Scilab Textbook Companion for Examples in Thermodynamics Problems by W. R. Crawford[1]

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Book Description

Title: Examples in Thermodynamics Problems

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Heating and expansion of gases entropy

Scilab code Exa 1.1 Example 1

```
clc
//initialisation of variables
p1=280//lb/in^2
v=2//ft^3
p2=20//lb/in^2
v2=18.03//ft^3
//CALCULATIONS
W=144*(p1*v-p2*v2)/(1.2-1)//ft/lb
//RESULTS
printf('The volume and work done during the
    expansion=%f ft/lb',W)
```

Scilab code Exa 1.2 Example 2

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

```
v=2//ft^3
v2=20//ft^3
p=100000//ft lb
v2=10.41//lb/in^2
v3=10//lb/in^2
p1=1.3//lb
p2=(v2*199.5)/9.95//lb/in^2
//CALCULATIONS
P=(p2/v3-v2)//lb/in^2
//RESULTS
printf('The initial andfinal pressure=% f lb/in^2',P
    )
```

Scilab code Exa 1.4 Example 3

```
clc
//initialisation of variables
Cp=0.24//lb/in^2
Cv=0.18//ft^3
p1=5//lb/in^2
T1=20//Degree C
T2=150//Degree C
//CALCULATIONS
W=p1*Cp*(T2-T1)//C.H.U
H=p1*Cv*(T2-T1)//C.H.U
Gamma=Cp/Cv//lb/in^2
//RESULTS
printf('the constant pressure=% f C.H.U',W)
printf('the constant volume the value of gas=% f lb/
    in^2',Gamma)
```

Scilab code Exa 1.5 Example 4

```
clc
//initialisation of variables
Gama=1.33//ft/lb
p=100//lb/in^2
p1=20//lb/in^2
v2=10.05//ft^3
v=3//ft/lb
//CALCULATIONS
W=144*(p*v-p1*v2)/0.33//ft lb
//RESULTS
printf('The work done=%f ft lb',W)
```

Scilab code Exa 1.8 Example 5

```
clc
//initialisation of variables
p=3.74//ft/lb
p1=2.48//ft/lb
v=5.7//ft lb
Cv=0.21//ft/lb
P=440//lb/in^2
P1=160//lb/in^2
P2=14//lb/in^2
T=25//degree C
T1=100//F
vs=(%pi*(p1)^2/4)*(p/1728)//ft^3
vc=5.7//ft^3
v1=4.7//ft^3
v2=vs/v1//ft^3
v3=0.01273//ft^3
T2=298//F
//CALCULATIONS
W=(P2*144*v3)/(T2*T1)//lb
T3=[(P1*144*1)/(P2*144*7)*T2]//Degree C
T4=(P/P1)*T3//Degree C
```

```
H=W*Cv*(T4-T3)//C.H.U
//RESULTS
printf('The heat supplied during explosion=% f C.H.U
   ',H)
```

Scilab code Exa 1.9 Example 6

```
clc
//initialisation of variables
v=10//ft^3
p=100//lb/in^2
p1=18//lb/in^2
v1=50//ft^3
n=log(p/p1)/log(5)
gama=1.4//air
//CALCULATIONS
W=[144*(p*v-p1*v1)]/(n-1)//ft lb
H=(gama-n)/(gama-1)*W//ft lb
E=W-H//ft lb
//RESULTS
printf('The heat supplied and the change of internal
    energy=% f ft lb',E)
```

Scilab code Exa 1.11 Example 7

```
clc
//initialisation of variables
v=2//ft^3
p=1100//lb/in^2
t1=44//Degree C
t2=15//Degree C
p1=300//lb/in^2
t3=3//Degree c
```

```
Cv=0.17//ft/lb
T=273//F
R=96//ft lb
p3=300//lb/in^2
n=1.12//lb
gama=1.404//lb
W=[(144*p*v)/(T+t1)]/R//lb
//CALCULATIONS
Wc=W*Cv*(t1-t2)//C.H.U
p2=p*(T+t2)/(T+t1)//lb /in^2
A=(144*p3*v)/(R*276)//lb
W1=(A/W)*v//ft^3
H=[(gama-n)/(gama-1)]*[144*(p*0.65-p1*v)/(n-1)]//ft lb
H1=H/1400//C.H.u
//RESULTS
printf('the heat was lost by all the air in the vessel before leakage began=%f C.H.U',Wc)
printf('the heat was lost or gainned leakage by the air=%f C.H .U',H1)
```

Scilab code Exa 1.13 Example 8

```
clc
//initialisation of variables
h=0.218//ft^3
h1=0.156//ft^3
n=0.249//lb
h2=0.178//lb
c=0.208//lb
c1=0.162//lb
w1=1//ft^3
p=150//lb/in^2
T=100//Degree C
T1=373//F
```

```
Cp=(h*0.2312)+(n*0.3237)+(c*0.4451)//C.H.U/lb
Cv=(h1*0.2312)+(h2*0.3237)+(c1*0.4451)//C.H.U//lb
R=1400*(Cp-Cv)//ft lb units
//CALCULATIONS
W=(144*p*w1)/(R*T1)//lb
//RESULTS
printf('The characteristic constant of the gas=% f
    lb',W)
```

Scilab code Exa 1.20 Example 9

```
clc
//initialisation of variables
T=200//Degree C
p=150//lb/in^2
v=12//ft^3
R=96//Lb
T1=473//F
T2=273//F
j=1400//lb
Cv=0.169//lb/in^2
v1=(R*T1)/(p*144)//ft^3
//CALCULATIONS
Fhi=(R/j)*log(v/v1)+Cv*log(T2/T1)//rank
//RESULTS
printf('The change of entropy=% f rank',Fhi)
```

Scilab code Exa 1.22 Example 10

```
clc
//initialisation of variables
v=10//ft^3
T=20//Degree C
```

```
p=15//lb in^2
p1=200//lb//in^2
gama=1.41 //lb
Cv=0.169//lb
v2=1.153//ft^3
j=1400//lb
T1=293//F
T2=451//F
T1=[(p1*v2)/(p*v)]*T1//Degree C
//CALCULATIONS
R=Cv*j*(gama-1)
W=0.816//lb
Fhi=Cv*[(gama-1.2)/(1.2-1)]*log(T1/T2)*W//rnak
//RESULTS
printf('The change of entropy=% f rank',Fhi)
```

Scilab code Exa 1.23 Example 11

```

clc
//initialisation of variables
p=1//lb
T=200//Degree C
p1=15//lb/in^2
v1=4//ft^3
gama=1.41//lb
Cv=0.169//lb
J=1400//lb
n=1.2
T=473//F
v2=16.1//ft^3
T1=473//F
//CALCULATIONS
T2=(p1*v2)/(p*v1)*T1//Degree C
R=Cv*J*(gama-p)//lb/in^2
```

```
Fhi=0.1772*log(1.317)//rank
//RESULTS
printf('the change of entropy from intial conditions
   =%f rank',Fhi)
```

Scilab code Exa 1.26 Example 12

```
clc
//initialisation of variables
w=0.066//ft^3
p=14.7//lb/in^2
w1=14.2//lb/in^2
w2=2780//lb/in^2
g=0.038//lb
a=28.9//lb
R=w2/w1//for gas
R1=93//for air
T=273//F
V=0.4245//ft^3
//CALCULATIONS\
W=(p*144*w)/(T*R)//lb
m=(g-W)//lb gas
T2=(V+w)//ft^3
//RESULTS
printf('The volume of mixture=%f ft^3',T2)
```

