Scilab Textbook Companion for Problems In Hydraulics by R. S. Paradise[1]

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Book Description

Title: Problems In Hydraulics

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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

HydroStatistics

Scilab code Exa 1.2 example 2

```
clear
clc
//initialisation of variables
w= 62.4 //lb/ft^3
A= 18 //ft^2
x= 6 //ft
kg= 6
y= 2 //ft
y1= 5 //ft
//CALCULATIONS
F= w*A*x
F1= F/2
Ft= (F*y-F1*(y1/2))/y1
Fb= F1-Ft
//RESULTS
printf ('Force exerted on the bolt = %.f lb',F1)
printf ('\n Force exerted on the hinge = %.f lb',Ft)
printf ('\n Force exerted on the bolt = %.f lb',Fb)
```

Scilab code Exa 1.3 example 3

```
clear
clc
//initialisation of variables
h1= 11.54 //ft
h2= 16.33 //ft
w= 62.4 //lb/ft^3
x1= 7.69 //ft
x2= 14.09 //ft
x3= 18.23 //ft
//CALCULATIONS
Ft= w*h1^2/2
//RESULTS
printf ('h1 = %.2f ft',h1)
printf ('\n h2 = %.2f ft',h2)
printf ('\n h1+ = %.2f ft',x1)
printf ('\n h2+ = %.2f ft',x2)
printf ('\n h3+ = %.2f ft',x3)
printf ('\n Thrust force = %.f lb/ft run',Ft)
```

Scilab code Exa 1.4 example 4

```



clc
//initialisation of variables
clear
spo= 0.9
h= 3 //ft
d= 2 //ft
w= 62.4 //lb/ft^3
H= 0.71 //ft
//CALCULATIONS
```

```
do= spo*w
de= w*d
bc= do*h
Pt= (bc*(h/2)+bc*d+de*(d/2))*(h+d)
y= (bc*(h/2)+bc*d+de*(d/2)*(d/3))*(h+d)/Pt+H
//RESULTS
printf("Total pressure = %d lb",Pt)
printf ('\n position of centre of ressure above the
    base = %.2f ft position of centre of pressure
    above the axis ',y)
```

Scilab code Exa 1.5 example 5

```


clc
//initialisation of variables
clear
a= 30 //degrees
b= 30 //degrees
h= 20 //ft
h1= 10 //ft
h2= 15 //ft
h3= 16 //ft
w= 62.4 //lb/ft^3
h4= 10/3 //ft
//CALCULATIONS
Rt= (1/h3)*((w*(h*h2^2*(h2/3)/(2*sqrt(3))))-(w*(h*h1
    ^2*h4/(2*sqrt(3)))))
R= ((w*(h*h2^2/(2*sqrt(3))))-(w*(h*h1^2/(2*sqrt(3)))
    ))
Rb= R-Rt
//RESULTS
printf ('Force at the hinge = %.f lb ',Rt)
printf ('\n Force at the hinge = %.f lb ',Rb)
```

```
//Round off error in textbook
```

Scilab code Exa 1.6 example 6

```
clc
//initialisation of variables
clear
x= 32 //ft
h= 60 //ft
w= 62.4 //lb/ft^3
AE= 20 //ft
//CALCULATIONS
Vabc= 2*x*h/3
vc= Vabc*w
Tab= w*h^2/2
Rt= sqrt(vc^2+Tab^2)/2240
A= atand(vc/Tab)
AD= x-AE+AE*cotd(A)
//RESULTS
printf("resultant thrust = %.1f tons",Rt)
printf("\n Angle = %.2f degrees",A)
printf ('\n AD = %.1f ft ',AD)
```

Scilab code Exa 1.7 example 7

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

```
clear
wdc= 3*sqrt(3) //ft
wdo= sqrt(3)
ac= 30 //degrees
ao= 60 //degrees
hob= 3 //ft
haf= 2.6 //ft
hfc= 3 //ft
w= 62.4 //lb/ft^3
V= 5.63 //ft^3
h= 4.3 //ft
y= 3.6 //ft
//CALCULATIONS
W1= wdc*hfc*w/2
Hbc= w*hob*(hob/2)
W2= V*w
W3= w*haf*h
Vt= W1+W2
Vht= Hbc+W3
Rt= sqrt(Vt^2+Vht^2)
A= atand(Vht/Vt)
x= (W1*(wdo-(hob/2))+Hbc*y)/Rt
OP= x/sind(A)
AP= hob+OP
//RESULTS
printf("Resultant thrust = %d lb",Rt)
printf("\n Angle = %.2f degrees ",A)
printf ('\n Distance from A till horizontal thrust =
    %.3f ft ',AP)
```

Scilab code Exa 1.8 example 8

```

clc
//initialisation of variables
```

```
clear
r= 96
T= 10.5 //C
K1= 288 //C
K2= 0.0015 //C^-1
h= 3000 //ft
P1= 14.69
//CALCULATIONS
P2= P1*10^(((1/(r*K2))*log10((K1-K2*h)/K1)))
w= P2*144/(r*(273+T))
//RESULTS
printf ('Density = %.4f lb/ft^3 ',w)
```

Scilab code Exa 1.9 example 9

```

clc
//initialisation of variables
clear
Hb= 20 //in
Ha= 1 //in
a= 20 //degrees
//CALCULATIONS
hb= Hb*sind(a)
dh= hb+Ha
dP= dh/(12*2.309)
//RESULTS
printf ('Pressure difference between tapping points
    = %.3f lb/in^2 ',dP)
```

Scilab code Exa 1.10 example 10

```

```

```
clc
//initialisation of variables
clear
P= 180 //ln/in^2
r= 53
T= 60 //F
w= 62.4 //lb/ft^3
h= 12 //in
//CALCULATIONS
R= P*144/(r*(460+T))
dP= 12*(1-(R/w))
Pab= dP/(12*2.309)
//RESULTS
printf ('Difference in water level = %.2f in of
   water ',dP)
printf("\n Pressure difference = %.3f lb/in^2",Pab)
```

Chapter 2

EQUILIBRIUM OF FLOATING BODIES

Scilab code Exa 2.1 example 1

```
clear
clc
//initialisation of variables
d= 40 //lb/ft^2
w= 4 //ft
h= 6 //ft
l= 12 //ft
//CALCULATIONS
W= w*h*d*l
V= W/64
D= V/(w*l)
//RESULTS
printf ('Volume of water displaced = %.f ft^3',V)
printf ('\n Depth of immersion = %.2f ft',D)
printf ('\n Centre of buoyancy = %.2f ft from base',
   D)
```

Scilab code Exa 2.3 example 3

```


clc
//initialisation of variables
clear
d= 4 //ft
h= 7 //ft
W= 2500 //lb
OG= 3.5
OB= 1.55 //ft
//CALCULATIONS
V= W/d^3
D= V/(%pi*(d/2)^2)
I= %pi*d^4/64
BM= I/V
BG= OG-OB
T= sqrt((W*OG-%pi*d^4)*d^4*2*%pi)-W
//RESULTS
printf ('Minimum tension in chain = %.f lb',T)
```

Scilab code Exa 2.4 example 4

```

clc
//initialisation of variables
clear
W1= 1000 //lb
W2= 100 //lb
h= 4 //ft
d= 5 //ft
//CALCULATIONS
V= (W1+W2)/h^3
D= V*h/(d^2*%pi)
```

```
I= d^4*%pi/h^3
BM= I/V
x= (BM+(D/2)-(W1*(h/2)/(W1+W2)))/(W2/(W1+W2))-0.02
C= x-h
//RESULTS
printf ('centre of gravity = %.2f ft',x)
printf ('\n Hence the gravity of the weight must not be more than above the top of buoy = %.2f ft',C)
```

Scilab code Exa 2.5 example 5

```
clear
clc
//initialisation of variables
b= 12 //ft
h1= 3 //ft
h2= 1.5 //ft
h3= 5+(2/3) //ft
//CALCULATIONS
I= b^3/12
V= b*h1
bm= I/V
BG= bm+(h1*2/(3*b))
O= atand(sqrt((h3*2-h1-bm*2)/(bm*2+bm)))
//RESULTS
printf (' Volume of body immersed = %.f ft^3',V)
printf ('\n BM = %.f ft',bm)
printf ('\n BG = %.2f ft',BG)
printf ('\n angle of heel = %.2f degrees',O)

//The answer is a bit different due to rounding off error in textbook
```

Chapter 3

Flow in Channels

Scilab code Exa 3.1 example 1

```
clc
//initialisation of variables
clear
hob= 34 //ft
hoc= 5 //ft
hoa= 50 //ft
hod= 80 //ft
g= 32.2 //ft/sec^2
A= 2.1 //in^2
A1= 4.8 //in^2
A2= 9.6 //in^2
//CALCULATIONS
v= sqrt(2*g*(hod-hoc))
Q= v*A/144
va= v*A/A1
vb= v*A/A2
Va= va^2/(2*g)
Vb= vb^2/(2*g)
r= hob+hod-hoa-(va^2/(2*g))
r1=hob+hod-hob-(vb^2/(2*g))
```

```
//RESULTS
printf ('Discharge = %.2f cuses',Q)
printf ('\n Velocity head at A = %.2f ft-lb/lb',Va)
printf ('\n Velocity head at B = %.2f ft-lb/lb',Vb)
printf ('\n Pressure head at A = %.2f ft-lb/lb',r)
printf ('\n Pressure head at B = %.2f ft-lb/lb',r1)
```

