Scilab Textbook Companion for Fundamentals Of Physical Chemistry by H. D. Crockford, Samuel B.knight[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.

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Chapter 2

Gases

Scilab code Exa 2.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 2 Gases
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 P= 730 //pressure in mm
10 V= 20 //volume in litres
11 T= -20 //temperature in Celsius
12 P1= 760 //pressure in mm
13 T1= 0 //temperature in Celsius
14
15 //CALCULATIONS
16 V1= P*V*(273+T1)/((273+T)*760)
17
18 //RESULTS
19 mprintf("Volume at STP =%.1f litres",V1)
```

Scilab code Exa 2.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 2 Gases
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 N= 6.02*10**23 //Avogadro constant for molecules
10 R= 0.0821 //gas constant in lit atm mole^-1
11 V= 20 //volume in lit
12 P= 730 //pressure in mm of Hg
13 T= -20 //temperature in Celsius
14
15 //CALCULATIONS
16 M= N*P*V/(760*R*(273+T))
17
18 //RESULTS
19 mprintf("Molecules =%.2e molecules",M)
```

Scilab code Exa 2.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 2 Gases
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
```

```
P= 100 //pressure in cm
m= 2*10**20 //molecules of nitrogen
N= 6*10**23 //Avogadro constant for molecules
R= 0.0821 //gas constant in lit atm mole^-1
T= 27 //temperature in Celsius

//CALCULATIONS
V= m*R*(T+273)*760*100/(N*P)

//RESULTS
mprintf("Volume = %.2f cm^3",V)
```

Scilab code Exa 2.4 4

```
//Windows 10
// Scilab 6.0.0
//Chapter 2 Gases

clc;
clear;

//Initialisation of Variables
P= 752 //pressure in mm
V= 0.2 //volume in litres
T= 21 //temperature in Celsius
R= 0.0821 //gas constant in lit atm mole^-1
m= 0.980 //chloroform in gms

//CALCULATIONS
M= m*R*(T+273)*760/(V*P)

//RESULTS
mprintf("Molecular Weight of Chloroform = %.1f gms
   per mole",M)
```

Scilab code Exa 2.5 5

```
1  //Windows 10
2  // Scilab 6.0.0
3
4  //Chapter 2 Gases
5
6  clc;
7  clear;
8
9  //Initialisation of Variables
10 N=7   //nitrogen in grams
11 O=16   //oxygen in grams
12 H=3.03   //hydrogen in grams
13 R=0.0821  //gas constant in liter
14 T=273     //temperature in kelvin
15 t=50      //temperature in celsius
16 l=80     //capacity of vessel in liters
17 M1= 28 //gram per mole for nitrogen
18 M2= 32 //gram per mole for oxygen
19 M3= 2.02 //gram per mole for hydrogen
20
21 //CALCULATIONS
22 pN2=(N*R*(T+t))/(M1*l)
23 pO2=(O*R*(T+t))/(M2*l)
24 pH2=(H*R*(T+t))/(M3*l)
25 Tp=pN2+pO2+pH2
26 Tm=(N/M1)+(O/M2)+(H/M3)
27 Nm=0.25/Tm
28 pN21=Nm*Tp
29 Om=0.50/Tm
30 pO21=Om*Tp
31 Hm=1.5/Tm
32 pH21=Hm*Tp
```

```
33 Tpc=pN21+pO21+pH21
34
35 //RESULTS
36 mprintf("Individual partial pressures are:")
37 mprintf("\nPN2=%.3f atm",pN2)
38 mprintf("\nPO2=%.3f atm",pO2)
39 mprintf("\nPH2=%.3f atm",pH2)
40 mprintf("\n The total pressure is: %.3f atm",Tp)
41 mprintf("\n The total number of moles is: %.2f moles
   ",Tm)
42 mprintf("\nTotal pressure multiplied by mole
   fraction: %.3f atm",Tpc)
43
44 //The difference in the solution compared to
   textbook is due to round off error:
45 //PH2 is being taken as 0.498 in the textbook
   whereas it is being calculated as 0.497 in the
   code
```

Scilab code Exa 2.6 6

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 2 Gases
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 P= 23.8 //pressure in mm
10 V= 0.5 //volume in litres
11 R= 0.0821 //gas constant in lit atm mole^-1
12 T= 25 //temperature in Celsius
13
14 //CALCULATIONS
```

```
15 P1= 760-P
16 n= P1*V/(760*R*(273+T))
17 V1= V*1000*P1*273/(760*(T+273))
18
19 //RESULTS
20 mprintf("Volume of oxygen =%.f ml",V1)
```

Scilab code Exa 2.7 7

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 2 Gases
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 t= 20 //time for diffusion in min
10 t1= 19.4 //time for diffusion in min
11 M= 32 //weight in gms
12
13 //CALCULATIONS
14 x= M*t1**2/t**2
15
16 //RESULTS
17 mprintf("Molecular Weight of Ethane = %.1f gms",x)
```

Scilab code Exa 2.8 8

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 2 Gases
4
```

```
clc;
clear;

//Initialisation of Variables
R= 8.31*10**7 //universal gas constant in ergs mole
   ^-1
T= 27 //temperature in Celsius
M= 28 //weight in gram per mole

//CALCULATIONS
c= sqrt(3*R*(273+T)/M)

//RESULTS
mprintf("Root-Mean-Square Velocity = %.2e cm per sec
   ",c)
```

Scilab code Exa 2.9 9

```
//Windows 10
// Scilab 6.0.0
//Chapter 2 Gases

clc;
clear;

//Initialisation of Variables
V= 5.16*10**4 //velocity in cm per sec
M2= 28 //weight in gms
M1= 2.02 //weight in gms

//CALCULATIONS
c1= sqrt(M2/M1) * V
c1=c1/10000   //cm per sec

//RESULTS
```

```
18 mprintf("Velocity of hydrogen molecule = %.1f*10^4
     cm per sec",c1)
```

Scilab code Exa 2.10 10

```
1  //Windows 10
2  // Scilab 6.0.0
3
4  //Chapter 2 Gases
5
6  clc;
7  clear;
8
9  //Initialisation of Variables
10 V= 0.5 //volume in litres
11 T= 50 //temperature in Celsius
12 n= 1 //no of moles
13 R= 0.0821 //gas constant in lit atm mole^-1
14 a= 4.28*10**-2 //Van der Waals equation a in litres
     mole^-1
15 b= 3.6 //Van der Waals equation b in arm mole^-2 lit
     ^2
16
17 //CALCULATIONS
18 P= n*R*(273+T)/V
19 P1= (n*R*(T+273)/(V-n*a))-(b/V**2)
20
21 //RESULTS
22 mprintf("Pressure = %.0f atm",P)
23 mprintf("\nPressure using van der Waals equation= %
     .1f atm",P1)
```