Chapter 2

Air cycle efficiencies

Scilab code Exa 2.2 Example 1

```
clc
//initialisation of variables
T1=(100+273)//Degree C
T2=(300+273)//degree C
T=(1-T1/T2)*100//F
lam=0.41//in
//CALCULATIONS
R=log(T2)-log(T1)//lb/in^2
r=2.849//ratio of compression
//RESULTS
printf('The ideal efficiency and the compression
   ratio=% f ratio of compression',r)
```

Scilab code Exa 2.4 Example 2

```

clc
//initialisation of variables
```

```
r=0.60//in
v=3//in
p=15.4//lb
r=5//in
P=2000//r p m
V=19000//B.Th.U  Per lb
lam=1.41 //lb
n=0.4831//percent
P=15.4/4//lb
H=P*V//B.Th.U
l=4.5//lb
A=9//lb
S=1000//lb
//CALCULATIONS
R=0.60*n*100//percent
C=H*R//B.Th.U
I=(C*778)/(60*33000)//lb
P1=(I*12*4*33)/(l*A*%pi)//lb/in^2
//RESULTS
printf('The mean efficity pressure=%f lb/in^2',P1)
```

Scilab code Exa 2.5 Example 3

```
clc
//initialisation of variables
v=15//in
S=(5*14/100)//ln
lam=1.4//in
v1=1.7//in
//CALCULATIONS
N=(1-0.38)*100//percent
//RESULTS
printf('the ideal effiecncy for an engine =%f
    percent',N)
```

Chapter 3

Properties of steam

Scilab code Exa 3.1 Example 1

```
clc
//initialisation of variables
p=100//lb/in^2
x=0.8//lb
t1=164//degree C
t2=4.45 //ft^3
p1=0.016//ft^3
h1=493.4//C.H.U/lb
h2=165.9//C.H.U/lb
S=h2+h1//C.H.U/lb
w=(144*p)/1400*(t2-p1)//C.H.U/lb
H=h2+(x*h1)//C.H.U//lb
w1=(x*144*p)/1400*(t2-p1)//C.H.U
//CALCULATIONS
E=S-w//C.H.U/lb
IE=H-w1//C.H.U/lb
//RESULTS
printf('The steam is total heat dry and satured=%f
   C.H.U/lb',E)
printf('Total heat of wet steam=%f C.H.U/lb',IE)
```

Scilab code Exa 3.2 Example 2

```
clc
//initialisation of variables
t1=35//degree C
p=100//lb/in^2
L=435//C.H.U
L2=539.3//C.H.U
h1=165.9//H.C.U/lb
h2=493.4//C.H.U/lb
S=(h1-t1)//C.H.U
h3=304.1//C.H.U
h4=335//C.H.U/lb
//CALCULATIONS
X1=h3/h2//C.H.U/lb
X2=h4/L2//C.H.U/lb
//RESULTS
printf('The heat giving to the water and steam is =%
    f C.H.U/lb',X2)
```

Scilab code Exa 3.3 Example 3

```
clc
//initialisation of variables
p=35//lb/in^2
w=1425//lb
q=1474//lb
s1=126.7//C.H.U/lb
s2=28//C.H.U/lb
t1=5//degree C
t2=28//degree C
L1=521.4//C.H.U/lb
```

```
w1=245//lb
w2=0.2//lb
//CALCULATIONS
W=(s1-s2)+L1//C.H.U/lb
H=q*(t2-t1)//C.H.U/lb
T=H/W//lb
//RESULTS
printf('The total equivalent=% f lb',T)
```

Scilab code Exa 3.4 Example 4

```
clc
//initialisation of variables
p=100//lb/in^2
w=2400//lb
t1=15//degree C
s1=165.9//C.H.U/lb
x=0.9//lb
L2=493.4//C.H.U/lb
t2=65//degree
x4=0.8//lb
s3=64.8//C.H.U/lb
w1=2000//lb
w2=2400//lb
b1=12400//lb
b2=22000//lb
p1=4400//lb
n=421.65//lb
h1=w2*[s1+(x*L2)]//C.H.U/hr
h2=w1*[s1+(x4+L2)]//C.H.U/hr
//CALCULATIONS
T=w*[(s1-t1)+(x*L2)]//C.H.U/hr
T1=w1*[(s1-s3)+(x4*L2)]//C.H.U/hr
H=T+T1//C.H.U/hr
X=n/L2//C.H.U/lb
```

```
//RESULTS
printf('The thermal capacity of the pipe=% f C.H.U/
    hr',X)
```

Scilab code Exa 3.5 Example 5

```
clc
//initialisation of variables
w1=4.5//lb
s1=45.5//lb
p1=165//lb/in^2
T=140//Degree C
h1=30//in
h2=4//in
p2=0.49//ln/in^2
T1=(w1+s1)//lb
T2=103.5//Degree C
T3=140//Degree
h3=0.48//in
x=0.988//berfore throttling
T=[103.12+537.1+h3*(T3-T2)]//C.H.U/lb
x1=0.012//lb of water
X=s1*x1//lb water
w=50//lb of steam
//CALCULATIONS
P=h2+h1//in of mercury
P1=s1*x1//lb/in^2
T4=w1+P1//lb
D=(w-T4)/w//lb
//RESULTS
printf('The dryness of steam with a combined=% f lb'
    ,D)
```

Scilab code Exa 3.6 Example 6

```
clc
//initialisation of variables
w=40//lb
w1=380//lb
t1=80//Degree
p=85//lb/in^2
p1=15//lb/in^2
W=w+w1//lb/hr
P=p+p1//lb/in^2
T=659.3//C.H.U/lb
d=10//h.p
//CALCULATIONS
H=W*T-w1*t1//C.H.U/hr
H1=(d*33000*60)/1400//C.H.U/hr
T1=H1/H*100//percent
D=w1/(w1+w)//C.H.U/hr
H2=[W*(99.6+D*539.3)-w1*t1]//C.H.U/hr
T2=H-H2//C.H.U/hr
H3=T2-H1//C.H.U/hr
E=(1400*H3)/(60*33000)//h.p
//RESULTS
printf('The amount of radiations from the engine =%
    f h.p',E)
```

Scilab code Exa 3.10 Example 7

```
clc
//initialisation of variables
w=40//lb
w1=380//lb
t1=80//Degree
p=85//lb/in^2
p1=15//lb/in^2
```

```
W=w+w1//lb/hr
P=p+p1//lb/in^2
T=659.3//C.H.U/lb
d=10//h.p
//CALCULATIONS
H=W*T-w1*t1//C.H.U/hr
H1=(d*33000*60)/1400//C.H.U/hr
T1=H1/H*100//percent
D=w1/(w1+w)//C.H.U/hr
H2=[W*(99.6+D*539.3)-w1*t1]//C.H.U/hr
T2=H-H2//C.H.U/hr
H3=T2-H1//C.H.U/hr
E=(1400*H3)/(60*33000)//h.p
//RESULTS
printf('The amount of radiations from the engine =%f h.p',E)
```