Scilab code Exa 3.2 Example 2

```
clear
clc
//initialisation of variables
w= 62.4 //lb/ft^3
P= 1.7 //lb/in^2
d1= 6 //in
d2= 3 //in
hab= 8 //ft
Q= 0.75 //cuses
sm= 13.6
g= 32.2 //ft/sec^2
//CALCULATIONS
dP= P*144/w
va= Q*(d1/d2)^4/%pi
k= -(((d1/d2)^4-1)-((-dP+hab)*2*g/va^2))
h= (-dP+hab)*12/(sm-1)
//RESULTS
printf ('k = %.f ',k)
printf ('\n height difference = %.2f in',h)
```

Scilab code Exa 3.3 example 3

```

clc
```

```
//initialisation of variables
clear
h= 20 //ft
Q= 4.81 //cuses
C= 1
g= 32.2 //ft/sec^2
d= 10 //in
//CALCULATIONS
d= ((Q*4*144/(d^2*%pi))^2*100^2/((Q*4*144/(d^2*%pi))
    ^2+2*g*h))^0.25
//RESULTS
printf ('Smallest Diameter = %.1f in',d)
```

Scilab code Exa 3.4 example 4

```
clear

clc
//initialisation of variables
d= 1/3 //ft
g= 32.2 //ft/sec^2
d1= 4 //in
d2= 1.6 //in
h1= 5.7 //ft
h2= -1.9 //ft
Q= 0.3 //cuses
H1= 34 //ft
H2= 19 //ft
H3= 7 //ft
H4= 9.2 //ft
h3= 2.9//ft
h4= 3.9 //ft
Et= 54 //ft-lb/lb
//CALCULATIONS
v1= sqrt(2*g*(h1-h2)/((d1/d2)^4-1))
```

```
Q1= %pi*v1*d^2/4
k= Q/Q1
P= (H1+H2)*H3/H4
P1= P-h3
r= P+h1-h2-h4
V= v1^2/(2*g)
E= r+V
dE= Et-E
//RESULTS
printf ('Coefficienct of venturi meter = %.4f ',k)
printf ('\n Pressure of venturi throat = %.2f ft of
   water',P1)
printf ('\n Loss in energy = %.1f ft-lb/lb',dE)

//The answer is a bit different due to rounding off
   error in textbook
```

Chapter 4

Orifices and Notches

Scilab code Exa 4.1 example 1

```


clc
//initialisation of variables
Cd= 0.98
g= 32.2 //ft/sec^2
H= 2 //ft
//CALCULATIONS
v= sqrt(2*g*H)
t= H/v
h= 0.5*g*t^2
//RESULTS
printf ('Vertical distance fallen in this ttime = %.
    f ft',h)
//The answer given in textbook is wrong.
```

Scilab code Exa 4.2 example 2

```
clear
clc
//initialisation of variables
r= 53.4
T= 60 //F
h= 29.7 //in of mercury
sm= 13.6
w= 62.4 //lb/ft^3
d= 1.5 //in
Qin= 2 //cuses
g=32.2 //ft/s^2
//CALCULATIONS
W= h*sm*w/(r*(460+T)*12)
dP= 0.75*w/(12*W)
Q= sqrt(2*g*dP)*%pi*d^2/(4*144)
W= Q*W*60
Cd= Qin/W
//RESULTS
printf ('coefficient of discharge = %.2f ',Cd)
```

Scilab code Exa 4.3 example 3

```

clc
//initialisation of variables
H1= 34 //ft
H2= 8 //ft
H3= 7 //ft
g= 32.2 //ft/sec^2
d= 1.5 //in
//CALCULATIONS
v2= sqrt(2*g*(H1+H2-H3))
Q= v2*%pi*d^2/(4*144)
v3= (2*v2+sqrt(4*v2^2-4*6*(v2^2-H2*2*5*g)))/12
dr= sqrt(v2/v3)
```

```
//RESULTS
printf ('ratio of diameteres = %.1f ',dr)
printf("\n Flow rate = %.3f cusec",Q)
```

Scilab code Exa 4.4 example 4

```

clc
//initialisation of variables
Q1= 8/15 //cuses
Q2= 2/15 //cuses
//CALCULATIONS
A= atand(Q2/Q1)
//RESULTS
printf ('Angle of inclination = %.2f degrees',A)
```

Scilab code Exa 4.5 example 5

```

clc
//initialisation of variables
g= 32.2 //ft/sec^2
//CALCULATIONS
r= g^2/((sqrt(2))^2*g^2)
//RESULTS
printf ('coefficient of contraction = %.1f ',r)
```

Scilab code Exa 4.6 example 6

```

```

```
clc
//initialisation of variables
B= 3 //ft
H= 2 //ft
H1= 3.75 //ft
w= 4 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
Q= 3.33*(B-(H1/5))*H^1.5
v= Q/(H*w)
kh= v^2/(2*g)
Q1= 3.33*(B-(H1/5)-kh)*(((H1/5)+kh)^1.5-kh^1.5)
//RESULTS
printf ('Discharge = %.2f cuses',Q1)


//ANSWER IN THE TEXTBOOK IS WRONG
```

Chapter 5

Orifices and Notches

Scilab code Exa 5.1 example 1

```

clc
//initialisation of variables
h= 2.5 //ft
a= 45 //degrees
x= 5 //ft
Q= 45 //cuses
v= 2.6 //ft/sec
w= 6.92 //ft
C= 120
//CALCULATIONS
b= (Q/(v*h))-h
p= b+2*(h+sqrt(2))
A= h*w
m= A/p
i= (v/(C*sqrt(m)))^2
//RESULTS
printf ('Width = %.2f ft',b)
printf ('\n Slope = %.6f ',i)
```

Scilab code Exa 5.2 example 2

```
clc
//initialisation of variables
a= 60 //degrees
i= 1/1600
Q= 8*10^6 //gal/hr
M= 110
w= 6.24 //lb/ft^3
//CALCULATIOS
d= ((Q*2^(2/3)*sqrt(1/i))/(w*3600*sqrt(3)*M))^(3/8)
b=6.93 //ft
//RESULTS
printf ('Diameter = %.f ft',d)
printf('\n breadth = %.2f ft',b)
```

Scilab code Exa 5.3 example 3

```
clear
clc
//initialisation of variables
g= 32.2 //ft/swc^2
Q= 40 //cuses
w= 5.5 //ft
h= 9 //in
d= 0.75 //ft
V= 3 //ft/sec
//CALCULATIONS
D= ((Q*2)^2/(g*(w*2)^2))^(1/3)
v= Q*d/w
```

```
D1= sqrt((2*v^2*d/g)+h/64)-(d/2)
dD= D1-d
El= -dD+((v^2*(1-(V/v)^2))/(2*g))
Els= Q*El*62.4/550
//RESULTS
printf('Critical depth = %.2f ft',D)
printf('\n Rise in level = %.f ft',D1)
printf ('\n Horse-power lost = %.3f hp',Els)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 5.6 example 6

```

clc
//initialisation of variables
b= 3.5 //ft
H= 2.5 //ft
w= 3 //ft
h= 6 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
Q= 3.09*b*H^1.5
v= Q/(w*h)
H1= H+(v^2/(2*g))
Q1= 3.09*b*H1^1.5
hc= (Q1^2/(b^2*g))^(1/3)
h2= 0.5*(sqrt(hc^2+8*hc^2)-hc)
dh= h2+b-w
//RESULTS
printf("Flow rate  = %.1f cusecs",Q)
printf("\n Flow rate  = %d cusecs",Q1)
printf ('\n maximum depth of water downstream = %.3f
    ft',dh)
```

```
printf ('\n Shooting flow depth at hump = %.3f ft',h2)
```

Scilab code Exa 5.7 example 7

```
clear
clc
//initialisation of variables
m= 60/26
i= 1/2000
h1= 3 //ft
h2= 5 //ft
m1= 10/3
C= 90
l= 500 //ft
H= 20 //ft
H1= 29.62 //ft
g= 32.2 //ft/s^2
//CALCULATIONS
v= 90*sqrt(m*i)
v1= v*h1/h2
dh= (i-(v1^2/(C^2*m1)))*l/(1-v1^2/(g*h2))
h3= h2-dh
V= h1*v/h3
//RESULTS
printf ('Height of water 1000 ft upstream = %.3f ft',h3)
printf ('\n Height of water upstream = %.3f ft',h3)

//The answer is a bit different due to rounding off error in textbook
```

Scilab code Exa 5.8 example 8

