Scilab Textbook Companion for Fundamentals Of Physical Chemistry by H. D. Crockford, J. W. Nowell, H. W. Baird And F. W. Getzen[1]

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Book Description

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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 2

Gases

Scilab code Exa 2.1 chapter 2 example 1

```
clc
//initialisation of variables
P= 730 //mm
V= 20 //litres
T= -20 //C
P1= 760 //mm
T1= 0 //C
//CALCULATIONS
V1= P*V*(273+T1)/((273+T)*760)
//RESULTS
printf (' volume at STP = %.1f litres',V1)
```

Scilab code Exa 2.2 chapter 2 example 2

```
clc
//initialisation of variables
N= 6*10^23 //molcules
R= 0.0821 //lit atm mole^-1
```

```
V= 20 //lit
P= 730 //mm of Hg
T= -20 //C
//CALCULATIONS
M= N*P*V/(760*R*(273+T))
//RESULTS
printf ('Molecules = %.2e molecules',M)
```

Scilab code Exa 2.3 chapter 2 example 3

```
clc
//initialisation of variables
P= 100 //cm
m= 2*10^20 //molecules
N= 6*10^23
R= 0.0821 //lit atm mole^-1
T= 27 //C
//CALCULATIONS
V= m*R*(T+273)*760*100/(N*P)
//RESULTS
printf ('Volume = %.2f cm^3',V)
```

Scilab code Exa 2.4 chapter 2 example 4

```
clc
//initialisation of variables
P= 752 //mm
V= 0.2 //lit
T= 21 //C
R= 0.0821 //lit atm mole^-1
m= 0.980 //gms
//CALCULATIONS
M= m*R*(T+273)*760/(V*P)
```

```
//RESULTS
printf (' molecular weight of chloroform = %.1f
   gmsper mole',M)
```

Scilab code Exa 2.5 chapter 2 example 5

```
clc
//initialisation of variables
m= 7 //gms
m1= 16 //gms
m2= 3.03 //gms
M= 32 //gms
M1= 28 //gms
M2= 2.02 //gms
T= 50 //C
V= 80 //lit
R= 0.0821 //atm lit mole^-1
//CALCULATIONS
Pn= m*R*(T+273)/(M1*V)
Po= m1*R*(T+273)/(M*V)
Ph= m2*R*(T+273)/(M2*V)
P= Pn+Po+Ph
//RESULTS
printf (' Partial pressure of nitrogen = %.3f atm',
   Pn)
printf (' \n Partial pressure of oxygen = %.3f atm',
   Po)
printf (' \n Partial pressure of hydrogen = %.3f atm
   ',Ph)
printf (' \n total pressure = %.3f atm',P)
```

Scilab code Exa 2.6 chapter 2 example 6

```
clc
//initialisation of variables
P= 23.8 //mm
V= 0.5 //lit
R= 0.0821 //lit atm mole^-1
T= 25 //C
//CALCULATIONS
P1= 760-P
n= P1*V/(760*R*(273+T))
V1= V*1000*P1*273/(760*(T+273))
//RESULTS
printf ('Volume of oxygen = %.f ml',V1)
```

Scilab code Exa 2.7 chapter 2 example 7

```
clc
//initialisation of variables
t= 20 //min
t1= 19.4 //min
M= 32 //gms
//CALCULATIONS
x= M*t1^2/t^2
//RESULTS
printf ('molecular weight of ethane = %.1f gms',x)
```

Scilab code Exa 2.8 chapter 2 example 8

```
clc
//initialisation of variables
R= 8.31*10^7 //ergs mole^-1
T= 27 //C
M= 28 //gram per mole
//CALCULATIONS
```

```
c= sqrt(3*R*(273+T)/M)
//RESULTS
printf (' root-mean-square velocity = %.2e cm per
    sec',c)
```

Scilab code Exa 2.9 chapter 2 example 9

```
clc
//initialisation of variables
V= 5.16*10^14 //cm per sec
M2= 28 //gms
M1= 2.02 //gms
//CALCULATIONS
c1= V*sqrt(M2/M1)
//RESULTS
printf (' Velocity of hydrogen molecule = %.1e cm
    per sec',c1)
```

Scilab code Exa 2.10 chapter 2 example 10

```
clc
//initialisation of variables
V= 0.5 //lit
T= 50 //C
n= 1//mole
R= 0.0821 //lit atm mole^-1
a= 4.28*10^-2 //litres mole^-1
b= 3.6 //arm mole^-2 lit^2
//CALCULATIONS
P= n*R*(273+T)/V
P1= (n*R*(T+273)/(V-n*a))-(b/V^2)
//RESULTS
printf (' Pressure = %.f atm',P)
```

```
printf('\n Pressure using vanderwals equation= %.1
   f atm',P1)
```

Chapter 3

Liquids

Scilab code Exa 3.1 chapter 3 example 1

```
clc
//initialisation of variables
p= 388.6 //mm
p1=26.5 //mm
T= 60 //C
R= 1.99 //cal mole^-1 A^-1
//CALCULATIONS
Lv= log10(p/p1)*2.303*R*273*(273+T)/(T)
//RESULTS
printf ('heat of vapourisation of benzene= %.f cal
    per mole',Lv+2)
```

