

Scilab Textbook Companion for
Problems In Hydraulics
by R. S. Paradise¹

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

HydroStatistics

Scilab code Exa 1.2 example 2

```
1 clear
2 clc
3 //initialisation of variables
4 w= 62.4 //lb/ft^3
5 A= 18 //ft^2
6 x= 6 //ft
7 kg= 6
8 y= 2 //ft
9 y1= 5 //ft
10 //CALCULATIONS
11 F= w*A*x
12 F1= F/2
13 Ft= (F*y-F1*(y1/2))/y1
14 Fb= F1-Ft
15 //RESULTS
16 printf ('Force exerted on the bolt = %.f lb ',F1)
17 printf ('\n Force exerted on the hinge = %.f lb ',Ft)
18 printf ('\n Force exerted on the bolt = %.f lb ',Fb)
```

Scilab code Exa 1.3 example 3

```
1 clear
2 clc
3 //initialisation of variables
4 h1= 11.54 //ft
5 h2= 16.33 //ft
6 w= 62.4 //lb/ft^3
7 x1= 7.69 //ft
8 x2= 14.09 //ft
9 x3= 18.23 //ft
10 //CALCULATIONS
11 Ft= w*h1^2/2
12 //RESULTS
13 printf ('h1 = %.2 f ft ',h1)
14 printf ('\n h2 = %.2 f ft ',h2)
15 printf ('\n h1+ = %.2 f ft ',x1)
16 printf ('\n h2+ = %.2 f ft ',x2)
17 printf ('\n h3+ = %.2 f ft ',x3)
18 printf ('\n Thrust force = %.f lb/ft run ',Ft)
```

Scilab code Exa 1.4 example 4

```
1
2
3
4 clc
5 //initialisation of variables
6 clear
7 spo= 0.9
8 h= 3 //ft
9 d= 2 //ft
10 w= 62.4 //lb/ft^3
11 H= 0.71 //ft
12 //CALCULATIONS
```

```

13 do= spo*w
14 de= w*d
15 bc= do*h
16 Pt= (bc*(h/2)+bc*d+de*(d/2))*(h+d)
17 y= (bc*(h/2)+bc*d+de*(d/2)*(d/3))*(h+d)/Pt+H
18 //RESULTS
19 printf("Total pressure = %d lb",Pt)
20 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

```

1
2
3 clc
4 //initialisation of variables
5 clear
6 a= 30 //degrees
7 b= 30 //degrees
8 h= 20 //ft
9 h1= 10 //ft
10 h2= 15 //ft
11 h3= 16 //ft
12 w= 62.4 //lb/ft^3
13 h4= 10/3 //ft
14 //CALCULATIONS
15 Rt= (1/h3)*((w*(h*h2^2*(h2/3)/(2*sqrt(3))))-(w*(h*h1
    ^2*h4/(2*sqrt(3))))))
16 R= ((w*(h*h2^2/(2*sqrt(3))))-(w*(h*h1^2/(2*sqrt(3))))
    ))
17 Rb= R-Rt
18 //RESULTS
19 printf ('Force at the hinge = %.f lb ',Rt)
20 printf ('\n Force at the hinge = %.f lb ',Rb)

```

21
22 //Round off error in textbook

Scilab code Exa 1.6 example 6

```
1
2
3
4 clc
5 //initialisation of variables
6 clear
7 x= 32 //ft
8 h= 60 //ft
9 w= 62.4 //lb/ft^3
10 AE= 20 //ft
11 //CALCULATIONS
12 Vabc= 2*x*h/3
13 vc= Vabc*w
14 Tab= w*h^2/2
15 Rt= sqrt(vc^2+Tab^2)/2240
16 A= atand(vc/Tab)
17 AD= x-AE+AE*cotd(A)
18 //RESULTS
19 printf("resultant thrust = %.1f tons",Rt)
20 printf("\n Angle = %.2f degrees",A)
21 printf (' \n AD = %.1f ft ',AD)
```

Scilab code Exa 1.7 example 7

```
1
2
3 clc
4 //initialisation of variables
```

```

5 clear
6 wdc= 3*sqrt(3) //ft
7 wdo= sqrt(3)
8 ac= 30 //degrees
9 ao= 60 //degrees
10 hob= 3 //ft
11 haf= 2.6 //ft
12 hfc= 3 //ft
13 w= 62.4 //lb/ft^3
14 V= 5.63 //ft^3
15 h= 4.3 //ft
16 y= 3.6 //ft
17 //CALCULATIONS
18 W1= wdc*hfc*w/2
19 Hbc= w*hob*(hob/2)
20 W2= V*w
21 W3= w*haf*h
22 Vt= W1+W2
23 Vht= Hbc+W3
24 Rt= sqrt(Vt^2+Vht^2)
25 A= atand(Vht/Vt)
26 x= (W1*(wdo-(hob/2))+Hbc*y)/Rt
27 OP= x/sind(A)
28 AP= hob+OP
29 //RESULTS
30 printf("Resultant thrust = %d lb",Rt)
31 printf("\n Angle = %.2f degrees ",A)
32 printf ('\n Distance from A till horizontal thrust =
        %.3f ft ',AP)

```

Scilab code Exa 1.8 example 8