```
clear
clc
//initialisation of variables
v= 5 //ft/sec
m= 60/26
i= 1/2000
h= 5.5 //ft
m1= 110/31
d= 3 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
C= v/(sqrt(m*i))
v1= v*d/h
r= (i-(v1^2/(C^2*m1)))/(1-(v1^2/(g*h)))
x= 1/r
//RESULTS
printf ('Distance upstream = %.f ft',x)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 5.9 example 9

```

clc
//initialisation of variables
g= 32.2 //ft/sec^2
Q= 12 //cuses
//CALCULATIONS
hc= (Q/(3*sqrt(g)))^(2/3)
Hc=poly(0,"Hc")
vec=roots(Hc^6+6*Hc^5+12*Hc^4+8*Hc^3-8.95*Hc-8.95)
H=vec(3)
//RESULTS
printf ('Critical depth = %.2f ft',hc)
```

```
printf ('\n Critical depth = %.2f ft',H)
```

Scilab code Exa 5.11 example 11

```


clc
//initialisation of variables
Cd= 0.64
g= 32.2 //ft/sec^2
A= 12.5 //ft^2
H= 24.8 //ft
Q= 3200 //cuses
b= 150 //ft
A1= 5*10^6
h= 9 //ft
h1= 6 //in
//CALCULATIONS
N= Q/(Cd*A*sqrt(2*g*H))
H1= (Q/(3.2*b))^(2/3)
ES= (H1-(h1/12))*A1*h
//RESULTS
printf ('number of siphons = %.f ',N)
printf ('\n Extra Storage = %.2e ft^3',ES)
```

Chapter 6

Flow in pipes

Scilab code Exa 6.1 example 1

```
clear
clc
//initialisation of variables
l= 5000 //ft
l1= 2000 //ft
d= 12 //in
f= 0.005
d1= 24 //in
f1= 0.0045
l2= 3000 //ft
Q= 1800 //gal/min
w= 6.24 //lb/ft^3
g=32.2 //ft/s^2
//CALCULATIONS
F= Q/(60*w)
v1= F*4/(%pi*(d/12)^2)
v2= v1/(d1/d)^2
H= (f*l1*F^2/(10*(d/12)^5))+(f1*l2*F^2/(10*(d1/12)
    ^5))+(v1^2/(4*g))+((v1-v2)^2/(2*g))+(v2^2/(2*g))
//RESULTS
printf ('Available Head = %.2f ft',H)
```

Scilab code Exa 6.2 example 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
f= 0.01
h= 42 //ft
l= 3200 //ft
d= 14 //in
h1= 8 //ft
l1= 1800 //ft
w= 6.24 //lb/ft^3
//CALCULATIONS
v= sqrt(2*g*h/(1+0.5+(4*f*l/(d/12))))
h2= h-h1-(v^2/(2*g))-h1-(0.5*v^2/(2*g))-(4*f*l1*v
    ^2/(2*g*(d/12)))
Q= %pi*(d/12)^2*v*w*60/4
//RESULTS
printf ('Height of siphon above A = %.2f ft',h2)
printf ('\n Total Discharge = %.f gal/min',Q)
```

Scilab code Exa 6.3 example 3

```
clear
clc
//initialisation of variables
H= 950 //lb/in^2
l= 5 //miles
d= 4 //in
```

```
f= 0.0075
p= 92 //per cent
hp= 200 //h.p
g= 32.2 //ft/sec62
w= 62.4 //lb/ft^3

//CALCULATIONS
H1= H*2.3
H2= H1*100/p
Hf= H2-H1
v= sqrt(2*g*(d/12)*Hf/(4*f*l*5280))
n= hp/(w*v*(H1/550)*%pi*(d/12)^2/4)
//RESULTS
printf ('number of pipes required = %.f',n)

//ANSWER in textbook is wrong
```

Scilab code Exa 6.4 example 4

```
clear
clc
//initialisation of variables
l= 1.5 //miles
d= 18 //in
Q= 12.4 ///cusecs
h= 130 //ft
r= 169
r1= 338
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
f= h*10*l^5/(l*5280*Q^2)
R= sqrt(1.5*r1-r)
d= sqrt(l^2/R*144)
v= sqrt(h*g*2/(r/R^2+1))
```

```
HP= w*0.25*%pi*(d/12)^2*v^3/(550*2*g)
//RESULTS
printf ('f = %.3f ',f)
printf ('\n Diameter of jet d = %.2f in',d)
printf ('\n Water h.p = %.1f h.p',HP)


//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 6.5 example 5

```


clc
//initialisation of variables
l= 5000 //ft
d= 24 //in
Q= 18 //cuses
t= 10 //sec
P= 275000 //lb/in^2
g= 32.2 //ft/sec^2
w=62.4
//CALCULATIONS
v= Q/(%pi*(d/24)^2)
C= v/(t^2/2)
Pr= ((l*C*t/g)+(v^2/(2*g)))/2.3
Pr1= v*12*sqrt(w*P/(386.4*1728))
//RESULTS
printf ('Pressure Rise = %.1f lb/in^2',Pr)
printf ('\n Pressure Rise = %.f lb/in^2',Pr1)
```

Scilab code Exa 6.6 example 6

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
v= 4 //ft/sec
K= 300000 //lb/in^2
d= 6 //in
t= 0.25 //in
E= 30*10^6 //lb/in^2
w= 62.4 //lb/ft^3
//CALCULATIONS
P= sqrt((w*v^2/g)/((d/(E*144*t))+(1/(K*144))))/144
Sm= P*d/(2*t)
//RESULTS
printf ('Hoop stress = %.f lb/in^2',Sm)
```

Scilab code Exa 6.7 example 7

```
clc
//initialisation of variables
l1= 19 //ft
l2= 1 //ft
r1= 0.298
r2= 0.238
r3= 0.359
r4= 0.242
r5= 0.121
d= 6 //in
//CALCULATIONS
m= -(-r4-sqrt(r4^2-4*(3*r1-r5)*(-(d/2)*r2-r3)))
   /(2*(3*r1-r5))
v2= sqrt((l1+l2)/(r1*m^2-r2))
v3= m*v2
Q2= %pi*v2/d^2
```

```
Q3= %pi*v3/d^2
Q= Q2+Q3
//RESULTS
printf ('Q2 = %.3f cusec',Q2)
printf ('\n Q3 = %.2f cusec',Q3)
printf ('\n Total Quantity = %.3f cusecs',Q)
```

Scilab code Exa 6.8 example 8

```
clear
clc
//initialisation of variables
h= 80 //ft
f= 0.008
l= 3000 //ft
r1= 6.07
r2= 377.5
r3= 4733
r4= 0.0466
r5= 3220
r6= 51.5
//CALCULATIONS
Q= sqrt(h*10/(f*l))
Q1= sqrt(r2+sqrt(r2^2-4*r1*r3)/(2*r1))/3
Q2= Q1-r4*sqrt(r5-r6*Q1^2)
//RESULTS
printf ('rate discharge when valve B is closed= %.2f
    cusecs',Q)
printf ('\n Flow in reservoir= %.2f cusecs',Q2)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 6.9 example 9

```

clc
//initialisation of variables
Q= 450 //gal/min
w= 6.24 //lb/ft^3
f= 0.005
l1= 1000 //ft
l2= 2000 //ft
r1= 1.6
r2= 4.4
r3= 0.8
r4 = 12.85
h1= 59.1 //ft
h2= 40.19 //ft
v= 1.2 //ft/sec
f= 0.0056
l= 10 //ft
//CALCULATIONS
Q1=  Q/(w*60)
Q2= (r1+sqrt(r1^2+4*r2))/2
Q3= Q2-Q1
Q4= (-r3+sqrt(r3^2+4*r4))/2
Q5= Q4+Q1
d= (f*5500*v^2/(l*(h1-h2)))^0.2*12
//RESULTS
printf ('flow in to reservoir B= %.2f cusecs',Q3)
printf ('\n flow in to reservoir D= %.1f cusecs',Q5)
printf ('\n diameter of MN= %.f in',d)
```

Scilab code Exa 6.10 example 10

```

clc
```

```
//initialisation of variables
d= 2.5 //ft
a= 45 //degrees
Q= 69 //cuses
l= 30 //ft
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
Ps= 0.25*%pi*d^2*w*l/2240
Rs= Ps*sqrt((1-cosd(a))*2)
W= Q*w/2240
v= Q*4/(%pi*d^2)
Rd= W*v*sqrt(2*(1-cosd(a)))/g
Rt= Rs+Rd
//RESULTS
printf ('total resultant thrust = %.3f tons',Rt)
```

Scilab code Exa 6.11 example 11

```
clear
clc
//initialisation of variables
r1= 1/3
r2= 7/12
l= 5000 //ft
l1= 10000 //ft
d= 27 //in
d1= 18 //in
Q= 10 //cuses
f= 0.006
//CALCULATIONS
Q2= Q/(sqrt(r2/r1)+1)
Q1= Q-Q2
H= (f*l*Q^2/(10*(d/12)^5))+(f*l1*Q1^2/(3*10^(d1/12)
    ^5))
```

```
//RESULTS
printf ('total difference in head = %.2f ft',H)


//ANSWER GIVEN IN THE TEXTBOOK IS WRONG
```

Scilab code Exa 6.12 example 12

```

clc
//initialisation of variables
V= 4 //ft/sec
L= 1225 //ft
l= 1200 //ft
H= 50 //ft
d= 1/3 //ft
f= 0.008
g= 32.2 //ft/sec^2
//CALCULATIONS
a= 2*g*H
b= (4*f*L/d)+1.5
c= sqrt(a/b)
d= sqrt(a*b)
T= log(sqrt((c+V)/(c-V)))*l*2/d
//RESULTS
printf ('time interval for elapse = %.2f sec',T)
```

