Scilab Textbook Companion for Applied Chemistry by T. Paradkar[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: Applied Chemistry

Author: T. Paradkar

Publisher: Technical Publications, Pune

Edition: 1

Year: 2012

ISBN: 9789350387795

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

Water

Scilab code Exa 1.1 hardness calculation

```
1  //water//
2  //page 1.7 example 1//
3  clc
4  W1=16.8;//Mg(HCO3)2 in water in mg/L//
5  W2=19;//MgCl2 in water in mg/L//
6  W3=24;//MgSO4 in water in mg/L//
7  W4=29.6;//Mg(NO3)2 in water in mg/L//
8  W5=04;//CaCO3 in water in mg/L//
9  W6=10;//MgCO3 in water in mg/L//
10 M1=100/146;//multiplication factor of Mg(HCO3)2//
11 M2=100/95;//multiplication factor of MgCl2//
12 M3=100/120;//multiplication factor of MgSO4//
13 M4=100/148;//multiplication factor of Mg(NO3)2//
14 M5=100/100;//multiplication factor of CaCO3//
15 M6=100/84;//multiplication factor of MgCO3//
16 P1=W1*M1;//Mg(HCO3)2 in terms of CaCO3 equivalent/
     litre//
17 P2=W2*M2;//MgCl2 in terms of CaCO3 equivalent/litre
     //
18 P3=W3*M3;//MgSO4  in terms of CaCO3 equivalent/litre
     //
```

```
19 P4=W4*M4;//Mg(NO3)2 in terms of CaCO3 equivalent/
     litre//
20 P5=W5*M5;//CaCO3 in terms of CaCO3 equivalent/litre
     //
21 P6=W6*M6;//MgCO3 in terms of CaCO3 equivalent/litre
     //
22 T=P1+P5+P6;
23 printf("\nTemporary hardness is %.1f mg CaCO3
     equivalent/litre",T);
24 P=P2+P3+P4;
25 printf("\nPermanant hardness is %.0f mg CaCO3
     equivalent/litre",P);
```

Scilab code Exa 1.2 hardness calculation

```
1 //water//
2 //page 1.8 example 2//
3 clc
4 W1=7.1;//Mg(HCO3)2 in water in mg/L//
5 W2=8.1;//Ca(HCO3)2 in water in mg/L//
6 W3=4.2;//MgCO3 in water in mg/L//
7 W4=10;//CaCO3 in water in mg/L//
8 W5=24;//MgSO4 in water in mg/L//
9 M1=100/146;//multiplication factor of Mg(HCO3)2//
10 M2=100/162;//multiplication factor of Ca(HCO3)2//
11 M3=100/84;//multiplication factor of MgCO3//
12 M4=100/100;//multiplication factor of CaCO3//
13 M5=100/120;//multiplication factor of MgSO4//
14 P1=W1*M1;//Mg(HCO3)2 in terms of CaCO3//
15 P2=W2*M2;//Ca(HCO3)2 in terms of CaCO3//
16 P3=W3*M3;//MgCO3 in terms of CaCO3//
17 P4=W4*M4;//CaCO3 in terms of CaCO3//
18 P5=W5*M5;//MgSO4 in terms of CaCO3//
19 C=P1+P2+P3+P4;
20 printf("\nCarbonate hardness is %.0f ppm",C);
```

```
21 NC=P5;
22 printf("\nNon-Carbonate hardness is %.0f ppm",NC);
```

Scilab code Exa 1.3 hardness calculation

```
1 //water//
2 //page 1.9 example 3//
3 clc
4 W1=150;//Ca2+ in water in mg/L//
5 W2=60;//Mg2+ in water in mg/L//
6 M1=100/40;//multiplication factor of Ca2+//
7 M2=100/24;//multiplication factor of Mg2+//
8 P1=W1*M1;//Ca2+ in terms of CaCO3//
9 P2=W2*M2;//Mg2+ in terms of CaCO3//
10 T=P1+P2;
11 printf("\nTotal hardness is %.0f mg/L",T);
```

Scilab code Exa 1.4 calculation of Fe2O3 required

```
1 //water//
2 //page 1.9 example 4//
3 clc
4 H=210.5;//hardness in ppm//
5 M1=100;//molecular weight of CaCO3//
6 M2=136;//molecular weight of FeSO4//
7 M=M1/M2;//multiplication factor of FeSO4//
8 W=H/M;//weight of FeSO4 required//
9 printf("\nFeSO4 required is %.1f ppm",W);
```

Scilab code Exa 1.5 hardness calculation

```
//water//
//page 1.10 example 5//
clc
W1=32.4;//Ca(HCO3)2 in water in mg/L//
W2=29.2;//Mg(HCO3)2 in water in mg/L//
W3=13.6;//CaSO4 in water in mg/L//
M1=100/162;//multiplication factor of Ca(HCO3)2//
M2=100/146;//multiplication factor of Mg(HCO3)2//
M3=100/136;//multiplication factor of CaSO4//
P1=W1*M1;//Ca(HCO3)2 in terms of CaCO3//
P2=W2*M2;//Mg(HCO3)2 in terms of CaCO3//
P3=W3*M3;//CaSO4  in terms of CaCO3//
T=P1+P2;
printf("\nTemporary hardness is %.0f ppm",T);
P=P3;
printf("\nPermanant hardness is %.0f ppm",P);
To=T+P;
printf("\nTotal hardness is %.0f ppm",To);
```

Scilab code Exa 1.6 `hardness calculation`

```
//water//
//page 1.10 example 6//
clc
W1=14.6;//Mg(HCO3)2 in water in mg/L//
W2=8.1;//Ca(HCO3)2 in water in mg/L//
W3=29.6;//Mg(NO3)2 in water in mg/L//
W4=19;//MgCl2 in water in mg/L//
W5=24;//MgSO4 in water in mg/L//
M1=100/146;//multiplication factor of Mg(HCO3)2//
M2=100/162;//multiplication factor of Ca(HCO3)2//
M3=100/148;//multiplication factor of Mg(NO3)2//
M4=100/95;//multiplication factor of MgCl2//
M5=100/120;//multiplication factor of MgSO4//
P1=W1*M1;//Mg(HCO3)2 in terms of CaCO3//
```

```
15 P2=W2*M2;//Ca(HCO3)2 in terms of CaCO3//
16 P3=W3*M3;//Mg(NO3)2  in terms of CaCO3//
17 P4=W4*M4;//MgCl2  in terms of CaCO3//
18 P5=W5*M5;//MgSO4  in terms of CaCO3//
19 T=P1+P2;
20 printf("\nTemporary hardness is %.0f ppm",T);
21 P=P3+P4+P5;
22 printf("\nPermanant hardness is %.0f ppm",P);
```

Scilab code Exa 1.7 hardness calculation

```
1 //water//
2 //page 1.11 example 7//
3 clc
4 W1=7.3;//Mg(HCO3)2 in water in mg/L//
5 W2=9.5;//MgCl2 in water in mg/L//
6 W3=16.2;//Ca(HCO3)2 in water in mg/L//
7 W4=13.6;//CaSO4 in water in mg/L//
8 M1=100/146;//multiplication factor of Mg(HCO3)2//
9 M2=100/95;//multiplication factor of MgCl2//
10 M3=100/162;//multiplication factor of Ca(HCO3)2//
11 M4=100/136;//multiplication factor of CaSO4//
12 P1=W1*M1;//Mg(HCO3)2 in terms of CaCO3//
13 P2=W2*M2;//MgCl2 in terms of CaCO3//
14 P3=W3*M3;//Ca(HCO3)2  in terms of CaCO3//
15 P4=W4*M4;//CaSO4  in terms of CaCO3//
16 T=P1+P3;
17 printf("\nTemporary hardness is %.0f ppm",T);
18 P=P2+P4;
19 printf("\nPermanant hardness is %.0f ppm",P);
20 To=T+P;
21 printf("\nTotal hardness is %.0f ppm",To);
```

Scilab code Exa 1.8 hardness calculation

```
1 //water//
2 //page 1.12 example 8//
3 clc
4 W1=19;//MgCl2 in water in mg/L//
5 W2=5;//CaCO3 in water in mg/L//
6 W3=29.5;//Ca(HCO3)2 in water in mg/L//
7 W4=13;//CaSO4 in water in mg/L//
8 M1=100/95;//multiplication factor of MgCl2//
9 M2=100/100;//multiplication factor of CaCO3//
10 M3=100/162;//multiplication factor of Ca(HCO3)2//
11 M4=100/136;//multiplication factor of CaSO4//
12 P1=W1*M1;//MgCl2 in terms of CaCO3//
13 P2=W2*M2;//CaCO3 in terms of CaCO3//
14 P3=W3*M3;//Ca(HCO3)2 in terms of CaCO3//
15 P4=W4*M4;//CaSO4 in terms of CaCO3//
16 T=P2+P3;
17 printf("\nTemporary hardness is %.2f ppm",T);
18 P=P1+P4;
19 printf("\nPermanant hardness is %.2f ppm",P);
20 To=T+P;
21 printf("\nTotal hardness is %.2f ppm",To);
```

Scilab code Exa 1.9 hardness calculation by EDTA method

```
1 //water//
2 //page 1.15 example 1//
3 clc
4 strength=1.1//in terms of mgs/ml CaCO3//
5 volume=50//volume titrated(ml)//
6 EDTA=38//volume in terms of ml//
7 volume_hardwater=100//volume of hardwater titrated(
    ml)//
8 EDTA_hardwater=21//volume used to titrate unknown
```

```
    hardwater//
CaCO3_equivalent=strength*volume//in terms of mg//
one_ml_EDTA=CaCO3_equivalent/EDTA//in terms of CaCO3
    equivalent//
titrate_equivalent=one_ml_EDTA*EDTA_hardwater/
    volume_hardwater//CaCO3 equivalent of titrated
    volume//
Hardness=titrate_equivalent*1000//in terms of mg/lit
    or ppm//
printf("\nHardness of water is %.1f mg/L",Hardness);
```

Scilab code Exa 1.10 hardness calculation by EDTA method

```
//water//
//page 1.16 example 2//
clc
conc_SH=0.28/1000//in terms of g/lit//
strength_SH=conc_SH*1000//in terms of mgs/lit//
volume_SH=100//in terms of ml//
volume_H=100//in terms of ml//
EDTA_SH=28//volume for Std hardwater(ml)//
EDTA_H=33//volume for sample hardwater(ml)//
AB_EDTA=10//volume required after boiling(ml)//
CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
    of CaCO3 equivalent//
one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
    CaCO3 equivalent//
To_sample=one_ml_EDTA*EDTA_H/volume_H//total
    hardness for given volume//
To=To_sample*1000//total hardness per litre(ppm)//
P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
    hardness for given volume//
P=P_sample*1000//permanent hardness per litre(ppm)//
T=To-P
printf("\nTotal Hardness is %.f ppm",To);
```

```
19 printf("\nPermanent Hardness is %.f ppm",P);
20 printf("\nTemporary Hardness is %.f ppm",T);
```

Scilab code Exa 1.11 hardness calculation by EDTA method

```
1  //water//
2  //page 1.17 example 3//
3  clc
4  conc_SH=1/1000//in terms of g/lit//
5  strength_SH=conc_SH*1000//in terms of mgs/lit//
6  volume_SH=50//in terms of ml//
7  volume_H=50//in terms of ml//
8  EDTA_SH=20//volume for Std hardwater(ml)//
9  EDTA_H=25//volume for sample hardwater(ml)//
10 AB_EDTA=18//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
      of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
       CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
      hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
      hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.f ppm",To);
19 printf("\nPermanent Hardness is %.f ppm",P);
20 printf("\nTemporary Hardness is %.f ppm",T);
```