```

1
2 clc
3 //initialisation of variables

```

```

4 clear
5 r= 96
6 T= 10.5 //C
7 K1= 288 //C
8 K2= 0.0015 //C^-1
9 h= 3000 //ft
10 P1= 14.69
11 //CALCULATIONS
12 P2= P1*10^(((1/(r*K2))*log10((K1-K2*h)/K1)))
13 w= P2*144/(r*(273+T))
14 //RESULTS
15 printf ('Density = %.4f lb/ft^3 ',w)

```

Scilab code Exa 1.9 example 9

```

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

```

Scilab code Exa 1.10 example 10

1

```
2
3 clc
4 //initialisation of variables
5 clear
6 P= 180 //lb/in^2
7 r= 53
8 T= 60 //F
9 w= 62.4 //lb/ft^3
10 h= 12 //in
11 //CALCULATIONS
12 R= P*144/(r*(460+T))
13 dP= 12*(1-(R/w))
14 Pab= dP/(12*2.309)
15 //RESULTS
16 printf ('Difference in water level = %.2f in of
    water ',dP)
17 printf("\n Pressure difference = %.3f lb/in^2",Pab)
```

Chapter 2

EQUILIBRIUM OF FLOATING BODIES

Scilab code Exa 2.1 example 1

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

Scilab code Exa 2.3 example 3

```
1
2
3 clc
4 //initialisation of variables
5 clear
6 d= 4 //ft
7 h= 7 //ft
8 W= 2500 //lb
9 OG= 3.5
10 OB= 1.55 //ft
11 //CALCULATIONS
12 V= W/d^3
13 D= V/(%pi*(d/2)^2)
14 I= %pi*d^4/64
15 BM= I/V
16 BG= OG-OB
17 T= sqrt((W*OG-%pi*d^4)*d^4*2*%pi)-W
18 //RESULTS
19 printf ('Minimum tension in chain = %.f lb',T)
```

Scilab code Exa 2.4 example 4

```
1
2 clc
3 //initialisation of variables
4 clear
5 W1= 1000 //lb
6 W2= 100 //lb
7 h= 4 //ft
8 d= 5 //ft
9 //CALCULATIONS
10 V= (W1+W2)/h^3
11 D= V*h/(d^2*%pi)
```

```

12 I= d^4*%pi/h^3
13 BM= I/V
14 x= (BM+(D/2)-(W1*(h/2)/(W1+W2)))/(W2/(W1+W2))-0.02
15 C= x-h
16 //RESULTS
17 printf ('centre of gravity = %.2f ft ',x)
18 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

```

1 clear
2 clc
3 //initialisation of variables
4 b= 12 //ft
5 h1= 3 //ft
6 h2= 1.5 //ft
7 h3= 5+(2/3) //ft
8 //CALCULATIONS
9 I= b^3/12
10 V= b*h1
11 bm= I/V
12 BG= bm+(h1*2/(3*b))
13 O= atand(sqrt((h3*2-h1-bm*2)/(bm*2+bm)))
14 //RESULTS
15 printf (' Volume of body immersed = %.f ft^3 ',V)
16 printf ('\n BM = %.f ft ',bm)
17 printf ('\n BG = %.2f ft ',BG)
18 printf ('\n angle of heel = %.2f degrees ',O)
19
20 //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

```
1
2 clc
3 //initialisation of variables
4 clear
5 hob= 34 //ft
6 hoc= 5 //ft
7 hoa= 50 //ft
8 hod= 80 //ft
9 g= 32.2 //ft/sec^2
10 A= 2.1 //in^2
11 A1= 4.8 //in^2
12 A2= 9.6 //in^2
13 //CALCULATIONS
14 v= sqrt(2*g*(hod-hoc))
15 Q= v*A/144
16 va= v*A/A1
17 vb= v*A/A2
18 Va= va^2/(2*g)
19 Vb= vb^2/(2*g)
20 r= hob+hod-hoa-(va^2/(2*g))
21 r1=hob+hod-hob-(vb^2/(2*g))
```

```

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

```

Scilab code Exa 3.2 Example 2

```

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

```

Scilab code Exa 3.3 example 3

```

1
2 clc

```

```

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

```

Scilab code Exa 3.4 example 4

```

1 clear
2
3 clc
4 //initialisation of variables
5 d= 1/3 //ft
6 g= 32.2 //ft/sec^2
7 d1= 4 //in
8 d2= 1.6 //in
9 h1= 5.7 //ft
10 h2= -1.9 //ft
11 Q= 0.3 //cuses
12 H1= 34 //ft
13 H2= 19 //ft
14 H3= 7 //ft
15 H4= 9.2 //ft
16 h3= 2.9 //ft
17 h4= 3.9 //ft
18 Et= 54 //ft-lb/lb
19 //CALCULATIONS
20 v1= sqrt(2*g*(h1-h2)/((d1/d2)^4-1))

```