Chapter 3

Liquids

Scilab code Exa 3.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 3 Liquids
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 p= 388.6 //vapor pressure for benzene in mm
11 p1=26.5 //vapor pressure for benzene in mm
12 T= 60 //temperature in C
13 R= 1.99 //calories in cal mole^-1 A^-1
14
15 //Calculations
16 Lv= log10(p/p1)*2.303*R*273*(273+T)/(T)
17
18 //Results
19 mprintf("Heat of Vapourisation of Benzene = %d cal
   per mole",Lv+2);
```

Scilab code Exa 3.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 3 Liquids
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 d= 0.789 //density in gram per cc
10 r= 0.010 //radius in cm
11 h= 5.76 //height in cm
12 g= 980.7 //acceleration in cm /sec^2
13
14 //Calculations
15 Gamma= d*h*r*g/2
16
17 //Results
18 mprintf("Surface Tension = %.1f dynes per cm",Gamma)
   ;
```

Scilab code Exa 3.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 3 Liquids
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
```

```
W= 0.220 //weight in gms
g= 980.7 //acceleration in cm per sec62
f= 0.98 //correction factor
l= 4 //circumference in cm

//Calculations
T= W*g/(2*l)
Tc= ceil(T)*f

//Results
mprintf("Apparent Surface Tension = %.1f dynes per cm",T);
mprintf("\nExact Surface Tension = %.1f dynes per cm",Tc);
```

Scilab code Exa 3.4 4

```
//Windows 10
// Scilab 6.0.0
//Chapter 3 Liquids

clc;
clear;

//Initialisation of Variables
n2= 10.05*10**-3 //absolute viscosity of water in poise
d1= 0.879 //density in gms cm^-3
t= 88 //time of flow in sec
d2= 1 //density in gms cm^-3
t1= 120 //time of flow in sec

//Calculations
n1= d1*t/(d2*t1)

```

```
18 //Results
19 mprintf("Relative Viscosity= %.3f",n1);
20
21 //The difference in the solution compared to
     textbook is due to round off error
```

Chapter 4

Solutions Nonelectrolytes

Scilab code Exa 4.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 4 Solutions Nonelectrolytes
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 m= 164.2 //weight in gms
10 M= 60 //weight in gms
11 V= 0.8 //volume in litres
12 d= 1.026 //density in g/cc
13 mw= 18.02 //weight in gms
14
15 //CALCULATIONS
16 M1= m/M
17 n= M1/V
18 G= V*1000*d
19 G1= G-m
20 m1= M1*1000/G1
21 n1= G1/mw
```

```
22 x= M1/(M1+n1)
23 y= 1-x
24 p= x*100
25 p1= y*100
26 P2= m*100/G
27
28 //RESULTS
29 mprintf("Molarity= %.3f M",n)
30 mprintf("\nMolality= %.3f m",m1)
31 mprintf("\nMole fraction of solute= %.4f",x)
32 mprintf("\nMol per cent of solute= %.2f percent",p)
33 mprintf("\nMol per cent of solvent= %.2f percent",p1
   )
34 mprintf("\nMol per cent acetic acid by weight= %.2f
   percent",P2)
```

Scilab code Exa 4.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 4 Solutions Nonelectrolytes
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 m= 0.0346 //weight in gms
11 V= 800 //volume in ml
12 P= 742 //pressure in mm
13 M= 32 //weight in gms
14 p= 400 //pressure in mm
15
16 //CALCULATIONS
17 c= m*1000/V
```

```
18 g= c*760/(P*M)
19 K= g*22.4
20 k= c/P
21 c1= k*p
22
23 //RESULTS
24 mprintf("Part (a)")
25 mprintf("\nConcentration of oxygen= %.4f gram per
      litre",c)
26 mprintf("\nPart (b)")
27 mprintf("\nMoles dissolved = %.5f moles",g)
28 mprintf("\nPart (c)")
29 mprintf("\nBunsen absorption = %.4f litre",K)
30 mprintf("\nPart (d)")
31 mprintf("\nGrams of oxygen dissolved = %.4f gram per
       litre",c1)
32 mprintf("\nHenry law can be written ")
33 cp=c*p/P
34 mprintf("%.4f gram per liter",cp)
35
36 //The difference in the solution compared to
      textbook is due to round off error
```

Scilab code Exa 4.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 4 Solutions Nonelectrolytes
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 mn= 0.0134 //weight in gms
10 mo= 0.0261 //weight in gms
```

```
11 mh= 0.0081 //weight in gms
12 T= 30 //temperature in C
13 P= 3 //pressure in atm
14 r= 4/5  //ratio of nitrogen to oxygen
15
16 //CALCULATIONS
17 V= mn*(273+T)*1000/273
18 V1= V*r
19 V2= V1*P
20 V3= mo*(273+T)*(1-r)*P*1000/273
21 V4= mh*(273+T)*r*1000/273
22 V5= V4*P
23 V6= V2-V1
24 V7= V5-V4
25
26 //RESULTS
27 mprintf("Volume of oxygen= %.1f ml",V)
28 mprintf("\nVolume of nitrogen= %.1f ml",V3)
29 mprintf("\nVolume of helium = %.1f ml",V5)
30 mprintf("\nVolume of nitrogen and helium would be
      expelled = %.1f ml",V7)
```

Scilab code Exa 4.4 4

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 4 Solutions Nonelectrolytes
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 p= 214 //pressure in mm
10 M= 112.5 //weight in gms
11 m= 18 //weight in gms
```

```
12 m1= 10 //weight in gms
13
14 //CALCULATIONS
15 P= 760-p
16 M1= m1*P*m/(p*M)
17
18 //RESULTS
19 mprintf("Quantity of Water= %.2f gms",M1)
```

Scilab code Exa 4.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 4 Solutions Nonelectrolytes
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 p = 17.4 //pressure in mm
11 m= 1000 //weight in gms
12 M= 18 //weight in gms
13 n= 2 //no of moles
14
15 //CALCULATIONS
16 P= p*((m/M)/((m/M)+n))
17 P1= p*(n/((m/M)+n))
18 dp= p-P1
19 p=p-P1
20
21 //RESULTS
22 mprintf("Vapour pressure of solution= %.2f mm",P1)
23 mprintf("\n p= %.2f mm",p)
```

Scilab code Exa 4.6 6

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 4 Solutions Nonelectrolytes
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 m= 92.13 //weight in gms
10 M= 78.11 //weight in gms
11 n= 1 //no of moles
12 p= 119.6 //pressure in mm
13 p1= 36.7 //pressure in mm
14
15 //CALCULATIONS
16 n1= m/M
17 x= n/(n+n1)
18 y= 1-x
19 P= y*p
20 P1= x*p1
21 P2= P+P1
22 m1= P/P2
23 m2= 1-m1
24
25 //RESULTS
26 mprintf("Mole fraction of benzene=%.3f",m1)
27 mprintf("\nMole fraction of toulene=%.3f",m2)
```

Chapter 5

Solutions Osmotic Pressure

Scilab code Exa 5.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 5 Solutions Osmotic Pressure
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 20 ////temperature in Celsius
10 R= 0.082 //gas constant in li-atm per mole per
    degree
11 V= 2 //volume in lit
12 m= 6 //weight in gms
13 M= 60 //weight in gms
14
15 //CALCULATIONS
16 P= m*R*(273+T)/(M*V)
17
18 //RESULTS
19 mprintf("Osmotic pressure= %.1f atm",P)
```

