually boiling
   of benzene starts in K
DelH_v=394.57;//in J/gm
```

```
8 M1=w2/0.122;//amount of benzoic acid in mol
9 R=8.314;//in J/Kmol
10 M2=((M1*78*10^-3)*R*Tb1^2*w2)/(w1*(Tb2-Tb1)*(DelH_v
    *78));//apparant molar mass of benzoic acid in kg
    /mol
11 printf('M2=%.4f kg/mol',M2)
12 alpha=2*(1-(w2/M2));//degree of dimerisation in mol
13 printf('\nalpha=%.4f mol',alpha)
14
15 //There are some errors in the solution given in
    textbook
16 //page 75
```

Scilab code Exa 2.11.2 Ex 17

```
1 clear
2 clc
3 w2=0.011;//amount of barium nitrate in kg
4 M2=0.2613;//molar mass of barium nitrate inkg/mol
5 w1=0.1;//amount of water in kg
6 Kb=5.2;//for 100gm of water in K
7 m=(w2/M2)/w1;//molality of solution in mol/kg
8 DelTb_0=Kb/10*m;//in K
9 T=100.46;//boiling point of water
10 i=(T-100)/DelTb_0;//van't hoff factor
11 v=3;
12 alpha=(i-1)/(v-1);//degree of ionization
13 printf('alpha=%.2f',alpha)
14
15 //page 75
```

Scilab code Exa 2.11.3 Ex 18

```
clear
clc
M1=324.6;//molar mass of Hg(NO3)2 in gm
m1=3.24;//amount of Hg(NO3)2 in gm dissolved in
   water
w=1;//amount of water in kg
M0=(m1/M1)*(1/w);//molality of the solution in K
Kf=1.86;//in Kkg/mol
DelTf_0=(Kf*M0);// here DelTf_0 is negative
DelTf=0.0558;//freezing point of the solution here
   DelTf is negative
i=(DelTf/DelTf_0);//van't hoff factor
v=3;
alpha=(i-1)/(v-1);//degree of dissociation
printf('alpha=%1d',alpha)
M2=271.5;//molar mass of HgCl2 in gm
m2=10.84;//amount of HgCl2 dissolved in water in gm
M=(m2/M2)*(1/w);//molality of HgCl2 solution in mol/
   kg
DelTf1_0=Kf*M;//for HgCl2 solution
printf('\nDelTf1_0=%.3f K',DelTf1_0)

//page 76
```

Scilab code Exa 2.11.4 Ex 19

```
clear
clc
M=78*10^-3;//molar mass of C6H6 in Kg/mol
R=8.314;//gas constant in J/Kmol
Tf2=278.4;//melting point of pure C6H6 in K
DelHm_v=10.042*10^3;//heat of fusion in J/mol
Kf=((M*R*Tf2^2)/DelHm_v);//inKkg/mol
Tf1=277.4;//melting point of C6H6 in Kg/mol
M1=(Tf2-Tf1)/Kf;//molality in mol/kg
```

```
10 X1=0.02;//molefraction of CH3COOH
11 M2=X1/M;//molality in mol/kg
12 Md=(M2-M1);//molality of dimer in mol/kg
13 Mm=M1-Md;//molality of monomer in mol/kg
14 Keq=(Md)/(Mm^2);//equilibrium constant fo
      dimerization of CH3COOH
15 printf('Keq=%.2f',Keq)
16
17 //There are some errors in the solution given in
      textbook
18 //page 76
```

Scilab code Exa 2.11.5 Ex 20

```
1 clear
2 clc
3 DelTf1=0.704;//freezing point of aqueous KCN in K
4 Kf=1.86;//in kg/mol
5 M1=(DelTf1)/Kf;//molality of the solution containing
     KCN
6 DelTf2=0.530;//freezing point on addition of Hg(CN)2
7 M2=(DelTf2)/Kf;//molality on addition og Hg(CN)2
8 Kplus=0.1892;//amount of K+ in 1000gm of solvent
9 HgCN2=0.095;//amount of Hg(CN)2 added to form
     complex
10 M=(Kplus+Kplus+HgCN2-M2);//
11 N=(M/HgCN2);//no. of CN- units combined
12 printf('N=%.1f',N)
13
14 //Formula is Hg(CN)2^-4
15 //page 77
```

Scilab code Exa 2.11.6 Ex 21

```
clear
clc
M1=148.31;//molar mass of Mg(NO2)2 in gm
m1=6.69;//amount of Mg(NO2)2 dissolved in water
m2=100;//amount of water
P1=747;//pressure in torr
T2=373;//temperature in K
P=760;//pressure at normal temperature
X=(m1/M1)/((m1/M1)+(m2/18));//mole fraction of
   solute in solution \
DelP=X*P;//
i=(P-P1)/DelP;//van't hoff factor
v=3;//
alpha=(i-1)/(v-1);//degree of dissociation of salt
   in solution
printf('alpha=%.3f',alpha)

//page 78
```

Scilab code Exa 2.11.7 Ex 22

```
clear
clc
C_Mg=0.5;//concentration of Mg2+ ion
C_SO4=0.7;//concentration of SO4_2- ion
C_Al=0.1;//concentration of Al3+ ion
C_Cl=0.3;//cocncentration of Cl- ion
C_NH4=0.4;//concentration of NH4+ ion
Z1=2;//valence of Mg2+ ion
Z2=2;//valence of SO4_2- ion
Z3=3;//valence of Al3+ ion
Z4=1;//valence of Cl- ion
Z5=1;//valence of NH4+ ion
mu=1/2*(C_Mg*(Z1^2)+C_SO4*(Z2^2)+C_Al*(Z3^2)+C_Cl*(
   Z4^2)+C_NH4*(Z5^2));//ionic strength
```

```
14 printf('mu=%.1f',mu)
15
16 //page 78
```

Scilab code Exa 2.11.8 Ex 23

```
1  clear
2  clc
3  Kf=1.86;//in Kkg/mol
4  m=0.2;//amount of aqueous solution of KCL freezes in
       mol/kg
5  DelTf_0=Kf*m;//in K
6  DelTf_1=0.680;//in K
7  i1=DelTf_1/DelTf_0;//van't hoff factor
8  printf('i1=%.2f',i1)
9  v=2;
10 alpha=(i1-1)/(v-1);//degree of dissociation
11 printf('\nalpha=%.2f',alpha)
12 z=1;//valency
13 mu=(1/2)*((m*z^1)+(m*z^1))
14 printf('\nmu=%.1f',mu)
15 i2=v*(1-((0.375+z-z)*(sqrt(mu))))
16 printf('\ni2=%.4f',i2)
17 Kb=0.52;//in Kkg/mol
18 DelTb=i1*Kb*m
19 printf('\nDelTb=%.3f K',DelTb)
20 R=8.314;//in J/Kmol
21 T=273;//in K
22 P=i1*(m*10^3)*R*T*(1/101325);//osmotic pressure in
      atm
23 printf('\nP=%.1f atm',P)
24
25 //page 79
```

Scilab code Exa 2.12.1 Ex 24

```
clear
clc
DelH2m_f=10;//molar heat of fusion in kJ/mol
T1=298.15;//temperature in K
T2=353.35;//freezing temperature in K
R=8.314;//in J/Kmol
X=(10^-(((DelH2m_f*10^3)/R)*((1/T1)-(1/T2))));//
    solubility of napthalene
printf('X=%.4f',X)

//solution is wrong
//There are some errors in the solution given in
    textbook
//page 81
```

Scilab code Exa 2.12.2 Ex 25

```
clear
clc
n2=6.2;//in mol
n1=1000;//in mol
X=(n2)/((n1/18)+n2);//solubility of sucrose
T1=298;//in K
T2=473;//freezing point temperature in K
R=8.314;//in J/Kmol
DelH2m_f=-(R*2.303*log10(X)/((1/T1)-(1/T2)));//molar
    heat of fusion
printf('DelH2m_f=%.1d J/mol',DelH2m_f)

```

```
12 //There are some errors in the solution given in
      textbook
13 //page 82
```

Chapter 3

Phase Rule

Scilab code Exa 3.3.1 Ex 1