Scilab code Exa 3.12 Example 8

```
clc
//initialisation of variables
p=120//lb/in^2
ts=264//degree C
T1=(273+130.6)//F
v=0.0171//ft^3/lb
L1=518.4//lb
T2=(273+171.9)//F
L2=487.4//lb
Cp=0.48//lb
L=0.0894/Cp//lb
Ts=T2*1.205//degree
ta=536-273//Degree C
T=649.9//C.H.U
S=131.2//C.H.U
w=(144*40)/1400*(10.49-v)//C.H.U
```

```
C=T-S//C.H.U
I=C-w//C.H.U
E=(704.7-57.8)//C.H.U
E1=E-606.5//C.H.U
//CALCULATIONS
E1=E-606.5//C.H.U
H=(704.7-T)//C.H.U
//RESULTS
printf('Heat and internal energy after each
   operation=%f C.H.U',H)
```

Scilab code Exa 3.17 Example 9

```
clc
//initialisation of variables
A=28.1//in Hg vacuum
a=0.93//lb/in^2
T=33//Degree
p=0.729//lb/in^2
P=-p+a//lb/in^2
p1=120000//lb
p2=28.1//in
a1=0.9//ln
p3=1000//lb
t=15//degree C
A1=[a1*(p1/(60*p3))]//lb/mim
v=(A1*96*306)/(144*P)//ft^3 of air per min
V=37.3+a1*610//C.H.U/lb
//CALCULATIONS
H=(V-T)//C.H.U
W=(H/t)*(p1/60)//gal/min
//RESULTS
printf('The water per minute in cubic feet per
   minute passing to air extractor=%f gal/min',W)
```

Chapter 4

The steam engine

Scilab code Exa 4.1 Example 1

```
clc
//initialisation of variables
p=90//lb/in^2
x1=0.9//lb
p1=10//lb/in^2
x2=0.81//lb
s1=161.5//lb.in^2
s2=89.1//lb.in^2
L1=496.8//lb.in^2
L2=545.5//lb.in^2
//CALCULATIONS
bc=(s1-s2)+(x1*L1)//C.H.U/lb
da=x2*L2//C.H.U/lb
W=bc-da//C.H.U/lb
R=W/bc*100//percent
//RESULTS
printf('the work done per =% f percent',R)
```

Scilab code Exa 4.2 Example 2

```
clc
//initialisation of variables
h=1600//i.h.p
h1=20000//lb
h2=230//lb/in^2
T1=293.3//Degree C
x=25.91//in
v=30//in
T2=201//Degree C
T=T1-T2//degree C
x2=0.845//lb
L2=566.51//lb
s1=724//lb
h3=1400//C.H.U/hr
x=33000//ft^3
//CALCULATIONS
H=671.48//C.H.U/lb
ea=x2*L2//C.H.U/lb
W=H-ea//C.H.U/lb
R=W/H*100//percent
S=h2*s1//C.H.U
I=[(h*x*60)/(h3*h1*s1)]*100//percent
R1=I/R*100//pecent
//RESULTS
printf('The indicated thermal efficiency ratio=%f
    percent',R1)
```

Scilab code Exa 4.3 Example 3

```
clc
//initialisation of variables
h1=180//lb/in^2
h2=3//lb/in^2
r1=60//percent
r2=90//percent
```

```
p3=100//lb/in^2
p4=10//lb/in^2
v1=4.4//ft^3/lb
v2=2*v1//ft^3
p=44//lb/in^2
x2=0.95//ft^3
s1=165.9//lb
s2=89.1//lb
L1=493.4//lb
H=(s1-s2)+L1//C.H.U/lb
W=65.8//C.H.U/lb
//CALCULATIONS
R=W/H*100//percent
//RESULTS
printf('The rankine efficiency of the engine=%f
    percent',R)
```

Scilab code Exa 4.10 Example 4

```
clc
//initialisation of variables
p=85//lb/in^2
h=210//i.p.m
h1=8//in
h2=2.5//in
h3=20//in
x=0.75//in
p1=100//ln/in^2
x1=33000//in
p2=15//lb/in^2
v2=%pi/4*(h1/12)^2*(h3/12)//ft^3
A=144*[29.08*1.6931-8.724]//ft/lb
d=x*A//ft/lb
v3=0.5816//ft^3
P=d/(144*v3)//lb/in^2
```

```
P1=%pi/4*64//in^2
r=25*%pi/16//in^2
//CALCULATIONS
H=P*(h3/12)*P1*h/(x1)
I=(P*(h3/12)*(P1-r)*h)/(x1)//I.h.P
T=H+I//I.h.p
//RESULTS
printf('the h.p diameter of the piston and piston
   rod =% f I.h.p',T)
```

Scilab code Exa 4.14 Example 5

```
clc
//initialisation of variables
a=1.025//in^2
h=18//in
h1=24//in
x=8.2//percent
v=15//in
v2=6.9//ft^3
p=0.74//lb/in^2
p1=50//lb/in^2
p2=83//lb/in^2
P3=48.0//lb/in
P1=29.8//lb/in^2
P2=14.6//lb/in^2
h2=29.8//in
D=(%pi/4)*(3/2)^2*2//ft^3
v1=23400//ft.lb
W=a*v1//ft.lb
V=0.082*D//ft^3
Q=1.530//ft^3
//CALCULATIONS
I=V+Q//ft^3
P=P3+P2//lb/in^2
```

```
V1=p*v2//ft^3
W1=I/V1//lb
S=p2+P2///l/in^2
H=659.06//C.H.U/lb
T=W/(H*W1*1400)*100//percent
//RESULTS
printf('The thermal efficiency of the engine=%f
   percent',T)
```

Scilab code Exa 4.16 Example 6

```
clc
//initialisation of variables
v=4.6//ft^3
h=5//percent
p=60//lb/in^2
p1=0.8//ft^3
p2=19//lb/in^2
a=100//r.p.m
h1=5920//lb
W=h1/(2*a*p)//lb
V=(0.25*v)//ft^3
v1=21.07//ft^3
w=V/v1//lb
H=W+w//lb
v2=H*7.17//ft^3
P=w*v2//ft^3
P1=0.675*v//ft^3
//CALCULATIONS
DP=P1/v2//ft^2
//RESULTS
printf('The assumptions do you make in working out
   the dryness of the steam=%f ft^3',DP)
```

Scilab code Exa 4.17 Example 7

```
clc
//initialisation of variables
h=0.08//lb
p=60//lb/in^2
p1=0.50//lb/in^2
v=0.5//ft^3
v1=7.17//ft^3
V=h*v1//ft^3
//CALCULATIONS
W=p1/v1//lb
I=v/v1//lb
M=h-I//lb
//RESULTS
printf('the dryness of the steam at this pressure
   and missing quantity =% f lb',M)
```

Scilab code Exa 4.19 Example 8

```
clc
//initialisation of variables
p1=120//lb/in^2
p2=15//lb/in^2
//CALCULATIONS
v=1.65//lb
D=sqrt(v)//lb
//RESULTS
printf('The above pressure are by gauge=% f lb',D)
```