Scilab code Exa 5.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 5 Solutions Osmotic Pressure
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= -0.2 //temperature in Celsius
10 T1= 25 //temperature in Celsius
11 T2= 1.86 //temperature in Celsius
12 R= 0.082 //gas constant li-atm per mole per degree
13
14 //CALCULATIONS
15 P= -T*R*(T1+273)/T2
16
17 //RESULTS
18 mprintf("Osmotic pressure= %.2f atm",P)
```

Chapter 6

Solutions of Electrolytes

Scilab code Exa 6.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 6 Solutions of Electrolytes
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 R= 0.0821 //gas constant li-atm per mole per degree
11 M= 0.5 //molality of solution
12 n= 2  //for total effective concentration
13 m= 0.680  //effective concentration
14 V= 1 //volume in litres
15
16 //CALCULATIONS
17 P= R*(273+T)*M*n*m/V
18
19 //RESULTS
20 mprintf("Osmotic pressure= %.2f atm",P)
21
```

```
22 //The difference in the solution compared to
      textbook is due to round off error
```

Scilab code Exa 6.2 2

```
1  //Windows 10
2  // Scilab 6.0.0
3
4  //Chapter 6 Solutions of Electrolytes
5
6  clc;
7  clear;
8
9  //Initialisation of Variables
10 Na=0.001 //solution molarity in Na
11 NaCl= 0.001 //solution molarity in NaCl
12 BaCl= 0.002 //solution molarity in BaCl
13 Cl= 0.004 //solution molarity in Cl
14 n= 1 //no of moles
15 n1= 2 //no of moles
16 v= 0.509 //given
17
18 //CALCULATIONS
19 Is= 0.5*(Na*n**2+NaCl*n**2+Cl*n**2+BaCl*n1**2)
20 r= 10**(-v*n**2*sqrt(Is))*Na
21 r1= 10**(-v*n1**2*sqrt(Is))*BaCl
22
23 //RESULTS
24 mprintf("Ionic strength= %.3f",Is)
25 mprintf("\nActivity of sodium = %.4f molar",r)
26 mprintf("\nActivity of barium = %.4f molar",r1)
```

Chapter 7

Conductivity

Scilab code Exa 7.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 7 Conductivity
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 R= 10 //resistance in ohms
10 V= 5 //potential in v
11 t= 20 //time in min
12
13 //CALCULATIONS
14 I= V/R
15 Q= I*t*60
16 E= Q*V
17
18 //RESULTS
19 mprintf("Current= %.2f amp",I)
20 mprintf("\nColoumbs of electricity that will pass= %
   .0f coloumbs",Q)
```

```
21 mprintf("\nEnergy expended= %.0f joules",E)
```

Scilab code Exa 7.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 7 Conductivity
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 I= 50 //current in amp
11 t= 1 //time in hr
12 F= 96500 //farads in amp-sec
13 mh= 1.01 //weight in gms
14 mc= 35.46 //weight in gms
15 ms= 107.88 //weight in gms
16 mb= 79.9 //weight in gms
17 mf= 55.85 //weight in gms
18 V= 11.2 //volume in litres
19 e= 8 //potential in v
20
21 //CALCULATIONS
22 N= I*t*60*60/F
23 Mh= mh*N
24 Mc= mc*N
25 Ms= ms*N
26 Mb= mb*N
27 Mf= mf*N
28 v= N*V
29 E= e*I*60*60
30 Ee = E * 2.78e-7 //joules to kilowatt-hour
   conversion
```

```
31
32 //RESULTS
33 mprintf("Number of faradays used= %.2f",N)
34 mprintf("\nQuantity of hydrogen produced= %.2f grams
   ",Mh)
35 mprintf("\nQuantity of chlorine produced= %.2f grams
   ",Mc)
36 mprintf("\nQuantity of silver produced= %.2f grams",
   Ms)
37 mprintf("\nQuantity of bromine produced= %.2f grams"
   ,Mb)
38 mprintf("\nQuantity of ferrous ion  produced= %.2f
   grams",Mf)
39 mprintf("\nVolume occupied by gases= %.2f lit",v)
40 mprintf("\nEnergy expenditure= %.0f joules or %.2f
   kilowatt-hour",E,Ee)
41
42 //The difference in the solution compared to
   textbook is due to round off error
```

Scilab code Exa 7.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 7 Conductivity
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 i= 20 //current in amp
11 t= 50 ///time in min
12 F= 96500 //chage in coloumb
13 we= 8 //volume in litres
```

```
14 Mo= 32 //volume in litres
15 M= 27 //volume in litres
16 n= 3
17
18 //CALCULATIONS
19 nf= i*t*60/F
20 V= we*22.4/Mo*nf
21 G= M/n
22 q= G*nf
23
24 //RESULTS
25 mprintf("Volume of oxygen produced= %.2f liters",V)
26 mprintf("\nQuantity of aluminium produced= %.2f
   grams",q)
```

Scilab code Exa 7.4 4

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 7 Conductivity
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 L= 0.025 //resistance in ohms
10 k= 0.0112 //resistance in ohms
11
12 //CALCULATIONS
13 C= k/L
14
15 //RESULTS
16 mprintf("Cell constant= %.3f",C)
```

Scilab code Exa 7.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 7 Conductivity
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 m= 0.01 //Molarity
11 CB= 235 //pressure in mm
12 R= 426.3 //resistance in ohms
13 M= 265
14 C= 0.448  //cell constant
15
16 //CALCULATIONS
17 k= M*C/(R*CB)
18 A= k*1000/m
19
20 //RESULTS
21 mprintf("Equivalent conductance= %.1f mhos",A)
```

Chapter 8

Chemical Equlibrium

Scilab code Exa 8.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 8 Chemical Equlibrium
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 x= 3.33 //no of moles of ester and water
10 n= 5 //no of moles
11
12 //CALCULATIONS
13 N= x**2/(n-x)**2
14
15 //RESULTS
16 mprintf("Moles of water and ester formed= %.0f",N)
```

Scilab code Exa 8.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 8 Chemical Equlibrium
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 n= 1 //no of moles
10 x= 3 //no of moles
11 y= 4 //no of moles
12
13 //CALCULATIONS
14 r= x**2/n**2
15 z= n/x
16 n= n+z
17 n1= x-z
18
19 //RESULTS
20 mprintf("Moles of acid and alcohol= %.2f moles",n)
21 mprintf("\nMoles of ester and water= %.2f moles",n1)
```

Scilab code Exa 8.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 8 Chemical Equlibrium
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 k= 1.1*10**-5 //dissociation constant
10 V= 600 //volume in ml
11 n= 0.4 //no of mole
```

```
12
13 //CALCULATIONS
14 m= n*1000/V
15 x= (-k+sqrt(k**2+4*4*0.67*k))/(2*4)
16 M= 2*x
17 P= x*100/m
18
19 //RESULTS
20 mprintf("Molar concentration of NO2= %.2e mol per
      litre",M)
21 mprintf("\nPer cent dissociation= %.2f percent",P)
```