```
1  clear
2  clc
3  //In KCL NaCl H20 system
4  r=3;//no.of reactions
5  C=8;//no. of constituents
6  Z=2;//no.of restricting equations
7  C1=C-r-Z;//no. of components
8  printf('C1=%.1d',C1)
9
10 //If salts present in equal amounts
11 C1=C-r-(Z+1);//no. of components
12 printf('\nC1=%.1d',C1)
13
14 //If KCL NaCl as strong electrolytes
15 r=1;//no.of reactions
16 C=6;//no. of constituents
17 Z=2;//no.of restricting equations
18 C3=C-r-Z;//no. of components
19 printf('\nC3=%.1d',C3)
20
21 //If salts present in equal amounts
```

```
22 C4=C-r-(Z+1);//no. of components
23 printf('\nC4=%.1d',C4)
24
25 //In KCL NaCl H20 system
26 r=5;//no.of reactions
27 C=11;//no. of constituents
28 Z=2;//no.of restricting equations
29 C5=C-r-Z;//no. of components
30 printf('\nC5=%.1d',C5)
31
32 //If salts present in equal amounts
33 C6=C-r-(Z+1);//no. of components
34 printf('\nC6=%.1d',C6)
35
36 //If KCL NaCl NaBr and KBr as strong electrolytes
37 r=1;//no.of reactions
38 C=7;//no. of constituents
39 Z=2;//no.of restricting equations
40 C7=C-r-Z;//no. of components
41 printf('\nC7=%.1d',C7)
42
43 //If salts present in equal amounts
44 C8=C-r-(Z+1);//no. of components
45 printf('\nC8=%.1d',C8)
46
47 //page 103
```

Scilab code Exa 3.3.2 Ex 2

```
1 clear
2 clc
3 //For system when P_NH3=P_HCl
4 r=1;//no.of equations
5 C=3;//no. of constituents
6 Z1=1;//no. of restricting equations
```

```
7 C1=C-r-Z1;//no. of components
8 printf('C1=%.1d',C1)
9
10 //For system when P_NH3 not equal P_HCl
11 Z2=0;//no. of restricting equations
12 C1=C-r-Z2
13 printf('\nC1=%.1d',C1)
14
15 //page 103
```

Scilab code Exa 3.3.3 Ex 3

```
1 clear
2 clc
3 C=9;//no. of constituents
4 r=5;//no. of equilibium reactions
5 Z=1;//no. of restricting conditions
6 C1=C-r-Z;//no. of components
7 printf('C1=%.1d',C1)
8
9 //page 103
```

Scilab code Exa 3.3.4 Ex 4

```
1 clear
2 clc
3 //Arbitrary amounts of A1 and A2 only
4 C=4;//no. of constituents
5 r=1;//no. of reactions
6 Z1=1;//no. of restrictions
7 C1=C-r-Z1;//no. of components
8 printf('C1=%.1d',C1)
9
```

```
10 //Arbitrary amounts of A1,A2,A3,A4
11 Z2=0
12 C1=C-r-Z2;//no. of components
13 printf('\nC1=%.1d',C1)
14
15 //Different moles of A1 and A2 only
16 Z3=2
17 C1=C-r-Z3;//no. of components
18 printf('\nC1=%.1d',C1)
19
20 //page 103
```

Chapter 4

Solutions

Scilab code Exa 4.6.1 Ex 1

```
clear
clc
T1=273;//in K
T2=283;//in K
R=8.314;//in J/Kmol
alpha1=0.04889;//absorption coefficients in /atm
alpha2=0.03802;//absorption coefficients in /atm
DelH=(2.303*R*log10(alpha2/alpha1))/((1/T1)-(1/T2));
   //enthalpy of solution
printf('DelH=%.1d J/mol',DelH)

//Answer comes negative,error in the textbook
//page 118
```

Scilab code Exa 4.6.2 Ex 2

```
clear
clc
```

```
3 V1=500;//volume of H2O in cm^3
4 V2=15.03;//volume of CH4 in cm^3
5 V=V2/V1;//volume dissolved in 1 cm^3 water
6 P=1;//pressure in atm
7 T=273;//Temperature in K
8 R=82.06;//In cm^3atm/Kmol
9 X=(P*V)/(R*T);//amount of gas dissolved in mol
10 M=(X*16);//mass of gas dissolved in gm
11 K=M/P;//
12 m1=0.001;//amount of CH4 in mol
13 m2=300;//amount of H20 in cm^3
14 M1=(m1*16)/m2;//mass of gas dissolved in 1 cm^3
15 P0=M1/K;//pressure if Henry's law holds in atm
16 printf('P0=%.3f atm',P0)
17
18  //There are some errors in the solution given in
      textbook
19 //page 58
```

Scilab code Exa 4.6.3 Ex 3

```
1 clear
2 clc
3 Kh=150;//Henry's law constant in torr
4 X1=0.12;//mole fraction of acetone
5 P=(Kh*X1);//vapour pressure of acetone in torr
6 printf('P=%.1d torr',P)
7 Kh1=175;//Henry's law constant for chloroform in
     torr
8 X2=(P/Kh1);
9 printf('\nX2=%.3f',X2)
10
11 //page 119
```

Scilab code Exa 4.6.4 Ex 4

```
clear
clc
X1=4/100;// amount of NH3 solution
X2=(1-X1);//amount of water]
P=17;//vapour pressure of pure water
PT=50;//total pressure in torr
P2=(P*X2);//vapour pressure of water in torr
P1=(PT-P2);//vapour pressure of NH3 in torr
Kh=P1/X1;//Henry's constant for NH3 in torr
X=5/100;//mol % of solution
P10=Kh*X;//pressure of NH3 at 5% mol in torr
printf('P10=%.1f torr',P10)
P20=P*(1-X);//pressure of water at 5% mol in torr
printf('\nP20=%.1f torr',P20)
PT0=(P10+P20);//total pressure for 5% of mol
   solution in torr
printf('\nPT0=%.1f torr',PT0)

//There are some errors in the solution given in
   textbook
//page 119
```

Scilab code Exa 4.6.5 Ex 5

```
clear
clc
P1=2/100*101325;//partial pressure of O2 in Pa
P2=8/100*101325;//partial pressure of N2 in Pa
Kh1=2.53*10^9;//Henry's law constant for O2 in Pa
Kh2=5.47*10^9;//Henry's law constant for N2 in Pa
```

```
7  X1=(P1/Kh1);//mole fraction of O2
8  X2=(P2/Kh2);//mole fraction of N2
9  K=(X1/X2);
10 P=1;//in atm
11 M1=(K/(P+K))*100;//mol % of O2
12 printf('M1=%.2f',M1)
13 M2=100-M1;//mol % of N2
14 printf('\nM2=%.2f',M2)
15 X=X1+X2;//total mole fraction
16 N=X*(1000/18);//in mol
17 Kf=1.86;//Kkg/mol
18 DelTf=(Kf*N);//freezing point of saturated water in
     K
19 printf('\nDelTf=%.5f',DelTf)
20
21 //Freezing point will be negative of DelTf
22 //There are some errors in the solution given in
     textbook
23 //page 120
```

Scilab code Exa 4.7.3 Ex 6

```
1  clear
2  clc
3  Xt=1/2;//mole fraction of toluene
4  Xb=1/2;//mole fraction of benzene
5  Pt=4.274;//Partial pressure of toluene in kNm^2
6  Pb=13.734;//Partial pressure of benzene in kNm^2
7  P=(Xt*Pt)+(Xb*Pb);//total pressure in kNm^2
8  printf('P=%.4f kNm^2',P)
9  Yt=(Xt*Pt)/P;//compostion of toluene
10 printf('\nYt=%.4f ',Yt)
11 Yb=(1-Yt);//compostion of benzene
12 printf('\nYb=%.4f ',Yb)
13 P0=(Pb*Pt)/(Pt+((Pb-Pt)*Xt));//pressure at which
```

```
    last trace liquid disappear
14 printf('\nP0=%.3f kNm^2',P0)
15 Xt1=(Xt*P0)/Pt;//composition of last trace of
    toluene
16 printf('\nXt1=%.4f kNm^2',Xt1)
17 Xb1=(1-Xt1);//composition of last trace of benzene
18 printf('\nXb1=%.4f kNm^2',Xb1)
19 P=sqrt(Pt*Pb);//pressure when 1 mol of mixture is
    vaporized in kN/m^2
20 printf('\nP=%.3f kN/m^2',P)
21 Yb1=1-((P-Pt)/(Pb-Pt));//composition of benzene when
     1 mol of mixture is vaporized
22 printf('\nYb1=%.3f ',Yb1)
23 Yt1=(1-Yb1);//composition of toluene when 1 mol of
    mixture is vaporized
24 printf('\nYt1=%.3f ',Yt1)
25
26 //There are some errors in the solution given in
    textbook
27 //page 143
```

Scilab code Exa 4.7.4 Ex 7