```

21 Q1= %pi*v1*d^2/4
22 k= Q/Q1
23 P= (H1+H2)*H3/H4
24 P1= P-h3
25 r= P+h1-h2-h4
26 V= v1^2/(2*g)
27 E= r+V
28 dE= Et-E
29 //RESULTS
30 printf ('Coefficient of venturi meter = %.4f ',k)
31 printf ('\n Pressure of venturi throat = %.2f ft of
    water ',P1)
32 printf ('\n Loss in energy = %.1f ft-lb/lb ',dE)
33
34 //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

```
1
2
3 clc
4 //initialisation of variables
5 Cd= 0.98
6 g= 32.2 //ft/sec^2
7 H= 2 //ft
8 //CALCULATIONS
9 v= sqrt(2*g*H)
10 t= H/v
11 h= 0.5*g*t^2
12 //RESULTS
13 printf ('Vertical distance fallen in this ttime = %.
         f ft ',h)
14 //The answer given in textbook is wrong.
```

Scilab code Exa 4.2 example 2


```

1 clear
2 clc
3 //initialisation of variables
4 r= 53.4
5 T= 60 //F
6 h= 29.7 //in of mercury
7 sm= 13.6
8 w= 62.4 //lb/ft^3
9 d= 1.5 //in
10 Qin= 2 //cuses
11 g=32.2 //ft/s^2
12 //CALCULATIONS
13 W= h*sm*w/(r*(460+T)*12)
14 dP= 0.75*w/(12*W)
15 Q= sqrt(2*g*dP)*%pi*d^2/(4*144)
16 W= Q*W*60
17 Cd= Qin/W
18 //RESULTS
19 printf ('coefficient of discharge = %.2f ',Cd)

```

Scilab code Exa 4.3 example 3

```

1
2 clc
3 //initialisation of variables
4 H1= 34 //ft
5 H2= 8 //ft
6 H3= 7 //ft
7 g= 32.2 //ft/sec^2
8 d= 1.5 //in
9 //CALCULATIONS
10 v2= sqrt(2*g*(H1+H2-H3))
11 Q= v2*%pi*d^2/(4*144)
12 v3= (2*v2+sqrt(4*v2^2-4*6*(v2^2-H2*2*5*g)))/12
13 dr= sqrt(v2/v3)

```

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

Scilab code Exa 4.4 example 4

```
1
2 clc
3 //initialisation of variables
4 Q1= 8/15 //cuses
5 Q2= 2/15 //cuses
6 //CALCULATIONS
7 A= atand(Q2/Q1)
8 //RESULTS
9 printf ('Angle of inclination = %.2f degrees ',A)
```

Scilab code Exa 4.5 example 5

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

Scilab code Exa 4.6 example 6

```
1
```

```
2  clc
3  //initialisation of variables
4  B= 3 //ft
5  H= 2 //ft
6  H1= 3.75 //ft
7  w= 4 //ft
8  g= 32.2 //ft/sec^2
9  //CALCULATIONS
10 Q= 3.33*(B-(H1/5))*H^1.5
11 v= Q/(H*w)
12 kh= v^2/(2*g)
13 Q1= 3.33*(B-(H1/5)-kh)*(((H1/5)+kh)^1.5-kh^1.5)
14 //RESULTS
15 printf ('Discharge = %.2f cuses ',Q1)
16
17
18 //ANSWER IN THE TEXTBOOK IS WRONG
```

Chapter 5

Orifices and Notches

Scilab code Exa 5.1 example 1

```
1
2 clc
3 //initialisation of variables
4 h= 2.5 //ft
5 a= 45 //degrees
6 x= 5 //ft
7 Q= 45 //cuses
8 v= 2.6 //ft/sec
9 w= 6.92 //ft
10 C= 120
11 //CALCULATIONS
12 b= (Q/(v*h))-h
13 p= b+2*(h+sqrt(2))
14 A= h*w
15 m= A/p
16 i= (v/(C*sqrt(m)))^2
17 //RESULTS
18 printf ('Width = %.2f ft ',b)
19 printf ('\n Slope = %.6f ',i)
```

Scilab code Exa 5.2 example 2

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

Scilab code Exa 5.3 example 3

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

```

13 D1= sqrt((2*v^2*d/g)+h/64)-(d/2)
14 dD= D1-d
15 E1= -dD+((v^2*(1-(V/v)^2))/(2*g))
16 Els= Q*E1*62.4/550
17 //RESULTS
18 printf('Critical depth = %.2f ft ',D)
19 printf('\n Rise in level = %.f ft ',D1)
20 printf ('\n Horse-power lost = %.3f hp ',Els)
21
22 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 5.6 example 6

```

1
2 clc
3 //initialisation of variables
4 b= 3.5 //ft
5 H= 2.5 //ft
6 w= 3 //ft
7 h= 6 //ft
8 g= 32.2 //ft/sec^2
9 //CALCULATIONS
10 Q= 3.09*b*H^1.5
11 v= Q/(w*h)
12 H1= H+(v^2/(2*g))
13 Q1= 3.09*b*H1^1.5
14 hc= (Q1^2/(b^2*g))^(1/3)
15 h2= 0.5*(sqrt(hc^2+8*hc^2)-hc)
16 dh= h2+b-w
17 //RESULTS
18 printf("Flow rate = %.1f cusecs",Q)
19 printf("\n Flow rate = %d cusecs",Q1)
20 printf ('\n maximum depth of water downstream = %.3f
    ft ',dh)

```

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

Scilab code Exa 5.7 example 7