Scilab code Exa 1.12 hardness calculation by EDTA method

```
1  //water//
```

```
2 //page 1.18 example 4//
3 clc
4 conc_SH=15/1000//in terms of g/lit//
5 strength_SH=conc_SH*1000//in terms of mgs/lit//
6 volume_SH=20//in terms of ml//
7 volume_H=100//in terms of ml//
8 EDTA_SH=25//volume for Std hardwater(ml)//
9 EDTA_H=18//volume for sample hardwater(ml)//
10 AB_EDTA=12//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
     of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
     CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
     hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
     hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.f ppm",To);
19 printf("\nPermanent Hardness is %.f ppm",P);//Final
     answer in book is incorrect//
20 printf("\nTemporary Hardness is %.f ppm",T);//Final
     answer in book is incorrect//
```

Scilab code Exa 1.13 hardness calculation by EDTA method

```
1 //water//
2 //page 1.19 example 5//
3 clc
4 conc_SH=0.5/500//in terms of g/lit//
5 strength_SH=conc_SH*1000//in terms of mgs/lit//
6 volume_SH=50//in terms of ml//
7 volume_H=50//in terms of ml//
```

```
8  EDTA_SH=48//volume for Std hardwater(ml)//
9  EDTA_H=15//volume for sample hardwater(ml)//
10 AB_EDTA=10//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
      of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
       CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
      hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
      hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.1f ppm",To);
19 printf("\nPermanent Hardness is %.2f ppm",P);
20 printf("\nTemporary Hardness is %.2f ppm",T);
```

Scilab code Exa 1.14 hardness calculation by EDTA method

```
1  //water//
2  //page 1.20 example 6//
3  clc
4  conc_SH=1/1000//in terms of g/lit//
5  strength_SH=conc_SH*1000//in terms of mgs/lit//
6  volume_SH=50//in terms of ml//
7  volume_H=50//in terms of ml//
8  EDTA_SH=45//volume for Std hardwater(ml)//
9  EDTA_H=25//volume for sample hardwater(ml)//
10 AB_EDTA=15//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
      of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
       CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
```

```
    hardness for given volume//
To=To_sample*1000//total hardness per litre(ppm)//
P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
    hardness for given volume//
P=P_sample*1000//permanent hardness per litre(ppm)//
T=To-P
printf("\nTotal Hardness is %.2f ppm",To);
printf("\nPermanent Hardness is %.2f ppm",P);
printf("\nTemporary Hardness is %.2f ppm",T);
```

Scilab code Exa 1.15 hardness calculation by EDTA method

```
//water//
//page 1.21 example 7//
clc
conc_SH=1/20//in terms of g/lit//
strength_SH=conc_SH*1000//in terms of mgs/lit//
volume_SH=50//in terms of ml//
volume_H=50//in terms of ml//
EDTA_SH=1000//volume for Std hardwater(ml)//
EDTA_H=7.2//volume for sample hardwater(ml)//
AB_EDTA=4//volume required after boiling(ml)//
CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
    of CaCO3 equivalent//
one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
    CaCO3 equivalent//
To_sample=one_ml_EDTA*EDTA_H/volume_H//total
    hardness for given volume//
To=To_sample*1000//total hardness per litre(ppm)//
P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
    hardness for given volume//
P=P_sample*1000//permanent hardness per litre(ppm)//
T=To-P
printf("\nTotal Hardness is %.f ppm",To);
printf("\nPermanent Hardness is %.f ppm",P);
```

```
20 printf("\nTemporary Hardness is %.f ppm",T);
```

Scilab code Exa 1.16 hardness calculation by EDTA method

```
1  //water//
2  //page 1.22 example 8//
3  clc
4  conc_SH=1.2/1000//in terms of g/lit//
5  strength_SH=conc_SH*1000//in terms of mgs/lit//
6  volume_SH=20//in terms of ml//
7  volume_H=50//in terms of ml//
8  EDTA_SH=35//volume for Std hardwater(ml)//
9  EDTA_H=30//volume for sample hardwater(ml)//
10 AB_EDTA=25//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
      of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
       CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
      hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
      hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.f ppm",To);
19 printf("\nPermanent Hardness is %.1f ppm",P);
20 printf("\nTemporary Hardness is %.1f ppm",T);
```

Scilab code Exa 1.17 calculation of required lime and soda

```
1  //water//
2  //page 1.31 example 1//
```

```
clc
Purity_Lime=.90
Purity_soda=1
W1=136;//amount of CaSO4 in ppm//
W2=49;//amount of H2SO4 in ppm//
W3=95;//amount of MgCl2 in ppm//
W4=60;//amount of MgSO4 in ppm//
M1=100/136;//multiplication factor of CaSO4//
M2=100/98;//multiplication factor of H2SO4//
M3=100/95;//multiplication factor of MgCl2//
M4=100/120;//multiplication factor of MgSO4//
P1=W1*M1;//in terms of CaCO3//S
P2=W2*M2;//in terms of CaCO3//L+S
P3=W3*M3;//in terms of CaCO3//L+S
P4=W4*M4;//in terms of CaCO3//L+S
printf ("We do not take SiO2 since it does not react
    with lime/soda");
V=1000000;//volume of water in litres//
L=0.74*(P2+P3+P4)*V/Purity_Lime;//lime required in
   mg//
L=L/10^3;
printf("\n Amount of Lime required is %.f g",L);
S=1.06*(P1+P2+P3+P4)*V/Purity_soda;//soda required
   in mg//
S=S/10^3;
printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.18 calculation of required lime and soda

```
//water//
//page 1.31 example 2//
clc
Purity_Lime=.90
Purity_soda=.95
W1=156;//amount of Mg(HCO3)2 in ppm//
```

```
7  W2=4.9;//amount of H2SO4 in ppm//
8  W3=23.75;//amount of MgCl2 in ppm//
9  W4=5.6;//amount of NaCl in ppm//
10 W5=111;//amount of CaCl2 in ppm//
11 W6=16.2;//amount of SiO2 in ppm//
12 M1=100/146;//multiplication factor of Mg(HCO3)2//
13 M2=100/98;//multiplication factor of H2SO4//
14 M3=100/95;//multiplication factor of MgCl2//
15 M5=100/111;//multiplication factor of CaCl2//
16 P1=W1*M1;//in terms of CaCO3//2*L
17 P2=W2*M2;//in terms of CaCO3//L+S
18 P3=W3*M3;//in terms of CaCO3//L+S
19 P5=W5*M5;//in terms of CaCO3//S
20 printf ("We do not take NaCl and SiO2 since they do
     not react with lime/soda");
21 V=50000;//volume of water in litres//
22 L=0.74*(2*P1+P2+P3)*V/Purity_Lime;//lime required in
     mg//
23 L=L/10^3;
24 printf("\n Amount of Lime required is %.2f g",L);
25 S=1.06*(P2+P3+P5)*V/Purity_soda;//soda required in
     mg//
26 S=S/10^3;
27 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.19 calculation of required lime and soda

```
1  //water//
2  //page 1.32 example 3//
3  clc
4  Purity_Lime=.74
5  Purity_soda=.90
6  W1=73;//amount of Mg(HCO3)2 in ppm//
7  W2=222;//amount of CaCl2 in ppm//
8  W3=120;//amount of MgSO4 in ppm//
```

```
W4=164;//amount of Ca(NO3)2 in ppm//
M1=100/146;//multiplication factor of Mg(HCO3)2//
M2=100/111;//multiplication factor of CaCl2//
M3=100/120;//multiplication factor of MgSO4//
M4=100/164;//multiplication factor of Ca(NO3)2//
P1=W1*M1;//in terms of CaCO3//2*L
P2=W2*M2;//in terms of CaCO3//S
P3=W3*M3;//in terms of CaCO3//L+S
P4=W4*M4;//in terms of CaCO3//S
V=5000;//volume of water in litres//
L=0.74*(2*P1+P3)*V/Purity_Lime;//lime required in mg
   //
L=L/10^3;
printf("\n Amount of Lime required is %.f g",L);
S=1.06*(P2+P3+P4)*V/Purity_soda;//soda required in
   mg//
S=S/10^3;
printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.20 calculation of required lime and soda

```
//water//
//page 1.33 example 4//
clc
Purity_Lime=1
Purity_soda=1
W1=144;//amount of MgCO3 in ppm//
W2=95;//amount of MgCl2 in ppm//
W3=25;//amount of CaCO3 in ppm//
W4=111;//amount of CaCl2 in ppm//
M1=100/84;//multiplication factor of MgCO3//
M2=100/95;//multiplication factor of MgCl2//
M3=100/100;//multiplication factor of CaCO3//
M4=100/111;//multiplication factor of CaCl2//
P1=W1*M1;//in terms of CaCO3//2*L
```

```
15 P2=W2*M2;//in terms of CaCO3//L+S
16 P3=W3*M3;//in terms of CaCO3//L
17 P4=W4*M4;//in terms of CaCO3//S
18 printf ("We do not take Fe2O3 and Na2SO4 since they
     do not react with lime/soda");
19 V=50000;//volume of water in litres//
20 L=0.74*(2*P1+P2+P3)*V/Purity_Lime;//lime required in
     mg//
21 L=L/10^3;
22 printf("\n Amount of Lime required is %.2f g",L);
23 S=1.06*(P2+P4)*V/Purity_soda;//soda required in mg//
24 S=S/10^3;
25 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.21 calculation of required lime and soda

```
1 //water//
2 //page 1.34 example 5//
3 clc
4 Purity_Lime=1
5 W1=13.6;//amount of CaSO4 in ppm//
6 W2=8.4;//amount of MgCO3 in ppm//
7 W3=05;//amount of CaCO3 in ppm//
8 M1=100/136;//multiplication factor of CaSO4//
9 M2=100/84;//multiplication factor of MgCO3//
10 M3=100/100;//multiplication factor of CaCO3//
11 P1=W1*M1;//in terms of CaCO3//S
12 P2=W2*M2;//in terms of CaCO3//2*L
13 P3=W3*M3;//in terms of CaCO3//L
14 printf ("We do not take KNO3 since it does not react
     with lime/soda");
15 V=5000;//volume of water in litres//
16 L=0.74*(2*P2+P3)*V/Purity_Lime;//lime required in mg
     //
17 L=L/10^3;
```

```
18 printf("\n Amount of Lime required is %.1f g",L);
```

Scilab code Exa 1.22 calculation of required lime

```
1  //water//
2  //page 1.35 example 6//
3  clc
4  Purity_soda=1
5  W1=5;//amount of CaCO3 in ppm//
6  W2=22.2;//amount of CaCl2 in ppm//
7  W3=2;//amount of MgSO4 in ppm//
8  M1=100/100;//multiplication factor of CaCO3//
9  M2=100/111;//multiplication factor of CaCl2//
10 M3=100/120;//multiplication factor of MgSO4//
11 P1=W1*M1;//in terms of CaCO3//L
12 P2=W2*M2;//in terms of CaCO3//S
13 P3=W3*M3;//in terms of CaCO3//L+S
14 printf ("We do not take Na2SO4 and SiO2 since they
      do not react with lime/soda");
15 V=10000;//volume of water in litres//
16 S=1.06*(P2+P3)*V/Purity_soda;//soda required in mg//
17 S=S/10^3;
18 printf("\n Amount of Soda required is %.1f g",S)
```