```
1 clear
2 clc
3 XA=0.70;
4 YA=0.35;
5 P=600;//in torr
6 PA=(YA*P)/XA;//vapour pressure of pure A
7 printf('PA=%.1d torr',PA)
8 PB=((1-YA)*P)/(1-XA);//vapour pressure of pure B
9 printf('\nPB=%.1f torr',PB)
10
11 //page 145
```

Scilab code Exa 4.7.5 Ex 8

```
clear
clc
PA=54.4;//vapour pressure of n-hexane in kN/m^2
PB=18.8;//vapour pressure of n-heptane in kN/m^2
YA=0.85;//molar fraction of n-hexane
XA=(YA*PB)/(PA-((PA-PB)*YA));//mole fraction of n-
    hexane in equilibrium with vapour
printf('XA=%.3f',XA)
R=8.314;//J/Kmol
DelS_mix=(-((XA*2.303*log10(XA))+((1-XA)*2.303*log10
    (1-XA))))*R
printf('\nDelS_mix=%.3f J/K',DelS_mix)

//page 146
```

Scilab code Exa 4.7.6 Ex 9

```
clear
clc
P1=36.7;//vapour pressure of pure toluene in torr
P2=118.2;//vapour pressure of pure benzene in torr
nt=50;//% amount of toluene in gm
nb=50;//% amount of benzene in gm
Nt=92;//molar mass of toluene in gm/mol
Nb=78;//molar mass of benzene in gm/mol
Xt=(nt/Nt)/((nt/Nt)+(nb/Nb));//mole fraction of
    toluene
Pt=Xt*P1;//partial pressure of toluene on torr
Pb=(1-Xt)*P2;//partial pressure of benzene on torr
P=Pt+Pb;//total pressure of toluene on torr
```

```
13 printf('P=%.2f torr',P)
14 Yt=Pt/P;//mole fraction of toluene in vapour phase
15 printf('\nYt=%.3f ',Yt)
16 Yb=(1-Yt);//mole fraction of benzene in vapour phase
17 printf('\nYb=%.3f ',Yb)
18 P0=50;//in torr
19 Xt1=(P0-P2)/(P1-P2);//mole fraction of toluene at P
     =50 torr
20 printf('\nXt1=%.4f ',Xt1)
21 Xb1=(1-Xt1);//mole fraction of benzene at P=50 torr
22 printf('\nXb1=%.4f ',Xb1)
23
24 //page 146
```

Scilab code Exa 4.7.7 Ex 10

```
1 clear
2 clc
3 PA=22.93;//vapour pressure of pure ethyl bromide in
     kNm^-2
4 PB=16.93;//vapour pressure of pure propylene bromide
     in kNm^-2
5 nA=3;//in mol
6 nB=2;//in mol
7 P=20.4;//in kNm^-2
8 XA=(P-PB)/(PA-PB);//mole fraction of ethyl bromide
9 printf('XA=%.3f',XA)
10 XB=(1-XA);//mole fraction of propylene bromide
11 printf('\nXB=%.3f',XB)
12 YA=(XA*PA)/P;
13 printf('\nYA=%.4f',YA)
14 NA=(nA-(XA*(nA+nB)))/(1-(XA/YA));//amount of
     vaporized ethyl bromide at P
15 printf('\nNA=%.4f',NA)
16 NB=(NA/YA)-NA;//amount of vaporized propylene
```

```
    bromide at P
printf('\nNB=%.4f',NB)
//There are some errors in the solution given in
    textbook
//page 147
```

Scilab code Exa 4.7.8 Ex 11

```
clear
clc
YA=0.6497;//
XA=0.578;//
nA=3;//
nB=2;//
N1=(YA-(nA/(nA+nB)))/((nA/(nA+nB))-XA);//amount of
    liquid phase
N2=(1/(1+N1))*(nA+nB);//amount of vapour phase
NA=YA*((nA+nB)/(1+N1));//mole fraction of ethyl
    bromide at P
printf('\nNA=%.4f mol',NA)
NB=(1-YA)*((nA+nB)/(1+N1));//
printf('\nNB=%.4f mol',NB)

//page 148
```

Scilab code Exa 4.7.9 Ex 12

```
clear
clc
PA=300;//in torr
PB=800;//in torr
YA=0.25;
```

```
6  XA=(YA*PB)/(PA-((PA-PB)*YA));//mole fraction of
       component A
7  printf('XA=%.4f',XA)
8  XB=(1-XA)
9  P=(PA*XA)+(PB*XB);//total pressure P in torr
10 printf('\nP=%.1f torr',P)
11 P0=760;//in torr
12 XA1=(P0-PB)/(PA-PB);//mole fraction at normal
       boiling point
13 printf('\nXA1=%.2f ',XA1)
14 XB1=(1-XA1);//
15 printf('\nXB1=%.2f ',XB1)
16 P1=(PA*YA)+(PB*(1-YA));//
17 printf('\nP1=%.1d torr ',P1)
18 YA1=(YA*PA)/P1;//
19 printf('\nYA1=%.3f ',YA1)
20 YB1=(1-YA1);//
21 printf('\nYB1=%.3f ',YB1)
22
23 //page 149
```

Scilab code Exa 4.7.10 Ex 13

```
1  clear
2  clc
3  PA=300;//in torr
4  PB=800;//in torr
5  XA=0.60;//
6  XB=1-XA;//
7  P=(PA*XA)+(PB*XB);//pressure at which first bubble
       of vapour is formed
8  printf('P=%.1d torr',P)
9  YA=(XA*PA)/P;//mole fraction of components in first
       bubble of vapour
10 printf('\nYA=%.2f ',YA)
```

```
11 YB=(1-YA);//ole fraction of components in first
      bubble of vapour
12 printf('\nYB=%.2f ',YB)
13 XA1=(XA*PB)/(PA+((PB-PA)*XA));//mole fraction of
      last drop of liquid
14 printf('\nXA1=%.2f ',XA1)
15 XB1=(1-XA1);//mole fraction of last drop of liquid
16 printf('\nXB1=%.2f ',XB1)
17 P=(PA*XA1)+(PB*XB1);//pressure when the last droplet
       of liquid remains
18 printf('\nP=%.1d torr',P)
19
20 //page 151
```

Scilab code Exa 4.7.11 Ex 14

```
1  clear
2  clc
3  Tb=353.25;//temperature of benzene in K
4  Tt=383.75;//temperature of toluene in K
5  T=368.15;//temperature in K
6  DelS_vR=-10.6;//
7  Xb=((exp(DelS_vR))-(exp((DelS_vR)*(Tt/T))))/((exp((
      DelS_vR)*(Tb/T)))-(exp((DelS_vR)*(Tt/T))));//mole
       fraction of benzene
8  printf('Xb=%.4f',Xb)
9  Xt=(1-Xb);//mole fraction of benzene
10 printf('\nXt=%.4f',Xt)
11 Yb=Xb*(exp((-DelS_vR)*(1-(Tb/T))));//
12 printf('\nYb=%.4f',Yb)
13 Yt=1-Yb;//
14 printf('\nYt=%.4f',Yt)
15
16 //There are minor errors in solution in textbook
17 //page 151
```

Scilab code Exa 4.7.12 Ex 15

```
clear
clc
T1=5100;//in K
T2=4530;//in K
A=16.24;//
B=13.38;//
PA=760;//in torr
PB=PA
TA=-(T1/(log10(PA)-A));//in K
printf('TA=%.1f K',TA)
TB=-(T2/(log10(PB)-B));//in K
printf('\nTB=%.1f K',TB)
l=round(TA)+3;
u=round(TB)-6;
T=l:5:u;
for i=1:length(T)
P_A=10^(-T1/T(i)+A);
P_B=10^(-T2/T(i)+B);
x_A(i)=(PA-P_B)/(P_A-P_B);
y_A(i)=x_A(i)*P_A/PB
end
plot(x_A,T,y_A,T); xlabel('Mole fraction xA');ylabel
   ('T/K');