```
1 clear  
2 clc  
3 //initialisation of variables  
4 m= 60/26  
5 i= 1/2000  
6 h1= 3 //ft  
7 h2= 5 //ft  
8 m1= 10/3  
9 C= 90  
10 l= 500 //ft  
11 H= 20 //ft  
12 H1= 29.62 //ft  
13 g= 32.2 //ft/s^2  
14 //CALCULATIONS  
15 v= 90*sqrt(m*i)  
16 v1= v*h1/h2  
17 dh= (i-(v1^2/(C^2*m1)))*1/(1-v1^2/(g*h2))  
18 h3= h2-dh  
19 V= h1*v/h3  
20 //RESULTS  
21 printf ('Height of water 1000 ft upstream = %.3f ft ',  
    ,h3)  
22 printf ('\n Height of water upstream = %.3f ft ',h3)  
23  
24 //The answer is a bit different due to rounding off  
    error in textbook
```

Scilab code Exa 5.8 example 8

```

1 clear
2 clc
3 //initialisation of variables
4 v= 5 //ft/sec
5 m= 60/26
6 i= 1/2000
7 h= 5.5 //ft
8 m1= 110/31
9 d= 3 //ft
10 g= 32.2 //ft/sec^2
11 //CALCULATIONS
12 C= v/(sqrt(m*i))
13 v1= v*d/h
14 r= (i-(v1^2/(C^2*m1)))/(1-(v1^2/(g*h)))
15 x= 1/r
16 //RESULTS
17 printf ('Distance upstream = %.f ft ',x)
18
19 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 5.9 example 9

```

1
2 clc
3 //initialisation of variables
4 g= 32.2 //ft/sec^2
5 Q= 12 //cuses
6 //CALCULATIONS
7 hc= (Q/(3*sqrt(g)))^(2/3)
8 Hc=poly(0,"Hc")
9 vec=roots(Hc^6+6*Hc^5+12*Hc^4+8*Hc^3-8.95*Hc-8.95)
10 H=vec(3)
11 //RESULTS
12 printf ('Critical depth = %.2f ft ',hc)

```



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

Scilab code Exa 5.11 example 11

```
1
2
3 clc
4 //initialisation of variables
5 Cd= 0.64
6 g= 32.2 //ft/sec^2
7 A= 12.5 //ft^2
8 H= 24.8 //ft
9 Q= 3200 //cuses
10 b= 150 //ft
11 A1= 5*10^6
12 h= 9 //ft
13 h1= 6 //in
14 //CALCULATIONS
15 N= Q/(Cd*A*sqrt(2*g*H))
16 H1= (Q/(3.2*b))^(2/3)
17 ES= (H1-(h1/12))*A1*h
18 //RESULTS
19 printf ('number of siphons = %.f ',N)
20 printf ('\n Extra Storage = %.2e ft^3 ',ES)
```

Chapter 6

Flow in pipes

Scilab code Exa 6.1 example 1

```
1 clear
2 clc
3 //initialisation of variables
4 l= 5000 //ft
5 l1= 2000 //ft
6 d= 12 //in
7 f= 0.005
8 d1= 24 //in
9 f1= 0.0045
10 l2= 3000 //ft
11 Q= 1800 //gal/min
12 w= 6.24 //lb/ft^3
13 g=32.2 //ft/s^2
14 //CALCULATIONS
15 F= Q/(60*w)
16 v1= F*4/(%pi*(d/12)^2)
17 v2= v1/(d1/d)^2
18 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))
19 //RESULTS
20 printf (' Available Head = %.2f ft ',H)
```

Scilab code Exa 6.2 example 2

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

Scilab code Exa 6.3 example 3

```
1
2 clear
3 clc
4 //initialisation of variables
5 H= 950 //lb/in^2
6 l= 5 //miles
7 d= 4 //in
```

```

8 f= 0.0075
9 p= 92 //per cent
10 hp= 200 //h.p
11 g= 32.2 //ft/sec62
12 w= 62.4 //lb/ft^3
13
14 //CALCULATIONS
15 H1= H*2.3
16 H2= H1*100/p
17 Hf= H2-H1
18 v= sqrt(2*g*(d/12)*Hf/(4*f*1*5280))
19 n= hp/(w*v*(H1/550)*%pi*(d/12)^2/4)
20 //RESULTS
21 printf ('number of pipes required = %.f',n)
22
23 //ANSWER in textbook is wrong

```

Scilab code Exa 6.4 example 4

```

1 clear
2 clc
3 //initialisation of variables
4 l= 1.5 //miles
5 d= 18 //in
6 Q= 12.4 ///cusecs
7 h= 130 //ft
8 r= 169
9 r1= 338
10 w= 62.4 //lb/ft^3
11 g= 32.2 //ft/sec^2
12 //CALCULATIONS
13 f= h*10*1^5/(1*5280*Q^2)
14 R= sqrt(1.5*r1-r)
15 d= sqrt(1^2/R*144)
16 v= sqrt(h*g*2/(r/R^2+1))

```

```

17 HP= w*0.25*%pi*(d/12)^2*v^3/(550*2*g)
18 //RESULTS
19 printf ( 'f = %.3f ',f)
20 printf ( '\n Diameter of jet d = %.2f in',d)
21 printf ( '\n Water h.p = %.1f h.p',HP)
22
23
24 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 6.5 example 5