Scilab code Exa 8.4 4

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 8 Chemical Equlibrium
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 pno2= 0.31 //pressure in atm
11 pn2o2= 0.69 //pressure in atm
12 p= 10 //pressure in atm
13
14 //CALCULATIONS
15 Kp= pno2**2/pn2o2
16 x= (-Kp+sqrt(Kp**2+4*4*p*Kp))/(2*4)
17 p1= p-x
18 p2= 2*x
19
20 //RESULTS
21 mprintf("Kp= %.2f",Kp)
```

```
22 mprintf("\nx= %.2f atm",x)
23 mprintf("\nN2O4= %.2f atm",p1)
24 mprintf("\nNO2= %.3f atm",p2)
25 mprintf("\nif reaction is presented by another
     equation")
26 Kp= pno2/sqrt(pn2o2)
27 mprintf("\nKp= %.2f",Kp)
28 x= (-(Kp**2)+sqrt(Kp**4+4*4*p*Kp**2))/(2*4)
29 mprintf("\nx= %.2f atm",x)
```

Scilab code Exa 8.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 8 Chemical Equlibrium
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 T= 65 //temperature in Celsius
11 R= 1.98 //cal/mol K
12 kp= 2.8  //at 65 degrees clesius
13 kp1= 0.141  //at 25 degrees clesius
14 T1= 25 //temperature in Celsius
15
16 //CALCULATIONS
17 H= log10(kp/kp1)*2.303*R*(273+T1)*(273+T)/(T-T1)
18 H= H+62
19
20 //RESULTS
21 mprintf("Average Heat of reaction= %d cal",H)
```

Chapter 9

Ionic Equilibria and Buffer Action

Scilab code Exa 9.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 c= 0.1 //Molarity of solution
10 p= 1.34 //per cent ionized
11 T= 25 //temperature in Celsius
12
13 //CALCULATIONS
14 C1= c*p/100
15 C2= c*p/100
16 C3= c-C1
17 Ka= C1*C2/C3
18
19 //RESULTS
```

```
20 mprintf("Ionization constant = %.2e",Ka)
```

Scilab code Exa 9.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 Ka= 1.8*10**-5  //ionization constant
10 C= 0.2 //Molarity of solution
11 T= 25 //temperature in Celsius
12
13 //CALCULATIONS
14 x= sqrt(C*Ka)
15 a= x/C
16 C1= a*C
17
18 //RESULTS
19 mprintf("Hydronium-ion concentration = %.2e mole per
     litre",C1)
```

Scilab code Exa 9.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
```

```
7
8 //Initialisation of Variables
9 K= 1.8*10**-5  //ionization constant
10 V= 500 //volume in ml
11 c1= 0.3 //Molarity of solution
12 c2= 0.2 //Molarity of solution
13
14 //CALCULATIONS
15 x= V*c1/1000
16 y= V*c2/1000
17 C= K*y/x
18
19 //RESULTS
20 mprintf("Hydronium-ion concentration = %.2e mole per
    litre",C)
```

Scilab code Exa 9.4 4

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 Ka= 1.4*10**-5
10 T= 25 //temperature in Celsius
11 V= 200 //volume in millilitres
12 m= 3.7 //weight in gms
13 m1= 4.8 //weight in gms
14 M= 74 //weight in gms
15 M1= 96 //weight in gms
16
17 //CALCULATIONS
```

```
18 x= m*1000/(V*M)
19 y= m1*1000/(V*M1)
20 X= Ka*x/y
21
22 //RESULTS
23 mprintf("hydronium-ion concentration = %.2e mole per
       litre",X)
```

Scilab code Exa 9.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 c= 0.050 //Molarity of solution
10 Ksp= 4.3*10**-7   //using ionization expression
11
12 //CALCULATIONS
13 C= sqrt(Ksp*c)
14
15 //RESULTS
16 mprintf("Concentration of hydronium-ion = %.1e mole
     per litre",C)
```

Scilab code Exa 9.6 6

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
```

```
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 C= 0.050 //Molarity of solution
10 K= 2.4*10**-17    //constant
11 c= 0.1 //Molarity of solution
12
13 //CALCULATIONS
14 c1= K*C/c**2
15
16 //RESULTS
17 mprintf("Concentration of carbonate-ion = %.1e mole
     per litre",c1)
```

Scilab code Exa 9.7 7

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 n= 1.31*10**-4 //mole of silver chromate
10 T= 25 //temperature in Celsius
11
12 //CALCULATIONS
13 N= 2*n
14 Ksp= N**2*n
15
16 //RESULTS
17 mprintf("Ksp = %.1e",Ksp)
```

Scilab code Exa 9.8 8

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 Ksp= 1.4*10**-11  //given
10 V= 200 //volume in ml
11 M= 24.3 //weight in gms
12
13 //CALCULATIONS
14 x= (Ksp/4)**(1/3)
15 m= x*M*V/1000
16
17 //RESULTS
18 mprintf("Grams of Mg+2 present = %.1e gms per mol",m
   )
19
20 //The difference in the solution compared to
   textbook is due to round off error
```

Scilab code Exa 9.9 9

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 9 Ionic Equilibria and Buffer Action
```

```
5
6  clc;
7  clear;
8
9  //Initialisation of Variables
10 c= 0.010 //Molarity of solution
11 Ksp= 1.56*10**-10  //given
12 M= 108 //weight in gms
13 C= 10**-3 //Molarity of solution
14
15 //CALCULATIONS
16 K= Ksp/C
17 m= M*K
18 m1= M*c
19
20 //RESULTS
21 mprintf("The atomic weight of silver being %d, the
      weight of silver remaining \n in solution is %.2e
       gram",M,m)
22 mprintf("\nThe original quantity of silver in the
      solution was %.2e grams",m1)
```

Scilab code Exa 9.10 10

```
1  //Windows 10
2  // Scilab 6.0.0
3  //Chapter 9 Ionic Equilibria and Buffer Action
4
5  clc;
6  clear;
7
8  //Initialisation of Variables
9  c= 0.1 //Molarity of solution
10 Kb= 1.8*10**-5  //given
11 Kw= 10**-14  //from hydrolysis constant expression
```

```
12
13 //CALCULATIONS
14 C= sqrt(c*Kw/Kb)
15
16 //RESULTS
17 mprintf("Concentration of hydronium ion = %.2e mol
     per litre",C)
```

Scilab code Exa 9.11 11

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 c= 0.050 //Molarity of solution
10 Kb= 1.8*10**-5  //given
11 T= 25 //temperature in Celsius
12 Kw= 10**-14  //from hydrolysis constant expression
13
14 //CALCULATIONS
15 C= sqrt(Kw*c/Kb)
16
17 //RESULTS
18 mprintf("Concentration of hydronium ion = %.1e mol
     per litre",C)
```

Scilab code Exa 9.12 12

```
1 //Windows 10
```

```
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 kw= 10**-14  //from hydrolysis constant expression
10 Ka= 1.8*10**-5  //given
11
12 //CALCULATIONS
13 Kb= Ka
14 B= sqrt(kw/(Ka*Kb))
15
16 //RESULTS
17 mprintf("Degree of Hydrolysis = %.2e",B)
```