//There is no numerical solution to the given
   question only a graph is plotted
//page 152
```

Scilab code Exa 4.7.13 Ex 16

```
clear
clc
T=391;//temperature in K
Yb=0.045;//
Ya=0.955;//
T=410;//in K
X=50/100;//
XA=0.09;//composition of liquid at l2
XB=0.91;//composition of liquid at l2
YA=0.74;//composition of liquid at v2
YB=0.26;//composition of liquid at v2
N=(YA-X)/(X-XA);//
M1=(X-XA)/((YA-X)+(X-XA))*100;//mol % of vapour
printf('M1=%.2f',M1)
M2=100-M1;//mol % of vapour
printf('\nM2=%.2f',M2)
XA1=0.035;//composition of liquid at l3
XB1=0.965;////composition of liquid at l3
Yaf=0.743;//
X1=(Ya+Yaf)/2;//
printf('\nX1=%.2f',X1)

//page 154
```

Scilab code Exa 4.7.14 Ex 17

```
clear
clc
n1=270;//amount of sugar in gm
N1=358;//molar mass of sugar in gm/mol
n2=1;//amount of water in kg
N2=18;//molar mass of water in gm/mol
M1=n1/N1;//amount of sugar in mol
M2=(n2*1000)/N2;//amount of water in mol
Mt=M1+M2;//total amount in mol
```

```
10 Xs=M1/Mt;//mole fraction of sugar
11 Xw=M2/Mt;//mole fraction of water
12 R=8.314;//in J/Kmol
13 T=298;//in K
14 DelG_m=(Xs*R*T*log(Xs))+(Xw*R*T*log(Xw))
15 printf('DelG_m=%.3f J/mol',DelG_m)
16 DelGm=Mt*DelG_m;//
17 printf('\nDelGm=%.2f J',DelGm)
18 DelS_m=-(DelG_m/T);//
19 printf('\nDelS_m=%.3f J/Kmol',DelS_m)
20 DelSm=-(DelGm/T);//
21 printf('\nDelSm=%.3f J/Kmol',DelSm)
22
23 //There are some errors in the solution given in
     textbook
24 //page 154
25
26 //there are some minor errors in solutions in
     textbook
```

Scilab code Exa 4.7.15 Ex 18

```
1 clear
2 clc
3 R=8.314;//in J/Kmol
4 T=300;//in K
5 Nt=10;//in mol
6 m1=1;//in mol
7 m2=9;//in mol
8 M=10;//in mol
9 DelGm1=Nt*R*T*((m1/M*log(m1/M))+(m2/M*log(m2/M)))
     *(10^-3);//
10 printf('DelGm1=%.3f kJ',DelGm1)
11 DelSm1=-((DelGm1/T)*1000);//
12 printf('\nDelSm1=%.2f J/K',DelSm1)
```

```
13 Nt1=20;//in mol
14 m3=19;//in mol
15 M1=20;//in mol
16 DelGm3=Nt1*R*T*((m1/M1*log(m1/M1))+(m3/M1*log(m3/M1)
   ))*(10^-3);//
17 printf('\nDelGm3=%.3f kJ',DelGm3)
18 DelSm3=-((DelGm3/T)*1000);//
19 printf('\nDelSm3=%.2f J/K',DelSm3)
20 DelGm2=DelGm3-DelGm1
21 printf('\nDelGm2=%.3f kJ',DelGm2)
22 DelSm2=DelSm3-DelSm1
23 printf('\nDelSm2=%.2f J/K',DelSm2)
24
25 //There are some errors in the solution given in
   textbook
26 //page 155
```

Scilab code Exa 4.10.1 Ex 19

```
1 clear
2 clc
3 P=760;//total vapour pressure in torr
4 MA=112.5;//molar mass of chlorobenzene in gm
5 MB=18;//molar mass of water in gm
6 P1=538.9;//vapour pressure of water at 90.6 C
7 PA=(P-P1);//vapour pressure of pure chlorobenzene in
    torr
8 W1=(PA*MA)/(P1*MB);//
9 W2=1/W1;//
10 W=W2+1;//
11 M=100;//in gm
12 WA=M/W;//
13 printf('WA=%.1d gm',WA)
14
15 //There are some errors in the solution given in
```

```
    textbook
16 //page 191
```

Scilab code Exa 4.10.2 Ex 20

```
1  clear
2  clc
3  Pt=747.3;//toatal pressure in torr
4  PB=638.6;//vapour pressure of water
5  PA=Pt-PB;//vapour pressure of liquid
6  WA=1.27;//in gm
7  WB=1;//in gm
8  MB=18;//molar mass of water in gm/mol
9  MA=(WA/WB)*((PB*MB)/PA);//molar mass of liquid in gm
       /mol
10 printf('MA=%.1f gm/mol',MA)
11
12 //page 192
```

Scilab code Exa 4.11.1 Ex 21

```
1  clear
2  clc
3  Xw1=0.01;//in gm/dm^3
4  Xw2=0.12;//in gm/dm^3
5  Xw3=0.24;//in gm/dm^3
6  Xb1=1.848*10^-5;//in gm/dm^3
7  Xb2=2.661*10^-3;//in gm/dm^3
8  Xb3=1.089*10^-2;//in gm/dm^3
9  //Taking Xw1,Xw2,Xb1,Xb1 to calculate n
10 n=((log10(Xb1))-(log10(Xb2)))/((log10(Xw1))-(log10(
       Xw2)));//degree of complexity
11 printf('n=%.1f',n)
```

```
12
13 //Similarly can be done using lines(4,5,7,8) and
      also for lines (3,5,6,8)
14 //For all we get n=2
15 //page 200
```

Scilab code Exa 4.11.2 Ex 22

```
1  clear
2  clc
3  KD=9;//distribution coefficient
4  M1=0.10825;//amount of p-nitroaniline in gm
5  N=0.00693;//amount of p-nitroaniline chlorine
      dissolved in mol
6  N0=0.04342;//molarity of dil HCl
7  m1=138;//molar mass of p-nitroaniline in gm/mol
8  N1=60;//amount of benzene added in cm^3
9  N2=25;//amount of benzene withdrawn in cm^3
10 M2=(M1/m1);//amount of free base in 25cm^3 of
      benzene
11 X=(M2*(N1/N2));//amount in mol
12 M=(X/(N1/1000));//in mol/dm^3
13 M0=(M/KD);//molar concentration of free bas e in
      aqeous solution
14 C=(N-(X+M0));//concentration of unhydrolyzed cation
15 C1=(X+M0);//amount of free base in benzene and water
16 Ct=(N0+C1);//total amount of acid
17 Kh=(M0*Ct)/C;//hydrolysis constant
18 printf('kh=%.4f mol/dm^3',Kh)
19
20 //There are some errors in the solution given in
      textbook
21 //page 201
```

Scilab code Exa 4.11.3 Ex 23

```
clear
clc
KD=25.8;//
M1=0.385;//concentration of NH3 in aqueous CuSO4
    solution in mol/dm^-3
M2=0.0112;//concentration of NH3 in chloroform in
    mol/dm^-3
m=0.025;//concentration of CuSO4 in mol/dm^-3
M0=(M2*KD);//concentration of NH3 in aqueous layer
    in mol/dm^-3
M=M1-M0;//concentration of combined NH3 in mol/dm^-3
X=(M/m);//
printf('X=%.2f',X)

// X is approximately equal to 4
//page 202
```

Scilab code Exa 4.11.4 Ex 24

```
clear
clc
Ac=10;//
Ab=1;//
Kd=Ab/Ac;//
wn=0.01;//in gm
w=1.00;//in gm
Vb=100;//in cm^3
Vc=10;//in cm^3
n=log10(wn/w)/(log10((Kd*Vb)/((Kd*Vb)+Vc)));//
printf('n=%.1f',n)
```

```
12 V=n*10;//in am^3
13 printf('\nV=%.1d',V)
14
15 //approximately equal to 7,n=7 is taken in the text
      book
16 ////There are some errors in the solution given in
      textbook
17 //page 202
```

Scilab code Exa 4.11.5 Ex 25