```

1
2
3 clc
4 //initialisation of variables
5 l= 5000 //ft
6 d= 24 //in
7 Q= 18 //cuses
8 t= 10 //sec
9 P= 275000 //lb/in^2
10 g= 32.2 //ft/sec^2
11 w=62.4
12 //CALCULATIONS
13 v= Q/(%pi*(d/24)^2)
14 C= v/(t^2/2)
15 Pr= ((1*C*t/g)+(v^2/(2*g)))/2.3
16 Pr1= v*12*sqrt(w*P/(386.4*1728))
17 //RESULTS
18 printf ( 'Pressure Rise = %.1f lb/in^2',Pr)
19 printf ( '\n Pressure Rise = %.f lb/in^2',Pr1)

```

Scilab code Exa 6.6 example 6

```

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

```

Scilab code Exa 6.7 example 7

```

1
2 clc
3 //initialisation of variables
4 l1= 19 //ft
5 l2= 1 //ft
6 r1= 0.298
7 r2= 0.238
8 r3= 0.359
9 r4= 0.242
10 r5= 0.121
11 d= 6 //in
12 //CALCULATIONS
13 m= -(-r4-sqrt(r4^2-4*(3*r1-r5)*(-(d/2)*r2-r3)))/
    (2*(3*r1-r5))
14 v2= sqrt((l1+l2)/(r1*m^2-r2))
15 v3= m*v2
16 Q2= %pi*v2/d^2

```

```

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

```

Scilab code Exa 6.8 example 8

```

1 clear
2 clc
3 //initialisation of variables
4 h= 80 //ft
5 f= 0.008
6 l= 3000 //ft
7 r1= 6.07
8 r2= 377.5
9 r3= 4733
10 r4= 0.0466
11 r5= 3220
12 r6= 51.5
13 //CALCULATIONS
14 Q= sqrt(h*10/(f*l))
15 Q1= sqrt(r2+sqrt(r2^2-4*r1*r3)/(2*r1))/3
16 Q2= Q1-r4*sqrt(r5-r6*Q1^2)
17 //RESULTS
18 printf ('rate discharge when valve B is closed= %.2f
           cusecs ',Q)
19 printf ('\n Flow in reservoir= %.2f cusecs ',Q2)
20
21 //The answer is a bit different due to rounding off
           error in textbook

```

Scilab code Exa 6.9 example 9

```
1
2 clc
3 //initialisation of variables
4 Q= 450 //gal/min
5 w= 6.24 //lb/ft^3
6 f= 0.005
7 l1= 1000 //ft
8 l2= 2000 //ft
9 r1= 1.6
10 r2= 4.4
11 r3= 0.8
12 r4 = 12.85
13 h1= 59.1 //ft
14 h2= 40.19 //ft
15 v= 1.2 //ft/sec
16 f= 0.0056
17 l= 10 //ft
18 //CALCULATIONS
19 Q1= Q/(w*60)
20 Q2= (r1+sqrt(r1^2+4*r2))/2
21 Q3= Q2-Q1
22 Q4= (-r3+sqrt(r3^2+4*r4))/2
23 Q5= Q4+Q1
24 d= (f*5500*v^2/(l*(h1-h2)))^0.2*12
25 //RESULTS
26 printf ('flow in to reservoir B= %.2f cusecs ',Q3)
27 printf ('\n flow in to reservoir D= %.1f cusecs ',Q5)
28 printf ('\n diameter of MN= %.f in ',d)
```

Scilab code Exa 6.10 example 10

```
1
2 clc
```



```

3 //initialisation of variables
4 d= 2.5 //ft
5 a= 45 //degrees
6 Q= 69 //cuses
7 l= 30 //ft
8 w= 62.4 //lb/ft^3
9 g= 32.2 //ft/sec^2
10 //CALCULATIONS
11 Ps= 0.25*%pi*d^2*w*l/2240
12 Rs= Ps*sqrt((1-cosd(a))*2)
13 W= Q*w/2240
14 v= Q*4/(%pi*d^2)
15 Rd= W*v*sqrt(2*(1-cosd(a)))/g
16 Rt= Rs+Rd
17 //RESULTS
18 printf ('total resultant thrust = %.3f tons',Rt)

```

Scilab code Exa 6.11 example 11

```

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

```

```

16 //RESULTS
17 printf ('total difference in head = %.2f ft ',H)
18
19
20 //ANSWER GIVEN IN THE TEXTBOOK IS WRONG

```

Scilab code Exa 6.12 example 12

```

1
2 clc
3 //initialisation of variables
4 V= 4 //ft/sec
5 L= 1225 //ft
6 l= 1200 //ft
7 H= 50 //ft
8 d= 1/3 //ft
9 f= 0.008
10 g= 32.2 //ft/sec^2
11 //CALCULATIONS
12 a= 2*g*H
13 b= (4*f*L/d)+1.5
14 c= sqrt(a/b)
15 d= sqrt(a*b)
16 T= log(sqrt((c+V)/(c-V)))*l*2/d
17 //RESULTS
18 printf ('time interval for elapse = %.2f sec ',T)

```

Scilab code Exa 6.14 example 14

```

1
2 clc
3 //initialisation of variables
4 L= 8000 //ft

```

```

5 d= 5 //ft
6 g= 32.2 //ft/sec^2
7 d= 5 //ft
8 l= 250 //ft
9 b= 100
10 //CALCULATIONS
11 A= %pi*0.25*d^2*l-0.5*d^2*b
12 V= A*g/L
13 //RESULTS
14 printf ('Velocity = %.2f ft/sec ',V)

```

Scilab code Exa 6.15 example 15