Scilab code Exa 3.2 chapter 3 example 2

```
clc
//initialisation of variables
d= 0.789 //gram per cc
r= 0.010 //cm
```

```
h= 5.76 //cm
g= 980.7 // cm /sec^2
//CALCULATIONS
R= d*h*r*g/2
//RESULTS
printf ('Surface tension= %.1f dynes per cm',R)
```

Scilab code Exa 3.3 chapter 3 example 3

```
clc
//initialisation of variables
W= 0.220 //gms
g= 980.7 //cm per sec62
f= 0.98
l= 4 //cm
//CALCULATIONS
T= W*g/(2*l)
Tc= T*f
//RESULTS
printf ('apparent surface tension= %.1f dynes per
   cm',T)
printf ('\n exact surface tension= %.1f dynes per
   cm',Tc)
```

Scilab code Exa 3.4 chapter 3 example 4

```
clc
//initialisation of variables
n2= 10.05*10^-3 //poise
d1= 0.879 //gms cm^-3
t= 88 //sec
d2= 1 //gms cm^-3
t1= 120 //sec
```

```
//CALCULATIONS
n1= d1*t/(d2*t1)
//RESULTS
printf (' relative viscosity= %.3f ',n1)
```

Chapter 4

Solutions Nonelectrolytes

Scilab code Exa 4.1 chapter 4 example 1

```
clc
//initialisation of variables
m= 164.2 //gms
M= 60 //gms
V= 0.8 //lit
d= 1.026 //g/cc
mw= 18.02 //gms
//CALCULATIONS
M1= m/M
n= M1/V
G= V*1000*d
G1= G-m
m1= M1*1000/G1
n1= G1/mw
x= M1/(M1+n1)
y= 1-x
p= x*100
p1= y*100
P= m*100/G
//RESULTS
printf (' molarity= %.3f M',n)
```

```
printf (' \n molality= %.3f m',m1)
printf (' \n mole fraction of solute= %.4f ',x)
printf (' \n mol per cent of solute= %.2f per cent',
    p)
printf (' \n mol per cent of solvent= %.2f per cent'
    ,p1)
printf (' \n mol per cent acetic acid by weight= %.2
    f per cent',P)
```

Scilab code Exa 4.2 chapter 4 example 2

```
clc
//initialisation of variables
m= 0.0346 //gms
V= 800 //ml
P= 742 //mm
M= 32 //gms
p= 400 //mm
//CALCULATIONS
c= m*1000/V
g= c*760/(P*M)
K= g*22.4
k= c/P
c1= k*p
//RESULTS
printf (' concentration of oxygen= %.4f gram per
    litre',c)
printf (' \n moles dissolved = %.5f moles',g)
printf (' \n Bunsen absorption = %.4f litre',K)
printf (' \n grams of oxygen dissolved = %.4f gram
    per litre',c1)
```

Scilab code Exa 4.3 chapter 4 example 3

```
clc
//initialisation of variables
mn= 0.0134 //gms
mo= 0.0261 //gms
mh= 0.0081 //gms
T= 30 //C
P= 3 //atm
r= 4/5
//CALCULATIONS
V= mn*(273+T)*1000/273
V1= V*r
V2= V1*P
V3= mo*(273+T)*(1-r)*P*1000/273
V4= mh*(273+T)*r*1000/273
V5= V4*P
V6= V2-V1
V7= V5-V4
//RESULTS
printf ('volume of oxygen= %.1f ml',V)
printf ('\n volume of nitrogen= %.1f ml',V3)
printf ('\n volume of helium = %.1f ml',V5)
printf ('\n volume of nitrogen and helium would be
   expelled = %.1f ml',V7)
```

Scilab code Exa 4.4 Chapter 4 example 4

```
clc
//initialisation of variables
p= 214 //mm
M= 112.5 //gms
m= 18 //gms
m1= 10 //gms
//CALCULATIONS
P= 760-p
M1= m1*P*m/(p*M)
```

```
//RESULTS
printf ('quantity of water= %.2f gms',M1)
```

Scilab code Exa 4.5 chapter 4 example 5

```
clc
//initialisation of variables
p = 17.4 //mm
m= 1000 //gms
M= 18 //gms
n= 2 //moles
//CALCULATIONS
P= p*((m/M)/((m/M)+n))
P1= p*(n/((m/M)+n))
dp= p-P1
//RESULTS
printf ('vapour pressure of solution= %.2f mm',P1)
```

Scilab code Exa 4.6 chapter 4 example 6

```
clc
//initialisation of variables
m= 92.13 //gms
M= 78.11 //gms
n= 1 //moles
p= 119.6 //mm
p1= 36.7 //mm
//CALCULATIONS
n1= m/M
x= n/(n+n1)
y= 1-x
P= y*p
P1= x*p1
```

```
P2= P+P1
m1= P/P2
m2= 1-m1
//RESULTS
printf (' mole fraction of benzene= %.3f ',m1)
printf (' \n mole fraction of toulene= %.3f ',m2)
```

Chapter 5

Solutions Osmotic Pressure

Scilab code Exa 5.1 chapter 5 example 1

```
clc
//initialisation of variables
T= 20 //C
R= 0.082 //li-atm per mole per degree
V= 2 //lit
m= 6 //gms
M= 60 //gms
//CALCULATIONS
P= m*R*(273+T)/(M*V)
//RESULTS
printf ('osmotic pressure= %.1f atm',P)
```