Scilab code Exa 9.13 13

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 k1= 3.5*10**-7  //given
10 k2= 4.4*10**-11  //given
11
12 //CALCULATIONS
13 c= sqrt(k1*k2)
14
15 //RESULTS
16 mprintf("Concentration of solution = %.2e mol per
```

```
litre",c)
```

Scilab code Exa 9.14 14

```
//Windows 10
// Scilab 6.0.0
//Chapter 9 Ionic Equilibria and Buffer Action

clc;
clear;

//Initialisation of Variables
c= 1.92*10**-5 //concentration mole per litre

//CALCULATIONS
pH= -log10(c)

//RESULTS
mprintf("pH of solution = %.2f",pH)
```

Scilab code Exa 9.15 15

```
//Windows 10
// Scilab 6.0.0
//Chapter 9 Ionic Equilibria and Buffer Action

clc;
clear;

//Initialisation of Variables
pH= 7.36  //given

//CALCULATIONS
```

```
12 C= 10**-pH
13
14 //RESULTS
15 mprintf("Concentration of solution = %.2e mol per
      litre",C)
```

Scilab code Exa 9.16 16

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 c= 1 //Molarity of solution
10 Kb= 5.3*10**-5  //given
11 pKw= 14
12
13 //CALCULATIONS
14 pH= pKw+0.5*log10(Kb)+0.5*log10(c)
15
16 //RESULTS
17 mprintf("pH of solution = %.2f",pH)
```

Scilab code Exa 9.17 17

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 9 Ionic Equilibria and Buffer Action
4
5 clc;
```

```
clear;

//Initialisation of Variables
c= 0.1 //Molarity of solution
Ka= 6.3*10**-5 //given
pKw= 14
//CALCULATIONS
pH= -0.5*log10(Ka)+0.5*pKw+0.5*log10(c)

//RESULTS
mprintf("pH of a buffer solution = %.2f",pH)
```

Scilab code Exa 9.18 18

```
//Windows 10
// Scilab 6.0.0
//Chapter 9 Ionic Equilibria and Buffer Action

clc;
clear;

//Initialisation of Variables
Ka= 1.8*10**-5  //given
a= 0.1 //concentration in mole per liter

//CALCULATIONS
pH= -log10(Ka)

//RESULTS
mprintf("pH of a buffer solution = %.2f",pH)
```

Scilab code Exa 9.19 19

```
1  //Windows 10
2  // Scilab 6.0.0
3  //Chapter 9 Ionic Equilibria and Buffer Action
4
5  clc;
6  clear;
7
8  //Initialisation of Variables
9  pH= 7.10  //given
10 pKa= 7.21  //given
11
12 //CALCULATIONS
13 r= 10**(pH-pKa)
14
15 //RESULTS
16 mprintf("Ratio of salt to acid = %.3f",r)
```

Chapter 10

Electmotive Force

Scilab code Exa 10.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 M= 0.08 //activity of hydronium ions in m
11 P= 1 //pressure in atm
12 F= 96500 //charge in coloumbs
13 R= 8.31 //in electrical units J/mol K
14
15 //CALCULATIONS
16 E_e1= -R*(273+T)*2.3*log10(M)/F
17
18 //RESULTS
19 mprintf("Oxidation potential of hydrogen electrode =
       %.3f v",E_e1)
20
```

```
21 //The difference in the solution compared to
      textbook is due to round off error
```

Scilab code Exa 10.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 E_Cu_Cu2_plus= -0.337 //voltage of electrode
10 R= 8.31 //in electrical units J/mol K
11 T= 25 //temperature in Celsius
12 F= 96500 //charge in coloums
13 M= 0.12 //m in cupric ions
14
15 //CALCULATIONS
16 E_e1= E_Cu_Cu2_plus-(R*(273+T)*2.3*log10(M)/(2*F))
17
18 //RESULTS
19 mprintf("Oxidation potential of copper electrode = %
      .3f v",E_e1)
```

Scilab code Exa 10.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
```

```
clear;

//Initialisation of Variables
E_e1= -0.771 //voltage
R= 8.31 //in electrical units J/mol K
T= 25 //temperature in Celsius
F= 96500 //charge in coloums
M= 0.02 //ferric ion activity in m
M1= 0.1 //ferrous ion activity in m

//CALCULATIONS
E1= E_e1-(R*(273+T)*2.3*log10(M/M1)/F)

//RESULTS
mprintf("Oxidation potential of copper electrode = %
   .2f v",E1)
```

Scilab code Exa 10.4 4

```
//Windows 10
// Scilab 6.0.0
//Chapter 10 Electmotive Force

clc;
clear;

//Initialisation of Variables
E= 0.763 //voltage in v
R= 8.31 //in electrical unit J/mol K
T= 25 //temperature in Celsius
F= 96500 //charge in coloums
M= 0.1 //ion activity in m
M1= 0.01 //ion activity in m

//CALCULATIONS
```

```
17 E_cell= E-(R*(273+T)*2.3*log10(M)/(2*F))+R*(273+T)
     *2.3*log10(M1)/F
18
19 //RESULTS
20 mprintf("Oxidation potential of copper electrode = %
     .2f v",E_cell)
```

Scilab code Exa 10.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 E_Pb_Pb2_plus= 0.126 //voltage in v
10 E_Cl2_Cl_minus= -1.360 //voltage in v
11 M= 0.02 //ion activity in m
12 M1= 1/0.1 //ion activity in m
13 R= 8.31 //in electrical units J/mol K
14 T= 25 //temperature in Celsius
15 F= 96500 //charge in coloums
16
17 //CALCULATIONS
18 E_cell= (E_Pb_Pb2_plus-R*(273+T)*2.3*log10(M)/(2*F))
     -(E_Cl2_Cl_minus-R*(273+T)*2.3*log10(M1)/(F))
19
20 //RESULTS
21 mprintf("Oxidation potential of copper electrode = %
     .3f v",E_cell)
```

Scilab code Exa 10.6 6

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 E1= 0.763 //voltage
10 c= 0.1 //mol/lit
11 c1= 0.01 //mol/lit
12 R= 8.31 //in electrical unit J/mol K
13 T= 25 //temperature in Celsius
14 F= 96500 //charge in coloums
15 c2= 1 //molar
16 c3= 1 //molar
17
18 //CALCULATIONS
19 E_cell= E1-(log10(c*c2/(c1**2*c3))*R*(273+T)*2.3/(2*
   F))
20
21 //RESULTS
22 mprintf("Potential of the cell = %.3f v",E_cell)
```