```
1  clear
2  clc
3  KD=4.7;//distribution coefficient
4  W1=20;//amount of ether added in cm^3
5  W2=50;//amount of solution in cm^3
6  M=0.20;//amount of aspirin in gm
7  w2=(M/(1+(W1*KD)/W2));//mass of aspirin in ether
      phase in gm
8  printf('w2=%.4f gm',w2)
9  w1=M-w2;//mass of aspirin in aqueous phase in gm
10 printf('\nw1=%.4f gm',w1)
11 n=2
12 W=10;//
13 wn=(((1/KD)*W2)/(((1/KD)*W2)+W))^n*(M);//amount of
      aspirin unextracted in gm
14 printf('\nwn=%.4f gm',wn)
15 w=(M-wn);//amount of aspirin extracted in gm
16 printf('\nw=%.4f gm',w)
17
18 //page 203
```

Chapter 5

Phase Diagrams of one component systems

Scilab code Exa 5.2.1 Ex 1

```
clear
clc
DelHm_f=6008.5;//in J/mol
m=18;//molar mass of water in gm/mol
rho_i=0.917;//density of ice in gm/cm^3
rho_l=0.99987;//density of liquid in gm/m^3
DelV=((m/rho_l)-(m/rho_i));
printf('DelV=%.3f*10^-6 m^3/mol',DelV/10^-6)
T=273.15;//in K
P=760;//in mmHg
Pt=4.6;//triple point pressure in mmHg
DelPDelT=((DelHm_f)/(T*DelV*10^-6));
printf('\nDelPdelT=%.3f 10^6 J/Km^3',DelPDelT/10^6)
DelP=((P-Pt)/P)*101.325*10^3;//in N/m^3
DelT=(DelP/DelPDelT);
printf('\nDelT=%.4f K',DelT)

//There are some errors in the solution given in
   textbook
```

```
19 //page 222
```

Scilab code Exa 5.2.2 Ex 2

```
1  clear
2  clc
3  R=8.314;//in J/Kmol
4  T=273.15;//in K
5  m=18;//molar mass of water in gm /mol
6  rho_l=0.99987;//density of water ingm/cm^3
7  P2=101.325*10^3;//atmospheric pressure in N/m^2
8  Pt=4.6;//triple point pressure in mmHg
9  P1=(Pt/760)*P2;//
10 P=Pt*10^((((m*10^-3)/(rho_l*10^3))*(P2-P1))/(2.303*R
       *T));//vapour pressure of liquid water in mmHg
11 printf('P=%.3f mmHg',P)
12
13 //page 223
```

Chapter 6

Phase Diagrams of two component systems

Scilab code Exa 6.6.1 Ex 1

```
clear
clc
DelHmA_f=28.87;//enthalpy of fusion of NaCl in KJ/
   mol
DelHmB_f=24.06;//enthalpy of fusion of Na2SO4 in KJ/
   mol
R=8.314;//in J/Kmol
TA=1074;//melting point temperature of NaCl
XB=48.2/100;//composition of Na2SO4
XA=(1-XB);//composition of NaCl
TB=1/((1/TA)-(2.303*R*log10(XA)/(DelHmA_f*10^3))
   +(2.303*R*log10(XB)/(DelHmB_f*10^3)));//melting
   point of Na2SO4 in K
printf('TB=%.1d K',TB)
T=(1)/((-(2.303*R*log10(XA)/(DelHmA_f*10^3))+(1/TA))
   );//temperature of the sysytem in K
printf('\nT=%.1f K',T)

//There are some errors in the solution given in
```

```
    textbook
15 //page 313
```

Scilab code Exa 6.6.2 Ex 2

```
1  clear
2  clc
3  M=20;//in Kg
4  BC=35;//in mm
5  BA=31;//in mm
6  M1=(BA/(BA+BC))*M;//mass of Sb in Kg
7  printf('M1=%.2f Kg',M1)
8  L=(BA+20);//in mm
9  M2=(L/(L+BC))*20;//mass of Sb in Kg
10 printf('\nM2=%.2f Kg',M2)
11
12 //page 314
```

Scilab code Exa 6.6.3 Ex 3

```
1  clear
2  clc
3  X1=80;//mol % of n-heptane
4  X2=90;//mol % of n-heptane
5  X3=95;//mol % of n-heptane
6  X=24;//mol % of n-heptane at -114.4 C
7  N1=(100-X1)/(X1-X);//at 80% of n-heptane
8  N2=(X1-X)/(100-X);//at 80% of n-heptane
9  N=((N2*100)/X1)*100;//%of n-heptane recovered w.r.t
       to original n-heptane
10 printf('N=%.1f',N)
11 N3=(100-X2)/(X2-X);//at 90% of n-heptane
12 N4=(X2-X)/(100-X);//at 90% of n-heptane
```

```
13 N=((N4*100)/X2)*100;//%of n-heptane recovered w.r.t
      to original n-heptane
14 printf('\nN=%.1f',N)
15 N5=(100-X3)/(X3-X);//at 95% of n-heptane
16 N6=(X3-X)/(100-X);//at 95% of n-heptane
17 N=((N6*100)/X3)*100;//%of n-heptane recovered w.r.t
      to original n-heptane
18 printf('\nN=%.1f',N)
19
20 //page 315
```

Scilab code Exa 6.6.5 Ex 4

```
1  clear
2  clc
3  X1=1.04;//solubility of  KBr in gm/gm
4  w=1;//amount of H20 in gm
5  X2=0.64;//solubility of KBr after cooling in gm/gm
6  M1=(w/X1)*(X1-X2);//mass of water to be added in gm
7  M2=(X2/w)*M1;//mass of KBr in the solution in gm
8  M=(X1-X2)-M2;//mass of KBr separated in gm
9  N1=M*(100/X1);//percent yield of pure KBr
10 printf('N1=%.2f',N1)
11 M3=(w/X1)*X2;//mass of water remained in above
      evaporation process in gm
12 M4=(X2/w)*(M3);//mass of water remained after
      cooling in above evaporation process in gm
13 M=(X2)*M4;//mass of KBr separated in second crop in
      gm
14 Mt=(X1-X2)+M;//total mass of kBr separated in two
      crops in gm
15 N2=Mt*(100/X1);//percent of KBr recovered
16 printf('\nN2=%.2f',N2)
17
18 //There are some errors in the solution given in
```

```
    textbook
19 //page 317
```

Scilab code Exa 6.6.6 Ex 5

```
1  clear
2  clc
3  M1=40;//total amount of mixture of calcium and
       aluminium in gm
4  w1=54;//amount of aluminium in CaAl2 in gm
5  w2=81;//amount of aluminium in CaAl3 in gm
6  W1=70;//total amount of aluminium in gm
7  X1=(W1-((w2/M1)*M1))/((w1/M1)-(w2/M1));//amount of
       calcium in gm
8  printf('X1=%.1f gm',X1)
9  N1=(w1/M1)*X1;//amount of calcium in mixture of
       CaAl2 in gm
10 printf('\nN1=%.1f gm',N1)
11 N2=(w2/M1)*(M1-X1);//amount of aluminium in mixture
       of CaAl3 in gm
12 printf('\nN2=%.1f gm',N2)
13 M2=20;//total amount of mixture of calcium and
       aluminium in gm
14 W2=90;//total amount of aluminium in gm
15 w3=86;//amount of aluminium after melting
16 M3=14;//percent of clacium mass melted
17 X2=(W2-((w3/M3)*M2))/((w2/M1)-(w3/M3));//amount of
       calcium in gm
18 printf('\nX2=%.1f gm',X2)
19 N3=(w2/M1)*X2;//amount of calcium in mixture of
       CaAL2 in gm
20 printf('\nN3=%.1f gm',N3)
21 N4=(w3/M3)*(M2-X2);//amount of aluminium in mixture
       of CaAL3 in gm
22 printf('\nN4=%.1f gm',N4)
```

```
23
24 //There are some errors in the solution given in
      textbook
25 //page 318
26
27 //There are some errors in the solution given in
      textbook
```

Chapter 8

Electrochemical cells

Scilab code Exa 8.9.2 Ex 1