Scilab code Exa 5.2 chapter 5 example 2

```
clc
//initialisation of variables
T= -0.2 //C
T1= 25 //C
```

```
T2= 1.86 //C
R= 0.082 //li-atm per mole per degree
//CALCULATIONS
P= -T*R*(T1+273)/T2
//RESULTS
printf ('osmotic pressure= %.2f atm',P)
```

Chapter 6

Solutions Solutions of Electrolytes

Scilab code Exa 6.1 chapter 6 example 1

```
clc
//initialisation of variables
T= 25 //C
R= 0.0821 //li-atm per mole per degree
M= 0.5 //m
n= 2
m= 0.680
V= 1 //lit
//CALCULATIONS
P= R*(273+T)*M*n*m/V
//RESULTS
printf ('osmotic pressure= %.2f atm',P)
```

Scilab code Exa 6.2 chapter 6 example 2

```
clc
```

```
//initialisation of variables
M= 0.001 //molar
M1= 0.002 //molar
M2= 0.004 //molar
n= 1 //moles
n1= 2 //moles
v= 0.509
//CALCULATIONS
Is= 0.5*(M*n^2+M1*n^2+M1*n1^2+M2*n^2)
r= 10^(-v*n^2*sqrt(Is))*M
r1= 10^(-v*n1^2*sqrt(Is))*M1
//RESULTS
printf ('ionic strength= %.3f ',Is)
printf ('\n activity of sodium = %.4f molar',r)
printf ('\n activity of barium = %.4f molar',r1)
```

Chapter 7

Conductivity

Scilab code Exa 7.1 chapter 7 example 1

```
clc
//initialisation of variables
R= 10 //ohms
V= 5 //v
t= 20 //min
//CALCULATIONS
I= V/R
Q= I*t*60
E= Q*V
//RESULTS
printf (' current= %.1f amp',I)
printf (' \n coloumbs of electricity will pass= %.f
    coloumbs',Q)
printf (' \n energy expended= %.f joules',E)
```

Scilab code Exa 7.2 chapter 7 example 2

```
clc
```

```
//initialisation of variables
I= 50 //amp
t= 1 //hr
F= 96500 //amp-sec
mh= 1.01 //gms
mc= 35.46 //gms
ms= 107.88 //gms
mb= 79.9 //gms
mf= 55.85 //gms
V= 11.2 //lit
e= 8 //v
//CALCULATIONS
N= I*t*60*60/F
Mh= mh*N
Mc= mc*N
Ms= ms*N
Mb= mb*N
Mf= mf*N
v= N*V
E= e*I*60*60
//RESULTS
printf (' quantity of hydrogen produced= %.2f gms',Mh)
printf (' \n quantity of chlorine produced= %.2f gms',Mc)
printf (' \n quantity of silver produced= %.2f gms',Ms)
printf (' \n quantity of bromine produced= %.2f gms',Mb)
printf (' \n quantity of ferrous ion  produced= %.2f gms',Mf)
printf (' \n Volume occupied by gases= %.1f lit',v)
printf (' \n energy expenditure= %.f joules',E)
```

Scilab code Exa 7.3 chapter 7 example 3

```
clc
//initialisation of variables
i= 20 //amp
t= 50 //min
F= 96500 //coloumb
we= 8 //gms
Mo= 32 //gms
M= 27 //gms
n= 3
//CALCULATIONS
nf= i*t*60/F
V= we*22.4/Mo*nf
G= M/n
q= G*nf
//RESULTS
printf ('volume of oxygen produced= %.2f lit',V)
printf ('\n quantity of aluminium produced= %.2f
    grams',q)
```

Scilab code Exa 7.4 chapter 7 example 4

```
clc
//initialisation of variables
L= 0.025 //ohms
k= 0.0112 //ohms
//CALCULATIONS
C= k/L
//RESULTS
printf ('cell constant= %.3f ',C)
```

Scilab code Exa 7.5 chapter 7 example 5

```
clc
```

```
//initialisation of variables
m= 0.01 //M
CB= 235 //mm
R= 426.3 //ohms
M= 265
C= 0.448
//CALCULATIONS
k= M*C/(R*CB)
A= k*1000/m
//RESULTS
printf (' equivalent conductance= %.1f ohms',A)
```

Chapter 8

Chemical Equlibrium

Scilab code Exa 8.1 chapter 8 example 1

```
clc
//initialisation of variables
x= 3.33
n= 5 //moles
//CALCULATIONS
N= x^2/(n-x)^2
//RESULTS
printf ('moles of water and ester formed= %.f ',N)
```

Scilab code Exa 8.2 chapter 8 example 2

```
clc
//initialisation of variables
n= 1 //mole
x= 3
y= 4
//CALCULATIONS
r= x^2/n^2
```

```
z= n/x
n= n+z
n1= x-z
//RESULTS
printf ('moles of acid and alcohol= %.2f moles',n)
printf ('\n moles of ester and water= %.2f moles',
    n1)
```

Scilab code Exa 8.3 chapter 8 example 3

```
clc
//initialisation of variables
k= 1.1*10^-5
V= 600 //ml
n= 0.4 //mole
//CALCULATIONS
m= n*1000/V
x= (-k+sqrt(k^2+4*4*0.67*k))/(2*4)
M= 2*x
P= x*100/m
//RESULTS
printf ('molar concentration of NO2= %.1e mol per
    litre',M)
printf ('\n per cent dissociation= %.2f per cent',P
    )
```