Scilab code Exa 4.21 Example 9

```
clc
//initialisation of variables
p=150//lb/in^2
x=198//r.p.m
x1=33000//lb
h=2700//lb
h1=1400//lb
h2=51600//lb
r=165//C.H.U/lb
s=60//lb
t=48//Degree C
t1=11//degree C
t2=36//Degree C
P1=(40*75*t2*x)/(12*x1)//lb
P2=(38*70*t2*x)/(12*x1)//lb
L1=(t1*300*t2*x)/(12*x1)//lb
L2=(12*295*t2*x)/(12*x1)//lb
T=P1*P2*L1*L2//lb
H=5294//C.H.U/min
T1=h/s///lb/min
H1=T1*663//lb/min
H2=(h2/s*(36-11)+(h/s)*(t))//C.H.U
H3=(h/60)*t//C.H.U
//CALCULATIONS
TE=H/H1-H3*100//percent
R=r/(663-t)*100//percent
//RESULTS
printf('The rankine efficiency =%f percent',R)
```

Scilab code Exa 4.23 Example 10

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

```
p1=100//ln/in^2
p2=2.5//lb/in^2
p3=20//lb/in^2
d=0.75//lb
p=0.5//lb
r=16//in
p4=p1/r//lb/in^2
P5=50//lb/in^2
W1=13960//ft/lb
W2=19040//ft/lb
T=33000//ft/lb
v=4.43//ft^3
v1=v*d//ft^3
W3=T*v1//ft/lb
Hp=3416//ft/lb
Lp=3416//ft/lb
//CALCULATIONS
W=Lp*v1//ft lb
//RESULTS
printf('The thermal efficiency of a compound steam
    and work done=% f ft lb',W)
```

Chapter 5

Air compressors and motors refrigeration

Scilab code Exa 5.1 Example 1

```
clc
//initialisation of variables
a=7//in
b=10//in
c=12//in
r=96//in
p1=15//lb/in^2
p2=100//lb/in^2
T=16//Degree C
gama=1.4//in
h=120//r.p.m
T1=T+273//C absolute
//CALCULATIONS
v1=(%pi/4)*(a/c)^2*(b/c)//ft^3
w=(p1*144*v1)/(r*T1)//lb
w1=h*w//lb
W=1680*[1.72-1]//ft lb
I=144*p1*v1*log(p2/p1)//ft lb
E=I/W*100//percent
```

```
//RESULTS
printf('The ideal efficiency is defined as the ratio
    of tthis work=% f percent',E)
```

Scilab code Exa 5.2 Example 2

```
clc
//initialisation of variables
h1=16//i.h.p
p1=100//lb/in^2
p2=15//lb/in^2
R=275//R.p.m
h=550//ft/min
q=33000//in^2
v1=4.85//lb
B=8.53//in
//CALCULATIONS
M=(p1/v1)-p2+(p1/v1-p2)*1/0.2
S=h/(2*R)//ft
I=(q*h1)/(M*S*R)//in^2
//RESULTS
printf('The effect of the clearance volume=% f in^2'
    ,I)
```

Scilab code Exa 5.3 Example 3

```
clc
//initialisation of variables
h=100//ft^3
t=15//degree C
p=120//lb/in^2
gama=1.3//in
t1=15//Degree C
```

```
M=[(144*t*h*2.6)/(0.3)*(1.271-1)]//ft lb
//CALCULATIONS
V=sqrt(p/t)//ft lb
//RESULTS
printf('Compare the values of the two cylinders=% f
   ft lb',V)
```

Scilab code Exa 5.5 Example 4

```
clc
//initialisation of variables
h=0.2//ft^3
v=10//percent
T=15//degree c
p=30//lb/in62
t1=15//Degree C
p1=60//lb/in^2
v1=2.2//ft^3
v3=0.328//ft^3
A=(v1-v3)//ft^3
v2=1.341//ft^3
V=v2-h//ft^
t2=288//Degree C
//CALCULATIONS
T2=(t2*p*v2)/(t1*v1)//Degree C absolute
v5=(t2/T2)*V//ft^3
v7=0.164//ft^3
v8=v5-(v7/11)*v5
v6=v8/(1-v7/11)//ft^3
//RESULTS
printf('The required volume of the H.P cylinder
   including clearance=% f ft^3',v6)
```

Scilab code Exa 5.6 Example 5

```
clc
//initialisation of variables
p1=80//lb/in^2
p2=20//lb/in^2
//CALCULATIONS
P=sqrt(p1*p2)//lb/in62
V=P/p1//stroke
W=p2/P//stroke
//RESULTS
printf('the ratio of cut off to length of stroke=%f
    stroke',W)
```

Scilab code Exa 5.9 Example 6

```
clc
//initialisation of variables
p1=25//lb/in^2
p2=50//lb/in^2
p3=75//lb/in^2
p4=100//lb/in^2
v1=29.2//ft^3
v2=28.8//ft^3
v3=28.1//ft^3
v4=27.2//ft^3
h=14.7//lb/in^2
v=3//percent
s=5//stroke
//CALCULATIONS
V=(%pi*p1)/(4)*4//in^3
V1=v/p4*V//in^3
//RESULTS
printf('The volume of efficiency of pressure=%f in
   ^3',V1)
```

Scilab code Exa 5.12 Example 7

```
clc
//initialisation of variables
p1=15//lb/in^2
p2=60//lb/in^2
t=16//Degree C
Ta=273+t//Degree C absolute
T=1.486//lb/in^2
Td=Ta/T//Degree C absolute
//CALCULATIONS
P=Td/(Ta-Td)//Degree C absolute
//RESULTS
printf('The lowest temperature and coefficient of
    performance=%f Degree C absolute',P)
```

Scilab code Exa 5.14 Example 8

```
clc
//initialisation of variables
T1=30//Degree c
T2=-10//degree C
t1=263//F
t2=303//F
h1=20//Units
h2=79//C.H.U/lb
h=24//hours
T3=1//Degree C
p=2.2046//C.H.U/sec
//CALCULATIONS
P=h1*p//C.H.U/sec
```

```
T=t1/(t2-t1)//F
H=P*60//C.H.U
W=(H*1400)/T//ft/lb
hp=W/33000//h.p
W1=(H*60*h)/(80*2240)//tons
//RESULTS
printf('the cycle is a perfect one=%f tons',W1)
```

Scilab code Exa 5.15 Example 9

```
clc
//initialisation of variables
p1=930//lb/in^2
p2=440//lb/in^2
T=268//F
t1=25//F
t2=5//F
h1=19.4//C.H.U
h2=-1.8//C.H.U
h3=29//C.H.U
h4=58.6//C.H.U
d=0.6//C.H.U
d1=0.06//lb
d2=-0.01//lb
c=40//percent
h=24//hour
t3=10//C
d3=15//lb
h5=80//C.H.U
//CALCULATIONS
A=[h1-(h2)]-[d1-(d2)]*T//C.H.U
FD=A/T//units of entropy
AD=(d*h4/T-0.07-A/T)*T//C.H.U
W=4.28//C.H.U
T=AD/W//C.H.U
```

```
P=0.4*T//C.H.U
H=P*W*d3//C.H.U
H1=P*W*d3*60*h//C.H.U
H2=t3+h5//C.H.U
W1=H1/(H2*2240)//tond
//RESULTS
printf('The many tons of ice would a machine working
    between the same limit and having a relative
    coefficient=%f tons',W1)
```