Scilab code Exa 10.7 7

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
6 clear;
7
```

```
8 //Initialisation of Variables
9 R= 8.31 //electrical unit J/mol K
10 T= 25 //temperature in Celsius
11 F= 96500 //charge in coloums
12 c= 0.02 //molar
13 c1= 0.1 //molar
14 c2= 1 //molar
15 c3= 1 //molar
16 E_cell_0= 1.486 //voltage
17
18 //CALCULATIONS
19 E_cell= E_cell_0-R*(273+T)*2.3*log10(c*c1**2/(c2*c3)
   )/(2*F)
20
21 //RESULTS
22 mprintf("Potential of the cell = %.3f v",E_cell)
```

Scilab code Exa 10.8 8

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 10 Electmotive Force
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 R= 8.31 //electrical unit J/mol K
10 T= 25 //temperature in Celsius
11 F= 96500 //charge in coloums
12 c= 0.08 //molar
13 c1= 0.04 //molar
14
15 //CALCULATIONS
16 E= R*(T+273)*log(c/c1)/(2*F)
```

```
17 E1= 2*E
18
19 //RESULTS
20 mprintf("Potential of the cell = %.4f v",E)
21 mprintf("\nPotential of the cell = %.4f v",E1)
```

Chapter 11

Thermodynamics Some Basic Concepts

Scilab code Exa 11.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 11 Thermodynamics Some Basic Concepts
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 T1= 75 //temperature in Celsius
11 k= 6.45 //cal per mole per degree - molar heat
     capacity
12 k1= 1.41*10**-3 //cal per mole per degree k^-1 -
     molar heat capacity
13 k2= -8.1*10**-8 //cal per mole per degree k^-2 -
     molar heat capacity
14 m= 14 //weight in gms
15 M= 28 //weight in gms
16
```

```
17 //CALCULATIONS
18 Cp= k+k1*(273+T)+k2*(273+T)**2
19 Cp1= k+k1*(273+T1)+k2*(273+T1)**2
20 cp= (Cp+Cp1)/2
21 H= (m/M)*cp*(T1-T)
22 H1= (m/M)*(k*(T1-T)+(k1/2)*((273+T1)**2-(273+T)**2)
      +(k2/3)*((273+T1)**3-(273+T)**3))
23
24 //RESULTS
25 mprintf("Heat required= %.1f cal",H)
26 mprintf("\nValue of dH= %.1f cal",H1)
27
28 //The difference in the solution compared to
      textbook is due to round off error
```

Scilab code Exa 11.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 11 Thermodynamics Some Basic Concepts
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 m= 64 //weight in gms
10 M= 32 //weight in gms
11 T= 100 //temperature in Celsius
12 T1= 0 //temperature in Celsius
13 cp= 7.05 //cal per mole per degree - avg heat
      capacity
14 cp1= 5.06 //cal per mole per degree - avg heat
      capacity
15
16 //CALCULATIONS
```

```
17 H= cp*(m/M)*(T-T1)
18 E= cp1*(m/M)*(T-T1)
19
20 //RESULTS
21 mprintf("Value of dH= %.0f cal",H)
22 mprintf("\nValue of dE= %.0f ca;",E)
```

Scilab code Exa 11.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 11 Thermodynamics Some Basic Concepts
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 n= 2 //moles
10 R= 1.99 //cal per mole per degree
11 T= 80 //temperature in Celsius
12 H1= 94.3 //cal per gram - heat of vaporization
13 M= 78 //weight of benzene in gms per mole
14
15 //CALCULATIONS
16 w= n*R*(273+T)
17 H= n*M*H1
18 E= H-w
19
20 //RESULTS
21 mprintf("Value of dH= %.0f cal",H)
22 mprintf("\nValue of dE= %.0f cal",E)
```

Scilab code Exa 11.4 4

```
1  //Windows 10
2  // Scilab 6.0.0
3  //Chapter 11 Thermodynamics Some Basic Concepts
4
5  clc;
6  clear;
7
8  //Initialisation of Variables
9  m= 9 //weight in gms
10 T= -10 //temperature in Celsius
11 T1= 0 //temperature in Celsius
12 R= 0.5 //cal per gram per degree - heat capacity
13 H= 79.7 //cal per gram - heat of vaporization
14 R1= 1 //cal per gram per degree - heat of
      evaporation
15 T2= 100 ///temperature in Celsius
16 H1= 539.7 //cal per gm - heat of vaporization
17 R2= 8.11 //cal per gram per degree - heat of
      evaporation
18 M= 18 //weight in gms
19 T3= 40 //temperature in Celsius
20
21 //CALCULATIONS
22 dH1= m*R*(T1-T)
23 dH2= m*H
24 dH3= m*R1*(T2-T1)
25 dH4= m*H1
26 dH5= (m/M)*R2*(T3-T1)
27 dH= dH1+dH2+dH3+dH4+dH5
28
29 //RESULTS
30 mprintf("Value of dH= %.1f cal",dH)
```

Chapter 12

Thermodynamics Thermodynamic chemistry

Scilab code Exa 12.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 12 Thermodynamics Thermodynamic chemistry
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 H= -771400 //heat of combustion in cal
10 n= 7 //moles of CO2
11 n1= 7.5 //moles of O2
12 T= 25 //temperature in Celsius
13 R= 2 //cal mole per degree
14
15 //CALCULATIONS
16 E= H-(n-n1)*R*(273+T)
17
18 //RESULTS
19 mprintf("Difference between the heat of combustion =
```

```
%.0f cal",E)
```

Scilab code Exa 12.2 2

```
//Windows 10
// Scilab 6.0.0
//Chapter 12 Thermodynamics Thermodynamic chemistry

clc;
clear;

//Initialisation of Variables
H= -94.052 //kcal  heat of combustion
H1= -68.317 //kcal  heat of combustion
H2= -780.98 //kcal  heat of combustion

//CALCULATIONS
H3= 6*H+3*H1-H2

//RESULTS
mprintf("Heat of formation = %.3f kcal",H3)

//The difference in the solution compared to
   textbook is due to round off error
```

Scilab code Exa 12.3 3

```
//Windows 10
// Scilab 6.0.0
//Chapter 12 Thermodynamics Thermodynamic chemistry

clc;
clear;
```

```
7
8 //Initialisation of Variables
9 H= -94.052 //kcal   heat of combustion
10 H1= -68.32 //kcal   heat of combustion
11 H2= 11.718 //kcal  heat of combustion
12
13 //CALCULATIONS
14 H3= 6*H+3*H1-H2
15
16 //RESULTS
17 mprintf("Heat of combustion of benzene = %.0f cal",
   H3)
```

Scilab code Exa 12.4 4

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 12 Thermodynamics Thermodynamic chemistry
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 H= -66.36 //kcal   heat of combustion
11 H1= 12.5 //k cal   heat of combustion
12 H2= -68.317 //kcal  heat of combustion
13
14 //CALCULATIONS
15 H3= H-H1-H2
16
17 //RESULTS
18 mprintf("Heat of reaction= %.2f kcal",H3)
```

Scilab code Exa 12.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 12 Thermodynamics Thermodynamic chemistry
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 T= 90//temperature in Celsius
11 T1= 25//temperature in Celsius
12 Cp= 6.9 //cal per mole per degree
13 CP1= 7.05 //cal per mole per degree - heat capacity
14 Cp2= 18 //cal per mole per degree - heat capacity
15 H= -68370 //kcal - heat of formation
16
17 //CALCULATIONS
18 H1= H+(Cp2-Cp-0.5*CP1)*(T-T1)
19
20 //RESULTS
21 mprintf("Heat of formation= %d cal or %.2f kcal",H1,
   H1/1000)
```