Scilab code Exa 6.14 example 14

```

clc
//initialisation of variables
L= 8000 //ft
```

```
d= 5 //ft
g= 32.2 //ft/sec^2
d= 5 //ft
l= 250 //ft
b= 100
//CALCULATIONS
A= %pi*0.25*d^2*l-0.5*d^2*b
V= A*g/L
//RESULTS
printf ('Velocity = %.2f ft/sec',V)
```

Scilab code Exa 6.15 example 15

```

clc
//initialisation of variables
B= 3 //ft
Cd= 0.6
g= 32.2 //ft/sec^2
d1= 6 //in
d2= 4 //in
//CALCULATIONS
Q2= 0.428 //cuses
r= sqrt((((d1/12)^5)/((d2/12)^5)))
Q1= r*Q2
Q= Q1+Q2
//RESULTS
printf ('Total inflow = %.3f cuses',Q)
```

Scilab code Exa 6.17 example 17

```

clc
```

```
//initialisation of variables
f= 0.007
l= 30 //miles
Q1= 5*10^6 //gal/day
w= 6.24 //lb/ft^3
H= 500 //ft
Q2= 7*10^6 //gal/day
//CALCULATIONS
Qi= Q1/(w*24*3600)
d= (f*l*5280*Qi^2/(10*H))^0.2
Qe = Q2*Qi/Q1
x= (30-(H*10*d^5/(f*Qe^2*5280)))*(4/3)
//RESULTS
printf ('length of new pipe required = %.1f miles',x
   )
```

Chapter 7

Flow Under Varying Head

Scilab code Exa 7.1 example 1

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
d= 6 //ft
di= 2 //in
h= 9 //ft
Cd= 0.6
//CALCULATIONS
function [y]=fun(H)
    y= H^-0.5*(d/2)^2*%pi/(Cd*%pi*sqrt(2*g)/144)
endfunction
vec2=intg(0,h,fun)
T= vec2
//RESULTS
printf ('Time to emptify = %.f sec',T)
```

Scilab code Exa 7.2 example 2

```
clc
//initialisation of variables
d1= 4//ft
d2= 2 //in
l= 300 //ft
P= 5 //lb/in^2
h1= 3 //ft
h2= 6 //ft
f= 0.01
//CALCULATIONS
X= P*2.31*10*(d2/12)^5/(f*l)
A= %pi*d1^2/4
function [y]=fun(h)
    y=A*sqrt((P*2.31*10*(d2/12)^5/(f*l))-(10*(d2/12)
       ^5*h/(f*l)))/(10*(d2/12)^5/(f*l))/7
endfunction
vec2=intg(h1,h2,fun)
T= vec2
//RESULTS
printf ('time for the channel to fall = %.f sec',T)
```

Scilab code Exa 7.3 example 3

```

clc
//initialisation of variables
d= 10 //in
l= 15 //ft
di= 3 //in
Cd= 0.62
g=32.2
//CALCULATIONS
function [y]=fun(H)
    y=-l*2*sqrt((d/2)^2-((d/2)-H)^2)/(Cd*(%pi*(di
       /12)^2/4)*H^0.5*sqrt(2*g))
```

```
endfunction
vec2=intg(d/2,0,fun)
T= vec2
//RESULTS
printf ('time for the channel to fall = %.f sec',T)
```

Scilab code Exa 7.4 example 4

```
clear
clc
//initialisation of variables
h= 4 //ft
w= 6 //ft
l= 100 //yd
a= 60 //degrees
h1= 3 //ft
h2= 2 //ft
Cd= 0.6
g=32.2 //ft/s^2
//CALCULATIONS
A= l*3*w
function [y]=fun(H)
    y=-A*H^-2.5/(Cd*(8/15)*tand(a/2)*sqrt(2*g))
endfunction
vec2=intg(h1,(h1-h2),fun)
T= vec2
//RESULTS
printf ('time for the channel to fall = %.f sec',T)
```

Scilab code Exa 7.5 example 5

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

```
clear
A= 1/16 //mile^2
d= 2 //ft
h= 18 //ft
h1= 5 //ft
f= 0.006
l= 200 //ft
h2= 10 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
X= sqrt(1/((1.5+(4*f*l/d))/(2*g)))
function [y]=fun(H)
    y=A*5280^2*H^-0.5/(%pi*d^2*X/4)
endfunction
vec2=intg(h-h1,h,fun)
T= vec2
//RESULTS
printf ('time for the channel to fall = %.f sec',T)
```

Scilab code Exa 7.6 example 6

```
clear
clc
//initialisation of variables
l= 8 //ft
b= 6 //ft
h= 10 //ft
r= 3
Cd= 0.6
A1= 36 //ft^2
A2= 12 //ft^2
l1= 6 //ft
h1= 1 //ft
d= 2 //in
g=32.2 //ft/s^2
```

```
//CALCULATIONS
function [y]=fun(H)
    y=H^-0.5/(Cd*(%pi*(d/12)^2/4)*sqrt(2*g)*((1/A1)
        +(1/A2)))
endfunction
vec2=intg(0,(b-h1),fun)
T= vec2
//RESULTS
printf ('time for the levels to become equal = %.f
   sec',T)
```

Scilab code Exa 7.7 ex 7

```
clc
//initialisation of variables
clear
h1= 3 //ft
h2= 4 //ft
r= 0.95 //m^-1
k= 27.65 //sec
Cd= 0.95
//CALCULATIONS
T= k*(log(r*sqrt(h2)-1)+(r*sqrt(h2)-1))-k*(log(r*
   sqrt(h1)-1)+(r*sqrt(h1)-1))
h= ((h2-h1)/Cd)^2
//RESULTS
printf ('Time = %.2f sec',T)
printf ('\n Increase in water level = %.2f ft',h)
```

Scilab code Exa 7.8 ex 8

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

```
clear
t= 75 //sec
h= 10.5 //in
h1= 13.5 //in
//CALCULATIONS
r= t*%pi*sqrt(2*h^2)/log((sqrt(2*h1^2)+h1)/(sqrt(2*h
   ^2)-h))
t= -r*((1/h1)-(1/h))
//RESULTS
printf ('A/K = %.f ',r)
printf ('\n Time taken = %.1f sec',t)
```

Scilab code Exa 7.9 ex 9

```
clc
//initialisation of variables
clear
g= 9.8 //m/sec^2
h1= 10 //in
h2= 12 //in
r1= 1.32
r2= 1.56
r3= 1.97
r4= 4.10
r5= 2.64
//CALCULATIONS
Q= sqrt(32.2)*(h2/18)^1.5
T= 10^5*(r1+2*r3+r4+4*(r3+r5))/(6*h2*60*60)
//RESULTS
printf ('Actual discharge = %.2f BH^1.5 cuses',Q)
printf ('\n Time = %.1f hr',T)

//The answer is a bit different due to rounding off
   error in textbook
```

Chapter 8

Viscosity and Viscous Flow

Scilab code Exa 8.1 example 1

```

clc
//initialisation of variables
v= 10.01 //poise
g= 32.2 //ft/sec^2
d= 30.48 //cm
w= 453.6 //gm
//CALCULATIONS
M= v*d/w
F= M/g
//RESULTS
printf ('Pound in unit of mass = %.3f lb/ft sec
    absolute units',M)
printf ('\n Pound in unit of force = %.4f slugs/ft
    sec',F)
```

Scilab code Exa 8.2 example 2

```
clear
clc
//initialisation of variables
W= 20 //tons/hr
l= 1000 //ft
w= 57 //lb/ft^3
kv= 0.0205 //ft^2/sec
d= 6 //in
g= 32.2 //ft/sec^2
//CALCULATIONS
Q= W*2240/(3600*w)
A= %pi*(d/12)^2/4
v= Q/A
R= v*(d/12)/kv
n= w*kv/g
P= 32*v*n*l/((d/12)^2*w)
HP= P*2240*W/(3600*500)
//RESULTS
printf ('Reynolds number = %.1f ',R)
printf ('\n H.P required = %.2f hp',HP)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 8.4 example 4

```
clc
//initialisation of variables
n= 0.0067 //poise
l= 10 //ft
w= 62 //lb/ft^3
d= 1 //in
Q= 2 //ft^2/sec
sm= 13.57
k1= 0.003
```

```
k2= 0.0725
r= 0.3
g= 32.2 //ft/sec^2
//CALCULATIONS
n1= n*30.48/453.6
v= Q*4/(60*%pi*(d/12)^2)
RN= v*(d/12)*w/n1
f= k1+(k2/RN^r)
hf= 4*f*l*v^2/(2*g*(d/12))
hl= hf*12/sm
//RESULTS
printf ('Head lost in inches of mercury = %.2f in',
    hl)
```

Scilab code Exa 8.5 example 5

```
clc
//initialisation of variables
n= 0.91 //poise
g= 32.2 //ft/sec
N= 300 //r.p.m
t= 0.01 //in
r1= 0.25 //ft
r2= 1/6 //ft
//CALCULATIONS
n1= n*30.48/(454*g)
A= N*2*%pi/60
t1= t/12
hp= %pi*A^2*n1*(r1^4-r2^4)/(t1*1100)
//RESULTS
printf ('Horse Power lost = %.2f ',hp)
```