Scilab code Exa 8.4 chapter 8 example 4

```
clc
//initialisation of variables
pno2= 0.31 //atm
pn2o2= 0.69 //atm
p= 10 //atm
```

```
//CALCULATIONS
Kp= pno2^2/pn2o2
x= (-Kp+sqrt(Kp^2+4*4*p*Kp))/(2*4)
p1= p-x
p2= 2*x
//RESULTS
printf (' Kp= %.2f ',Kp)
printf (' \n N2O4= %.2f ',p1)
printf (' \n NO2= %.2f ',p2)
```

Scilab code Exa 8.5 chapter 8 example 5

```
clc
//initialisation of variables
T= 65 //C
R= 1.98 //cal/mol K
kp= 2.8
kp1= 0.141
T1= 25 //C
//CALCULATIONS
H= log10(kp/kp1)*2.303*R*(273+T1)*(273+T)/(T-T1)
//RESULTS
printf (' average heat of reaction= %.f cal',H+62)
```

Chapter 9

Ionic Equilibria and Buffer Action

Scilab code Exa 9.1 chapter 9 example 1

```
clc
//initialisation of variables
c= 0.1 //M
p= 1.34 //per cent
T= 25 //C
//CALCULATIONS
C1= c*p/100
C2= c*p/100
C3= c-C1
Ka= C1*C2/C3
//RESULTS
printf ('ionization constant = %.2e ',Ka)
```

Scilab code Exa 9.2 chapter 9 example 2

```
clc
```

```
//initialisation of variables
k= 1.8*10^-5
C= 0.2 //M
T= 25 //C
//CALCULATIONS
x= sqrt(C*k)
a= x/C
C1= a*C
//RESULTS
printf ('hydronium-ion concentration = %.1e mole
   per litre',C1)
```

Scilab code Exa 9.3 chapter 9 example 3

```
clc
//initialisation of variables
K= 1.8*10^-5
V= 500 //ml
c1= 0.3 //M
c2= 0.2 //M
//CALCULATIONS
x= V*c1/1000
y= V*c2/1000
C= K*y/x
//RESULTS
printf ('hydronium-ion concentration = %.1e mole
   per litre',C)
```

Scilab code Exa 9.4 chapter 9 example 4

```
clc
//initialisation of variables
K= 1.4*10^-5
```

```
T= 25 //C
V= 200 //ml
m= 3.7 //gms
m1= 4.8 //gms
M= 74 //gms
M1= 96 //gms
//CALCULATIONS
x= m*1000/(V*M)
y= m1*1000/(V*M1)
X= K*x/y
//RESULTS
printf ('hydronium-ion concentration = %.1e mole
   per litre',X)
```

Scilab code Exa 9.5 chapter 9 example 5

```
clc
//initialisation of variables
c= 0.050 //M
Ksp= 4.3*10^-7
//CALCULATIONS
C= sqrt(Ksp*c)
//RESULTS
printf ('concentration of hydronium-ion = %.1e mole
    per litre',C)
```

Scilab code Exa 9.6 chapter 9 example 6

```
clc
//initialisation of variables
C= 0.050 //M
K= 2.4*10^-17
c= 0.1 //M
```

```
//CALCULATIONS
c1= K*C/c^2
//RESULTS
printf (' concentration of carbonate-ion = %.1e mole
    per litre',c1)
```

Scilab code Exa 9.7 chapter 9 example 7

```
clc
//initialisation of variables
n= 1.31*10^-4 //mole
T= 25 //C
//CALCULATIONS
N= 2*n
Ksp= N^2*n
//RESULTS
printf (' Ksp = %.e ',Ksp)
```

Scilab code Exa 9.8 chapter 9 example 8

```
clc
//initialisation of variables
Ksp= 1.4*10^-11
V= 200 //ml
M= 24.3 //gms
//CALCULATIONS
x= (Ksp/4)^(1/3)
m= x*M*V/1000
//RESULTS
printf (' grams of Mg+2 present = %.1e gms per mol',
   m)
```

Scilab code Exa 9.9 chapter 9 example 9

```
clc
//initialisation of variables
c= 0.010 //M
Ksp= 1.56*10^-10
M= 108 //gms
C= 10^-3 //M
//CALCULATIONS
K= Ksp/C
m= M*K
m1= M*c
//RESULTS
printf (' quantity = %.2e gms',m)
printf (' \n quantity = %.2f gms',m1)
```

Scilab code Exa 9.10 chapter 9 example 10

```
clc
//initialisation of variables
c= 0.1 //M
Kb= 1.8*10^-5
Kw= 10^-14
//CALCULATIONS
C= sqrt(c*Kw/Kb)
//RESULTS
printf (' concentration of hydronium ion = %.1e mol
    per litre',C)
```

Scilab code Exa 9.11 chapter 9 example 11

```
clc
//initialisation of variables
c= 0.050 //M
Kb= 1.8*10^-5
T= 25 //C
Kw= 10^-14
//CALCULATIONS
C= sqrt(Kw*c/Kb)
//RESULTS
printf (' concentration of hydronium ion = %.1e mol
   per litre',C)
```

Scilab code Exa 9.12 chapter 9 example 12

```
clc
//initialisation of variables
kw= 10^-14
Ka= 1.8*10^-5
//CALCULATIONS
Kb= Ka
B= sqrt(kw/(Ka*Kb))
//RESULTS
printf (' degree of hydrolysis = %.1e ',B)
```