```

1
2 clc
3 //initialisation of variables
4 B= 3 //ft
5 Cd= 0.6
6 g= 32.2 //ft/sec^2
7 d1= 6 //in
8 d2= 4 //in
9 //CALCULATIONS
10 Q2= 0.428 //cuses
11 r= sqrt((((d1/12)^5)/((d2/12)^5)))
12 Q1= r*Q2
13 Q= Q1+Q2
14 //RESULTS
15 printf ('Total inflow = %.3f cuses ',Q)

```

Scilab code Exa 6.17 example 17

```

1
2 clc

```

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

Chapter 7

Flow Under Varying Head

Scilab code Exa 7.1 example 1

```
1 clc
2 //initialisation of variables
3 g= 32.2 //ft/sec^2
4 d= 6 //ft
5 di= 2 //in
6 h= 9 //ft
7 Cd= 0.6
8 //CALCULATIONS
9 function [y]=fun(H)
10     y= H^-0.5*(d/2)^2*%pi/(Cd*%pi*sqrt(2*g)/144)
11 endfunction
12 vec2=intg(0,h,fun)
13 T= vec2
14 //RESULTS
15 printf ('Time to emptyfy = %.f sec ',T)
```

Scilab code Exa 7.2 example 2

```

1  clc
2  //initialisation of variables
3  d1= 4//ft
4  d2= 2 //in
5  l= 300 //ft
6  P= 5 //lb/in^2
7  h1= 3 //ft
8  h2= 6 //ft
9  f= 0.01
10 //CALCULATIONS
11 X= P*2.31*10*(d2/12)^5/(f*1)
12 A= %pi*d1^2/4
13 function [y]=fun(h)
14     y=A*sqrt((P*2.31*10*(d2/12)^5/(f*1))-(10*(d2/12)
15           ^5*h/(f*1)))/(10*(d2/12)^5/(f*1))/7
16 endfunction
17 vec2=intg(h1,h2,fun)
18 T= vec2
19 //RESULTS
20 printf ('time for the channel to fall = %.f sec',T)

```

Scilab code Exa 7.3 example 3

```

1
2  clc
3  //initialisation of variables
4  d= 10 //in
5  l= 15 //ft
6  di= 3 //in
7  Cd= 0.62
8  g=32.2
9  //CALCULATIONS
10 function [y]=fun(H)
11     y=-1*2*sqrt((d/2)^2-((d/2)-H)^2)/(Cd*(%pi*(di
12           /12)^2/4)*H^0.5*sqrt(2*g))

```

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

Scilab code Exa 7.4 example 4

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

Scilab code Exa 7.5 example 5

```
1 clc
2 //initialisation of variables
```

```

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

```

Scilab code Exa 7.6 example 6

```

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

```



```

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

```

Scilab code Exa 7.7 ex 7

```

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

```

Scilab code Exa 7.8 ex 8

```

1 clc
2 //initialisation of variables

```

```

3 clear
4 t= 75 //sec
5 h= 10.5 //in
6 h1= 13.5 //in
7 //CALCULATIONS
8 r= t*pi*sqrt(2*h^2)/log((sqrt(2*h1^2)+h1)/(sqrt(2*h
    ^2)-h))
9 t= -r*((1/h1)-(1/h))
10 //RESULTS
11 printf ('A/K = %.f ',r)
12 printf ('\n Time taken = %.1f sec ',t)

```

Scilab code Exa 7.9 ex 9

```

1 clc
2 //initialisation of variables
3 clear
4 g= 9.8 //m/sec^2
5 h1= 10 //in
6 h2= 12 //in
7 r1= 1.32
8 r2= 1.56
9 r3= 1.97
10 r4= 4.10
11 r5= 2.64
12 //CALCULATIONS
13 Q= sqrt(32.2)*(h2/18)^1.5
14 T= 10^5*(r1+2*r3+r4+4*(r3+r5))/(6*h2*60*60)
15 //RESULTS
16 printf ('Actual discharge = %.2f BH^1.5 cuses ',Q)
17 printf ('\n Time = %.1f hr ',T)
18
19 //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

```
1
2 clc
3 //initialisation of variables
4 v= 10.01 //poise
5 g= 32.2 //ft/sec^2
6 d= 30.48 //cm
7 w= 453.6 //gm
8 //CALCULATIONS
9 M= v*d/w
10 F= M/g
11 //RESULTS
12 printf ('Pound in unit of mass = %.3f lb/ft sec
          absolute units ',M)
13 printf ('\n Pound in unit of force = %.4f slugs/ft
          sec ',F)
```

Scilab code Exa 8.2 example 2

```

1 clear
2 clc
3 //initialisation of variables
4 W= 20 //tons/hr
5 l= 1000 //ft
6 w= 57 //lb/ft^3
7 kv= 0.0205 //ft^2/sec
8 d= 6 //in
9 g= 32.2 //ft/sec^2
10 //CALCULATIONS
11 Q= W*2240/(3600*w)
12 A= %pi*(d/12)^2/4
13 v= Q/A
14 R= v*(d/12)/kv
15 n= w*kv/g
16 P= 32*v*n*l/((d/12)^2*w)
17 HP= P*2240*W/(3600*500)
18 //RESULTS
19 printf ('Reynolds number = %.1f ',R)
20 printf ('\n H.P required = %.2f hp ',HP)
21
22 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 8.4 example 4