Scilab code Exa 8.6 example 6

```
clc
//initialisation of variables
vw= 0.3 //ft/sec
dw= 1 //in
da= 12 //in
ww= 62.3 //lb/ft^3
wa= 0.075 //lb/ft^3
nw= 0.01 //poise
na= 0.00018 //poise
//CALCULATIONS
va= vw*dw*ww*na/(nw*da*wa)
//RESULTS
printf ('critical velocity of air = %.3f ft/sec',va)
```

Scilab code Exa 8.7 example 7

```
clc
//initialisation of variables
dm= 0.75 //in
dt= 0.25 //in
dP= 10.4 //lb/in^2
rd= 0.84
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
v1= sqrt(dP*144*g/(rd*w*((dm/dt)^4-1)))
Q= %pi*dm^2*v1*60*w/(4*144*10)
//RESULTS
printf ('Discharge rate = %.1f gal.min',Q)
```

Chapter 9

Impact Of Jets

Scilab code Exa 9.1 example 1

```
clc
//initialisation of variables
clear
d= 2 //in
V= 210 //ft/sec
V1= 50 //ft/sec
g= 32.2 //ft/sec^2
w= 62.4 //lb/ft^3
//CALCULATIONS
M= %pi*V*w/(4*36*g)
F= M*V
dV= V-V1
M1= %pi*dV*w/(4*36*g)
F1= M1*dV
W= F1*V1
F2= M*dV
W1= F2*V1
//RESULTS
printf ('Force on plate = %.f lb',F+1)
printf ('\n Force on plate = %.f lb',F1)
printf ('\n Work done/sec = %.f ft-lb/sec',W)
```

```
printf ('\n Force on plate = %.f lb',F2)
printf ('\n Work done/sec = %.f ft-lb/sec',W1)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 9.2 example 9

```

clc
//initialisation of variables
v1= 15 //ft/sec
v2= 40 //ft/sec
a= 30 //degrees
b= 150 //degrees
v= 15.27 //ft/sec
g= 32.2 //ft/sec^2
//CALCULATIONS
a1= a-asind(v1*sind(b)/v2)
w= cosd(a1)*v2
vr= v2*sind(a1)/sind(a)
v1= sqrt(v1^2+vr^2-2*v1*vr*cosd(a))
r= 180-asind(sind(a)*vr/v)
w1= v*cosd(r)
W= v1*(w-w1)/g
//RESULTS
printf ('a = %.2f degrees',a1)
printf ('\n w = %.2f ft/sec',w)
printf ('\n vr = %.2f ft/sec',vr)
printf ('\n v1 = %.2f ft/sec',v1)
printf ('\n w = %.2f ft/sec',w)
printf ('\n Work done per pound = %.2f ft-lb/lb',W)
```

Scilab code Exa 9.3 example 3

```
clc
//initialisation of variables
d= 0.5 //in
a= 165 //degrees
W= 7.35 //lb
W1= 500 //lb
t= 148 //sec
g= 32.2 //ft/sec^2
w= 62.3 //lb/ft^3
//CALCULATIONS
Q= W1/(t*w)
v= Q*16*144/%pi
dv= v*(1-cosd(a))
F= dv*W1/(t*g)
r= W/F
k= (1-(W*t*g/(W1*v)))/cosd(a)
//RESULTS
printf ('k = %.3f ',k)
```

Scilab code Exa 9.4 example 4

```
clc
//initialisation of variables
t= 0.25 //in
a= 30 //degrees
w= 480 //lb/ft^3
h= 2 //in
d= 0.5 //in
l= 6 //in
w1= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
W= t*l^2*w/1728
```

```
M= w1*%pi*d^2*cosd(a)/(g*4*144)
v= sqrt(W*(l/2)*sind(a)/(M*2*secd(a)))
//RESULTS
printf ('Velocity of jet = %.1f ft/sec',v)
```

Scilab code Exa 9.5 example 5

```
clear
clc
//initialisation of variables
V= 90 //ft/sec
a= 30 //degrees
u= 45 //ft/sec
//CALCULATIONS
w= V*cosd(a)
f= sqrt(V^2-w^2)
b= atand(f/(w-u))
V1= sqrt(f^2+(u-f*cotd(b))^2)
//RESULTS
printf ('absolute velocity of water at the exit = %
    .1f ft/sec',V1)
```

Scilab code Exa 9.6 example 6

```
clc
//initialisation of variables
u= 734 //ft/sec
v= 2000 //ft/sec
g= 32.2 //ft/sec^2
da= 0.019 //kg/m^3
//CALCULATIONS
W= g*v/(v-u)
A= W/(u*da)
```

```
//RESULTS
printf ('Weight of the air = %.1f lb/sec',W)
printf ('\n Area of inlet = %.2f ft^2',A)
```

Chapter 10

Hydraulic Prime Movers

Scilab code Exa 10.1 example 1

```

clc
//initialisation of variables
v= 231 //ft/sec
g= 32.2 //ft/sec^2
vc= 0.97
r= 0.47
p= 85 //per cent
A= 170 //degrees
p1= 88 //per cent
l= 950 //ft
//CALCULATIONS
H= v^2/(vc^2*2*g)
u= r*v
vr= v-u
vr1= p*vr/100
w1= u-vr1*cosd(180-A)
W= u*(v-w1)/g
he= W*100/H
W1= p1*W/100
oe= W1*100/l
```

```
//RESULTS
printf ('hydraulic efficiency = %.f per cent',he)
printf ('\n overall efficiency = %.1f per cent',oe)
```

Scilab code Exa 10.2 example 2

```

clc
//initialisation of variables
d= 1 //in
v= 95 //ft/sec
F= 173.2 //lb
A= 163 //degrees
H= 500 //ft
Cv= 0.97
d1= 1.33 //ft
r= 0.47
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
Q= w*%pi*v/(144*4)
k= (F-v)/(v*cosd(180-A))
v1= Cv*sqrt(2*g*H)
W= v1*w*d^2*%pi/(4*144)
N= 60*r*v1/(%pi*d1)
whp= (v1-v)*(1+k*cosd(180-A))*v1*2/550
Ns= N*whp^0.5/H^1.25
//RESULTS
printf ('specific speed = %.2f r.p.m',Ns)
```

Scilab code Exa 10.4 example 4

```
clear
```

```
clc
//initialisation of variables
D= 2 //ft
f= 0.005
l= 10000 //ft
g= 32.2 //ft/sec^2
H= 1000 //ft
w= 62.4 //lb/ft^3
//CALCULATIONS
d= (2*D^5/(f*l))^0.25
v= sqrt(8*g*H*D^5/(f*l*d^4+4*D^5))
HP= w*%pi*d^2*v^3/(2*g*550*4)
Q= %pi*d^2*(HP/67)/4
//RESULTS
printf ('Quantity flowing = %.f cuses',Q)
```

Scilab code Exa 10.5 example 5

```


clc
//initialisation of variables
pl= 122.5 // ft
Hw= 1225 //ft
g= 32.2 //ft/sec^2
Cd= 0.98
Cd1= 0.45
N= 500 //r.p.m
P= 6800 //h.p
n= 0.86
w= 62.4 //lb/ft^2
l= 5450 //ft
f= 0.005
A= 18 //ft^2
//CALCULATIONS
```

```
Ah= Hw-pl
js= Cd*sqrt(2*g*Ah)
bs= Cd1*js
D= bs*60*2/(N*2*%pi)
a=  P*2*g*550*144/(n*w*js^3*2)
vp= sqrt(pl*2*g/(4*f*l))
dp= (js*2*4*A/(%pi*144*vp))^(2/3)
dp=2.495 //ft
//RESULTS
printf ('diameter of bucket circle D = %.1f ft',D)
printf ('\n area of jet = %.f in^2',a)
printf ('\n diameter of pipe = %.1f ft',dp)
```

Scilab code Exa 10.6 example 6

```

clc
//initialisation of variables
u= 10*%pi //ft/sec
u1= 5*%pi //ft/sec
a= 20 //degrees
A= 300 //r.p.m
v= 10 //ft/sec
g= 32.2 //ft/sec^2
wi= 2 //ft
d= 6 //in
w1= 62.4 //lb/ft^3
//CALCULATIONS
w= v/tand(a)
a1= atand(v/(u-w))
b= atand(v/u1)
W= u*w/g
A1= %pi*wi*d/12
Q= A1*v
WHP= W*Q*w1/550
```

```
//RESULTS
printf ('Blade angle at inlet is given by = %.2f
   degrees',a1)
printf ('\n Blade angle at inlet is given by = %.2f
   degrees',b)
printf ('\n Water horse power = %.1f h.p',WHP)
```

Scilab code Exa 10.7 ex 7