Scilab code Exa 9.13 chapter 9 example 13

```
clc
//initialisation of variables
k1= 3.5*10^-7
k2= 4.4*10^-11
//CALCULATIONS
```

```
c= sqrt(k1*k2)
//RESULTS
printf ('concentration of solution = %.1e mol per
   litre',c)
```

Scilab code Exa 9.14 chapter 9 example 14

```
clc
//initialisation of variables
c= 1.92*10^-5 //mole per litre
//CALCULATIONS
pH= -log10(c)
//RESULTS
printf ('pH of solution = %.2f ',pH)
```

Scilab code Exa 9.15 chapter 9 example 15

```
clc
//initialisation of variables
pH= 7.36
//CALCULATIONS
C= 10^-pH
//RESULTS
printf ('concentration of solution = %.2e mol per
   litre',C)
```

Scilab code Exa 9.16 chapter 9 example 16

```
clc
//initialisation of variables
```

```
c= 1 //M
Kb= 5.3*10^-5
pKw= 14
//CALCULATIONS
pH= pKw+0.5*log10(Kb)+0.5*log10(c)
//RESULTS
printf (' pH of solution = %.2f ',pH)
```

Scilab code Exa 9.17 chapter 9 example 17

```
clc
//initialisation of variables
c= 0.1 //M
Ka= 6.3*10^-5
pKw= 14
//CALCULATIONS
pH= -0.5*log10(Ka)+0.5*pKw+0.5*log10(c)
//RESULTS
printf (' pH of a buffer solution = %.2f ',pH)
```

Scilab code Exa 9.18 chapter 9 example 18

```
clc
//initialisation of variables
Ka= 1.8*10^-5
a= 0.1 //molar
//CALCULATIONS
pH= -log10(Ka)
//RESULTS
printf (' pH of a buffer solution = %.2f ',pH)
```

Scilab code Exa 9.19 chapter 9 example 19

```
clc
//initialisation of variables
pH= 7.10
pH1= 7.21
//CALCULATIONS
r= 10^(pH-pH1)
//RESULTS
printf (' ratio of salt to acid = %.3f ',r)
```

Chapter 10

Electmotive Force

Scilab code Exa 10.1 chapter 10 example 1

```
clc
//initialisation of variables
T= 25 //C
M= 0.08 //m
P= 1 //atm
F= 96500 //coloumbs
R= 8.31 //J/mol K
//CALCULATIONS
E= -R*(273+T)*2.3*log10(M)/F
//RESULTS
printf (' oxidation potential of hydrogen elctrode =
    %.4f v',E)
```

Scilab code Exa 10.2 chapter 10 example 2

```
clc
//initialisation of variables
E= -0.337 //v
```

```
R= 8.31 //J/mol K
T= 25 //C
F= 96500 //coloums
M= 0.12 //m
//CALCULATIONS
E1= E-(R*(273+T)*2.3*log10(M)/(2*F))
//RESULTS
printf (' oxidation potential of copper elctrode = %
    .3f v',E1)
```

Scilab code Exa 10.3 chapter 10 example 3

```
clc
//initialisation of variables
E= -0.771 //v
R= 8.31 //J/mol K
T= 25 //C
F= 96500 //coloums
M= 0.02 //m
M1= 0.1 //m
//CALCULATIONS
E1= E-(R*(273+T)*2.3*log10(M/M1)/F)
//RESULTS
printf (' oxidation potential of copper elctrode = %
    .3f v',E1)
```

Scilab code Exa 10.4 chapter 10 example 4

```
clc
//initialisation of variables
E= 0.763 //v
R= 8.31 //J/mol K
T= 25 //C
```

```
F= 96500 //coloums
M= 0.1 //m
M1= 0.01 //m
//CALCULATIONS
E1= E-(R*(273+T)*2.3*log10(M)/(2*F))+R*(273+T)*2.3*
    log10(M1)/F
//RESULTS
printf (' oxidation potential of copper elctrode = %
    .3f v',E1)
```

Scilab code Exa 10.5 chapter 10 example 5

```
clc
//initialisation of variables
E1= 0.126 //v
E2= -1.360 //v
M= 0.02 //m
M1= 1/0.1 //m
R= 8.31 //J/mol K
T= 25 //C
F= 96500 //coloums
//CALCULATIONS
E= (E1-R*(273+T)*2.3*log10(M)/(2*F))-(E2-R*(273+T)
    *2.3*log10(M1)/(F))
//RESULTS
printf (' oxidation potential of copper elctrode = %
    .3f v',E)
```

Scilab code Exa 10.6 chapter 10 example 6

```
clc
//initialisation of variables
E1= 0.763 //v
```

```
c= 0.1 //mol/lit
c1= 0.01 //mol/lit
R= 8.31 //J/mol K
T= 25 //C
F= 96500 //coloums
c2= 1 //molar
c3= 1 //molar
//CALCULATIONS
E= E1-(log10(c*c2/(c1^2*c3))*R*(273+T)*2.3/(2*F))
//RESULTS
printf (' potential of the cell = %.3f v',E)
```

Scilab code Exa 10.7 chapter 10 example 7

```
clc
//initialisation of variables
R= 8.31 //J/mol K
T= 25 //C
F= 96500 //coloums
c= 0.02 //molar
c1= 0.1 //molar
c2= 1 //molar
c3= 1 //molar
E1= 1.486 //v
//CALCULATIONS
E= E1-R*(273+T)*2.3*log10(c*c1^2/(c2*c3))/(2*F)
//RESULTS
printf (' potential of the cell = %.3f v',E)
```