Scilab code Exa 5.16 Example 10

```
clc
//initialisation of variables
t1=20//Degeree C
t2=-10//degree C
h=0.95//dry
t3=35//Degree C
h1=0.066//lb
h2=1.089//lb
v1=-0.033//lb
v2=1.193//lb
v3=0.508//lb
T1=263//F
T2=293//F
//CALCULATIONS
T=T1/(T2-T1)//F
E=h1-(v1)//lb
C=0.1079//lb
CP=E/C//lb
A=CP*(T2-T1)-E*T1//C.H.U
F=A/T1//units of entropy
H=254.212//C.H.U
H2=274.447//C.H.U
W=[CP*(T2-T1)+h*1.023*(T2-T1)-E*T1]//C.H.U
```

```
P=H/W//C.H.U
V=A+v3*15-T1*v3*0.0507//C.H.U
H1=T1*[v3*0.0507+0.05*1.023]//C.H.U
N=H2/(W+V)//C.H.U
//RESULTS
printf('The upper and lower temperature limits
    respectively=%f F',T)
printf('The vapour compression cycle work done=%f C
    .H.U',H)
printf('The vapour is now additional work done=%f C
    .H.U',N)
```

Scilab code Exa 5.18 Example 11

```
clc
//initialisation of variables
h=0.8//dry
p=120//lb/in^2
p1=1//lb/in^2
t=100//Degree C
A=99.6-38.6-0.178*311.8//C.H.U
G=311.8//units of entropy
AF=440.52//C.H.U
H=399.82//lb/in^2
p=307//lb
//CALCULATIONS
T=H/p//C.H.U
//RESULTS
printf('theoretical coefficient pf performance as a
    refrigeratior=%f C.H.U',T)
```

Chapter 6

flow through nozzles steam turbines

Scilab code Exa 6.1 Example 1

```
clc
//initialisation of variables
p1=150//lb/in^2
p2=10//lb/in^2
n=10//percent
T=183.6+479.4//C.H.U
x2=0.852//C.H.U
H=553.9//C.H.U/lb
h1=T-H//C.H.U/lb
//CALCULATIONS
V=sqrt(2*32.2*1400*h1)//ft/sec
V1=sqrt(2*32.2*1400*0.9*h1)//ft/sec
//RESULTS
printf('the neglecting friction=% f ft/sec',V)
printf('the frictional drop in the nozzle is 10
    recent of the total heat drop=% f ft/sec',V1)
```

Scilab code Exa 6.2 Example 2

```
clc
//initialisation of variables
v=((3140*%pi*60*60)/(4*4*144))//ft/sec
v1=0.852*38.37//ft^3
//CALCULATIONS
W=(v/v1)//lb
V=(2970*%pi*60*60)/(4*4*144)//ft^3
W1=(V/v1)//lb
//RESULTS
printf('the weight of steam per hour=% f lb',W)
printf('the weight of steam per hour=% f lb',W1)
```

Scilab code Exa 6.4 Example 3

```
clc
//initialisation of variables
p1=300//lb
p=75//lb/in^2
p2=8//lb/in^2
h=90//C.H.U/lb
Pt=0.58*p//lb/in^2 absolute
h1=24//lb/C.H.U
D=0.968//C.H.U
D1=0.886//C.H.U
v=9.7//ft^3
v1=47.24//ft^3
V=sqrt(2*32.2*1400*24)//ft/sec
V1=sqrt(2*32.2*1400*90)//ft/sec
//CALCULATIONS
H=(p1*v*D/3600)//ft^3
V2=(p1*v1*D1/3600)//ft^3
A=0.768//in^2
A1=1.72//in^2
```

```
d=sqrt(4*0.768/%pi)//in
d1=sqrt((4*A1)/(%pi))//in
//RESULTS
printf('the diameters at the throat and exit of the
    nozzle=% f in',d1)
```

Scilab code Exa 6.5 Example 4

```
clc
//initialisation of variables
d=2.15//in^2
a=0.98//dry
p=100//lb/in^2
p1=11000//lb
P=0.58*p//lb/in^2
H=24//C.H.U/lb
D=0.947//lb
s=7.407//ft^3
//CALCULATION
V=sqrt(2*32.2*1400*H)//ft/sec
V1=V*(d/144)//ft^3
T=V1/(s*D)//lb
A=(p1/3600)//lb
C=A/T//lb
//RESULTS
printf('the coefficient of discharge for the nozzles
    =% f lb',C)
```

Scilab code Exa 6.6 Example 5

```
clc
//initialisation of variables
p=9.5//lb
```

```
p1=120//lb
e=0.88//in
p2=80//lb/in^2
d=25//in
d1=0.125//in
t=14//degree C
T=e*19//C.H.U/lb
D=0.975//in
V=sqrt(2*32.2*1400*T)//ft/sec
S=5.467//ft^3
//CALCULATIONS
V1=p*S*D//ft^3
T1=(V1*144/V)//in^2
C=25*%pi//in
N=C/2.5//in
P=C/31//in
W=d1/sind(t)//in
L=P-W//in
W1=L*sind(t)//in
T2=(T1)/(31*W1)//in
//RESULTS
printf('The number of nozzles their breadth and heigh=%f in',T2)
```

Scilab code Exa 6.8 Example 6

```
clc
//initialisation of variables
p1=100//lb/in^2
p2=15//lb/in^2
d1=95//percent
d2=30//percent
P=0.58*p1//lb/in^2
H=0.95*25//C.H.U/lb
H1=0.95*76.5//C.H.U/lb
```

```
D=0.97//in
D1=0.905//in
V=7.407//ft^3
V1=sqrt(2*32.2*1400*H)//ft/sec
V2=sqrt(2*32.2*1400*H1)//ft/sec
//CALCULATIONS
V3=(2*%pi*1*V1)/(64*4*144)//ft^3
W=(V3*3600)/(V*D)//lb
K=V2/(2*32.2)//ft lb sec
E=[((V2)^2*W)/(2*32.2*3600)]//ft.lb
W1=(E*d2)/(p1*550)//ft.lb
//RESULTS
printf('the quantity of steam used per hour and
   horse power developed=% f ft.lb',W1)
```

Scilab code Exa 6.10 Example 7

```
clc
//initialisation of variables
d=0.15//lb
p=20//lb/in^2
p1=100//lb/iN62
t=200//degree C
f=10//percent
Pt=0.5457*p1//lb/in^2
x1=0.996//in
x2=0.952//in
h=29//C.H.U/lb
h1=65//C.H.U/lb
v=7.73//ft^3
v1=20.12//ft^3
T=0.364//in
T1=0.465//in
v2=sqrt(2*32.2*1400*h)//ft/sec
v3=sqrt(2*32.2*1400*h1)//ft/sec
```

```
//CALCULATIONS
V1=d*v*x1//ft^3
V2=d*v1*x2//ft^3
A1=(V1/v2)*144//in^2
A2=(V2/v3)*144//in^2
//RESULTS
printf('the throat and exit diameters of the nozzle=
    % f in^2',A2)
```

Scilab code Exa 6.11 Example 8

```
clc
//initialisation of variables
h=0.5//lb
p1=2.5//lb/in^2
p2=100//lb/in^2
t=250//Degree C
pv=1.3//constant
pt=0.5457*p2//lb/in^2
t1=18//degree C
h1=32//C.H.U/lb
h2=151//C.H.U/lb
D=0.887//in
V1=sqrt(2*32.2*1400*h1)//ft/sec
V2=sqrt(2*32.2*1400*h2)//ft.sec
s1=8.74//ft^3
s2=140.8//ft^3
T1=0.687//in
T1=1.77//in
V3=h*s1//ft^3/sec
V4=h*s2//ft^3/sec
//CALCULATIONS
A1=(V3/V1)*144//in^2
A2=(V4/V2)*144//in^2
//RESULTS
```

```
printf('the size os nozzle=% f in^2',A2)
```