Scilab code Exa 1.23 calculation of required soda

```
1  //water//
2  //page 1.36 example 7//
3  clc
4  Purity_Lime=1
5  Purity_soda=1
6  W1=10;//amount of CaCO3 in ppm//
7  W2=36.5;//amount of Mg(HCO3)2 in ppm//
```

```
W3=19;//amount of MgCl2 in ppm//
M1=100/100;//multiplication factor of CaCO3//
M2=100/146;//multiplication factor of Mg(HCO3)2//
M3=100/95;//multiplication factor of MgCl2//
P1=W1*M1;//in terms of CaCO3//L
P2=W2*M2;//in terms of CaCO3//2*L
P3=W3*M3;//in terms of CaCO3//L+S
printf ("We do not take SiO2 since it does not react
    with lime/soda");
V=1000000;//volume of water in litres//
L=0.74*(P1+2*P2+P3)*V/Purity_Lime;//lime required in
    mg//
L=L/10^3;
printf("\n Amount of Lime required is %.f g",L);
S=1.06*(P3)*V/Purity_soda;//soda required in mg//
S=S/10^3;
printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.24 calculation of required lime and soda

```
//water//
//page 1.37 example 8//
clc
Purity_Lime=.8
Purity_soda=.9
W1=7.1;//amount of Mg(HCO3)2 in ppm//
W2=8.1;//amount of Ca(HCO3)2 in ppm//
W3=4.195;//amount of MgCO3 in ppm//
W4=10;//amount of CaCO3 in ppm//
M1=100/146;//multiplication factor of Mg(HCO3)2//
M2=100/162;//multiplication factor of Ca(HCO3)2//
M3=100/84;//multiplication factor of MgCO3//
M4=100/100;//multiplication factor of CaCO3//
P1=W1*M1;//in terms of CaCO3//2*L
P2=W2*M2;//in terms of CaCO3//L
```

```
16 P3=W3*M3;//in terms of CaCO3//2*L
17 P4=W4*M4;//in terms of CaCO3//L
18 V=100000;//volume of water in litres//
19 L=0.74*(2*P1+P2+2*P3+P4)*V/Purity_Lime;//lime
      required in mg//
20 L=L/10^3;
21 printf("\n Amount of Lime required is %.f g",L);
22 S=1.06*(0)*V/Purity_soda;//soda required in mg//
23 S=S/10^3;
24 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.25 calculation of required lime and soda

```
1 //water//
2 //page 1.38 example 9//
3 clc
4 Purity_Lime=.9
5 Purity_soda=.9
6 W1=19;//amount of MgCl2 in ppm//
7 W2=27.2;//amount of CaSO4 in ppm//
8 W3=4.9;//amount of H2SO4 in ppm//
9 W4=6;//amount of AL3+ in ppm//
10 M1=100/95;//multiplication factor of MgCl2//
11 M2=100/136;//multiplication factor of CaSO4//
12 M3=100/49;//multiplication factor of H2SO4//
13 M4=100/18.0018;//multiplication factor of AL3+//
14 P1=W1*M1;//in terms of CaCO3//L+S
15 P2=W2*M2;//in terms of CaCO3//S
16 P3=W3*M3;//in terms of CaCO3//L+S
17 P4=W4*M4;//in terms of CaCO3//L+S
18 V=500000;//volume of water in litres//
19 L=0.74*(P1+P3+P4)*V/Purity_Lime;//lime required in
      mg//
20 L=L/10^3;
21 printf("\n Amount of Lime required is %.2f g",L);
```

```
22 S=1.06*(P1+P2+P3+P4)*V/Purity_soda;//soda required
      in mg//
23 S=S/10^3;
24 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.26 calculation of required lime and soda

```
1  //water//
2  //page 1.38 example 10//
3  clc
4  Purity_Lime=.9
5  Purity_soda=.95
6  W1=81;//amount of Ca(HCO3)2 in ppm//
7  W2=42;//amount of MgCO3 in ppm//
8  W3=4.1;//amount of NaAlO2 in ppm//
9  W4=3.65;//amount of HCl in ppm//
10 W5=82;//amount of Ca(NO3)2 in ppm//
11 M1=100/162;//multiplication factor of Ca(HCO3)2//
12 M2=100/84;//multiplication factor of MgCO3//
13 M3=100/82;//multiplication factor of NaAlO2//
14 M4=100/36.5;//multiplication factor of HCl//
15 M5=100/164;//multiplication factor of Ca(NO3)2//
16 P1=W1*M1;//in terms of CaCO3//L
17 P2=W2*M2;//in terms of CaCO3//2*L
18 P3=W3*M3;//in terms of CaCO3//-L
19 P4=W4*M4;//in terms of CaCO3//L+S
20 P5=W5*M5;//in terms of CaCO3//S
21 printf ("We do not take NaCl since it does not react
      with lime/soda");
22 V=20000;//volume of water in litres//
23 L=0.74*(P1+2*P2+P4-P3)*V/Purity_Lime;//lime required
      in mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.2f g",L);
26 S=1.06*(P4+P5)*V/Purity_soda;//soda required in mg//
```

```
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.3f g",S)
```

Scilab code Exa 1.27 calculation of required lime and soda

```
1  //water//
2  //page 1.39 example 11//
3  clc
4  Purity_Lime=.85
5  Purity_soda=.9
6  W1=16.2;//amount of Ca(HCO3)2 in ppm//
7  W2=6.8;//amount of CaSO4 in ppm//
8  W3=11.1;//amount of CaCl2 in ppm//
9  W4=6;//amount of MgSO4 in ppm//
10 W5=8.4;//amount of Mg(HCO3)2 in ppm//
11 M1=100/162;//multiplication factor of Ca(HCO3)2//
12 M2=100/136;//multiplication factor of CaSO4//
13 M3=100/111;//multiplication factor of CaCl2//
14 M4=100/120;//multiplication factor of MgSO4//
15 M5=100/146;//multiplication factor of Mg(HCO3)2//
16 P1=W1*M1;//in terms of CaCO3//L
17 P2=W2*M2;//in terms of CaCO3//S
18 P3=W3*M3;//in terms of CaCO3//S
19 P4=W4*M4;//in terms of CaCO3//L+S
20 P5=W5*M5;//in terms of CaCO3//2*L
21 printf ("We do not take NaCl since it does not react
       with lime/soda");
22 V=10000;//volume of water in litres//
23 L=0.74*(P1+P4+2*P5)*V/Purity_Lime;//lime required in
      mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.1f g",L);
26 S=1.06*(P2+P3+P4)*V/Purity_soda;//soda required in
     mg//
27 S=S/10^3;
```

```
28 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.28 calculation of required lime and soda

```
1  //water//
2  //page 1.40 example 12//
3  clc
4  Purity_Lime=.7
5  Purity_soda=.85
6  W1=30.2;//amount of Ca(HCO3)2 in ppm//
7  W2=20.8;//amount of Mg(HCO3)2 in ppm//
8  W3=28.31;//amount of CaCl2 in ppm//
9  W4=8.7;//amount of MgCl2 in ppm//
10 W5=35;//amount of CaSO4 in ppm//
11 W6=6.7;//amount of MgSO4 in ppm//
12 M1=100/162;//multiplication factor of Ca(HCO3)2//
13 M2=100/146;//multiplication factor of Mg(HCO3)2//
14 M3=100/111;//multiplication factor of CaCl2//
15 M4=100/95;//multiplication factor of MgCl2//
16 M5=100/136;//multiplication factor of CaSO4//
17 M6=100/120;//multiplication factor of MgSO4//
18 P1=W1*M1;//in terms of CaCO3//L
19 P2=W2*M2;//in terms of CaCO3//2*L
20 P3=W3*M3;//in terms of CaCO3//S
21 P4=W4*M4;//in terms of CaCO3//L+S
22 P5=W5*M5;//in terms of CaCO3//S
23 P6=W6*M6;//in terms of CaCO3//L+S
24 printf ("We do not take Na2SO4 since it does not
      react with lime/soda");
25 V=100000;//volume of water in litres//
26 L=0.74*(P1+2*P2+P4+P6)*V/Purity_Lime;//lime required
       in mg//
27 L=L/10^3;
28 printf("\n Amount of Lime required is %.1f g",L);
29 S=1.06*(P3+P4+P5+P6)*V/Purity_soda;//soda required
```

```
    in mg//
30 S=S/10^3;
31 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.29 calculation of required lime and soda

```
1  //water//
2  //page 1.41 example 13//
3  clc
4  Purity_Lime=.8
5  Purity_soda=.85
6  W1=162;//amount of Ca(HCO3)2 in ppm//
7  W2=7.3;//amount of Mg(HCO3)2 in ppm//
8  W3=9.5;//amount of MgCl2 in ppm//
9  W4=36.5;//amount of HCl in ppm//
10 W5=44;//amount of CO2 in ppm//
11 W6=111;//amount of CaCl2 in ppm//
12 W7=60;//amount of MgSO4 in ppm//
13 M1=100/162;//multiplication factor of Ca(HCO3)2//
14 M2=100/146;//multiplication factor of Mg(HCO3)2//
15 M3=100/95;//multiplication factor of MgCl2//
16 M4=100/73;//multiplication factor of HCl//
17 M5=100/44;//multiplication factor of CO2//
18 M6=100/111;//multiplication factor of CaCl2//
19 M7=100/120;//multiplication factor of MgSO4//
20 P1=W1*M1;//in terms of CaCO3//L
21 P2=W2*M2;//in terms of CaCO3//2*L
22 P3=W3*M3;//in terms of CaCO3//L+S
23 P4=W4*M4;//in terms of CaCO3//L+S
24 P5=W5*M5;//in terms of CaCO3//L
25 P6=W6*M6;//in terms of CaCO3//S
26 P7=W7*M7;//in terms of CaCO3//L+S
27 printf ("We do not take NaCl since it does not react
       with lime/soda");
28 V=1000000;//volume of water in litres//
```

```
29 L=0.74*(P1+2*P2+P3+P4+P5+P7)*V/Purity_Lime;//lime
      required in mg//
30 L=L/10^3;
31 printf("\n Amount of Lime required is %.f g",L);
32 S=1.06*(P3+P4+P6+P7)*V/Purity_soda;//soda required
      in mg//
33 S=S/10^3;
34 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.30 calculation of required lime and soda

```
1 //water//
2 //page 1.42 example 14//
3 clc
4 Purity_Lime=1
5 Purity_soda=1
6 W1=222;//amount of CaCl2 in ppm//
7 W2=296;//amount of Mg(NO3)2 in ppm//
8 W3=324;//amount of Ca(HCO3)2 in ppm//
9 W4=196;//amount of H2SO4 in ppm//
10 M1=100/111;//multiplication factor of CaCl2//
11 M2=100/148;//multiplication factor of Ca(HCO3)2//
12 M3=100/162;//multiplication factor of MgCO3//
13 M4=100/98;//multiplication factor of H2SO4//
14 P1=W1*M1;//in terms of CaCO3//S
15 P2=W2*M2;//in terms of CaCO3//L+S
16 P3=W3*M3;//in terms of CaCO3//L
17 P4=W4*M4;//in terms of CaCO3//L+S
18 printf ("We do not take organic matter since it does
     not react with lime/soda");
19 V=50000;//volume of water in litres//
20 L=0.74*(P2+P3+P4)*V/Purity_Lime;//lime required in
     mg//
21 L=L/10^3;
22 printf("\n Amount of Lime required is %.f g",L);
```

```
23 S=1.06*(P1+P2+P4)*V/Purity_soda;//soda required in
     mg//
24 S=S/10^3;
25 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.31 calculation of required lime and soda