Scilab code Exa 10.8 chapter 10 example 8

```
clc
//initialisation of variables
```

```
R= 8.31 //J/mol K
T= 25 //C
F= 96500 //coloums
c= 0.08 //molar
c1= 0.04 //molar
//CALCULATIONS
E= R*(T+273)*log(c/c1)/(2*F)
E1= 2*E
//RESULTS
printf (' potential of the cell = %.4f v',E)
printf (' \n potential of the cell = %.4f v',E1)
```

Chapter 11

Thermodynamics Some Basic Concepts

Scilab code Exa 11.1 chapter 11 example 1

```
clc
//initialisation of variables
T= 25 //C
T1= 75 //C
k= 6.45 //cal per mole per degree
k1= 1.41*10^-3 //cal per mole per degree k^-1
k2= -8.1*10^-8 //cal per mole per degree k^-2
m= 14 //gms
M= 28 //gms
//CALCULATIONS
Cp= k+k1*(273+T)+k2*(273+T)^2
Cp1= k+k1*(273+T1)+k2*(273+T1)^2
cp= (Cp+Cp1)/2
H= (m/M)*cp*(T1-T)
H1= (m/M)*(k*(T1-T)+(k1/2)*((273+T1)^2-(273+T)^2)+(
    k2/3)*((273+T1)^3-(273+T)^3))
//RESULTS
printf (' Heat required= %.1f cal',H)
printf (' \n value of dH= %.1f cal',H1)
```

Scilab code Exa 11.2 chapter 11 example 2

```
clc
//initialisation of variables
m= 64 //gms
M= 32 //gms
T= 100 //C
T1= 0 //C
cp= 7.05 //cal per mole per degree
cp1= 5.06 //cal per mole per degree
//CALCULATIONS
H= cp*(m/M)*(T-T1)
E= cp1*(m/M)*(T-T1)
//RESULTS
printf ('value of dH= %.f cal',H)
printf ('\n value of dE= %.f cal',E)
```

Scilab code Exa 11.3 chapter 11 example 3

```
clc
//initialisation of variables
n= 2 //moles
R= 1.99 //cal er mole per degree
T= 80 //C
H1= 94.3 //cal per gram
M= 78 //gms per mole
//CALCULATIONS
w= n*R*(273+T)
H= n*M*H1
E= H-w
//RESULTS
```

```
printf (' value of dH= %.f cal',H)
printf (' \n value of dE= %.f cal',E)
```

Scilab code Exa 11.4 chapter 11 example 4

```
clc
//initialisation of variables
m= 9 //gms
T= -10 //C
T1= 0 //C
R= 0.5 //cal per gram per degree
H= 79.7 //cal per gram
R1= 1 //cal per gram per degree
T2= 100 //C
H1= 539.7 //cal per gm
R2= 8.11 //cal per gram per degree
M= 18 //gms
T3= 40 //C
//CALCULATIONS
dH= m*R*(T1-T)
dH1= m*H
dH2= m*R1*(T2-T1)
dH3= m*H1
dH4= (m/M)*R2*(T3-T1)
dH5= dH+dH1+dH2+dH3+dH4
//RESULTS
printf (' value of dH= %.1f cal',dH5)
```

Chapter 12

Thermodynamics Thermodynamic chemistry

Scilab code Exa 12.1 chapter 12 example 1

```
clc
//initialisation of variables
H= -771400 //cal
n= 7 //moles
n1= 7.5 //moles
T= 25 //C
R= 2 //cal mole per degree
//CALCULATIONS
E= H-(n-n1)*R*(273+T)
//RESULTS
printf (' difference between the heat of combustion
    = %.f cal',E)
```

Scilab code Exa 12.2 chapter 12 example 2

```
clc
```

```
//initialisation of variables
H= -94.052 //kcal
H1= -68.317 //kcal
H2= -780.98 //kcal
//CALCULATIONS
H3= 6*H+3*H1-H2
//RESULTS
printf ('Heat of formation = %.3f kcal',H3)
```

Scilab code Exa 12.3 chapter 12 example 3

```
clc
//initialisation of variables
H= -94.052 //kcal
H1= -68.32 //kcal
H2= 11.718 //kcal
//CALCULATIONS
H3= 6*H+3*H1-H2
//RESULTS
printf ('heat of combustion of benzene = %.f cal',
   H3)
```

Scilab code Exa 12.4 chapter 12 example 4

```
clc
//initialisation of variables
H= -66.36 //kcal
H1= 12.5 //k cal
H2= -68.317 //kcal
//CALCULATIONS
H3= H-H1-H2
//RESULTS
printf ('heat of reaction= %.2f cal',H3)
```

Scilab code Exa 12.5 chapter 12 example 5

```
clc
//initialisation of variables
T= 90 //C
T1= 25 //C
Cp= 6.9 //cal per mole per degree
CP1= 7.05 //cal per mole per degree
Cp2= 18 //cal per mole per degree
H= -68.37 //kcal
//CALCULATIONS
H1= H+(Cp2-Cp-0.5*Cp1)*((T-T1)/1000)
//RESULTS
printf (' heat of formation= %.2f cal',H1)
```