Scilab code Exa 6.13 Example 9

```
clc
//initialisation of variables
h=500//gallons
p1=150//lb/in^2
p2=0.6//lb/in^2
P=p2*p1//lb/in^2
h=25//C.H.U/lb
p=62.4//lb/ft^2
V=sqrt(2*32.2*1400*h)//ft/sec
D=0.996//in^2
d=4.898//in^2
v1=1.2//in
vi=163.2//ft/sec
m=V/32.2//ft.lb.sec
//CALCULATIONS
W=V/vi-1//lb
W1=(5000)/(3600*W)//ft/sec
V1=W1*d*D//ft^3
A=V1/V*144//in^2
I=(50/36+W1)//lb/sec
A1=(I*144)/(62.4*vi)//in^2
//RESULTS
printf('the aera of the stream and water orifices=%
    f in^2',A1)
```

Scilab code Exa 6.15 Example 10

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

```
a=50//degree c
v=2000//ft/sec
p=800//ft/sec
b=20//Degree C
v1=0.9//in^2
v2=513//ft/sec
W=(1/32.2)*[1810-(-313)]*p//ft/lb lb stream /sec
K=(v^2)/(2*32.2)//ft/lb sec
//CALCULATIONS
D=(W/K)*100//percent/lb
//RESULTS
printf('the work done per lb=% f percent/lb',D)
```

Scilab code Exa 6.16 Example 11

```

clc
//initialisation of variables
t=65//B.Th.U per lb
n=0.98//dry
p=105//lb/in^2
a=14//Degree C
b=20//Degree C
p1=800//ft/sec
v=0.80//ft/lb
p2=3.5//lb/sec
q=1400//in
V=sqrt(2*32.2*778*t)//ft/sec
W=(p1)*(1750-b)/32.2//ft lb/lb stream/sec
H=(W*p2/550)//ft/lb
E=1/64.4*[(1053)^2-(825)^2]//ft.lb steam /sec
//CALCULATIONS
Hd=(E/q)//C.H.U
//RESULTS
printf('the steam as it leaves the blades and hourse
```

```
power=% f C.H.U',Hd)
```

Scilab code Exa 6.18 example 12

```
clc
//initialisation of variables
p=300//ft/sec
W=880//ft/sec
a=18//degree C
g=32.2//ft
//CALCULATIONS
Wd=(p*W)/g//ft lb
//RESULTS
printf('the work done /lb steam sec=% f ft lb',Wd)
```

Scilab code Exa 6.19 Example 13

```
clc
//initialisation of variables
a=35//Degree C
b=20//degree C
f=2//ft
w=422//ft
w1=222//ft
g=32.2//ft
s=1500//r p m
j=0.8//ft
p=3//lb/sec
h=80//percent
i=1400//ft
P=(%pi*(31/12)*(s/60))//ft/sec
W=P/g*[w-(-w1)]//ft lb
H=(p*W)/550//ft lb
```

```
//CALCULATIONS
E=W/(j*i)//C.H.U
//RESULTS
printf('the house -power developed per pair of rings
    if the steam=%f ft lb',E)
```

Scilab code Exa 6.23 Example 14

```
clc
//initialisation of variables
d=7//ft
h=2//in
s=750//r p m
s1=31.3//lb/sec
h1=1.5//in
a=25//Degree c
p=5.7//lb/in^2
d1=0.97//in
h2=370//ft/sec
j=32.2//in
k=1400//in
e=0.75//percent
w=326//in
p=290//in
vi=155//ft/sec
//CALCULATIONS
P=(%pi*7.69*s)/(60)//ft/sec
H=(P*h2*s1)/(550*j)//ft/sec
E=(P*h2)/(j*e*k)//C.H.U/lb
//RESULTS
printf('the drop in pressure while the steam is
   passing through the turbine=%f C.H.U/lb',E)
```

Scilab code Exa 6.25 Example 15

```
clc
//initialisation of variables
p=300//lb/in^2
ab=100//degree C
w=26.4//C
t=40//lb/in^2
t1=180//Degree C
p1=0.5//lb/in^2
T=732.38//C.H.U
W=26.2//C.H.U/lb
W1=102//C.H.U/lb
x=0.963//in
d=335//C.H.U/lb
E=743.85//C.H.U/lb
//CALCULATIONS
H=T-w//C.H.U/lb
h=T-W1//C.H.U/lb
H1=E-h//C.H.U/lb
T1=H+H1//C.H.U/lb
Wd=W1+d//C.H.U
//RESULTS
printf('the total work done per lb steam=%f C.H.U',
    Wd)
```

Scilab code Exa 16.28 Example 16

```
clc
//initialisation of variables
p=100//lb/in62
p1=0.5//lb/in^2
T1=659.3//C.H.U/lb
T2=26.2//C H U/lb
W=181//C H U/lb
```

```
H1=66//C H U/lb
H2=115//C H U /lb
D=0.912//C H U/lb
H3=533.4//C H U/lb
T3=108.5 //Degree C
T4=26.4//Degree C
W1=82.1/(D*H3)//lb
s=1-W1//lb
//CALCULATIONS
T=W/(T1-T2)*100//percent
Wd=H1+(H2*s)//C H U/lb
H=T1-T3//C H U//lb
TE=Wd/H*100//percent
//RESULTS
printf('the without bleeding % f pecent',T)
printf('the proper weight of steam is bled=% f
   percent',TE)
```

Chapter 7

Combustion boiler trials

Scilab code Exa 7.1 Example 1

```
clc
//initialisation of variables
C=86//percent
h=4.2//percent
w=20//lb
a=w+0.902//lb
C2=44/12//lb
N=0.77//lb
CO2=3.15
H2O=0.042*9//lb
N2=w*N//lb
Ox=a-CO2-H2O-N2//lb
//CALCULATIONS
Co2=CO2/a*100//percent
H2o=H2O/a*100//percent
n2=N2/a//percent
o2=Ox/a*100//percent
//RESULTS
printf('the composition of the products of
   combutions by weight=% f percent',o2)
```

Scilab code Exa 7.2 Example 2

```

clc
//initialisation of variables
g=0.05//percent
n=0.35//percent
c=0.5//percent
h=10//percent
m=167//C H U
h1=162//C H U
v=1//ft^3
H2=0.5//ft^3
Co=0.05//ft^3
v2=3//ft
//CALCULATIONS
G=(g*c)+(n*H2)//ft^3
Tv=(g*h1)+(n*m)//C H U
M=Tv/v2//C H U/ft^3
//RESULTS
printf('the gas with twice its volume of air=% f C H
    U/ft^3',M)
```

Scilab code Exa 7.4 Example 3

```
clc
//initialisation of variables
g=8//percent
f=88//percent
C=12//percent
w=20//lb
C1=11/3//lb
```

```
CO2=3/11//lb
e=0.08//lb
D=0.0218//lb C
w1=0.88//lb
//CALCULATIONS
W1=w1/D//lb lb fuel
T=w1/D*w//lb/hr
//RESULTS
printf('the total weight of exaust gas leaving the
    engine per hour=%f lb/hr',T)
```