```
1  //water//
2  //page 1.43 example 15//
3  clc
4  Purity_Lime=.85
5  Purity_soda=.95
6  W1=12.5;//amount of CaCO3 in ppm//
7  W2=8.4;//amount of MgCO3 in ppm//
8  W3=22.2;//amount of CaCl2 in ppm//
9  W4=9.5;//amount of MgCl2 in ppm//
10 W5=33;//amount of CO2 in ppm//
11 W6=7.3;//amount of HCl in ppm//
12 W7=16.8;//amount of NaHCO3 in ppm//
13 M1=100/100;//multiplication factor of CaCO3//
14 M2=100/84;//multiplication factor of MgCO3//
15 M3=100/111;//multiplication factor of CaCl2//
16 M4=100/95;//multiplication factor of MgCl2//
17 M5=100/44;//multiplication factor of CO2//
18 M6=100/73;//multiplication factor of HCl//
19 M7=100/168;//multiplication factor of NaHCO3//
20 P1=W1*M1;//in terms of CaCO3//L
21 P2=W2*M2;//in terms of CaCO3//2*L
22 P3=W3*M3;//in terms of CaCO3//S
23 P4=W4*M4;//in terms of CaCO3//L+S
24 P5=W5*M5;//in terms of CaCO3//L
25 P6=W6*M6;//in terms of CaCO3//L+S
26 P7=W7*M7;//in terms of CaCO3//L-S
27 V=1000000;//volume of water in litres//
28 L=0.74*(P1+2*P2+P4+P5+P6+P7)*V/Purity_Lime;//lime
```

```
    required in mg//
L=L/10^3;
printf("\n Amount of Lime required is %.f g",L);
S=1.06*(P3+P4+P6-P7)*V/Purity_soda;//soda required
    in mg//
S=S/10^3;
printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.32 calculation of required lime and soda

```
//water//
//page 1.44 example 16//
clc
Purity_Lime=1
Purity_soda=1
W1=8.1;//amount of Ca(HCO3)2 in ppm//
W2=7.5;//amount of Mg(HCO3)2 in ppm//
W3=13.6;//amount of CaSO4 in ppm//
W4=12;//amount of MgSO4 in ppm//
W5=2;//amount of MgCl2 in ppm//
M1=100/162;//multiplication factor of Ca(HCO3)2//
M2=100/146;//multiplication factor of Mg(HCO3)2//
M3=100/136;//multiplication factor of CaSO4//
M4=100/120;//multiplication factor of MgSO4//
M5=100/95;//multiplication factor of MgCl2//
P1=W1*M1;//in terms of CaCO3//L
P2=W2*M2;//in terms of CaCO3//2*L
P3=W3*M3;//in terms of CaCO3//S
P4=W4*M4;//in terms of CaCO3//L+S
P5=W5*M5;//in terms of CaCO3//S
printf ("We do not take NaCl since it does not react
    with lime/soda");
V=50000;//volume of water in litres//
L=0.74*(P1+2*P2+P4+P5)*V/Purity_Lime;//lime required
    in mg//
```

```
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.2f g",L);
26 S=1.06*(P3+P4+P5)*V/Purity_soda;//soda required in
      mg//
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.33 calculation of required lime and soda

```
1 //water//
2 //page 1.45 example 17//
3 clc
4 Purity_Lime=.9
5 Purity_soda=.95
6 W1=155;//amount of Mg(HCO3)2 in ppm//
7 W2=23;//amount of MgCl2 in ppm//
8 W3=5;//amount of H2SO4 in ppm//
9 W4=111;//amount of CaCl2 in ppm//
10 M1=100/146;//multiplication factor of Mg(HCO3)2//
11 M2=100/95;//multiplication factor of MgCl2//
12 M3=100/98;//multiplication factor of H2SO4//
13 M4=100/111;//multiplication factor of CaCl2//
14 P1=W1*M1;//in terms of CaCO3//2*L
15 P2=W2*M2;//in terms of CaCO3//L+S
16 P3=W3*M3;//in terms of CaCO3//L+S
17 P4=W4*M4;//in terms of CaCO3//S
18 printf ("We do not take NaCl and Na2SO4 since they
      do not react with lime/soda");
19 V=50000;//volume of water in litres//
20 L=0.74*(2*P1+P2+P3)*V/Purity_Lime;//lime required in
       mg//
21 L=L/10^3;
22 printf("\n Amount of Lime required is %.2f g",L);//
      Final answer in book is incorrect//
23 S=1.06*(P2+P3+P4)*V/Purity_soda;//soda required in
```

```
    mg//
24 S=S/10^3;
25 printf("\n Amount of Soda required is %.2f g",S)//
    Final answer in book is incorrect//
```

Scilab code Exa 1.34 calculation of required lime and soda

```
1  //water//
2  //page 1.45 example 18//
3  clc
4  Purity_Lime=.9
5  Purity_soda=.95
6  W1=81;//amount of Ca(HCO3)2 in ppm//
7  W2=95;//amount of MgCl2 in ppm//
8  W3=68;//amount of CaSO4 in ppm//
9  W4=146;//amount of Mg(HCO3)2 in ppm//
10 W5=49;//amount of H2SO4 in ppm//
11 M1=100/162;//multiplication factor of Ca(HCO3)2//
12 M2=100/95;//multiplication factor of MgCl2//
13 M3=100/136;//multiplication factor of CaSO4//
14 M4=100/146;//multiplication factor of Mg(HCO3)2//
15 M5=100/98;//multiplication factor of H2SO4//
16 P1=W1*M1;//in terms of CaCO3//L
17 P2=W2*M2;//in terms of CaCO3//L+S
18 P3=W3*M3;//in terms of CaCO3//S
19 P4=W4*M4;//in terms of CaCO3//2*L
20 P5=W5*M5;//in terms of CaCO3//L+S
21 printf ("We do not take SiO2 since it does not react
    with lime/soda");
22 V=50000;//volume of water in litres//
23 L=0.74*(P1+P2+2*P4+P5)*V/Purity_Lime;//lime required
    in mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.2f g",L);
26 S=1.06*(P2+P3+P5)*V/Purity_soda;//soda required in
```

```
    mg//
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.35 calculation of required lime and soda

```
1  //water//
2  //page 1.46 example 19//
3  clc
4  Purity_Lime=.95
5  Purity_soda=.9
6  W1=81;//amount of Ca(HCO3)2 in ppm//
7  W2=73;//amount of Mg(HCO3)2 in ppm//
8  W3=68;//amount of CaSO4 in ppm//
9  W4=95;//amount of MgCl2 in ppm//
10 W5=14.8;//amount of Mg(NO3)2 in ppm//
11 W6=14.7;//amount of H2SO4 in ppm//
12 M1=100/162;//multiplication factor of Ca(HCO3)2//
13 M2=100/146;//multiplication factor of Mg(HCO3)2//
14 M3=100/136;//multiplication factor of CaSO4//
15 M4=100/95;//multiplication factor of MgCl2//
16 M5=100/148;//multiplication factor of Mg(NO3)2//
17 M6=100/98;//multiplication factor of H2SO4//
18 P1=W1*M1;//in terms of CaCO3//L
19 P2=W2*M2;//in terms of CaCO3//2*L
20 P3=W3*M3;//in terms of CaCO3//S
21 P4=W4*M4;//in terms of CaCO3//L+S
22 P5=W5*M5;//in terms of CaCO3//L+S
23 P6=W6*M6;//in terms of CaCO3//L+S
24 V=1000000;//volume of water in litres//
25 L=0.74*(P1+2*P2+P4+P5+P6)*V/Purity_Lime;//lime
       required in mg//
26 L=L/10^3;
27 printf("\n Amount of Lime required is %.1f g",L);
28 S=1.06*(P3+P4+P5+P6)*V/Purity_soda;//soda required
```

```
    in mg//
29 S=S/10^3;
30 printf("\n Amount of Soda required is %.1f g",S);
```

Scilab code Exa 1.36 calculation of hardness using Zeolite process

```
1  //water//
2  //page 1.50 example 1//
3  clc
4  volume_hardwater=10000//in litres//
5  volume_NaCl=5000//Volume of NaCl in litres//
6  conc_NaCl=1170/10000//% NaCl consumed by zeolite bed
     //
7  Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
     zeolite bed per litre//
8  total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
     consumed by zeolite bed//
9  CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
     lit)//
10 H=CaCO3_equivalent/volume_hardwater//Hardness of
     water(gms/lit)//
11 Hardness=H*1000//Hardness of water(mg/lit) or ppm//
12 printf("\nHardness of water sample is %.f ppm",
     Hardness);
```

Scilab code Exa 1.37 calculation of hardness using Zeolite process

```
1  //water//
2  //page 1.50 example 2//
3  clc
4  volume_hardwater=75000//in litres//
5  volume_NaCl=1500//Volume of NaCl in litres//
```

```
conc_NaCl=1.170/100//% NaCl consumed by zeolite bed
   //
Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
   zeolite bed per litre//
total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
   consumed by zeolite bed//
CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
   lit)//
H=CaCO3_equivalent/volume_hardwater//Hardness of
   water(gms/lit)//
Hardness=H*1000//Hardness of water(mg/lit) or ppm//
printf("\nHardness of water sample is %.f ppm",
   Hardness);
```

Scilab code Exa 1.38 Hardwater quantity softened using Zeolite process

```
//water//
//page 1.51 example 3//
clc
Hardness=300//Hardness of water(mg/lit) or ppm//
H=Hardness/100//Hardness of water(gms/lit)//
volume_NaCl=75//Volume of NaCl//
conc_NaCl=75//% NaCl consumed by zeolite bed//
Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
   zeolite bed per litre//
total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
   consumed by zeolite bed//
CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
   lit)//
volume_hardwater=CaCO3_equivalent/H
printf("\nQuantity of water softened using zeolite
   bed is %.f litres",volume_hardwater);
```

Scilab code Exa 1.39 Hardwater quantity softened using Zeolite process

```
1 //water//
2 //page 1.51 example 4//
3 clc
4 Hardness=400//Hardness of water(mg/lit) or ppm//
5 H=Hardness/100//Hardness of water(gms/lit)//
6 volume_NaCl=100//Volume of NaCl//
7 conc_NaCl=60//% NaCl consumed by zeolite bed//
8 Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
    zeolite bed per litre//
9 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
10 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
11 volume_hardwater=CaCO3_equivalent/H
12 printf("\nQuantity of water softened using zeolite
    bed is %.f litres",volume_hardwater);
```

Scilab code Exa 1.40 calculation of hardness using Zeolite process

```
1 //water//
2 //page 1.52 example 5//
3 clc
4 volume_hardwater=100000//in litres//
5 volume_NaCl=400//Volume of NaCl in litres//
6 conc_NaCl=100//% NaCl consumed by zeolite bed//
7 Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
    zeolite bed per litre//
8 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
9 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
10 H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
```

```
11 Hardness=H*100//Hardness of water(mg/lit) or ppm//
12 printf("\nHardness of water sample is %.1f mg/L",
      Hardness);
```

Scilab code Exa 1.41 calculation of hardness using Zeolite process

```
1 //water//
2 //page 1.52 example 6//
3 clc
4 volume_hardwater=800//in litres//
5 volume_NaCl=40//Volume of NaCl in litres//
6 conc_NaCl=110//% NaCl consumed by zeolite bed//
7 Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
      zeolite bed per litre//
8 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
      consumed by zeolite bed//
9 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
      lit)//
10 H=CaCO3_equivalent/volume_hardwater//Hardness of
      water(gms/lit)//
11 Hardness=H*100//Hardness of water(mg/lit) or ppm//
12 printf("\nHardness of water sample is %.2f ppm",
      Hardness);
```