Scilab code Exa 12.6 chapter 12 example 6

```
clc
//initialisation of variables
Cp= 2.7 //cal per mole per degree
CP1= 6.9 //cal per mole per degree
Cp2= 15.4 //cal per mole per degree
H= -20.24 //kcal
T= 200 //C
T1= 25 //C
//CALCULATIONS
H1= H+(Cp2-2*Cp-3*Cp1)*((T-T1)/1000)
//RESULTS
printf (' heat of formation= %.2f cal',H1)
```

Chapter 13

Thermodynamics Entropy and Free Energy

Scilab code Exa 13.1 chapter 13 example 1

```
clc
//initialisation of variables
H= 540 //cal per gram
m= 9 //gms
T= 100 //C
//CALCULATIONS
S= H*m/(273+T)
//RESULTS
printf (' Entropy change = %.2f E.U',S)
```

Scilab code Exa 13.2 chapter 13 example 2

```
clc
//initialisation of variables
m= 9 //gms
H= 79.7 //cal per gram
```

```
T= 0 //C
//CALCULATIONS
S= m*H/(273+T)
//RESULTS
printf (' Entropy change = %.2f E.U',S)
```

Scilab code Exa 13.3 chapter 13 example 3

```
clc
//initialisation of variables
m= 14 //gms
M= 28 //gms
R= 1.99 // cal per mole per degree
V= 30 //lit
v1= 10 //lit
//CALCULATIONS
S1= (m/M)*R*2.303*log10(V/V1)
//RESULTS
printf (' Entropy change = %.2f E.U',S1)
```

Scilab code Exa 13.4 chapter 13 example 4

```
clc
//initialisation of variables
m= 14 //gms
M= 28 //gms
S= 6.94 //cal per mole
T= 127 //C
T1= 27 //C
S1= 4.94 //cal per mole
//CALCULATIONS
dS= (m/M)*S*log((273+T)/(273+T1))
dS1= (m/M)*S1*log((273+T)/(273+T1))
```

```
//RESULTS
printf (' Entropy change = %.2f E.U',dS-0.01)
printf (' \n Entropy change = %.2f E.U',dS1)
```

Scilab code Exa 13.5 chapter 13 example 5

```
clc
//initialisation of variables
Scl= 53.29 //E.U
Sag= 10.21 //E.U
Sagcl= 22.97 //E.U
//CALCULATIONS
dS= Sagcl-Sag-0.5*Scl
//RESULTS
//RESULTS
printf (' Entropy change = %.2f E.U',dS)
```

Scilab code Exa 13.6 chapter 13 example 6

```
clc
//initialisation of variables
Scl= 13.17 //E.U
Sag= 17.67 //E.U
Sagcl= 22.97 //E.U
//CALCULATIONS
dS= Scl+Sag-Sagcl
//RESULTS
printf (' Entropy change = %.2f E.U',dS)
```

Scilab code Exa 13.7 chapter 13 example 7

```
clc
//initialisation of variables
F1= -94260 //cal
F2= -56690 //cal
F3= -7860 //cal
//CALCULATIONS
F= 2*F1+3*F2-F3
//RESULTS
printf (' value of dF = %.f ',F)
```

Scilab code Exa 13.8 chapter 13 example 8

```
clc
//initialisation of variables
T= 25 //C
F1= -35180 //cal
//CALCULATIONS
F= F1
//RESULTS
printf (' value of dF = %.f ',F)
```

Scilab code Exa 13.9 chapter 13 example 9

```
clc
//initialisation of variables
F= -51180 //cal
T= 25 //C
R= 1.99 //cal/mole K
//CALCULATIONS
K= 10^(-F/(R*(273+T)*2.303))
//RESULTS
printf (' equilibrium constant = %.e ',K)
```

Scilab code Exa 13.10 chapter 13 example 10

```
clc
//initialisation of variables
F= 18430 //cal
F1= -31350 //cal
F2= 26224 //cal
R= 1.99 //cal/mole K
T= 25 //C
//CALCULATIONS
F3= F+F1+F2
Ksp= 10^(-F3/(R*(273+T)*2.303))
//RESULTS
printf (' solubility product = %.1e ',Ksp)
```

Scilab code Exa 13.11 chapter 13 example 11

```
clc
//initialisation of variables
F= -51108 //cal
f= 96500 //coloumbs
n= 2 //moles
//CALCULATIONS
E= -F*4.184/(n*f)
//RESULTS
printf (' value of E = %.3f v',E)
```

Scilab code Exa 13.12 chapter 13 example 12

```
clc
//initialisation of variables
F1= 31350 //cal
F2= 26224 //cal
F= 96500 //coloumbs
//CALCULATIONS
F3= -F1+F2
E= F3*4.184/F
//RESULTS
printf (' value of E = %.4f cal',E)
```

Scilab code Exa 13.13 chapter 13 example 13

```
clc
//initialisation of variables
T= 25 //C
a= 0.2 //molar
P= 1 //atm
F1= -5126 //cal
R= 2 //cal/mole K
//CALCULATIONS
F= F1+R*(273+T)*2.303*log10(a^2)
//RESULTS
printf (' value of F = %.f cal',F)
```