```
clear
clc
EFe_Pt=0.771;//in V
EFe=-0.440;//in V
Ecell=(EFe_Pt-EFe);//in V
printf('Ecell=%.3f V',Ecell)
E1=1.510;//in V
E2=1.223;//in V
Ecell=(E1-E2);//in V
printf('\nEcell=%.3f V',Ecell)
E3=0.401;//in V
E4=-0.601;//in V
Ecell=(E3-E4);//in V
printf('\nEcell=%.3f V',Ecell)
E5=0.337;//in V
E6=0.799;//in V
Ecell=(E5-E6);//in V
printf('\nEcell=%.3f V',Ecell)
E7=1.44;//in V
E8=0.5355;//in V
Ecell=(E7-E8);//in V
```

```
22 printf('\nEcell=%.4f V',Ecell)
23 E9=0.7991;//in V
24 E10=-0.126;//in V
25 Ecell=(E9-E10);//in V
26 printf('\nEcell=%.4f V',Ecell)
27 E11=1.51;//in V
28 E12=-0.49;//in V
29 Ecell=(E11-E12);//in V
30 printf('\nEcell=%.3f V',Ecell)
31 E13=1.33;//in V
32 E14=0.771;//in V
33 Ecell=(E13-E14);//in V
34 printf('\nEcell=%.3f V',Ecell)
35 E15=0.771;//in V
36 E16=0.150;//in V
37 Ecell=(E15-E16);//in V
38 printf('\nEcell=%.3f V',Ecell)
39 E17=0.771;//in V
40 E18=0.76;//in V
41 Ecell=(E17-E18);//in V
42 printf('\nEcell=%.3f V',Ecell)
43 E19=0.771;//in V
44 E20=1.080;//in V
45 Ecell=(E19-E20);//in V
46 printf('\nEcell=%.3f V',Ecell)
47
48 //page 448
```

Scilab code Exa 8.9.3 Ex 2

```
1 clear
2 clc
3 E1=1.3595;//in V
4 E2=0.337;//in V
5 Ecell=(E1-E2);//in V
```

```
6  printf('\nEcell=%.4f V',Ecell)
7  E3=1.510;//in V
8  E4=0.337;//in V
9  Ecell=(E3-E4);//in V
10 printf('\nEcell=%.3f V',Ecell)
11 E5=0.7791;//in V
12 E6=0.337;//in V
13 Ecell=(E5-E6);//in V
14 printf('\nEcell=%.4f V',Ecell)
15 E7=0.771;//in V
16 E8=0.150;//in V
17 Ecell=(E7-E8);//in V
18 printf('\nEcell=%.3f V',Ecell)
19 E9=0.771;//in V
20 E10=1.51;//in V
21 Ecell=(E9-E10);//in V
22 printf('\nEcell=%.3f V',Ecell)
23 E11=0.771;//in V
24 E12=-0.126;//in V
25 Ecell=(E11-E12);//in V
26 printf('\nEcell=%.3f V',Ecell)
27
28 //All the positive values of Ecell gives forward
     reaction,negative values of Ecell gives backward
     reaction
29 //page 451
```

Scilab code Exa 8.9.4 Ex 3

```
1 clear
2 clc
3 E1=1.3595;//in V
4 E2=0.337;//in V
5 Ecell=(E1-E2);//in V
6 printf('\nEcell=%.4f V',Ecell)
```

```
E3=1.510;//in V
E4=0.337;//in V
Ecell=(E3-E4);//in V
printf('\nEcell=%.3f V',Ecell)
E5=0.7791;//in V
E6=0.337;//in V
Ecell=(E5-E6);//in V
printf('\nEcell=%.4f V',Ecell)
E7=0.771;//in V
E8=0.150;//in V
Ecell=(E7-E8);//in V
printf('\nEcell=%.3f V',Ecell)
E9=0.771;//in V
E10=1.51;//in V
Ecell=(E9-E10);//in V
printf('\nEcell=%.3f V',Ecell)
E11=0.771;//in V
E12=-0.126;//in V
Ecell=(E11-E12);//in V
printf('\nEcell=%.3f V',Ecell)

//page 451
```

Scilab code Exa 8.9.6 Ex 4

```
clear
clc
E1=1.07;//in V
E2=0.45;//in V
Ecell=(E1-E2);//in V
printf('\nEcell=%.2f V',Ecell)
E3=0.71;//in V
E4=0.54;//in V
Ecell=(E3-E4);//in V
printf('\nEcell=%.2f V',Ecell)
```

```
11
12 //page 454
```

Scilab code Exa 8.9.7 Ex 5

```
1  clear
2  clc
3  E_RHE=(0.5335-(-2.363));//reduction reaction at RHE
      in V
4  RT_F=0.05915;//
5  E_LHE=((RT_F/2)*log10(0.1*0.2^2));//reduction
      reaction at LHE in V
6  Ecell=E_RHE-E_LHE;//cell reaction in V
7  printf('Ecell=%.4f V',Ecell)
8  E_RHE=(0.0-0.0713);//reduction reaction at RHE in V
9  RT_F=0.05915;//
10 E_LHE=((RT_F)*log10((0.5^(1/2))/(0.02*0.02)));//
      reduction reaction at LHE in V
11 Ecell=E_RHE-E_LHE;//cell reaction in V
12 printf('\nEcell=%.4f V',Ecell)
13 E_RHE=(0.337-(-0.441));//reduction reaction at RHE
      in V
14 RT_F=0.05915;//
15 E_LHE=((RT_F/2)*log10(0.05/0.01));//reduction
      reaction at LHE in V
16 Ecell=E_RHE-E_LHE;//cell reaction in V
17 printf('\nEcell=%.4f V',Ecell)
18 E_RHE=(0.0-0.0);//reduction reaction at RHE in V
19 RT_F=0.05915;//
20 E_LHE=((RT_F/2)*log10(6.43/0.127));//reduction
      reaction at LHE in V
21 Ecell=E_RHE-E_LHE;//cell reaction in V
22 printf('\nEcell=%.4f V',Ecell)
23 E_RHE=(-0.763-0.337);//reduction reaction at RHE in
      V
```

```
24 RT_F=0.05915;//
25 E_LHE=((RT_F/2)*log10((0.1^2)*0.732));//reduction
      reaction at LHE in V
26 Ecell=E_RHE+E_LHE;//cell reaction in V
27 printf('\nEcell=%.3f V',Ecell)
28
29 //There are some errors in the solution given in
      textbook
30 //page 455
```

Scilab code Exa 8.10.1 Ex 6

```
1 clear
2 clc
3 RT_F=0.05915;//in V
4 Ecell=0.0295;//in V
5 A=0.1;//
6 B=0.01;//
7 n=(RT_F/Ecell)*(log10(A/B));//
8 printf('n=%.1f',n)
9
10 //page 459
```

Scilab code Exa 8.11.1 Ex 7

```
1 clear
2 clc
3 k = [24.4,48.8,73.2,85.4]
4 E = [0.101,0.116,0.129,0.139]
5 l = log10(k./(100-k))
6 plot(l,E,'mo-')
7 [m,c]=reglin(l,E)
8 V=0.0603;//in V
```

```
9  n=V/m;//
10 printf('n=%.1f',n)
11
12 //page 460
```

Scilab code Exa 8.12.1 Ex 8

```
1  clear
2  clc
3  E0=0.7991;//in V
4  RT_F=0.05915;//in V
5  K1=6.02*10^-8;//
6  K2=1.995*10^-19;//
7  E1=(E0-(RT_F*(-log10(K1))));//
8  printf('E1=%.4f V',E1)
9  E2=(E0-(RT_F*(-log10(K2))));//
10 printf('\nE2=%.4f V',E2)
11
12 //page 464
```

Scilab code Exa 8.12.2 Ex 9

```
1  clear
2  clc
3  T=298;//temperature in K
4  R=8.314;//J/K
5  F=96500;//in C
6  Kw=(10^-14);//
7  E=((2.303*R*T)/F)*log10(Kw);//reduction potential in
       V
8  printf('E=%.3f V',E)
9
10 //page 464
```

Scilab code Exa 8.14.1 Ex 10

```
clear
clc
E3=0.54;//in V
E4=0.45;//in V
n3=4;//
n4=1;//
n1=5;//
E1=((-n3*(E3))-(n4*(E4)))/(-n1);// in V
printf('E1=%.2f V',E1)
n2=6;//
n5=1;//
E5=1.07;//in V
E2=((-n3*(E3))-(n4*(E4))-(n5*E5))/(-n2);// in V
printf('\nE2=%.2f V',E2)