Scilab code Exa 1.42 NaCl required for zeolite bed regeneration

```
1 //water//
2 //page 1.53 example 7//
3 clc
4 volume_hardwater=1//in litres//
5 CaCl2=4.5//Hardness of water(gms/lit)//
6 moles_NaCl=2;//Na3Ze giving NaCl and CaZe//
7 mol_wt_NaCl=58.5;
```

```
8 mol_wt_Na3Ze=111;
9 NaCl=CaCl2*moles_NaCl*mol_wt_NaCl/mol_wt_Na3Ze;
10 printf("\Quantity of NaCl produced is %.2f gm",NaCl)
   ;
```

Scilab code Exa 1.43 Hardwater quantity softened using Zeolite process

```
1 //water//
2 //page 1.53 example 8//
3 clc
4 Hardness=500//Hardness of water(mg/lit) or ppm//
5 H=Hardness/100//Hardness of water(gms/lit)//
6 volume_NaCl=100//Volume of NaCl//
7 conc_NaCl=120//% NaCl consumed by zeolite bed//
8 Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
   zeolite bed per litre//
9 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
   consumed by zeolite bed//
10 CaCO3_equivalent=total_wt*50/58.48//in terms of (gms
   /lit)//
11 volume_hardwater=CaCO3_equivalent/H
12 printf("\nQuantity of water softened using zeolite
   bed is %.f litres",volume_hardwater);
```

Scilab code Exa 1.44 calculation of hardness using Zeolite process

```
1 //water//
2 //page 1.54 example 9//
3 clc
4 volume_hardwater=4500//in litres//
5 volume_NaCl=30//Volume of NaCl in litres//
6 Wt_per_Litre=100//% NaCl consumed by zeolite bed//
```

```
7 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
8 CaCO3_equivalent=total_wt*50/58.55//in terms of (gms
    /lit)//
9 H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
10 Hardness=H*1000//Hardness of water(mg/lit) or ppm//
11 printf("\nHardness of water sample is %.f ppm",
    Hardness);
```

Scilab code Exa 1.45 calculation of hardness using Zeolite process

```
1 //water//
2 //page 1.54 example 10//
3 clc
4 volume_hardwater=3500//in litres//
5 volume_NaCl=25//Volume of NaCl in litres//
6 Wt_per_Litre=100//% NaCl consumed by zeolite bed//
7 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
8 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
9 H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
10 Hardness=H*1000//Hardness of water(mg/lit) or ppm//
11 printf("\nHardness of water sample is %.1f ppm",
    Hardness);
```

Scilab code Exa 1.46 calculation of hardness using Zeolite process

```
1 //water//
2 //page 1.55 example 11//
3 clc
```

```
4 volume_hardwater=15000//in litres//
5 volume_NaCl=120//Volume of NaCl in litres//
6 Wt_per_Litre=30//% NaCl consumed by zeolite bed//
7 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
8 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
9 H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
10 Hardness=H*1000//Hardness of water(mg/lit) or ppm//
11 printf("\nHardness of water sample is %.1f ppm",
    Hardness);
```

Scilab code Exa 1.47 Hardwater quantity softened using Zeolite process

```
1 //water//
2 //page 1.55 example 12//
3 clc
4 Hardness=480//Hardness of water(mg/lit) or ppm//
5 H=Hardness/100//Hardness of water(gms/lit)//
6 volume_NaCl=300//Volume of NaCl//
7 conc_NaCl=150//% NaCl consumed by zeolite bed//
8 Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
    zeolite bed per litre//
9 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
10 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
11 volume_hardwater=CaCO3_equivalent/H
12 printf("\nQuantity of water softened using zeolite
    bed is %.f litres",volume_hardwater);
```

Scilab code Exa 1.48 calculation of hardness using ion exchange process

```
1 //water//
2 //page 1.59 example 1//
3 clc
4 volume_water=10^4//in litres//
5 volume_HCl=200//in litres//
6 conc_HCl=0.1//in Normals//
7 totl_hardness=volume_HCl*conc_HCl*50//in terms of g
    CaCO3 equivalent//
8 h=totl_hardness/volume_water//in terms of g CaCO3
    equivalent//
9 printf("\nHardness of water sample is %.f mg/L",h
    *1000);
```

Scilab code Exa 1.49 calculation of BOD

```
1 //water//
2 //page 1.72 example 1//
3 clc
4 vol_init=50//initial volume of sample in ml//
5 vol_fin=80//final volume of sample in ml//
6 DOb=840//dissolved O2 present in effluent sample
    before incubation in ppm//
7 DOi=230//dissolved O2 present in effluent sample
    after incubation in ppm//
8 DF=vol_fin/vol_init//dilution factor//
9 BOD=(DOb-DOi)*DF//in ppm//
10 printf("\nBiological Oxygen Demand(BOD) of the
    sample is %.f ppm",BOD);
```

Scilab code Exa 1.50 calculation of COD

```
1 //water//
2 //page 1.73 example 2//
```

```
clc
Vb=27//volume of ferrous ammonium sulphate in blank
    experiment in ml//
Vt=6.5//volume of ferrous ammonium sulphate in test
    experiment in ml//
N=0.1//concentration in Normals//
Ve=25//volume of water sample taken in test in ml//
COD=(Vb-Vt)*N*8/Ve//in ppm//
printf("\nChemical Oxygen Demand(COD) of the sample
    is %.3f ppm",COD);
```

Scilab code Exa 1.51 hardness calculation using Zeolite process

```
//water//
//page 1.84 example 2//
clc
volume_hardwater=800//in litres//
volume_NaCl=40//Volume of NaCl in litres//
conc_NaCl=110//% NaCl consumed by zeolite bed//
Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
    zeolite bed per litre//
total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
Hardness=H*100//Hardness of water(mg/lit) or ppm//
printf("\nHardness of water sample is %.2f ppm",
    Hardness);
```

Scilab code Exa 1.52 calculation of required lime and soda

```
1  //water//
2  //page 1.84 example 3//
3  clc
4  Purity_Lime=.9
5  Purity_soda=.95
6  W1=81;//amount of Ca(HCO3)2 in ppm//
7  W2=42;//amount of MgCO3 in ppm//
8  W3=4.1;//amount of NaAlO2 in ppm//
9  W4=3.65;//amount of HCl in ppm//
10 W5=82;//amount of Ca(NO3)2 in ppm//
11 M1=100/162;//multiplication factor of Ca(HCO3)2//
12 M2=100/84;//multiplication factor of MgCO3//
13 M3=100/82;//multiplication factor of NaAlO2//
14 M4=100/36.5;//multiplication factor of HCl//
15 M5=100/164;//multiplication factor of Ca(NO3)2//
16 P1=W1*M1;//in terms of CaCO3//L
17 P2=W2*M2;//in terms of CaCO3//2*L
18 P3=W3*M3;//in terms of CaCO3//-L
19 P4=W4*M4;//in terms of CaCO3//L+S
20 P5=W5*M5;//in terms of CaCO3//S
21 printf ("We do not take NaCl since it does not react
       with lime/soda");
22 V=20000;//volume of water in litres//
23 L=0.74*(P1+2*P2+P4-P3)*V/Purity_Lime;//lime required
       in mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.2f g",L);
26 S=1.06*(P4+P5)*V/Purity_soda;//soda required in mg//
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.3f g",S)
```

Scilab code Exa 1.53 hardness calculation

```
1  //water//
2  //page 1.84 example 1//
```

```
clc
W1=32.4;//Ca(HCO3)2 in water in mg/L//
W2=29.2;//Mg(HCO3)2 in water in mg/L//
W3=13.6;//CaSO4 in water in mg/L//
M1=100/162;//multiplication factor of Ca(HCO3)2//
M2=100/146;//multiplication factor of Mg(HCO3)2//
M3=100/136;//multiplication factor of CaSO4//
P1=W1*M1;//Ca(HCO3)2 in terms of CaCO3//
P2=W2*M2;//Mg(HCO3)2 in terms of CaCO3//
P3=W3*M3;//CaSO4  in terms of CaCO3//
T=P1+P2;
printf("\nTemporary hardness is %.0f ppm",T);
P=P3;
printf("\nPermanant hardness is %.0f ppm",P);
To=T+P;
printf("\nTotal hardness is %.0f ppm",To);
```

Scilab code Exa 1.54 calculation of required lime and soda

```
//water//
//page 1.85 example 3//
clc
Purity_Lime=.85
Purity_soda=.9
W1=16.2;//amount of Ca(HCO3)2 in ppm//
W2=6.8;//amount of CaSO4 in ppm//
W3=11.1;//amount of CaCl2 in ppm//
W4=6;//amount of MgSO4 in ppm//
W5=8.4;//amount of Mg(HCO3)2 in ppm//
M1=100/162;//multiplication factor of Ca(HCO3)2//
M2=100/136;//multiplication factor of CaSO4//
M3=100/111;//multiplication factor of CaCl2//
M4=100/120;//multiplication factor of MgSO4//
M5=100/146;//multiplication factor of Mg(HCO3)2//
P1=W1*M1;//in terms of CaCO3//L
```

```
17 P2=W2*M2;//in terms of CaCO3//S
18 P3=W3*M3;//in terms of CaCO3//S
19 P4=W4*M4;//in terms of CaCO3//L+S
20 P5=W5*M5;//in terms of CaCO3//2*L
21 printf ("We do not take NaCl since it does not react
       with lime/soda");
22 V=10000;//volume of water in litres//
23 L=0.74*(P1+P4+2*P5)*V/Purity_Lime;//lime required in
      mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.1f g",L);
26 S=1.06*(P2+P3+P4)*V/Purity_soda;//soda required in
     mg//
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.55 hardness calculation by EDTA method

```
1 //water//
2 //page 1.85 example 4//
3 clc
4 conc_SH=15/1000//in terms of g/lit//
5 strength_SH=conc_SH*1000//in terms of mgs/lit//
6 volume_SH=20//in terms of ml//
7 volume_H=100//in terms of ml//
8 EDTA_SH=25//volume for Std hardwater(ml)//
9 EDTA_H=18//volume for sample hardwater(ml)//
10 AB_EDTA=12//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
     of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
      CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
     hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
```

```
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
     hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.f ppm",To);
19 printf("\nPermanent Hardness is %.f ppm",P);
20 printf("\nTemporary Hardness is %.f ppm",T);
```

Scilab code Exa 1.56 calculation of required lime and soda

```
1 //water//
2 //page 1.85 example 2//
3 clc
4 Purity_Lime=.7
5 Purity_soda=.85
6 W1=30.2;//amount of Ca(HCO3)2 in ppm//
7 W2=20.8;//amount of Mg(HCO3)2 in ppm//
8 W3=28.31;//amount of CaCl2 in ppm//
9 W4=8.7;//amount of MgCl2 in ppm//
10 W5=35;//amount of CaSO4 in ppm//
11 W6=6.7;//amount of MgSO4 in ppm//
12 M1=100/162;//multiplication factor of Ca(HCO3)2//
13 M2=100/146;//multiplication factor of Mg(HCO3)2//
14 M3=100/111;//multiplication factor of CaCl2//
15 M4=100/95;//multiplication factor of MgCl2//
16 M5=100/136;//multiplication factor of CaSO4//
17 M6=100/120;//multiplication factor of MgSO4//
18 P1=W1*M1;//in terms of CaCO3//L
19 P2=W2*M2;//in terms of CaCO3//2*L
20 P3=W3*M3;//in terms of CaCO3//S
21 P4=W4*M4;//in terms of CaCO3//L+S
22 P5=W5*M5;//in terms of CaCO3//S
23 P6=W6*M6;//in terms of CaCO3//L+S
24 printf ("We do not take Na2SO4 since it does not
     react with lime/soda");
```