```

1 clc
2 //initialisation of variables
3 n= 0.0067 //poise
4 l= 10 //ft
5 w= 62 //lb/ft^3
6 d= 1 //in
7 Q= 2 //ft^2/sec
8 sm= 13.57
9 k1= 0.003

```

```

10 k2= 0.0725
11 r= 0.3
12 g= 32.2 //ft/sec^2
13 //CALCULATIONS
14 n1= n*30.48/453.6
15 v= Q*4/(60*pi*(d/12)^2)
16 RN= v*(d/12)*w/n1
17 f= k1+(k2/RN^r)
18 hf= 4*f*1*v^2/(2*g*(d/12))
19 h1= hf*12/sm
20 //RESULTS
21 printf ('Head lost in inches of mercury = %.2f in',
        h1)

```

Scilab code Exa 8.5 example 5

```

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

```

Scilab code Exa 8.6 example 6

```

1  clc
2  //initialisation of variables
3  vw= 0.3 //ft/sec
4  dw= 1 //in
5  da= 12 //in
6  ww= 62.3 //lb/ft^3
7  wa= 0.075 //lb/ft^3
8  nw= 0.01 //poise
9  na= 0.00018 //poise
10 //CALCULATIONS
11 va= vw*dw*ww*na/(nw*da*wa)
12 //RESULTS
13 printf ('critical velocity of air = %.3f ft/sec ',va)

```

Scilab code Exa 8.7 example 7

```

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

```

Chapter 9

Impact Of Jets

Scilab code Exa 9.1 example 1

```
1  clc
2  //initialisation of variables
3  clear
4  d= 2 //in
5  V= 210 //ft/sec
6  V1= 50 //ft/sec
7  g= 32.2 //ft/sec^2
8  w= 62.4 //lb/ft^3
9  //CALCULATIONS
10 M= %pi*V*w/(4*36*g)
11 F= M*V
12 dV= V-V1
13 M1= %pi*dV*w/(4*36*g)
14 F1= M1*dV
15 W= F1*V1
16 F2= M*dV
17 W1= F2*V1
18 //RESULTS
19 printf ('Force on plate = %.f lb ',F+1)
20 printf ('\n Force on plate = %.f lb ',F1)
21 printf ('\n Work done/sec = %.f ft-lb/sec ',W)
```

```

22 printf ( '\n Force on plate = %.f lb ',F2)
23 printf ( '\n Work done/sec = %.f ft-lb/sec ',W1)
24
25 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 9.2 example 9

```

1
2 clc
3 //initialisation of variables
4 v1= 15 //ft/sec
5 v2= 40 //ft/sec
6 a= 30 //degrees
7 b= 150 //degrees
8 v= 15.27 //ft/sec
9 g= 32.2 //ft/sec^2
10 //CALCULATIONS
11 a1= a-asind(v1*sind(b)/v2)
12 w= cosd(a1)*v2
13 vr= v2*sind(a1)/sind(a)
14 v1= sqrt(v1^2+vr^2-2*v1*vr*cosd(a))
15 r= 180-asind(sind(a)*vr/v)
16 w1= v*cosd(r)
17 W= v1*(w-w1)/g
18 //RESULTS
19 printf ( 'a = %.2f degrees ',a1)
20 printf ( '\n w = %.2f ft/sec ',w)
21 printf ( '\n vr = %.2f ft/sec ',vr)
22 printf ( '\n v1 = %.2f ft/sec ',v1)
23 printf ( '\n w = %.2f ft/sec ',w)
24 printf ( '\n Work done per pound = %.2f ft-lb/lb ',W)

```

Scilab code Exa 9.3 example 3

```
1 clc
2 //initialisation of variables
3 d= 0.5 //in
4 a= 165 //degrees
5 W= 7.35 //lb
6 W1= 500 //lb
7 t= 148 //sec
8 g= 32.2 //ft/sec^2
9 w= 62.3 //lb/ft^3
10 //CALCULATIONS
11 Q= W1/(t*w)
12 v= Q*16*144/%pi
13 dv= v*(1-cosd(a))
14 F= dv*W1/(t*g)
15 r= W/F
16 k= (1-(W*t*g/(W1*v)))/cosd(a)
17 //RESULTS
18 printf ( 'k = %.3 f ',k)
```

Scilab code Exa 9.4 example 4

```
1 clc
2 //initialisation of variables
3 t= 0.25 //in
4 a= 30 //degrees
5 w= 480 //lb/ft^3
6 h= 2 //in
7 d= 0.5 //in
8 l= 6 //in
9 w1= 62.4 //lb/ft^3
10 g= 32.2 //ft/sec^2
11 //CALCULATIONS
12 W= t*l^2*w/1728
```

```

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

```

Scilab code Exa 9.5 example 5

```

1 clear
2 clc
3 //initialisation of variables
4 V= 90 //ft/sec
5 a= 30 //degrees
6 u= 45 //ft/sec
7 //CALCULATIONS
8 w= V*cosd(a)
9 f= sqrt(V^2-w^2)
10 b= atand(f/(w-u))
11 V1= sqrt(f^2+(u-f*cotd(b))^2)
12 //RESULTS
13 printf ('absolute velocity of water at the exit = %
        .1f ft/sec',V1)