//page 468
```

Scilab code Exa 8.16.1 Ex 11

```
clear
clc
E_RHE=(0.1385);//reduction reaction at RHE in V
RT_F=0.05915;//
E_LHE=((RT_F*2)*log10(0.2));//reduction reaction at
   LHE in V
Ecell=E_RHE-E_LHE;//cell reaction in V
printf('Ecell=%.4f V',Ecell)

//page 473
```

Scilab code Exa 8.16.2 Ex 12

```
clear
clc
Ecell=0.2860;//in V
E_RHE=(-0.1522-(-0.403));//in V
RT_F=0.05915;//
a=10^((-2/(3*RT_F))*(Ecell-E_RHE))
printf('a=%.4f',a)
a1=a^3;//
printf('\na1=%.5f',a1)

//page 474
```

Scilab code Exa 8.16.3 Ex 13

```
clear
clc
m=0.01021;//in mol/kg
m1=m*(2*m)^2
Ecell=1.1566;//in V
E_RHE=(0.222-(-0.762));//in V
RT_F=0.05915;//
K=10^((-2/(3*RT_F))*((Ecell-E_RHE)+((RT_F/2)*log10(
    m1))));//ion activity coefficient
printf('K=%.4f',K)

//There are some errors in the solution given in
    textbook
//page 474
```

Scilab code Exa 8.18.1 Ex 14

```
clear
clc
n1=2;//
F=96500;//in C
E=0.0455//in V
DelG=-(n1*F*E);//free energy change in J
printf('DelG=%.1d J',DelG)
T=298;//in K
dEdT_p=(3.38*10^-4)
DelH=-(n1*F*(E-(T*dEdT_p)));//enthalpy change in J
printf('\nDelH=%.1d J',DelH)
DelS=(n1*F*dEdT_p);//entropy change in J/K
printf('\nDelS=%.2f J/K',DelS)

//There are some errors in the solution given in
   textbook
//page 480
```

Scilab code Exa 8.18.2 Ex 15

```
clear
clc
n1=2;//
F=96500;//in C
E=0.1634//in V
DelG=-(n1*F*E);//free energy change in J
printf('DelG=%.1f J',DelG)
T=298;//in K
dEdT_p=(0.000837);//in V/K
DelH=-(n1*F*(E-(T*dEdT_p)));//enthalpy change in J
```

```
11 printf('\nDelH=%.1d J',DelH)
12 DelS=(n1*F*dEdT_p);//entropy change in J/K
13 printf('\nDelS=%.2f J/K',DelS)
14
15 //There are some errors in the solution given in
      textbook
16 //page 481
```

Scilab code Exa 8.18.3 Ex 16

```
1  clear
2  clc
3  x=[293,298,303]
4  y=[0.0663,0.06839,0.07048]
5  plot(x,y,'mo-')
6  [m,c]=reglin(x,y)
7  n=2;//
8  F=96500;//in C
9  T=298;//in K
10 E=0.06839;//in V
11 DelG=-n*F*E;//in J
12 printf('DelG=%.1f J',DelG)
13 DelH=-n*F*(E-(T*m));//in J
14 printf('\nDelH=%.1f J',DelH)
15 DelS=n*F*m;//in J/K
16 printf('\nDelS=%.1f J/K',DelS)
17
18 //There are some errors in the solution given in
      textbook
19 //page 482
```

Scilab code Exa 8.18.4 Ex 17

```
clear
clc
n1=2;//
F=96500;//in C
E=0.490//in V
DelG=-(n1*F*E);//free energy change in J
printf('DelG=%.1f J',DelG)
T=298;//in K
dEdT_p=-(1.86*10^-4);//in V/K
DelH=-(n1*F*(E-(T*dEdT_p)));//enthalpy change in J
printf('\nDelH=%.1f J',DelH)
DelS=(n1*F*dEdT_p);//entropy change in J/K
printf('\nDelS=%.2f J/K',DelS)

//page 483
```

Scilab code Exa 8.18.5 Ex 18

```
clear
clc
n=2;//
F=96500;//
DelH=-217780;//in J
T=273;//in K
E=1.015;//in V
dEdT_p=(1/T)*(E+(DelH/(n*F)));//
printf('dEdT_p=%.3f*10^-4 V/K',dEdT_p/10^-4)

//There are some errors in the solution given in
   textbook
//page 483
```

Scilab code Exa 8.18.6 Ex 19

```
clear
clc
DelG1=-237.23;//in kJ
DelG2=79.71;//in kJ
n=2;//
DelG=(DelG1+(n*DelG2));//in kJ
F=96500;//in C
T=298;//in K
E=-((DelG*10^3)/(n*F));//in V
printf('E=%.3f V',E)
DelH1=-285.85;//in kJ
DelH2=56.9;//in kJ
DelH=(DelH1+(n*DelH2));//in kJ
dEdT_p=((DelH-DelG)*10^3)/(n*F*T);//in V/K
printf('\ndEdT_p=%.5f V/K',dEdT_p)

//error in solution
////There are some errors in the solution given in
   textbook
//page 484
```

Scilab code Exa 8.18.7 Ex 20

```
clear
clc
E1=0.771;//in V
E2=0.150;//in v
E=(E1-E2);//in V
n=2;//
F=96500;//in C/mol
R=8.314;//in J/Kmol
T=298;//in K
Keq=10^((n*F*E)/(2.303*R*T));//equilibrium constant
printf('Keq=%.1f*10^21',Keq/10^21)

```

```
13 //page 485
```

Scilab code Exa 8.18.8 Ex 21

```
1  clear
2  clc
3  E1=1.51;//in V
4  E2=-0.49;//in v
5  E=(E1-E2);//in V
6  n=2;//
7  F=96500;//in C/mol
8  R=8.314;//in J/Kmol
9  T=298;//in K
10 Keq=10^((n*F*E)/(2.303*R*T));//equilibrium constant
11 printf('Keq=%.d10^331',Keq/10^331)
12 //There are some errors in the solution given in
      textbook
13 //page 486
```

Scilab code Exa 8.18.9 Ex 22

```
1  clear
2  clc
3  E1=-0.40;//in V
4  E2=-0.61;//in v
5  E=(E1-E2);//in V
6  n=2;//
7  F=96500;//in C/mol
8  R=8.314;//in J/Kmol
9  T=298;//in K
10 Keq=10^((n*F*E)/(2.303*R*T));//equilibrium constant
11 printf('Keq=%.2f*10^7',Keq/10^7)
12
```

```
13 //page 486
```

Scilab code Exa 8.18.10 Ex 23

```
1  clear
2  clc
3  E1=-0.224;//in V
4  E2=0.337;//in v
5  E=(E1-E2);//in V
6  n=2;//
7  F=96500;//in C/mol
8  R=8.314;//in J/Kmol
9  T=298;//in K
10 Keq=10^((n*F*E)/(2.303*R*T));//equilibrium constant
11 printf('Keq=%.1f*10^-19',Keq/10^-19)
12
13 //page 486
```

Scilab code Exa 8.18.11 Ex 24

```
1  clear
2  clc
3  E1=-0.151;//in V
4  E2=0.799;//in v
5  E=(E1-E2);//in V
6  RT_F=0.05913;//in V
7  Ksp=10^(E/RT_F);//solubility product
8  printf('Ksp=%.2f*10^-17',Ksp/10^-17)
9
10 //page 487
```

Scilab code Exa 8.18.12 Ex 25

```
clear
clc
E1=0.222;//in V
E2=0.095;//in v
E=(E1-E2);//in V
n=1;//
F=96500;//in C/mol
R=8.314;//in J/Kmol
T=298;//in K
Keq=10^((n*F*E)/(2.303*R*T));//equilibrium constant
printf('Keq=%.1f',Keq)
X=(Keq*0.1)/(1+Keq);//in moldm^3
printf('\nX=%.6f moldm^3',X)
Y=0.1-X;//in moldm^3
printf('\nY=%.6f moldm^3',Y)

//error in the solution
//There are some errors in the solution given in
   textbook
//page 487
```

Scilab code Exa 8.18.13 Ex 26

```
clear
clc
E1=0.337;//in V
E2=-0.763;//in v
E=(E1-E2);//in V
n=2;//
F=96500;//in C/mol
R=8.314;//in J/Kmol
T=298;//in K
Keq=10^((n*F*E)/(2.303*R*T));//equilibrium constant
```