```
25 V=100000;//volume of water in litres//
26 L=0.74*(P1+2*P2+P4+P6)*V/Purity_Lime;//lime required
       in mg//
27 L=L/10^3;
28 printf("\n Amount of Lime required is %.1f g",L);
29 S=1.06*(P3+P4+P5+P6)*V/Purity_soda;//soda required
      in mg//
30 S=S/10^3;
31 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.57 NaCl quantity produced in Zeolite process

```
1 //water//
2 //page 1.85 example 1//
3 clc
4 volume_hardwater=1//in litres//
5 CaCl2=4.5//Hardness of water(gms/lit)//
6 moles_NaCl=2;//Na3Ze giving NaCl and CaZe//
7 mol_wt_NaCl=58.5;
8 mol_wt_Na3Ze=111;
9 NaCl=CaCl2*moles_NaCl*mol_wt_NaCl/mol_wt_Na3Ze;
10 printf("\Quantity of NaCl produced is %.2f gm",NaCl)
      ;
```

Scilab code Exa 1.58 hardness calculation

```
1 //water//
2 //page 1.86 example 1//
3 clc
4 W1=14.6;//Mg(HCO3)2 in water in mg/L//
5 W2=8.1;//Ca(HCO3)2 in water in mg/L//
6 W3=29.6;//Mg(NO3)2 in water in mg/L//
7 W4=19;//MgCl2 in water in mg/L//
```

```
W5=24;//MgSO4 in water in mg/L//
M1=100/146;//multiplication factor of Mg(HCO3)2//
M2=100/162;//multiplication factor of Ca(HCO3)2//
M3=100/148;//multiplication factor of Mg(NO3)2//
M4=100/95;//multiplication factor of MgCl2//
M5=100/120;//multiplication factor of MgSO4//
P1=W1*M1;//Mg(HCO3)2 in terms of CaCO3//
P2=W2*M2;//Ca(HCO3)2 in terms of CaCO3//
P3=W3*M3;//Mg(NO3)2  in terms of CaCO3//
P4=W4*M4;//MgCl2  in terms of CaCO3//
P5=W5*M5;//MgSO4  in terms of CaCO3//
T=P1+P2;
printf("\nTemporary hardness is %.0f ppm",T);
P=P3+P4+P5;
printf("\nPermanant hardness is %.0f ppm",P);
```

Scilab code Exa 1.59 calculation of required lime and soda

```
//water//
//page 1.86 example 3//
clc
Purity_Lime=.8
Purity_soda=.85
W1=162;//amount of Ca(HCO3)2 in ppm//
W2=7.3;//amount of Mg(HCO3)2 in ppm//
W3=9.5;//amount of MgCl2 in ppm//
W4=36.5;//amount of HCl in ppm//
W5=44;//amount of CO2 in ppm//
W6=111;//amount of CaCl2 in ppm//
W7=60;//amount of MgSO4 in ppm//
M1=100/162;//multiplication factor of Ca(HCO3)2//
M2=100/146;//multiplication factor of Mg(HCO3)2//
M3=100/95;//multiplication factor of MgCl2//
M4=100/73;//multiplication factor of HCl//
M5=100/44;//multiplication factor of CO2//
```

```
18 M6=100/111;//multiplication factor of CaCl2//
19 M7=100/120;//multiplication factor of MgSO4//
20 P1=W1*M1;//in terms of CaCO3//L
21 P2=W2*M2;//in terms of CaCO3//2*L
22 P3=W3*M3;//in terms of CaCO3//L+S
23 P4=W4*M4;//in terms of CaCO3//L+S
24 P5=W5*M5;//in terms of CaCO3//L
25 P6=W6*M6;//in terms of CaCO3//S
26 P7=W7*M7;//in terms of CaCO3//L+S
27 printf ("We do not take NaCl since it does not react
       with lime/soda");
28 V=1000000;//volume of water in litres//
29 L=0.74*(P1+2*P2+P3+P4+P5+P7)*V/Purity_Lime;//lime
     required in mg//
30 L=L/10^3;
31 printf("\n Amount of Lime required is %.f g",L);
32 S=1.06*(P3+P4+P6+P7)*V/Purity_soda;//soda required
     in mg//
33 S=S/10^3;
34 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.60 hardness calculation by EDTA method

```
1 //water//
2 //page 1.86 example 4//
3 clc
4 conc_SH=0.5/500//in terms of g/lit//
5 strength_SH=conc_SH*1000//in terms of mgs/lit//
6 volume_SH=50//in terms of ml//
7 volume_H=50//in terms of ml//
8 EDTA_SH=48//volume for Std hardwater(ml)//
9 EDTA_H=15//volume for sample hardwater(ml)//
10 AB_EDTA=10//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
     of CaCO3 equivalent//
```

```
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
       CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
      hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
      hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.1f ppm",To);
19 printf("\nPermanent Hardness is %.2f ppm",P);
20 printf("\nTemporary Hardness is %.2f ppm",T);
```

Scilab code Exa 1.61 hardness calculation

```
1 //water//
2 //page 1.87 example 1//
3 clc
4 W1=7.3;//Mg(HCO3)2 in water in mg/L//
5 W2=9.5;//MgCl2 in water in mg/L//
6 W3=16.2;//Ca(HCO3)2 in water in mg/L//
7 W4=13.6;//CaSO4 in water in mg/L//
8 M1=100/146;//multiplication factor of Mg(HCO3)2//
9 M2=100/95;//multiplication factor of MgCl2//
10 M3=100/162;//multiplication factor of Ca(HCO3)2//
11 M4=100/136;//multiplication factor of CaSO4//
12 P1=W1*M1;//Mg(HCO3)2 in terms of CaCO3//
13 P2=W2*M2;//MgCl2 in terms of CaCO3//
14 P3=W3*M3;//Ca(HCO3)2  in terms of CaCO3//
15 P4=W4*M4;//CaSO4  in terms of CaCO3//
16 T=P1+P3;
17 printf("\nTemporary hardness is %.0f ppm",T);
18 P=P2+P4;
19 printf("\nPermanant hardness is %.0f ppm",P);
20 To=T+P;
```

```
21 printf("\nTotal hardness is %.0f ppm",To);
```

Scilab code Exa 1.62 calculation of required lime and soda

```
1 //water//
2 //page 1.87 example 2//
3 clc
4 Purity_Lime=1
5 Purity_soda=1
6 W1=222;//amount of CaCl2 in ppm//
7 W2=296;//amount of Mg(NO3)2 in ppm//
8 W3=324;//amount of Ca(HCO3)2 in ppm//
9 W4=196;//amount of H2SO4 in ppm//
10 M1=100/111;//multiplication factor of CaCl2//
11 M2=100/148;//multiplication factor of Ca(HCO3)2//
12 M3=100/162;//multiplication factor of MgCO3//
13 M4=100/98;//multiplication factor of H2SO4//
14 P1=W1*M1;//in terms of CaCO3//S
15 P2=W2*M2;//in terms of CaCO3//L+S
16 P3=W3*M3;//in terms of CaCO3//L
17 P4=W4*M4;//in terms of CaCO3//L+S
18 printf ("We do not take organic matter since it does
    not react with lime/soda");
19 V=50000;//volume of water in litres//
20 L=0.74*(P2+P3+P4)*V/Purity_Lime;//lime required in
   mg//
21 L=L/10^3;
22 printf("\n Amount of Lime required is %.f g",L);
23 S=1.06*(P1+P2+P4)*V/Purity_soda;//soda required in
   mg//
24 S=S/10^3;
25 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.63 calculation of required lime and soda

```
1 //water//
2 //page 1.87 example 3//
3 clc
4 Purity_Lime=.85
5 Purity_soda=.95
6 W1=12.5;//amount of CaCO3 in ppm//
7 W2=8.4;//amount of MgCO3 in ppm//
8 W3=22.2;//amount of CaCl2 in ppm//
9 W4=9.5;//amount of MgCl2 in ppm//
10 W5=33;//amount of CO2 in ppm//
11 W6=7.3;//amount of HCl in ppm//
12 W7=16.8;//amount of NaHCO3 in ppm//
13 M1=100/100;//multiplication factor of CaCO3//
14 M2=100/84;//multiplication factor of MgCO3//
15 M3=100/111;//multiplication factor of CaCl2//
16 M4=100/95;//multiplication factor of MgCl2//
17 M5=100/44;//multiplication factor of CO2//
18 M6=100/73;//multiplication factor of HCl//
19 M7=100/168;//multiplication factor of NaHCO3//
20 P1=W1*M1;//in terms of CaCO3//L
21 P2=W2*M2;//in terms of CaCO3//2*L
22 P3=W3*M3;//in terms of CaCO3//S
23 P4=W4*M4;//in terms of CaCO3//L+S
24 P5=W5*M5;//in terms of CaCO3//L
25 P6=W6*M6;//in terms of CaCO3//L+S
26 P7=W7*M7;//in terms of CaCO3//L-S
27 V=1000000;//volume of water in litres//
28 L=0.74*(P1+2*P2+P4+P5+P6+P7)*V/Purity_Lime;//lime
   required in mg//
29 L=L/10^3;
30 printf("\n Amount of Lime required is %.f g",L);
31 S=1.06*(P3+P4+P6-P7)*V/Purity_soda;//soda required
   in mg//
32 S=S/10^3;
33 printf("\n Amount of Soda required is %.f g",S)
```

Scilab code Exa 1.64 Hardwater quantity softened using Zeolite process

```
1 //water//
2 //page 1.87 example 4//
3 clc
4 Hardness=500//Hardness of water(mg/lit) or ppm//
5 H=Hardness/100//Hardness of water(gms/lit)//
6 volume_NaCl=100//Volume of NaCl//
7 conc_NaCl=120//% NaCl consumed by zeolite bed//
8 Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
    zeolite bed per litre//
9 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
10 CaCO3_equivalent=total_wt*50/58.48//in terms of (gms
    /lit)//
11 volume_hardwater=CaCO3_equivalent/H
12 printf("\nQuantity of water softened using zeolite
    bed is %.f litres",volume_hardwater);
```

Scilab code Exa 1.65 calculation of hardness using Zeolite process

```
1 //water//
2 //page 1.88 example 3//
3 clc
4 volume_hardwater=4500//in litres//
5 volume_NaCl=30//Volume of NaCl in litres//
6 Wt_per_Litre=100//% NaCl consumed by zeolite bed//
7 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
8 CaCO3_equivalent=total_wt*50/58.55//in terms of (gms
    /lit)//
```

```
9 H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
10 Hardness=H*1000//Hardness of water(mg/lit) or ppm//
11 printf("\nHardness of water sample is %.f ppm",
    Hardness);
```

Scilab code Exa 1.66 calculation of required lime and soda

```
1 //water//
2 //page 1.88 example 4//
3 clc
4 Purity_Lime=1
5 Purity_soda=1
6 W1=8.1;//amount of Ca(HCO3)2 in ppm//
7 W2=7.5;//amount of Mg(HCO3)2 in ppm//
8 W3=13.6;//amount of CaSO4 in ppm//
9 W4=12;//amount of MgSO4 in ppm//
10 W5=2;//amount of MgCl2 in ppm//
11 M1=100/162;//multiplication factor of Ca(HCO3)2//
12 M2=100/146;//multiplication factor of Mg(HCO3)2//
13 M3=100/136;//multiplication factor of CaSO4//
14 M4=100/120;//multiplication factor of MgSO4//
15 M5=100/95;//multiplication factor of MgCl2//
16 P1=W1*M1;//in terms of CaCO3//L
17 P2=W2*M2;//in terms of CaCO3//2*L
18 P3=W3*M3;//in terms of CaCO3//S
19 P4=W4*M4;//in terms of CaCO3//L+S
20 P5=W5*M5;//in terms of CaCO3//S
21 printf ("We do not take NaCl since it does not react
    with lime/soda");
22 V=50000;//volume of water in litres//
23 L=0.74*(P1+2*P2+P4+P5)*V/Purity_Lime;//lime required
    in mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.2f g",L);
```

```
26 S=1.06*(P3+P4+P5)*V/Purity_soda;//soda required in
     mg//
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.67 hardness calculation by EDTA method