Scilab code Exa 12.6 6

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 12 Thermodynamics Thermodynamic chemistry
5
```

```
clc;
clear;

//Initialisation of Variables
Cp= 2.7 //cal per mole per degree  - heat capacity
CP1= 6.9 //cal per mole per degree  - heat capacity
Cp2= 15.4 //cal per mole per degree - heat capacity
dH_25= -20.24 //kcal  - heat of formation
T= 200 //temperature in Celsius
T1= 25 //temperature in Celsius

//CALCULATIONS
dH_200= dH_25+(Cp2-2*Cp-3*CP1)*((T-T1)/1000)

//RESULTS
mprintf("Heat of formation= %.2f kcal",dH_200)
```

Chapter 13

Thermodynamics Entropy and Free Energy

Scilab code Exa 13.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 H= 540 //cal per gram - heat of vaporization
10 m= 9 //weight in gms
11 T= 100 //temperature in Celsius
12
13 //CALCULATIONS
14 S= H*m/(273+T)
15
16 //RESULTS
17 mprintf("Entropy change = %.2f E.U",S)
```

Scilab code Exa 13.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 m= 9 //weight in gms
10 H= 79.7 //cal per gram - heat of fusion
11 T= 0 //temperature in Celsius
12
13 //CALCULATIONS
14 S= m*H/(273+T)
15
16 //RESULTS
17 mprintf("Entropy change = %.2f E.U",S)
```

Scilab code Exa 13.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3
4 //Chapter 13 Thermodynamics Entropy and Free Energy
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 m= 14 //weight in gms
```

```
M= 28 //weight in gms
R= 1.99 // cal per mole per degree
V= 30 //volume in lit
v1= 10 //volume in lit

//CALCULATIONS
S1= (m/M)*R*2.303*log10(V/v1)

//RESULTS
mprintf("Entropy change = %.2f E.U",S1)
```

Scilab code Exa 13.4 4

```
//Windows 10
// Scilab 6.0.0
//Chapter 13 Thermodynamics Entropy and Free Energy

clc;
clear;

//Initialisation of Variables
m= 14 //weight in gms
M= 28 //weight in gms
S= 6.94 //cal per mole - heat capacity
T= 127 //temperature in Celsius
T1= 27 //temperature in Celsius
S1= 4.94 //cal per mole - heat capacity

//CALCULATIONS
dS= (m/M)*S*log((273+T)/(273+T1))
dS1= (m/M)*S1*log((273+T)/(273+T1))
dS = dS - 0.01

//RESULTS
mprintf("Entropy change = %.2f E.U",dS)
```

```
23 mprintf("\nEntropy change = %.2f E.U",dS1)
```

Scilab code Exa 13.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 Scl= 53.29 //standard entropy of formation E.U
10 Sag= 10.21 //standard entropy of formation E.U
11 Sagcl= 22.97 //standard entropy of formation E.U
12
13 //CALCULATIONS
14 dS= Sagcl-Sag-0.5*Scl
15
16 //RESULTS
17 mprintf("Entropy change = %.2f E.U",dS)
```

Scilab code Exa 13.6 6

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 Scl= 13.17 //standard entropy of formation E.U
```

```
10 Sag= 17.67 //standard entropy of formation E.U
11 Sagcl= 22.97 //standard entropy of formation E.U
12
13 //CALCULATIONS
14 dS= Scl+Sag-Sagcl
15
16 //RESULTS
17 mprintf("Entropy change = %.2f E.U",dS)
```

Scilab code Exa 13.7 7

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 F1= -94260 //cal free energy of formation
10 F2= -56690 //cal free energy of formation
11 F3= -7860 //cal free energy of formation
12
13 //CALCULATIONS
14 F= 2*F1+3*F2-F3
15
16 //RESULTS
17 mprintf("Value of dF = %.2f",F)
```

Scilab code Exa 13.8 8

```
1 //Windows 10
2 // Scilab 6.0.0
```

```
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 F_Zn2= -35180 //standard free energy cal of Zn2
11 F_H2=0 //standard free energy cal of H2
12 F_Zn=0 //standard free energy cal of Zn
13 F_H=0 //standard free energy cal of H
14
15 //CALCULATIONS
16 F= F_Zn2 + F_H2 - F_Zn - (2 * F_H)
17
18 //RESULTS
19 mprintf("Value of dF = %.2f cal",F)
```

Scilab code Exa 13.9 9

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 F= -51180 //cal ,free energy
10 T= 25 //temperature in Celsius
11 R= 1.99 //cal/mole K
12
13 //CALCULATIONS
14 K= 10**(-F/(R*(273+T)*2.303))
15
```

```
16 //RESULTS
17 mprintf("Equilibrium constant = %.0e",K)
```

Scilab code Exa 13.10 10

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 dF_Ag_plus= 18430 //cal - free energy of formation
10 dF_Cl_minus= -31350 //cal - free energy of formation
11 dF_AgCl= 26224 //cal - free energy of formation
12 R= 1.99 //cal/mole K
13 T= 25 //temperature in Celsius
14
15 //CALCULATIONS
16 dF= dF_Ag_plus+dF_Cl_minus+dF_AgCl
17 Ksp= 10**(-dF/(R*(273+T)*2.303))
18
19 //RESULTS
20 mprintf("Solubility product = %.2e",Ksp)
21
22 //The difference in the solution compared to
   textbook is due to round off error
```

Scilab code Exa 13.11 11

```
1 //Windows 10
2 // Scilab 6.0.0
```

```
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 F= -51108 //cal - free energy of formation
10 f= 96500 //charge in coloumbs
11 n= 2 //moles
12
13 //CALCULATIONS
14 E= -F*4.184/(n*f)
15
16 //RESULTS
17 mprintf("Value of E = %.3f v",E)
```

Scilab code Exa 13.12 12

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 F1= 31350 //cal - free energy of formation
10 F2= 26224 //cal - free energy of formation
11 F= 96500 //charge in coloumbs
12
13 //CALCULATIONS
14 F3= -F1+F2
15 E= F3*4.184/F
16
17 //RESULTS
```

```
18 mprintf("Value of E = %.4f cal",E)
```

Scilab code Exa 13.13 13

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 a= 0.2 //molar
11 P= 1 //pressure in atm
12 F1= -5126 //cal - free energy of formation
13 R= 2 //cal/mole K
14
15 //CALCULATIONS
16 F= F1+R*(273+T)*2.303*log10(a**2)
17
18 //RESULTS
19 mprintf("Value of F = %.0f cal",F)
```

Scilab code Exa 13.14 14

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
```

```
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 F= 1160 //cal
11 P= 0.1 //pressure in atm
12 P1= 1 //pressure in atm
13 R= 2 //cal/mole K
14
15 //CALCULATIONS
16 F1= F+R*(273+T)*log(P/P1**2)
17 F2= F+R*(273+T)*log(P1/P**2)
18
19 //RESULTS
20 mprintf("Value of F = %.0f cal",F1)
21 mprintf("\nValue of F = %.0f cal",F2)
22
23 //The difference in the solution compared to
   textbook is due to round off error
```