```
11 printf('Keq=%.1f*10^37',Keq/10^37)
12
13 //page 488
```

Scilab code Exa 8.18.14 Ex 27

```
1  clear
2  clc
3  m=[0.01,0.02,0.05,0.10,0.20];//
4  n=0.01;//
5  mu=m+n;//
6  E=[1.0495,1.0315,1.0073,0.9885,0.9694]
7  E2=0.2225;//in V
8  R=0.05913;//in V
9  O=log10(m/n);//
10 K=(E-E2)/R +O;//
11 plot(mu,K,'mo-');//
12 [m,c]=reglin(mu,K)
13 Ksp=10^-c;//
14 printf('Ksp=%.2f*10^-14',Ksp/10^-14)
15
16 //There are some errors in the solution given in
      textbook
17 //page 491
```

Scilab code Exa 8.18.15 Ex 28

```
1 clear
2 clc
3 RT_F=0.05913;//in V
4 pH=5;//
5 E1=0.280;//in V
6 E2=0.6996;//in V
```

```
7  E=(E1-E2)+(RT_F*pH);//in V
8  printf('E=%.4f V',E)
9  E=0;//
10 pH=(E-(E1-E2))/RT_F;//
11 printf('\npH=%.1f ',pH)
12 pH=7.5
13 E=(E1-E2)+(RT_F*pH);//in V
14 printf('\nE=%.4f V',E)
15
16 //page 489
```

Scilab code Exa 8.18.16 Ex 29

```
1  clear
2  clc
3  RT_F=0.05913;//in V
4  pH=7;//
5  E=0.062;//in V
6  E1=(E-(RT_F*pH));//in V
7  E2=0.145;//in V
8  pH1=(E2-E1)/RT_F;//
9  printf('pH1=%.1f ',pH1)
10 E=-0.062;//in V
11 E1=(E-(RT_F*pH));//in V
12 pH2=(E2-E1)/RT_F;//
13 printf('\npH2=%.1f ',pH2)
14
15 //page 499
```

Scilab code Exa 8.20.1 Ex 30

```
1  clear
2  clc
```

```
3 RT_F=0.05913;//in V
4 m_LHC=0.01;//
5 gamma_LHC=0.383;//
6 m_RHC=1.0;//
7 gamma_RHC=0.042;//
8 Ecell=-(RT_F*log10((m_LHC*gamma_LHC)/(m_RHC*
     gamma_RHC)));//
9 printf('Ecell=%.4f V',Ecell)
10
11 //page 525
```

Scilab code Exa 8.20.3 Ex 31

```
1 clear
2 clc
3 RT_F=0.05913;//in V
4 m_LHC=0.01;//
5 gamma_LHC=0.708;//
6 m_RHC=0.10;//
7 gamma_RHC=0.502;//
8 Ecell=((-3/2)*(RT_F*log10((m_LHC*gamma_LHC)/(m_RHC*
     gamma_RHC))));//
9 printf('Ecell=%.4f V',Ecell)
10
11 //page 527
```

Scilab code Exa 8.21.2 Ex 32

```
1 clear
2 clc
3 RT_F=0.05913;//in V
4 m_LHC=0.02;//
5 gamma_LHC=0.320;//
```

```
6  m_RHC=0.2;//
7  gamma_RHC=0.110;//
8  E1=0.370;//in V
9  Ecell_1=(-E1)*(RT_F*log10((m_LHC*gamma_LHC)/(m_RHC*
       gamma_RHC)));//in V
10 printf('Ecell_1=%.4f V',Ecell_1)
11 Ecell_2=(Ecell_1)/(2*E1);//in V
12 printf('\nEcell_2=%.5f V',Ecell_2)
13
14 //page 536
```

Scilab code Exa 8.23.1 Ex 33

```
1  clear
2  clc
3  E1=-0.277;//in V
4  E2=-0.744;//in V
5  Ecell_1=(E2-E1);//in V
6  printf('Ecell_1=%.3f V',Ecell_1)
7  Ecell_2=(E1-E2);//in V
8  printf('\nEcell_2=%.3f V',Ecell_2)
9
10 //page 539
```

Scilab code Exa 8.23.2 Ex 34

```
1  clear
2  clc
3  E1=-0.74;//in V
4  E2=-0.40;//in V
5  E3=-0.91;//in V
6  n1=3;//
7  n2=1;//
```

```
n3=6;//
n=2;//
E=((n1*E1)-(n2*E2))/n;//in V
printf('E=%.2f V',E)
E=E2-E1;//in V
DelG1=n1*E;//
printf('\nDelG1=%.2f V',DelG1)
E=E1-E3;//in V
DelG2=n3*E;//
printf('\nDelG2=%.2f V',DelG2)
E=E2-E3;//in V
DelG3=n*E;//
printf('\nDelG3=%.2f V',DelG3)
RT_F=0.05913;//in V
Keq=10^(DelG1/RT_F);//
printf('\nKeq=%.2f*10^17',Keq/10^17)

//page 540
```

Scilab code Exa 8.23.3 Ex 35

```
clear
clc
Ecell=0;//in V
E1=0;//in V
E2=-0.40;//in V
E=(E1-E2);//in V
T=298;//in K
RT_F=0.05913;//in V
Kw=10^-14;//in moldm^3
Ksp=Kw^2*(10^((-2/RT_F)*(-E)));//in (moldm^3)^2
printf('Ksp=%.2f*10^-15 (moldm^3)^2',Ksp/10^-15 )

dEdT_p=0.002;//in V/K
n=2
```

```
15 F=96500;//inC
16 DelG=n*F*E1;//change in gibbs energy
17 printf('\nDelG=%.1d ',DelG)
18
19 DelS=n*F*dEdT_p;//change in entropy in J/K
20 printf('\nDelS=%.1d J/K',DelS)
21
22 DelH=DelG+(T*DelS)*10^-3;//change in enthalpy in kJ
23 printf('\nDelH=%.3f kJ',DelH)
24
25 //page 543
```

Scilab code Exa 8.23.4 Ex 36

```
1 clear
2 clc
3 K1=1;//
4 K2=1.66*10^6;//in dm^3/mol
5 Keq=(K1/K2);//equilibrium constant in mol/dm^3
6 RT_F=0.05913;//in V
7 n=1;//
8 Ecell=RT_F/n*(log10(Keq))
9 printf('Ecell=%.4f V',Ecell)
10 E_h=0.337;//
11 n2=2
12 Ecell_2=n2*E_h
13 printf('\nEcell_2=%.3f V',Ecell_2)
14
15 //page 544
```

Scilab code Exa 8.23.5 Ex 37

```
1 clear
```

```
clc
RT_F=0.05913;//in V
Ecell=0.1185//in V
K1=0.379*10^-3//
K2=37.9*10^-3//
m=-(RT_F/Ecell)*log10(K1/K2);//
printf('m=%.1f',m)
K3=0.1;//
K4=1;//
Ecell_1=0.1263;//in V
n=(-(Ecell_1*m)/RT_F)/log10(K3/K4);//
printf('\nn=%.1d',n)

//page 545
```

Scilab code Exa 8.23.6 Ex 38

```
clear
clc
E1=0.6994;//in V
RT_F=0.05913;//in V
E=0.7314;//in V
kRHE_kLHE=10^((E-E1)/RT_F);//
printf('kRHE_kLHE=%.3f',kRHE_kLHE)
K=0.1;//in mol/dm^3
K2=2.1*10^-4;//in mol/dm^3
K1=(K2/(kRHE_kLHE^2));//in mol/dm^3
printf('\nK1=%.2f*10^-5 mol/dm^3',K1/10^-5)
pH1=-log10(sqrt(K2*K))
printf('\npH1=%.3f',pH1)
pH2=-log10(sqrt(K1*K))
printf('\npH2=%.3f',pH2)

//page 545
```

Scilab code Exa 8.23.7 Ex 39

```
clear
clc
Ecell=-0.188;//in V
RT_F=0.05913;//in V
H=10^(Ecell/RT_F);//in mol/dm^3
M=1/32;//
alpha=(H/M);//degree of freedom
printf('alpha=%.3f*10^-2',alpha/10^-2)
Kh=(M*alpha^2)/(1-alpha);//
printf('\nKh=%.2f*10^-5 mol/dm^3',Kh/10^-5)

//page 547
```