```
1  //water//
2  //page 1.88 example 4//
3  clc
4  conc_SH=1/1000//in terms of g/lit//
5  strength_SH=conc_SH*1000//in terms of mgs/lit//
6  volume_SH=50//in terms of ml//
7  volume_H=50//in terms of ml//
8  EDTA_SH=45//volume for Std hardwater(ml)//
9  EDTA_H=25//volume for sample hardwater(ml)//
10 AB_EDTA=15//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
     of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
     CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
     hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
     hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
17 T=To-P
18 printf("\nTotal Hardness is %.2f ppm",To);
19 printf("\nPermanent Hardness is %.2f ppm",P);
20 printf("\nTemporary Hardness is %.2f ppm",T);
```

Scilab code Exa 1.68 hardness calculation

```
//water//
//page 1.89 example 1//
clc
W1=19;//MgCl2 in water in mg/L//
W2=5;//CaCO3 in water in mg/L//
W3=29.5;//Ca(HCO3)2 in water in mg/L//
W4=13;//CaSO4 in water in mg/L//
M1=100/95;//multiplication factor of MgCl2//
M2=100/100;//multiplication factor of CaCO3//
M3=100/162;//multiplication factor of Ca(HCO3)2//
M4=100/136;//multiplication factor of CaSO4//
P1=W1*M1;//MgCl2 in terms of CaCO3//
P2=W2*M2;//CaCO3 in terms of CaCO3//
P3=W3*M3;//Ca(HCO3)2  in terms of CaCO3//
P4=W4*M4;//CaSO4  in terms of CaCO3//
T=P2+P3;
printf("\nTemporary hardness is %.2f ppm",T);
P=P1+P4;
printf("\nPermanant hardness is %.2f ppm",P);
To=T+P;
printf("\nTotal hardness is %.2f ppm",To);
```

Scilab code Exa 1.69 calculation of required lime and soda

```
//water//
//page 1.89 example 2//
clc
Purity_Lime=.9
Purity_soda=.95
W1=155;//amount of Mg(HCO3)2 in ppm//
W2=23;//amount of MgCl2 in ppm//
W3=5;//amount of H2SO4 in ppm//
W4=111;//amount of CaCl2 in ppm//
M1=100/146;//multiplication factor of Mg(HCO3)2//
M2=100/95;//multiplication factor of MgCl2//
```

```
12 M3=100/98;//multiplication factor of H2SO4//
13 M4=100/111;//multiplication factor of CaCl2//
14 P1=W1*M1;//in terms of CaCO3//2*L
15 P2=W2*M2;//in terms of CaCO3//L+S
16 P3=W3*M3;//in terms of CaCO3//L+S
17 P4=W4*M4;//in terms of CaCO3//S
18 printf ("We do not take NaCl and Na2SO4 since they
     do not react with lime/soda");
19 V=50000;//volume of water in litres//
20 L=0.74*(2*P1+P2+P3)*V/Purity_Lime;//lime required in
     mg//
21 L=L/10^3;
22 printf("\n Amount of Lime required is %.2f g",L);
23 S=1.06*(P2+P3+P4)*V/Purity_soda;//soda required in
     mg//
24 S=S/10^3;
25 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.70 hardness calculation by EDTA method

```
1 //water//
2 //page 1.89 example 3//
3 clc
4 conc_SH=1/20//in terms of g/lit//
5 strength_SH=conc_SH*1000//in terms of mgs/lit//
6 volume_SH=50//in terms of ml//
7 volume_H=50//in terms of ml//
8 EDTA_SH=1000//volume for Std hardwater(ml)//
9 EDTA_H=7.2//volume for sample hardwater(ml)//
10 AB_EDTA=4//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
     of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
     CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
```

```
    hardness for given volume//
To=To_sample*1000//total hardness per litre(ppm)//
P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
    hardness for given volume//
P=P_sample*1000//permanent hardness per litre(ppm)//
T=To-P
printf("\nTotal Hardness is %.f ppm",To);
printf("\nPermanent Hardness is %.f ppm",P);
printf("\nTemporary Hardness is %.f ppm",T);
```

Scilab code Exa 1.71 hardness calculation by Zeolite method

```
//water//
//page 1.89 example 4//
clc
volume_hardwater=3500//in litres//
volume_NaCl=25//Volume of NaCl in litres//
Wt_per_Litre=100//% NaCl consumed by zeolite bed//
total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
Hardness=H*1000//Hardness of water(mg/lit) or ppm//
printf("\nHardness of water sample is %.1f ppm",
    Hardness);
```

Scilab code Exa 1.72 hardness calculation by Zeolite process

```
//water//
//page 1.90 example 5//
clc
```

```
4 volume_hardwater=15000//in litres//
5 volume_NaCl=120//Volume of NaCl in litres//
6 Wt_per_Litre=30//% NaCl consumed by zeolite bed//
7 total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
    consumed by zeolite bed//
8 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
    lit)//
9 H=CaCO3_equivalent/volume_hardwater//Hardness of
    water(gms/lit)//
10 Hardness=H*1000//Hardness of water(mg/lit) or ppm//
11 printf("\nHardness of water sample is %.1f ppm",
    Hardness);
```

Scilab code Exa 1.73 hardness calculation by EDTA method

```
1 //water//
2 //page 1.90 example 6//
3 clc
4 conc_SH=1.2/1000//in terms of g/lit//
5 strength_SH=conc_SH*1000//in terms of mgs/lit//
6 volume_SH=20//in terms of ml//
7 volume_H=50//in terms of ml//
8 EDTA_SH=35//volume for Std hardwater(ml)//
9 EDTA_H=30//volume for sample hardwater(ml)//
10 AB_EDTA=25//volume required after boiling(ml)//
11 CaCO3_equivalent_SH=strength_SH*volume_SH//in terms
    of CaCO3 equivalent//
12 one_ml_EDTA=CaCO3_equivalent_SH/EDTA_SH//in terms of
    CaCO3 equivalent//
13 To_sample=one_ml_EDTA*EDTA_H/volume_H//total
    hardness for given volume//
14 To=To_sample*1000//total hardness per litre(ppm)//
15 P_sample=AB_EDTA*one_ml_EDTA/volume_H//permanent
    hardness for given volume//
16 P=P_sample*1000//permanent hardness per litre(ppm)//
```

```
17 T=To-P
18 printf("\nTotal Hardness is %.f ppm",To);
19 printf("\nPermanent Hardness is %.1f ppm",P);
20 printf("\nTemporary Hardness is %.1f ppm",T);
```

Scilab code Exa 1.74 calculation of required lime and soda

```
1  //water//
2  //page 1.90 example 7//
3  clc
4  Purity_Lime=.9
5  Purity_soda=.95
6  W1=81;//amount of Ca(HCO3)2 in ppm//
7  W2=95;//amount of MgCl2 in ppm//
8  W3=68;//amount of CaSO4 in ppm//
9  W4=146;//amount of Mg(HCO3)2 in ppm//
10 W5=49;//amount of H2SO4 in ppm//
11 M1=100/162;//multiplication factor of Ca(HCO3)2//
12 M2=100/95;//multiplication factor of MgCl2//
13 M3=100/136;//multiplication factor of CaSO4//
14 M4=100/146;//multiplication factor of Mg(HCO3)2//
15 M5=100/98;//multiplication factor of H2SO4//
16 P1=W1*M1;//in terms of CaCO3//L
17 P2=W2*M2;//in terms of CaCO3//L+S
18 P3=W3*M3;//in terms of CaCO3//S
19 P4=W4*M4;//in terms of CaCO3//2*L
20 P5=W5*M5;//in terms of CaCO3//L+S
21 printf ("We do not take SiO2 since it does not react
       with lime/soda");
22 V=50000;//volume of water in litres//
23 L=0.74*(P1+P2+2*P4+P5)*V/Purity_Lime;//lime required
       in mg//
24 L=L/10^3;
25 printf("\n Amount of Lime required is %.2f g",L);
26 S=1.06*(P2+P3+P5)*V/Purity_soda;//soda required in
```

```
    mg//
27 S=S/10^3;
28 printf("\n Amount of Soda required is %.2f g",S)
```

Scilab code Exa 1.75 calculation of required lime and soda

```
1  //water//
2  //page 1.90 example 3//
3  clc
4  Purity_Lime=.95
5  Purity_soda=.9
6  W1=81;//amount of Ca(HCO3)2 in ppm//
7  W2=73;//amount of Mg(HCO3)2 in ppm//
8  W3=68;//amount of CaSO4 in ppm//
9  W4=95;//amount of MgCl2 in ppm//
10 W5=14.8;//amount of Mg(NO3)2 in ppm//
11 W6=14.7;//amount of H2SO4 in ppm//
12 M1=100/162;//multiplication factor of Ca(HCO3)2//
13 M2=100/146;//multiplication factor of Mg(HCO3)2//
14 M3=100/136;//multiplication factor of CaSO4//
15 M4=100/95;//multiplication factor of MgCl2//
16 M5=100/148;//multiplication factor of Mg(NO3)2//
17 M6=100/98;//multiplication factor of H2SO4//
18 P1=W1*M1;//in terms of CaCO3//L
19 P2=W2*M2;//in terms of CaCO3//2*L
20 P3=W3*M3;//in terms of CaCO3//S
21 P4=W4*M4;//in terms of CaCO3//L+S
22 P5=W5*M5;//in terms of CaCO3//L+S
23 P6=W6*M6;//in terms of CaCO3//L+S
24 V=1000000;//volume of water in litres//
25 L=0.74*(P1+2*P2+P4+P5+P6)*V/Purity_Lime;//lime
       required in mg//
26 L=L/10^3;
27 printf("\n Amount of Lime required is %.1f g",L);
28 S=1.06*(P3+P4+P5+P6)*V/Purity_soda;//soda required
```

```
    in mg//
29 S=S/10^3;
30 printf("\n Amount of Soda required is %.1f g",S);
```

Scilab code Exa 1.76 Hardwater quantity softened using Zeolite process

```
1  //water//
2  //page 1.90 example 4//
3  clc
4  Hardness=480//Hardness of water(mg/lit) or ppm//
5  H=Hardness/100//Hardness of water(gms/lit)//
6  volume_NaCl=300//Volume of NaCl//
7  conc_NaCl=150//% NaCl consumed by zeolite bed//
8  Wt_per_Litre=conc_NaCl*10//gms NaCl consumed by
       zeolite bed per litre//
9  total_wt=Wt_per_Litre*volume_NaCl//total gms NaCl
       consumed by zeolite bed//
10 CaCO3_equivalent=total_wt*50/58.5//in terms of (gms/
       lit)//
11 volume_hardwater=CaCO3_equivalent/H
12 printf("\nQuantity of water softened using zeolite
       bed is %.f litres",volume_hardwater);
```

Chapter 3

Lubricants

Scilab code Exa 3.1 Acid value of oil

```
1 //lubricants//
2 //page 3.27 example 1//
3 clc
4 wt_oil=4.55//weight f oil saponified(gms)//
5 volume=2.1//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
6 normality_KOH=0.02//normality of KOH //
7 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
8 printf("\nAcid value of oil is %.3f mg/gm",A);
```