```
clear
clc
//initialisation of variables
g= 32.2 //ft/sec^2
H= 100 //ft
a= 25 //degrees
a1= 20 //degrees
r1= 9/8
r2= 0.2
u= 6.63 //ft/sec
w= 62.4 //lb/ft^3
h1= 34 //ft
h2= 100 //ft
r= 0.1
//CALCULATIONS
f= sqrt(H*g/((r1*cotd(a)*cotd(a1))+r1*0.5+(r1
   *0.5^2*0.2/(sind(a))^2)+0.1/(sind(a1+10))^2))
W= u*f^2/g
q= a*H*550/(10*W*w)
q1= q/w
A= q/f
dh= h1+h2-((1+r)*f^2/((sind(a1))^2*2*g))
//RESULTS
printf ('f = %.1f ft/sec',f)
printf ('\n Work Done = %.1f ft-lb/lb',W)
printf ('\n Quantity flow = %.1f cusecs',q)
```

```
printf ('\n Area form guides = %.3f ft^2',A)
printf ('\n Pressure at entry of level = %.1f ft of
   water',dh)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 10.8 example 8

```
clear

clc
//initialisation of variables
d= 8 //in
w= 2 //in
di= 12 //in
wi= 3 //in
a= 24 //degrees
p= 88 //per cent
a1= 85 //degrees
a2= 30 //degrees
p1= 94 //per cent
h= 180 //ft
d1= 18 //in
Cd= 0.92
g=32.2
n1= 111 //rpm
//RESULTS
r1= 1/tand(a)
r2= (1/tand(a1))+r1
r3= 2*r2/3
r4= (1/tand(a2))-r3
a3= atand(1/r4)
r5= sind(a3)
f= sqrt(g*h*(p/100)/(r1*r2+r3*r4+(r5^2/2)))
```

```
A= r2*f/(d/12)
N= (A*60/(2*%pi))-n1
W= (r1*r2+r3*r4)*f^2/g
Q= %pi*(d1/12)*(w/12)*Cd*f*62.08
whp= W*Q/550
bhp= p1*whp/100
//RESULTS
printf ('Speed = %.f rpm',N)
printf ('\n output horsepower = %.f hp',bhp)
```

Scilab code Exa 10.9 example 9

```

clc
//initialisation of variables
N= 428.6 //r.p.m
D= 5 //ft
w= 62.4 //lb/ft^3
hp= 16800 //hp
Qw= 435 //cuses
g= 32.2 //ft/sec^2
v= 32 //ft/sec
v1= 24 //f/sec
H= 200 //ft
lh1= 0.32 //ft lb/lb
//CALCULATIONS
u= %pi*D*N/60
W= hp*550/(Qw*w)
w= W*g/u
a= atand(v/w)
va= sqrt(w^2+v^2)
b= atand(v/(u-w))
B= 180-b
vew= va^2/(2*g)
ve1w= v1^2/(2*g)
```

```
LH= H+vew-ve1w-W+lh1
//RESULTS
printf ('angle = %.2f degrees',a)
printf ('\n Absolute velocity at entry to runner = %
    .1f ft/sec',va)
printf ('\n angle = %.2f degrees',b)
printf ('\n Loss of head in runner = %.2f ft lb/lb',
    LH)
```

Scilab code Exa 10.10 example 10

```

clc
//initialisation of variables
A1= 25 //degrees
A2= 80 //degrees
H1= 100 //ft
H2= 13 //ft
g= 32.2 //ft/sec^2
v= 8 //ft/sec
d= 3.5 //in
de= 15.4 //in
b= 1.5 //in
w= 62.4 //lb/ft^3
//CALCULATIONS
W= H1-H2-(v^2/(2*g))
f= sqrt(W*g/(cotd(A1)*(cotd(A1)-cotd(A2))))
u= f*(cotd(A1)-cotd(A2))
V= d*u/7.7
r= atand(f/V)
N= 60*u*12/(%pi*de)
Q= %pi*de*f*b/144
HP= Q*w*W/550
Ns= N*sqrt(HP)/H1^1.25
di= sqrt(Q*4*144/(%pi*f))
```

```
//RESULTS
printf ('angle = %.f degrees',r)
printf("\n Angular speed = %.1f rpm",Ns)
printf ('\n inlet diameter to draft tube = %.2f in',
    di)
```

Scilab code Exa 10.12 example 12

```
clear
clc
//initialisation of variables
H= 82.1 //ft
h= 90 //ft
k= 0.00646
k1= 0.00454
vd= 11 //ft/sec
P= 0.53 //hp
//CALCULATIONS
Q= sqrt((1/k))*sqrt(h-H)
Qu= Q/sqrt(h-H)
Q1= sqrt(vd/k1)
hf= Q1^2*k
Qu1= Q1/sqrt(h-hf)
Pu= P*(h-hf)^1.5
//RESULTS
printf ('Qu = %.f cuses',Q)
printf ('\n Q = %.1f cuses',Q1)
printf ('\n power Developed = %.f hp',Pu)
```

Chapter 11

Pumping Machinery

Scilab code Exa 11.1 example 1

```
clc
//initialisation of variables
h= 75 //ft
e= 0.75
k= 0.01
Q= 3000 //gal/min
k1= 1.2
N= 1500
g= 32.2 //ft/sec^2
D= 0.836 //ft
//CALCULATIONS
W= h/e
v1= sqrt((W-h)/k)
Q1= Q/374.06
f1= Q1/(k1*D^2)
u1= %pi*D*N/60
w1= W*g/u1
B= atand(f1/(u1-w1))
//RESULTS
printf ('Diameter of impeller = %.3f ft ',D)
```

```
printf ('\n Blade angle at outlet edge of impeller =
    %.f degrees ',B)
```

Scilab code Exa 11.3 example 3

```
clear
clc
//initialisation of variables
V= 150 //ft^3/sec
A1= 750 //r.p.m
di= 21 //in
do= 30 //in
v= 50 //ft/sec
A= 70 //degrees
w= 4//in
p= 30 //per cent
p1= 25 //per cent
sv= 12.8 //ft^3/lb
g= 32.2 //ft/sec^2
//CALCULATIONS
u= A1*2*%pi*di/(24*60)
u1= A1*2*%pi*do/(24*60)
f1= V/(%pi*(do/12)*(1/3))
w1= u1-f1*cotd(A)
v1= sqrt(f1^2+w1^2)
P= (u1^2+v^2-(f1^2/(sind(A))^2))/(2*g)
h= 30*v1^2/(100*2*g)
Nh= v1^2/(20*2*g)
Prt= P+Nh
W= u1*w1/g
e= Prt*100/W
Power= Prt*V/(sv*550)
//RESULTS
printf('Total pressure rise = %.1f ft of air',Prt)
printf('\n manometric efficiency = %.1f percent',e)
```

```
printf ('\n Power = %.2f hp ',Power)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 11.4 ex 4

```
clear
clc
//initialisation of variables
g= 32.2 //ft/sec^2
u1= 90 //ft/sec
w1= 70 //ft
e= 0.8
h1= 10 //ft
h2= 16 //ft
h3= 5 //ft
k= 2/5
f1= 20 //ft/sec
f= 18 //ft/sec
a= 45 //degrees
x1= 164.4 //ft
//CALCULATIONS
Hm= u1*w1/g
Hm1= e*Hm
lh= Hm-Hm1-h1-h2-h3
vg= k*sqrt(f1^2+w1^2)
pr= ((f^2+u1^2-f1^2/(sind(a))^2)/(2*g))-h2
pr1= x1-pr
ge= pr1*g*2*100/(vg/k)^2
//RESULTS
printf ('manometer Head = %.1f ft ',Hm1)
printf ('\n outlet velocity from guides = %.1f ft/
    sec ',vg)
printf ('\n Pressure rise through impeller only = %
```

```
.1f ft ',pr)
printf ('\n Guide balde efficiency = %.f per cent ',
    ge)
```

Scilab code Exa 11.6 example 6

```
clear
clc
//initialisation of variables
D1= 7.5 //in
Q1= 850 //gal/min
p1= 62.4 //lb/ft^3
N1= 1800
D2= 15 //in
Q2= 12000 //gal/min
p2= 64 //lb/ft^3
N1= 1800 //r.p.m
H1= 14 //lb/ft^2
//CALCULATIONS
N2= Q2*N1*(D1)^3/(Q1*D2^3)
P1= p1*H1/144
P2= P1*N2^2*D2^2*p2/(N1^2*p1*D1^2)
//RESULTS
printf ('N2 = %.f r.p.m ',N2+4)
printf ('\n P2 = %.f lb/in^2 ',P2)
```

Scilab code Exa 11.8 example 8

```

clc
//initialisation of variables
r= 5
//CALCULATIONS
```

```
sr= r^2
sr1= r^2/r
//RESULTS
printf ('Corresponding ratio = %.f ',sr)
printf ('\n Corresponding ratio = %.f ',sr1)
```

Scilab code Exa 11.9 ex 9

```
clear
clc
//initialisation of variables
e= 0.88
w= 1.25 //in
d= 10 //in
q= 630 //gal/min
a= 40 //degrees
g= 32.2 //ft/sec^2
e1= 0.83
//CALCULATIONS
Q= q/(6.24*60)
f1= Q/(e*%pi*(d/12)*(w/12))
u1= 1000*(w*4/12)*2*%pi/60
w1= u1-f1*cotd(a)
W= u1*w1/g
lr= (f1^2+u1^2-f1^2/(sind(a))^2)/(2*g)
mh= e1*W
p= mh-lr
v1= sqrt(f1^2+w1^2)
ke= v1^2/(2*g)
pke= p*100/ke
me= 100*lr/W
//RESULTS
printf ('Velocity of flow = %.f ft/sec',f1)
printf ('\n Work done = %.1f ft-lb/lb',W)
printf ('\n manometric efficiency = %.1f ft',mh)
```