Scilab code Exa 7.6 Example 4

```
clc
//initialisation of variables
a=30//percent
b=20//percent
c=8//percent
h=42//percent
t1=20//degree C
g=0.24//in
t2=320//degree c
M=7.654//lb/lb fuel
A=3*M//lb/lb fuel
W=0.08+0.04//lb
T=A+0.8//lb
w1=0.72+0.3//lb
w=T-w1//lb
d=w*0.24*(t2-b)//C H U/lb fuel
H=1.02*(639+0.49*220-t1)//C H U/lb fuel
//CALCULATIONS
T1=d+H//C H U/lb fuel
//RESULTS
printf('total heat carried away by flue gases=%f C
    H U/lb fuel',T1)
```

Scilab code Exa 7.7 Example 5

```
clc
//initialisation of variables
h=40//percent
g=30//percent
c=8//percent
n=10//percent
w=6//percent
g1=10//percent
g2=4.14//ft^3
Ch4=4.562//ft^3 of air
Co2=0.44//ft
H2o=1.18//ft^3
N2=3.7//ft63
x=41.4/11//ft63
//CALCULATIONS
T=Ch4+x//ft^3
v=1+T//ft^3
V=x+g2//ft^3
D=v-V//ft^3
P=D/v*100//percent
//RESULTS
printf('the volueme of air suplied per=%f percent',
   P)
```

Scilab code Exa 7.9 Example 6

```
clc
//initialisation of variables
Ox=2.679//lb
```

```
O2=Ox-0.03//lb O2/lb fuel
o2=O2*100/23//lb air lb fuel
E=o2/2//lb
a=17.325//lb /lb fuel
Co2=3.294//lb
H2o=0.315//lb
N2o=13.34//lb
O2=23/100*E//lb
So2=0.005*2//lb
//CALCULATIONS
W=Co2+N2o+O2+So2//lb /lb fuel
//RESULTS
printf('the totel weight of dry products=%f lb /lb
    fuel',W)
```

Scilab code Exa 7.11 Example 7

```
clc
//initialisation of variables
l=8.7//percent
Co2=42//percent
N=28//percent
O2=32//percent
x=27.65//lb air
W=(O2/12)*(100/23)//lb
//CALCULATIONS
A=x-W//lb
//RESULTS
printf('the air to flues /lb carbon=%f lb',A)
```

Scilab code Exa 7.13 Example 8

```
clc
```

```
//initialisation of variables
Co=2420//C H U
a=3400/6//C H U
R=Co/3246//C H U
T=1+0.745//lb
n=1.12 //lb
O2=1.33/1.745//lb
C=O2*100/23//lb
CB=n/T//lb
m=1.74//lb
k=2.33//lb
l=1.33//lb
c=77//lb
d=23//lb
//CALCULATIONS
Y=l*c/d//N2
//RESULTS
printf('the weight of air and steam =% f N2',Y)
```

Scilab code Exa 7.15 Example 9

```
clc
//initialisation of variables
w=20//lb
t=320//degree C
t1=22//Degree C
w1=0.0807//lb
A=0.03901//AH
W=0.07469//AH
g=5.2//A
Q=W-A//A
//CALCULATIONS
H=(g*0.625)/(Q)//ft
//RESULTS
printf('weight of equal column of external air=% f
```

```
   ft ',H)
```

Scilab code Exa 7.16 Example 10

```
clc
//initialisation of variables
p=120//lb/in^2
h=30//in
t=48//degree C
C=1000//lb
t1=26//degree C
m=2.2//percent
g=18//lb
f=127//lb
j=33000//in
q=1400//in
L=0.978*8000//C.H.U
b=50//in
t2=320//degree C
g1=0.24//in
d=0.90//in
a=0.4912*30//lb/in^2
P=p+a//lb/in^2 abs
T=178.62+d*483.45//C.H.U/lb
//CALCULATIONS
Wt=C/f//lb
H=Wt*(T-t)//C.H.U
F=0.022*(638.9+0.48*220-t1)//C.H.U
G=g*0.24*(t2-t1)//C.H.U
E=H/L*100//percent
E1=b*j*60/(L*f*q)*100//percent
//RESULTS
printf('the heat balance for the boiler and find its
    efficiency and the overall efficiency of the
   plant=% f percent',E1)
```

Scilab code Exa 7.17 Example 11

```
clc
//initialisation of variables
v=7950//lb C.H.U /lb
w=15//percent
c=0.85//lb
w1=14//percent
w2=9//percent
t1=15//degree C
t2=325//degree C
g=0.25//lb
//CALCULATIONS
H=c*v//C.H.U
H1=0.15*(638.9+0.48*225-15)//C.H.U
C=c*c//lb
A=19.2//lb
Wt=A+C//lb
P=Wt*g*(t2-t1)//C.H.U/lb coal
R=0.14*H//C.H.U
R1=H-H1-P-R//C.H.U
B=R1/H*100//percent
//RESULTS
printf('the efficiency of a boiler =% f percent',B)
```

Chapter 8

Internal combustion engines Variable specific heats

Scilab code Exa 8.1 Example 1

```
clc
//initialisation of variables
b=6//in
b1=9//in
r1=4//ratio
r2=1//ratio
p=50//lb/in^2
s=300//r p m
e=30//per cent
v=260//C.H.U
a=1.41
h=0.30//in
g=33000//in
g1=1400//in
A=1-(r2/r1)^0.41//lb/in^2
//CALCULATIONS
I=(p*%pi*36/4*9/12*s/2)*1/g//ft^3
X=(I*g)/(g1*v*h)//ft^3
C=X*60/I//ft^3
```

```
R=h/A*100//per cent
//RESULTS
printf('The fuel consumption in ft^3/h p hr and the
   efficiency relative to the air standard cycle=% f
    percent',R)
```

Scilab code Exa 8.3 Example 2

```
clc
//initialisation of variables
h=200//r p m
h1=50//i h p
P4=33.4//lb/in^2
W=9000//ft lb
x=33000//ft.lb
p=1728//ft/lb
//CALCULATIONS
w=h1*x/100//ft lb
T=w/W//ft^3
V =13/14*T//ft^3
D=((V*p*8)/(3*%pi))^(1/3)//in
//RESULTS
printf('The diameter of the cylinder of a single
   acting and swept volume=% f in',D)
```

Scilab code Exa 8.6 Example 3

```
clc
//initialisation of variables
h=12//in
h1=18//in
v=19000//B.Th.U/lb
T=12600//lb/in^2
```

```
m=90//lb/in^2
w=120//gal
t1=140//F
t2=60//F
t3=570//F
Cv=0.24//ft/lb
q=810//ft/lb
n=16.9//lb
//CALCULATIONS
H=(n/t2*v)//B.Th.U
H1=[m*%pi*(144/4)*(h1/h)*(T/t2)]/(778*2)//B.TH.U/min
H2=1750//B.Th.U
H3=(H1-H2)//B.Th.U
W=(w*10/t2)*(t1-t2)//B,Th.U
G=((q+n)/(t2))*(t3-t2)*Cv//B.TH.U
//RESULTS
printf('The heat balance showing heat quantities
   received and the discharged per min=% f B.TH.U',G
   )
```