Scilab code Exa 13.14 chapter 13 example 14

```
clc
//initialisation of variables
T= 25 //C
F= 1160 //cal
P= 0.1 //atm
P1= 1 //atm
```

```
R= 2 //cal/mole K
//CALCULATIONS
F1= F+R*(273+T)*log(P/P1^2)
F2= F+R*(273+T)*log(P1/P^2)
//RESULTS
printf (' value of F = %.f cal',F1)
printf (' \n value of F = %.f cal',F2)
```

Scilab code Exa 13.15 chapter 13 example 15

```
clc
//initialisation of variables
T= 25 //C
H= -94.05 //kcal
H1= -26.42 //kcal
S= 51.06 //cal per degree
S1= -47.3 //cal per degree
S2= -24.5 //cal per degree
//CALCULATIONS
dH= (H-H1)*1000
dS= S+S1+S2
F= dH-(273+T)*dS
//RESULTS
printf (' value of F = %.f cal',F)
```

Chapter 14

Determination of hydronium ion Concentrations

Scilab code Exa 14.1 chapter 14 example 1

```
clc
//initialisation of variables
E= 0.232 //v
R= 0.0592
p= 1 //atm
R1= 0.0296
P= 740 //atm
//CALCULATIONS
pH= E/R
pH1= (E-R1*log10(P/760))/R
e= pH1-pH
//RESULTS
printf (' error in pH of solution= %.3f ',e-0.002)
```

Scilab code Exa 14.2 chapter 14 example 2

```
clc
//initialisation of variables
e= 0.266 //v
R= 0.0592
//CALCULATIONS
pH= e/R
//RESULTS
printf (' pH of the unkown solution= %.2f ',pH)
```

Scilab code Exa 14.3 chapter 14 example 3

```
clc
//initialisation of variables
e= 0.323 //v
R= 0.0592
c= 0.001 //molar
//CALCULATIONS
pH= (e-R*log10(c))/R
//RESULTS
printf (' pH of the unkown solution= %.2f ',pH)
```

Scilab code Exa 14.4 chapter 14 example 4

```
clc
//initialisation of variables
E= 0.527 //v
T= 25 //C
R= 0.0592
e= -0.246 //v
//CALCULATIONS
pH= -(-E-e)/R
//RESULTS
printf (' pH of the unkown solution= %.2f ',pH)
```

Scilab code Exa 14.5 chapter 14 example 5

```
clc
//initialisation of variables
E= 0.034 //v
E1= -0.280 //v
E2= -0.699 //v
E3= 0.0592
//CALCULATIONS
pH= (E1-E-E2)/E3
pH1= (E-E2+E1)/E3
//RESULTS
printf ('pH of the unkown solution= %.2f ',pH)
printf ('\n pH of the unkown solution= %.2f ',pH1)
```

Chapter 16

Oxidation Reduction potentials

Scilab code Exa 16.1 chapter 16 example 1

```
clc
//initialisation of variables
x= 0.02 //m
y= 0.4 //m
R= 0.0592
e= -0.771 //V
e1= -1.520 //v
n= 5 //electrons
z= 0.80 //m
z1= 0.5 //m
//CALCULATIONS
E= e-R*log10(x/y)
E1= e1-(R/n)*log10(z1*z^8/x)
E2= E-E1
//RESULTS
printf ('Redox potential of sample= %.3f v',E)
printf ('\n Redox potential of sample= %.3f v',E1)
printf ('\n Redox potential of sample= %.3f v',E2)
```

Scilab code Exa 16.2 chapter 16 example 2

```
clc
//initialisation of variables
E= 0.3500 //v
E1= -0.2788 //v
//CALCULATIONS
e= E+E1
//RESULTS
printf ('Redox potential of sample= %.4f v',e)
```

Scilab code Exa 16.3 chapter 16 example 3

```
clc
//initialisation of variables
p= 60 //percent
x= 0.030 //v
E= -0.039 //v
//CALCULATIONS
V= E-x*log10((1-(p/100))/(p/100))
//RESULTS
printf ('Redox potential of sample= %.3f v',V)
```

Chapter 17

Speed of Reaction Catalysis

Scilab code Exa 17.1 chapter 17 example 1

```
clc
//initialisation of variables
t= 40 //min
r= 0.274
t1= 50 //min
//CALCULATIONS
k= 2.3*log10(1/(1-r))/t
R=10^( -k*t1/2.3)
R1= 1-R
//RESULTS
printf (' velocity constant= %.4f min^-1',k)
printf (' \n fraction decomposed= %.3f ',R1)
```

Scilab code Exa 17.3 chapter 17 example 3

```
clc
//initialisation of variables
t= 10 //min
```

```
c= 0.01 //molar
c1= 0.00464 //molar
//CALCULATIONS
k= (c-c1)/(c*c1*t)
T= 1/(k*0.01)
//RESULTS
printf (' velocity constant= %.1f min^-1',k)
printf (' \n half-time period= %.1f min',T)
```

Chapter 20

Radiochemistry

Scilab code Exa 20.1 chapter 20 example 1

```
clc
//initialisation of variables
t= 4.5*10^9 //years
t1= 1590 //years
//CALCULATIONS
l= log10(2)/(t*0.4343)
l1= log10(2)/(t1*0.4343)
r= l1/l
r1= t/t1
//RESULTS
printf (' disintegration constant= %.2e yr^-1',l)
printf (' \n disintegration constant= %.2e yr^-1',l1
    )
printf (' \n relative proportion= %.2e ',r)
printf (' \n relative proportion= %.2e ',r1)
```