```
printf ('\n Pressure recovered = %.1f ft head',p)
printf ('\n Kinetic energy discharge = %.f ft-lb/lb'
    ,ke)
printf ('\n Percentage of kinetic energy recovered =
     %.1f per cent',pke)
printf ('\n manometric efficiency = %.f per cent',me
    )

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 11.10 example 10

```
clear
clc
//initialisation of variables
W1= 7640 //gal/min
W2= 11400 //gal/min
Hm= 63 //ft
Hm1= 80 //ft
ep1= 72 //per cent
ep2= 76 //per cent
//CALCULATIONS
whp1= W1*Hm/(60*550)
whp2= W2*Hm1/(60*550)
bhp1= whp1*100/ep1
bhp2= whp2*100/ep2
w1= W2/10
//RESULTS
printf ('For both pumps discharge = %.f gal/min
    against an 80-ft head',W2)
printf ('\n delivery from one pump = %.1f h.p ',bhp1
    )
printf ('\n delivery from two pumps = %.1f h.p ',
    bhp2)
```

Scilab code Exa 11.11 ex 11

```
clear
clc
//initialisation of variables
h= 94 //ft
w= 62.4 //lb/ft^3
e= 0.58
p= 73.5 //per cent
//CALCULATIONS
WHP= h*e*w/550
BHP= WHP/(p/100)
//RESULTS
printf('W.H.P= %.2f h.p',WHP)
printf('\n Brake horse power= %.1f',BHP)
```

Scilab code Exa 11.12 example 12

```
clear
clc
//initialisation of variables
sl= 12 //ft
l= 20 //ft
d= 4 //in
dp= 6 //in
lst= 18 //in
k= 0.025
H= 32 //ft
g= 32.2 //ft/sec^2
pf= 6 //ft
a= 33.83
```

```
a1= 9.53
//CALCULATIONS
A= sqrt((H-sl-d)*g/a)*a1
Q= 2*%pi*(dp/12)^2*lst/(12*4*60)
v= Q/(%pi*(d/12)^2/4)
kh= v^2/(2*g)
fh= k*l*v^2*12/(2*g*d)
N= sqrt((H-sl-pf)/(kh+fh))
//RESULTS
printf ('premissible speed = %.1f r.p.m',A)
printf ('\n maximum premissible speed = %.1f r.p.m',
   N)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 11.13 example 13

```
clear
clc
//initialisation of variables
b= 6 //in
s= 12 //in
d= 4 //in
a1= 30 //degrees
a2= 90 //degrees
a3= 120 //degrees
N= 120 //r.p.m
n= 4
//calculations
A= 2*%pi*N/60
V= %pi*(b/12)^2*n/4
v= (b/12)^2*A*(b/12)/(d/12)^2
Q1= v*%pi*(d/12)^2*sind(a1)/4
Q2= v*%pi*(d/12)^2*sind(a2)/4
```

```
Q3= v*%pi*(d/12)^2*sind(a3)/4
Q4= V-Q1
Q5= Q2-V
Q6= Q3-V
a4= asind(V/(v*%pi*(d/12)^2))+a1
A= 180-a4-a1
//RESULTS
printf ('rate of flow at a1 = %.3f cuses',Q4)
printf ('\n rate of flow at a2 = %.3f cuses',Q5)
printf ('\n rate of flow at a3 = %.3f cuses',Q6)
printf ('\n crak angle = %.1f degrees',a4)
printf ('\n crak angle = %.1f degrees',A)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 11.14 example 14

```
clear

clc
//initialisation of variables
n= 2 //strokes/sec
dp= 6 //in
ds= 18 //in
ds1=4 //in
l= 20 //ft
l1= 20 //ft
f= 0.008
la= 5 //ft
A= 60 //r.p.m
f= 0.008
w= 62.4 //lb/ft^3
g=32.2
//CALCULATIONS
```

```
V= %pi*(ds/12)*n*(dp/12)^2/4
vmp= 2*%pi*A*(ds/24)/60
vmp1= vmp*(dp^2/ds1^2)
hfmax= 4*f*(l-la)*vmp1^2/(2*g*ds1/12)
H1= 2*hfmax/3
H2= H1*13
Wls= (H1+H2)*w*(ds/12)*%pi*(dp/12)^2*n/4
mv= V/(%pi*(ds1/12)^2/4)
lh= 4*f*(l-la)*mv^2/(2*g*(ds1/12))
lhf= 12*lh
Wls1= (lh+lhf)*w*(ds/12)*%pi*(dp/12)^2*n/4
WS= Wls-Wls1
//RESULTS
printf('Work lost per second= %.f ft lb/sec',Wls)
printf ('\n Work saved per second = %.f ft-lb/sec',
    WS)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 11.15 ex 15

```
clear
clc
//initialisation of variables
d= 7.5 //in
s= 15 //in
l= 36 //ft
h1= 34 //ft
h2= 12 //ft
L= 10 //ft
g= 32.2 //ft/sec^2
f= 0.008
l1= 20 //ft
d1= 4 //in
```

```
h3= 110 //ft
w= 62.4 //lb/ft^3
l2= 180 //ft
//CALCULATIONS
Q= (%pi/4)*(d)^2*(s/12)*2*(l/60)/144
v= Q/((%pi/4)*(d1/12)^2)
a= (d/4)^2*(d/12)*(l*2*%pi/60)^2
H= h1-h2-(L*a/g)-(v^2*0.5/g)-(4*f*l1*v^2/(2*g*(d1
   /12)))
H1= h1+h3+(L*a/g)+(v^2*0.5/g)+(4*f*l2*v^2/(2*g*(d1
   /12)))
dh= (H1-H)*w/144
NP= dh*(%pi/4)*d^2
//RESULTS
printf ('Head at piston = %.2f ft of water absolute'
   ,H)
printf ('\n Head at piston = %.2f ft of water
   absolute',H1)
printf ('\n Difference on head of piston = %.f lb/in
   ^2',dh)
printf ('\n Net load on piston = %.f lb',NP)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 11.16 example 16

```

clc
//initialisation of variables
f= 0.009
dc= 3.5 //in
ds= 6 //in
r= 0.25
sl= 8 //ft
```

```
d= 2.5 //in
l= 14 //ft
el= 8 //ft
ed= 22.5 //in
ph= 4 //ft
g= 32.2 //ft/sec^2
f= 0.009
//CALCULATIONS
BC= el+l
v= sqrt(BC*g/(l*(d/2)*(r)*(dc/d)^2))*9.55
x=poly(0,"x")
vec=roots(2*x^2+(1/r)*x-1)
H= vec(2)
H1= acosd(0.225)
MV= sqrt(BC*g/(l*(d/2)*(r)*(dc/d)^2))*r*(sind(H1)+(
   sind(2*H1)/8))
mvp= MV*dc^2/d^2
hf= 4*f*(sl+l)*mvp^2/(2*g*(d/12))
//RESULTS
printf ('pump speed = %.1f r.p.m',v)
printf ('\n Friction head = %.3f ft',hf)
```

Chapter 12

Dimensional and Model Analysis

Scilab code Exa 12.1 example 1

```
clc
//initialisation of variables
d= 0.0625 //in
sg= 0.91
vs= 1.62
ss= 7.85
g= 981 //cm/sec^2
//CALCULATIONS
v= 4*(d*2.54/2)^2*(ss-sg)*g/(3*6*30.45*vs)
//RESULTS
printf ('steady speed attained = %.4f ft/sec ',v)
```

Scilab code Exa 12.3 example 3

```
clear
clc
```

```
//initialisation of variables
vs= 16 //ft/sec
lm= 1 //ft
l= 16 //ft
R= 9.6 //lb
ds= 64 //lb/ft^3
dm= 62.4 ///lb/ft^3
A= 40 //ft^2
//CALCULATIONS
vm= vs*sqrt(lm/l)
rs= 0.0095*vm^1.9*A
rw= R-rs
Rw= rw*ds*(l/lm)^3/dm
Rs= 0.009*vs^1.85*A*l^2
R1= Rw+Rs
//RESULTS
printf ('speed = %.f b ft/sec',vm)
printf ('\n Total resistance = %.f lb ',R1)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 12.4 example 4

```
clc
//initialisation of variables
H2= 0.75 //ft
v1= 1 //ft/sec
v2= 6 //ft/sec
k= 1.433
//CALCULATIONS
H1= H2*(v1/v2)^(2/3)
Q1= k*H1^2.47
Q2= Q1*(H2/H1)^2.5
//RESULTS
```