Scilab code Exa 3.2 Acid value of oil

```
1 //lubricants//
2 //page 3.28 example 2//
3 clc
4 wt_oil=10//weight f oil saponified(gms)//
5 volume=2.4//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
```

```
normality_KOH=0.02//normality of KOH //
A=volume*normality_KOH*56/wt_oil//formula for acid
   value//
printf("\nAcid value of oil is %.3f mg/g",A);
if A<=0.1 then printf("\nAs the acid value is less
   than 0.1, oil can be used for lubrication");
else printf("\nAs the acid value is more than 0.1,
   oil cannot be used for lubrication");
    end
```

Scilab code Exa 3.3 Acid value of oil

```
//lubricants//
//page 3.28 example 3//
clc
vol_oil=20//in ml//
den_oil=0.86//density of oil in g/ml//
wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
   //
volume=2.5//volume of alcoholic KOH consumed to
   neutralize fatty acids(ml)//
normality_KOH=0.1//normality of KOH //
A=volume*normality_KOH*56/wt_oil//formula for acid
   value//
printf("\nAcid value of oil is %.3f mg/g",A);
```

Scilab code Exa 3.4 Acid value of oil

```
//lubricants//
//page 3.29 example 4//
clc
vol_oil=10//in ml//
den_oil=0.92//density of oil in g/ml//
```

```
6 wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
    //
7 volume=4//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
8 normality_KOH=0.01//normality of KOH //
9 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
10 printf("\nAcid value of oil is %.3f mg/g",A);
```

Scilab code Exa 3.5 Acid value of oil

```
1 //lubricants//
2 //page 3.29 example 5//
3 clc
4 vol_oil=9//in ml//
5 den_oil=0.81//density of oil in g/ml//
6 wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
    //
7 volume=1.5//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
8 normality_KOH=0.04//normality of KOH //
9 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
10 printf("\nAcid value of oil is %.3f mg/g",A);
```

Scilab code Exa 3.6 Acid value of oil

```
1 //lubricants//
2 //page 3.30 example 6//
3 clc
4 vol_oil=20//in ml//
5 den_oil=0.86//density of oil in g/ml//
```

```
6 wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
    //
7 volume=2.8//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
8 normality_KOH=1/10//normality of KOH //
9 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
10 printf("\nAcid value of oil is %.3f mg/g",A);
11 if A<=0.1 then printf("\nAs the acid value is less
    than 0.1, oil can be used for lubrication");
12 else printf("\nAs the acid value is more than 0.1,
    oil cannot be used for lubrication");
13     end
```

Scilab code Exa 3.7 Acid value of oil

```
1 //lubricants//
2 //page 3.30 example 7//
3 clc
4 vol_oil=7//in ml//
5 den_oil=0.88//density of oil in g/ml//
6 wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
    //
7 volume=3.8//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
8 normality_KOH=0.02//normality of KOH //
9 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
10 printf("\nAcid value of oil is %.2f mg/g",A);
11 if A<=0.1 then printf("\nAs the acid value is less
    than 0.1, oil can be used for lubrication");
12 else printf("\nAs the acid value is more than 0.1,
    oil cannot be used for lubrication");
13     end
```

Scilab code Exa 3.8 Acid value of oil

```
1 //lubricants//
2 //page 3.31 example 8//
3 clc
4 vol_oil=6//in ml//
5 den_oil=0.91//density of oil in g/ml//
6 wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
    //
7 volume=2.6//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
8 normality_KOH=0.02//normality of KOH //
9 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
10 printf("\nAcid value of oil is %.3f mg/g",A);
11 if A<=0.1 then printf("\nAs the acid value is less
    than 0.1, oil can be used for lubrication");
12 else printf("\nAs the acid value is more than 0.1,
    oil cannot be used for lubrication");
13     end
```

Scilab code Exa 3.9 Acid value of oil

```
1 //lubricants//
2 //page 3.31 example 9//
3 clc
4 wt_oil=1.3//weight f oil saponified(gms)//
5 volume=0.8//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
6 normality_KOH=0.001//normality of KOH //
7 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
```

```
8 printf("\nAcid value of oil is %.5f mg/g",A);
9 if A<=0.1 then printf("\nAs the acid value is less
    than 0.1, oil can be used for lubrication");
10 else printf("\nAs the acid value is more than 0.1,
    oil cannot be used for lubrication");
11     end
```

Scilab code Exa 3.10 Acid value of oil

```
1 //lubricants//
2 //page 3.31 example 10//
3 clc
4 vol_oil=10//in ml//
5 den_oil=0.91//density of oil in g/ml//
6 wt_oil=vol_oil*den_oil//weight f oil saponified(gms)
    //
7 volume=5//volume of alcoholic KOH consumed to
    neutralize fatty acids(ml)//
8 normality_KOH=0.02//normality of KOH //
9 A=volume*normality_KOH*56/wt_oil//formula for acid
    value//
10 printf("\nAcid value of oil is %.3f mg/g",A);
11 if A<=0.1 then printf("\nAs the acid value is less
    than 0.1, oil can be used for lubrication");
12 else printf("\nAs the acid value is more than 0.1,
    oil cannot be used for lubrication");
13     end
```

Scilab code Exa 3.11 Saponification value of oil

```
1 //lubricants//
2 //page 3.33 example 1//
3 clc
```

```
4 wt_oil=2.5//weight f oil saponified(gms)//
5 blank=49.0//volume blank titration reading(ml)//
6 back=26.4//volume back titration reading(ml)//
7 volume=blank-back//volume of alcoholic KOH consumed(
    ml)//
8 normality_KOH=0.4//normality of KOH//
9 S=volume*normality_KOH*56/wt_oil//formula for
    saponification value//
10 printf("\nSaponification value of oil is %.3f mg/g",
    S);
```

Scilab code Exa 3.12 Saponification value of oil

```
1 //lubricants//
2 //page 3.33 example 2//
3 clc
4 wt_oil=5//weight f oil saponified(gms)//
5 blank=44//volume blank titration reading(ml)//
6 back=17//volume back titration reading(ml)//
7 volume=blank-back//volume of alcoholic KOH consumed(
    ml)//
8 normality_KOH=0.5//normality of KOH//
9 S=volume*normality_KOH*56/wt_oil//formula for
    saponification value//
10 printf("\nSaponification value of oil is %.1f mg/g",
    S);
```

Scilab code Exa 3.13 alcoholic KOH consumed in saponification

```
1 //lubricants//
2 //page 3.34 example 3//
3 clc
4 S=180//Saponification value of oil//
```

```
5 wt_oil=1//weight f oil saponified(gms)//
6 blank=50//volume blank titration reading(ml)//
7 normality_KOH=0.4//normality of KOH //
8 volume=S*wt_oil/(normality_KOH*56)//formula for
    saponification value//
9 back=blank-volume//volume of alcoholic KOH consumed(
    ml)//
10 printf("\nQuantity of alcoholic KOH required per
    gram is %.0f ml",back);
```

Scilab code Exa 3.14 saponification value of oil

```
1 //lubricants//
2 //page 3.35 example 4//
3 clc
4 wt_oil=2.5//weight f oil saponified(gms)//
5 blank=40//volume blank titration reading(ml)//
6 back=20//volume back titration reading(ml)//
7 normality_KOH=0.25//normality of KOH //
8 normality_HCl=.5//normality of HCl//
9 e=normality_HCl/normality_KOH//for equivalence in
    titration //
10 volume=(blank-back)*e//volume of alcoholic KOH
    consumed(ml)//
11 S=volume*normality_KOH*56/wt_oil//formula for
    saponification value//
12 printf("\nSaponification value of oil is %.0f mg/g",
    S);
```

Scilab code Exa 3.15 composition of blended oils by saponification

```
1 //lubricants//
2 //page 3.35 example 5//
```

```
clc
S_C=192//Saponification value of castor oil//
wt_oil=16//weight f oil saponified(gms)//
blank=45//volume blank titration reading(ml)//
back=31.5//volume back titration reading(ml)//
volume=blank-back//volume of alcoholic KOH consumed(ml)//
N_H=0.5//normality of HCl in titration//
V_H=blank//volume of HCl in titration(ml)//
V_K=50//volume of KOH in titration(ml)//
N_K=N_H*V_H/V_K//normality of KOH for equivalence//
S_blended=volume*N_K*56/wt_oil//formula for saponification value//
printf("\nSaponification value of blended oil is %.2f mgs KOH",S_blended);
pc_C=(S_blended/S_C)*100
printf("\npercentage of castor oil in blend is %.3f percent",pc_C);
```

Scilab code Exa 3.16 saponification value of oil

```
//lubricants//
//page 3.36 example 6//
clc
wt_oil=3//weight f oil saponified(gms)//
blank=36//volume blank titration reading(ml)//
back=12//volume back titration reading(ml)//
volume=blank-back//volume of alcoholic KOH consumed(ml)//
normality_KOH=0.5//normality of KOH//
S=volume*normality_KOH*56/wt_oil//formula for saponification value//
printf("\nSaponification value of oil is %.f mg/g",S);
```

Scilab code Exa 3.17 saponification value of oil

```
1 //lubricants//
2 //page 3.37 example 7//
3 clc
4 wt_oil=1.55//weight f oil saponified(gms)//
5 blank=20//volume blank titration reading(ml)//
6 back=15//volume back titration reading(ml)//
7 volume=blank-back//volume of alcoholic KOH consumed(
    ml)//
8 normality_KOH=1/2//normality of KOH//
9 S=volume*normality_KOH*56/wt_oil//formula for
    saponification value//
10 printf("\nSaponification value of oil is %.2f mg/g",
    S);
```

Scilab code Exa 3.18 saponification value of oil

```
1 //lubricants//
2 //page 3.37 example 8//
3 clc
4 wt_oil=1.25//weight f oil saponified(gms)//
5 blank=50//volume blank titration reading(ml)//
6 back=7.5//volume back titration reading(ml)//
7 volume=blank-back//volume of alcoholic KOH consumed(
    ml)//
8 normality_KOH=0.1//normality of KOH//
9 S=volume*normality_KOH*56/wt_oil//formula for
    saponification value//
10 printf("\nSaponification value of oil is %.1f mg/g",
    S);
```

Scilab code Exa 3.19 composition of blended oils by saponification

```
1 //lubricants//
2 //page 3.38 example 9//
3 clc
4 S_C=188//Saponification value of castor oil//
5 wt_oil=12.3//weight f oil saponified(gms)//
6 blank=45//volume blank titration reading(ml)//
7 back=30.2//volume back titration reading(ml)//
8 volume=blank-back//volume of alcoholic KOH consumed(
    ml)//
9 N=0.5//normality of KOH for equivalence//
10 S_blended=volume*N*56/wt_oil//formula for
    saponification value//
11 printf("\nSaponification value of blended oil is %.2
    f mg/g",S_blended);
12 pc_C=(S_blended/S_C)*100
13 printf("\npercentage of castor oil in blend is %.2f
    percent",pc_C);
```

Scilab code Exa 3.20 composition of blended oils by saponification

```
1 //lubricants//
2 //page 3.38 example 10//
3 clc
4 S_C=191//Saponification value of castor oil//
5 wt_oil=2.5//weight f oil saponified(gms)//
6 blank=40//volume blank titration reading(ml)//
7 back=24//volume back titration reading(ml)//
8 volume=blank-back//volume of alcoholic KOH consumed(
    ml)//
9 N=0.5//normality of KOH for equivalence//
```

```
10 S_blended=volume*N*56/wt_oil//formula for
      saponification value//
11 printf("\nSaponification value of blended oil is %.1
      f mg/g",S_blended);
12 pc_C=(S_blended/S_C)*100
13 printf("\npercentage of castor oil in blend is %.2f
      percent",pc_C);
```