Scilab code Exa 8.8 Example 4

```
clc
//initialisation of variables
v=12.5 //i.p.h
p1=8.25//in
p2=12//in
t=110//per min
g1=280//C.H.U/ft^3
g2=215//ft^3
V=25//percent
e=0.875//in
T=33000//in
v1=0.4170//ft^3
//CALCULATIONS
```

```
M=(T*v)/((%pi*(p1)^2)/(4)*(p2/p2)*(t))//lb.in^2
V1=%pi*(p1)^2/4*p2/1728*e//ft^3
V2=(%pi*(p1)^2*p2)/(4*4*1728)//ft^3
G=(g2/60*1/t)//ft^3
T1=G*g1//C.H.U
T2=(T1/v1)//C.H.U
F=(M/T2)//C.H.U
//RESULTS
printf('The value of the Tookey factor for gas
   engine=%.f C.H.U',F)
```

Scilab code Exa 8.10 Example 5

```
clc
//initialisation of variables
p1=140//lb/in^2
p2=6.6//lb/in^2
v1=122//r.p.m
v2=1250//b.h.p
t=1425//i.h.p
p3=77.8//lb/in^2
h=0.356//lb
v=10000//C.H.U/lb
h2=2400//lb
q=33000//in
j=1400//in
//CALCULATIONS
t=(v2*q*60)/(j*h*v2*v)*100//percent
V=(p3*144*v1)/(q*2)//V
V1=(p2*144*v1)/q//V
T=24.16//V
V2=t/T//ft^3
I=V*V2//ft^3
I1=V1*V2//ft^3
H=24904//C/.H.U//mim
```

```
T=(I*q*60)/(j*h*v2*v)*100//percent
T1=(I1*q)/(j*H)*100//percent
T2=(h*v2*v)/(60)//C.H.U
H1=(v2*q)/(j)//C.H.U/mim
H2=H-(I1*q*v2)/(j*t)//C.H.U/mim
T3=H1+H2//C.H.U/mim
Tn=T2-T3//C.H.U/mim
//RESULTS
printf('the overall thermal effciency=%f percent',t)
printf('the cylinder volume in ft^3=%f volume',V)
printf('the thermal efficiency of steam engine=%f percent',T1)
printf('total heat in oil.mim=%f C.H.U/mim',Tn)
```

Scilab code Exa 8.12 Example 6

```
clc
//initialisation of variables
r=14//in
r1=1.8//in
t=30.4//lb
e=0.6//lb
lam=1.4
d=12//in
d1=18//in
v=10000//C.H.U/lb
P=200//r m p
//CALCULATIONS
A=1-(1/(lam*(r)^0.4))*((r1)^lam-1)/(r1-1)//percent
T=e*A//percent
H=t/60*v//C.H.U
H1=H*T//C.H.U
I=(H1*1400)/(33000)//ln/in^2
M=(I*33000)/(2*%pi*144/4*d1/12*P/2)//lb/in^2
```

```
//RESULTS
printf('the indicated hourse-power and the mean
   effiective pressure of the engine=% flb/in^2',M)
```

Scilab code Exa 8.19 Example 7

```
clc
//initialisation of variables
cv=0.1714//C.H.U
R=100.3//ft.lb
T=500//degree c
J=1400//in
Lam=R/J//C.H.U percent C
//CALCULATIONS
Cp=Lam+cv//C.H.U percent C
//RESULTS
printf('The specific heat at constant volume of a
   gaseous mixture is=% f C.H.U percent C',Cp)
```

Scilab code Exa 8.20 Example 8

```
clc
//initialisation of variables
a=0.124//in
b=0.000025//in
R=0.0671//heat units
//CALCULATIONS
Cp=(R+a+b)+b//T
//RESULTS
printf('the specific heat of a gas at constant
   volume=% f T',Cp)
```

Scilab code Exa 8.21 Example 9

```
clc
//initialisation of variables
v=18//ft^3
p=14//lb/in^2
p1=150//lb/in^2
Cp=0.242//T
Cv=0.171//T
j=1400//ft
R=j*(Cp-Cv)//ft.lb
p2=144//ft
I1=137500//ft/lb
I2=6.37//ft/lb
v2=3.282//ft^3
//CALCULATIONS
T=(p2*p*v)/R//Degree C
T2=(p2*p1*v2)/(R)//Degree c
W=Cp*(T2-T)+0.00002*[(T2)^2-(T)^2]//C.H.U/lb
C=v/v2//ratio
//RESULTS
printf('The work done the temperatures at the
    beginning and end of compression ratio=% f ratio'
    ,C)
```

Scilab code Exa 8.22 Example 10

```
clc
//initialisation of variables
r=12.5//rario
p=0.39*10^6//ft.lb
```

```
p1=14//lb/in^2
t=373//Degree C
g=18//ft^3
t1=100//Degree C
V=g/r//ft^3
I=0.2*10^6//ft lb/lb
T=0.59*10^6//ft.lb/lb
D=0.221*10^6//ft.lb/lb
A=0.095*10^6//ft.lb/lb
E=0.264*10^6//ft.lb/lb
E1=0.390*10^6//ft.lb/lb
//CALCULATIONS
W=(E/E1)*100//percent
M=(E)/(144*(g-V))//lb.in^2
//RESULTS
printf('the efficiency of the engine and the m e p
    on the assumption that the specific heats=%f lb
    in^2',M)
```

Chapter 9

Valve DIagrams and value gears

Scilab code Exa 9.5 Example 1

```
clc
//initialisation of variables
p=20//in
l=100//in
r=120//r.p.m
v=3.5//in
l2=1//in
l3=1/8//in
v1=1.44//umega in/sec
//CALCULATIONS
V=p*(1.06/1.166)//umega in./sec
R=(V/v1)//umega in/sec
//RESULTS
printf('The ratio of velocity of the piston to the
    velocity=% f umega in/sec',R)
```

Scilab code Exa 5.7 Example 2

```
clc
//initialisation of variables
v=0.6//in
m=1.0//in
t=0.75//in
p=4//in
//CALCULATIONS
D=t/m//in
A=(p*m/D)//in
//RESULTS
printf('the travel and laps of the value=% f in',A)
```

Scilab code Exa 9.10 Example 3

```
clc
//initialisation of variables
l=1.5//in
p=4.0//in
v=0.98//in
//CALCULATIONS
T=(l*p/v)//in
//RESULTS
printf('the particulars of a value and it eccentric=
   % f in',T)
```

Scilab code Exa 9.12 Example 4

```
clc
//initialisation of variables
p=1/10//in
v1=3/4//in
v2=3/5//in
m=1*1/2//in
```

```
l=4//cranks
a1=1.25//in
a2=0.7//in
//CALCULATIONS
C=a1/a2//in
A=l*a1/a2//in
S=(A/2-a1)//in
//RESULTS
printf('the travel of the value =%f in',S)
```

Scilab code Exa 9.17 Example 5

```
clc
//initialisation of variables
v=3*1/2//in
a=30//degree
l=0.8//in
v1=0.2//in
L=0.13//in
m=1.075//in
d=0.58//in
p=1.875//in
//CALCULATIONS
V=(p-d)//in
P=V+1.25//in
//RESULTS
printf('the main value and the maximum opening to
   steam=%f in',P)
```