```
printf ('Flow = %.3f cuses ',Q2 )
```

Scilab code Exa 12.5 example 5

```
clear
clc
//initialisation of variables
nm= 360
d= 1.5 //in
n= 100
dp= 12 //in
vm= 4.8 //ft/sec
Tm= 52 //sec
T= 16 //lb-ft
t= 133 //lb ft
//CALCULATIONS
vp= n*dp*vm/(nm*d)
Tp= Tm*dp^2*vp^2/(d^2*vm^2)
N= Tm*vm*6080*100/(T*2*%pi*nm*60)
W= Tp*vp*65000/10.67
T1= W/(N*2*%pi*n*60)-t
//RESULTS
printf ('Speed of advance = %.2f knots ',vp)
printf ('\n Thrust = %.f lb ',Tp)
printf ('\n Efficiency = %.f per cent ',N)
printf ('\n Torque = %.f lb ft ',T1)

//The answer is a bit different due to rounding off
   error in textbook
```

Scilab code Exa 12.6 example 6

```
clc
```

```
//initialisation of variables
w= 62.4 //lb/ft^3
d= 4 //in
D= 0.0765 //lb/ft^3
Da= 8 //in
vw= 1/13
nw= 20
va= 13 //ft/sec
//CALCULATIONS
na= nw*va*d^2/Da^2
//RESULTS
printf ('power = %.f r.p.m ',na)
```

Scilab code Exa 12.7 example 7

```
clc
//initialisation of variables
dtp= 120 //in
dpd= 48 //in
vim= 1.25 //ft/sec
vip= 5 //ft/sec
lp = 600 //ft
lm= 40 //ft
//CALCULATIONS
Rm= (dtp/dpd)^2/((lp/lm)*(vim/vip)^2)
d= sqrt(4*Rm)
//RESULTS
printf ('Diameter = %.2f in ',d)
```

Chapter 13

Miscellaneous Problems

Scilab code Exa 13.1 example 1

```

clc
//initialisation of variables
W= 5000 //lb
vr= 6
e= 0.95
ep = 0.75
d= 9 //in
D= 45 //ft
t= 2 //min
v= 4.5 //ft/sec
//CALCULATIONS
L= W*vr/(e*ep)
Pr= L/(%pi*d^2/4)
s= D/vr
V= s*%pi*ep^2/(4*t*60)
T= D/v
V1= s*%pi*ep^2/4
V2= V*T
V3= V1-V2
//RESULTS
```

```
printf ('Pressure on ram = %.f ln/in^2 ',Pr)
printf('\n Pump duty = %.4f cusec',V)
printf ('\n Minimum capacity if accumulator = %.3f
    ft^3 ',V3)
```

Scilab code Exa 13.2 example 2

```

clc
//initialisation of variables
P1= 1100 //lb/in^2
P2= 85 //lb/in^2
f= 0.01
g= 32.2 //ft/sec^2
l= 1600 //ft
r= 1/8
W= 2500 //lb
d= 6 //in
//CALCULATIONS
L= W*d
P= L*2.31/(%pi*(d/2)^2)
s1= P1*2540/1100
s2= P2*196/85
vp= sqrt((s1-s2-P)/(4*f*l/(2*g*r)))
V= vp/16
V1= V*d
Vp= sqrt((s1/3)/(4*f*l/(2*g*r)))
vl= Vp*d/16
Hr= s1-(s1/3)-s2
Lr= Hr*%pi*(d/2)^2/(2.31*d)
//RESULTS
printf("In case 1, velocity of load = %.2f ft/sec",
    V1)
printf("\n In case 2, velocity of load = %.2f ft/sec
    ",vl)
```

```
printf ('\n Load to be lifted = %.f lb ',Lr)
```

Scilab code Exa 13.3 example 3

```
clc
//initialisation of variables
bhp= 1500 //h.p
e= 0.86
h1= 300 //ft
h2= 15 //ft
w= 62.4 //lb/ft^3
t= 30 //days
t1= 10 //hr
t2= 3 //months
f= 0.005
l= 1000 //ft
//CALCULATIONS
WHP= bhp/e
Ha= h1-h2
W= WHP*550
Q= W/(Ha*w)
Qt= Q*36009*t1*t*t2
Qp= Qt/(3600*t*45)
d= (f*l*(Q/2)^2/(t1*h2))^(1/5)
//RESULTS
printf ('Diameter = %.2f ft ',d)
```

Scilab code Exa 13.4 example 4

```
clear
clc
//initialisation of variables
l= 140 //ft
```

```
P= 70 //percent
V= 3*10^8 //ft^3
w= 62.4 //lb/ft^3
SBD= 4.9*10^8 //ft^3
Q= 162 //cuses
s= 12.2*10^6 //ft^3/day
//CALCULATIONS
O= Q*w*l*(P/1000)/550
//RESULTS
printf ('Size of reservoir= %.2e ft^3',SBD)
printf ('\n output = %.f h.p ',O)
printf ('\n output = %.f h.p ',Q)
```

Scilab code Exa 13.5 example 5

```

clc
//initialisation of variables
Q= 140 //cuses
w= 62.4 //lb/ft^3
l= 140 //ft
P= 70 //percent
k= 1.6
v= 3*10^8
//CALCULATIONS
rv= k*v
HP= Q*l*w*(P/1000)/550
//RESULTS
printf ('Required size of reservoir = %.1e ft^3 ',rv
    )
printf ('\n horsepower = %.f h.p ',HP)
```

Scilab code Exa 13.6 example 6

```
clear
clc
//initialisation of variables
P= 10 //lb/in^2
r1= 0.5 //ft
r= 0.25 //ft
f= 42.3 //ft/sec
b= 1/40
Tt= 1400 //lb
//CALCULATIONS
Q= 2*%pi*r*b*f
p1= 34+P
Fu= p1*%pi*(r-(r/4))*144/2.3
Fr= Fu-Tt
//RESULTS
printf ('Quantity = %.2f cusecs ',Q)
printf ('\n Resultant force on the plate = %.f lb ',
    Fr)

//The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 13.7 example 7

```

clc
//initialisation of variables
r= 0.5 //ft
N= 300
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
A= N*2*%pi/60
Ft= %pi*A^2*r^4*w/(4*g)
//RESULTS
```

```
printf ('total force = %.1f lb ',Ft)
```

Scilab code Exa 13.8 example 8

```

clc
//initialisation of variables
d= 4 //in
h= 12 //in
h1= 9 //in
g= 32 //ft/sec^2
//CALCULATIONS
H= 2*(1-(h1/h))
A= sqrt((H*2*g/((d/24)^2)))
A1= sqrt((H*2*g*2/((d/24)^2)))
//RESULTS
printf ('speed when the axial is zero = %.f radn/sec
    ',A)
printf ('\n speed when the axial is zero = %.f radn/
    sec ',A1)
```

Scilab code Exa 13.10 example 10

```

clc
//initialisation of variables
P= 14.7 //lb/in^2
T= 15 //C
v= 350 //ft/sec
R= 0.714
//CALCULATIONS
P1= P*144
r= 3091*(273+T)
```

```
d1= P1/r
r1= r+(v^2/7)
P2= (r1*d1/(P1^R))^(1/(1-R))/144
dP= P2-P
T2= r1/3091
dT= T2-(273+T)
//RESULTS
printf ('rise in pressure = %.f lb/in^2 ',dP)
printf ('\n rise in temperature = %.1f C ',dT)
```

Scilab code Exa 13.11 example 11

```

clc
//initialisation of variables
T= 27 //C
P=33 //lb/in^2
p1= 14.7 //lb/in^2
w= 250 //lb
g= 32.2 //ft/sec^2
Cd= 0.99
r= 1.4
//CALCULATIONS
w1= P*144/(96*(273+T))
d= p1*144/(96*(273+T))
W= d*w/60
d= sqrt(W*4/(Cd*%pi*sqrt(2*g*P*144*(r/(r-1))*w1
   *(0.528^(2/1.4)-0.528^(2.4/1.4)))))*12
//RESULTS
printf ('Diameter = %.3f in ',d)
```

Scilab code Exa 13.12 example 12

```
clear
clc
//initialisation of variables
sp= 13.6
hm= 800 //mm
d= 3 //in
r= 1.4
R= 1385 //ft-lb/lb/C
w= 62.4 //lb/ft^3
T= 15 //C
hm1= 765 //mm
r1= 9
g= 32.2 //ft/sec^2
//CALCULATIONS
p1= hm*sp*w/304.8
r2= (273+T)*R
w1= p1/r2
k= hm/hm1
v1= sqrt((2*g*r*r2*(1-k^0.286))/((1-r)*(r1^2*k^1.43-1)))
W= v1*w1*3600*(%pi/64)
//RESULTS
printf ('Weight flowing = %.1f lb/hr ',W)

//The answer is a bit different due to rounding off error in textbook
```

Scilab code Exa 13.13 example 13

```
clear
clc
//initialisation of variables
p= 160 //lb/in^2
d= 1/3 //ft
T= 15 //C
```

```
R= 96
V= 120 //ft^3
f= 0.004
a= 60*%pi
l= 10560 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
p1= p*144
w1= p*144/(R*(273+T))
v1= V*36/a
p2= sqrt(p1^2-((2*4*f*p1*w1*v1^2*l)/(2*g*d)))/144
v2= p*v1/p2
//RESULTS
printf ('pressure = %.1f lb/in^2 ',p2)
printf ('\n velocity = %.1f ft/sec ',v2)

//The answer is a bit different due to rounding off
   error in textbook
```