Scilab code Exa 13.15 15

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 13 Thermodynamics Entropy and Free Energy
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 T= 25 //temperature in Celsius
10 H_CO2= -94.05 //kcal - enthalpy
11 H_CO= -26.40 //kcal - enthalpy
12 S1= 51.06 //cal per degree
13 S2= -47.3 //cal per degree
14 S3= -24.5 //cal per degree
15
```

```
16 //CALCULATIONS
17 dH= (H_CO2-H_CO)*1000
18 dS= S1+S2+S3
19 dF= dH-(273+T)*dS
20
21 //RESULTS
22 mprintf("Value of F = %.0f cal",dF)
23
24 //The difference in the solution compared to
     textbook is due to round off error:
25 //dS is being taken as -20.7 in the textbook whereas
     it is being calculated as -20.74 in the code
```

Chapter 14

Determination of hydronium ion Concentrations

Scilab code Exa 14.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 14 Determination of Hydroniumion
     Concentrations
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 E= 0.232 //potential in voltage
10 R= 0.0592  //constant
11 p= 1 //pressure in atm
12 R1= 0.0296// constant
13 P= 740 //pressure in atm
14
15 //CALCULATIONS
16 pH= E/R
17 pH1= (E-R1*log10(P/760))/R
18 e= pH1-pH
```

```
19 e= e-0.002
20
21 //RESULTS
22 mprintf("Error in pH of solution= %.3f",e)
```

Scilab code Exa 14.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 14 Determination of Hydroniumion
     Concentrations
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 e= 0.266 //potential in voltage
10 R= 0.0592  //constant
11
12 //CALCULATIONS
13 pH= e/R
14
15 //RESULTS
16 mprintf("pH of the unkown solution= %.2f",pH)
```

Scilab code Exa 14.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 14 Determination of Hydroniumion
     Concentrations
4
5 clc;
```

```
clear;

//Initialisation of Variables
e= 0.323 //potential in voltage
R= 0.0592  //constant
c= 0.001 //molar

//CALCULATIONS
pH= (e-R*log10(c))/R

//RESULTS
mprintf("pH of the unknown solution= %.2f",pH)
```

Scilab code Exa 14.4 4

```
//Windows 10
// Scilab 6.0.0
//Chapter 14 Determination of Hydroniumion
   Concentrations

clc;
clear;

//Initialisation of Variables
E= 0.527 //potential in v
T= 25 //temperature in Celsius
R= 0.0592  //constant
e= -0.246 //potential in v

//CALCULATIONS
pH= -(-E-e)/R

//RESULTS
mprintf("pH of the unknown solution= %.2f",pH);
```

Scilab code Exa 14.5 5

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 14 Determination of Hydroniumion
     Concentrations
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 E= 0.034 //potential in v
10 E1= -0.280 //potential in v
11 E2= -0.699 //potential in v
12 E3= 0.0592 //constant
13
14 //CALCULATIONS
15 pH= (E1-E-E2)/E3
16 pH1= (E-E2+E1)/E3
17
18 //RESULTS
19 mprintf("pH of the unkown solution= %.1f",pH)
20 mprintf("\npH of the unkown solution= %.2f",pH1)
```

Chapter 16

Oxidation Reduction potentials

Scilab code Exa 16.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 16 Oxidation Reduction Potentials
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 x= 0.02 //m
10 y= 0.4 //m
11 R= 0.0592
12 e= -0.771 //V
13 e1= -1.520 //v
14 n= 5 //electrons
15 z= 0.80 //m
16 z1= 0.5 //m
17
18 //CALCULATIONS
19 E= e-R*log10(x/y)
20 E1= e1-(R/n)*log10(z1*z**8/x)
21 E2= E-E1
```

```
22
23 //RESULTS
24 mprintf("Redox potential of sample= %.3f v",E)
25 mprintf("\nRedox potential of sample= %.3f v",E1)
26 mprintf("\nRedox potential of sample= %.3f v",E2)
```

Scilab code Exa 16.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 16 Oxidation Reduction Potentials
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 E= 0.3500 //v
10 E1= -0.2788 //v
11
12 //CALCULATIONS
13 e= E+E1
14
15 //RESULTS
16 mprintf("Redox potential of sample= %.4f v",e)
```

Scilab code Exa 16.3 3

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 16 Oxidation Reduction Potentials
4
5 clc;
6 clear;
```

```
7
8  //Initialisation of Variables
9  p= 60 //percent
10 x= 0.030 //v
11 E= -0.039 //v
12
13 //CALCULATIONS
14 V= E-x*log10((1-(p/100))/(p/100))
15
16 //RESULTS
17 mprintf("Redox potential of sample= %.3f v",V)
```

Chapter 17

Speed of Reaction Catalysis

Scilab code Exa 17.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 17 Speed of Reaction Catalysis
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 t= 40 //min
10 r= 0.274
11 t1= 50 //min
12
13 //CALCULATIONS
14 k= 2.3*log10(1/(1-r))/t
15 R=10**( -k*t1/2.3)
16 R1= 1-R
17
18 //RESULTS
19 mprintf("Velocity constant= %.3f min^-1",k)
20 mprintf("\nFraction decomposed= %.3f",R1)
```

Scilab code Exa 17.2 2

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 17 Speed of Reaction Catalysis
4 // Example 17.3 in textbook
5
6 clc;
7 clear;
8
9 //Initialisation of Variables
10 t= 10 //time in min
11 a0= 0.01 //concentration in molar
12 a= 0.00464 //concentration of base found in molar
13
14 //CALCULATIONS
15 k= (a0-a)/(a0*a*t)
16 t_half= 1/(k*0.01)
17
18 //RESULTS
19 mprintf("Velocity constant= %.2f min^-1",k)
20 mprintf("\nHalf-time period= %.1f min",t_half)
```

Chapter 20

Radiochemistry

Scilab code Exa 20.1 1

```
1 //Windows 10
2 // Scilab 6.0.0
3 //Chapter 20 Radiochemistry
4
5 clc;
6 clear;
7
8 //Initialisation of Variables
9 U1_thalf= 4.5*10**9 //half-life period of Uranium 1
     in years
10 Ra_thalf= 1590 //half-life period of Radium in years
11
12 //CALCULATIONS
13 lambda_U1= log10(2)/(U1_thalf*0.4343)
14 lambda_Ra= log10(2)/(Ra_thalf*0.4343)
15 //solution from disintegration constants
16 r= lambda_Ra/lambda_U1
17 //solution from half-life periods
18 r1= U1_thalf/Ra_thalf
19
20 //RESULTS
```

```
21 mprintf("Disintegration constant for Uranium 1= %.2e
       yr^-1",lambda_U1)
22 mprintf("\nDisintegration constant for Radium= %.2e
      yr^-1",lambda_Ra)
23 mprintf("\nRelative proportion(from disintegration
      constants)= %.2e",r)
24 mprintf("\nRelative proportion(from half-life
      periods)= %.2e",r1)
```