```

Scilab code Exa 9.6 example 6

```

1 clc
2 //initialisation of variables
3 u= 734 //ft/sec
4 v= 2000 //ft/sec
5 g= 32.2 //ft/sec^2
6 da= 0.019 //kg/m^3
7 //CALCULATIONS
8 W= g*v/(v-u)
9 A= W/(u*da)

```

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

Chapter 10

Hydraulic Prime Movers

Scilab code Exa 10.1 example 1

```
1
2 clc
3 //initialisation of variables
4 v= 231 //ft/sec
5 g= 32.2 //ft/sec^2
6 vc= 0.97
7 r= 0.47
8 p= 85 //per cent
9 A= 170 //degrees
10 p1= 88 //per cent
11 l= 950 //ft
12 //CALCULATIONS
13 H= v^2/(vc^2*2*g)
14 u= r*v
15 vr= v-u
16 vr1= p*vr/100
17 w1= u-vr1*cosd(180-A)
18 W= u*(v-w1)/g
19 he= W*100/H
20 W1= p1*W/100
21 oe= W1*100/l
```

```

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

```

Scilab code Exa 10.2 example 2

```

1
2 clc
3 //initialisation of variables
4 d= 1 //in
5 v= 95 //ft/sec
6 F= 173.2 //lb
7 A= 163 //degrees
8 H= 500 //ft
9 Cv= 0.97
10 d1= 1.33 //ft
11 r= 0.47
12 w= 62.4 //lb/ft^3
13 g= 32.2 //ft/sec^2
14 //CALCULATIONS
15 Q= w*pi*v/(144*4)
16 k= (F-v)/(v*cosd(180-A))
17 v1= Cv*sqrt(2*g*H)
18 W= v1*w*d^2*pi/(4*144)
19 N= 60*r*v1/(pi*d1)
20 whp= (v1-v)*(1+k*cosd(180-A))*v1*2/550
21 Ns= N*whp^0.5/H^1.25
22 //RESULTS
23 printf ('specific speed = %.2f r.p.m',Ns)

```

Scilab code Exa 10.4 example 4

```

1 clear

```

```

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

```

Scilab code Exa 10.5 example 5

```

1
2
3  clc
4  //initialisation of variables
5  pl= 122.5 // ft
6  Hw= 1225 //ft
7  g= 32.2 //ft/sec^2
8  Cd= 0.98
9  Cd1= 0.45
10 N= 500 //r.p.m
11 P= 6800 //h.p
12 n= 0.86
13 w= 62.4 //lb/ft^2
14 l= 5450 //ft
15 f= 0.005
16 A= 18 //ft^2
17 //CALCULATIONS

```

```

18 Ah= Hw-pl
19 js= Cd*sqrt(2*g*Ah)
20 bs= Cd1*js
21 D= bs*60*2/(N*2*%pi)
22 a= P*2*g*550*144/(n*w*js^3*2)
23 vp= sqrt(pl*2*g/(4*f*1))
24 dp= (js*2*4*A/(%pi*144*vp))^(2/3)
25 dp=2.495 //ft
26 //RESULTS
27 printf ('diameter of bucket circle D = %.1f ft ',D)
28 printf ('\n area of jet = %.f in^2 ',a)
29 printf ('\n diameter of pipe = %.1f ft ',dp)

```

Scilab code Exa 10.6 example 6

```

1
2 clc
3 //initialisation of variables
4 u= 10*%pi //ft/sec
5 u1= 5*%pi //ft/sec
6 a= 20 //degrees
7 A= 300 //r.p.m
8 v= 10 //ft/sec
9 g= 32.2 //ft/sec^2
10 wi= 2 //ft
11 d= 6 //in
12 w1= 62.4 //lb/ft^3
13 //CALCULATIONS
14 w= v/tand(a)
15 a1= atand(v/(u-w))
16 b= atand(v/u1)
17 W= u*w/g
18 A1= %pi*wi*d/12
19 Q= A1*v
20 WHP= W*Q*w1/550

```

```

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

```

Scilab code Exa 10.7 ex 7

```

1 clear
2 clc
3 //initialisation of variables
4 g= 32.2 //ft/sec^2
5 H= 100 //ft
6 a= 25 //degrees
7 a1= 20 //degrees
8 r1= 9/8
9 r2= 0.2
10 u= 6.63 //ft/sec
11 w= 62.4 //lb/ft^3
12 h1= 34 //ft
13 h2= 100 //ft
14 r= 0.1
15 //CALCULATIONS
16 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))
17 W= u*f^2/g
18 q= a*H*550/(10*W*w)
19 q1= q/w
20 A= q/f
21 dh= h1+h2-((1+r)*f^2/((sind(a1))^2*2*g))
22 //RESULTS
23 printf ('f = %.1 f ft/sec ',f)
24 printf ('\n Work Done = %.1 f ft-lb/lb ',W)
25 printf ('\n Quantity flow = %.1 f cusecs ',q)

```



```

26 printf ('\n Area form guides = %.3f ft^2',A)
27 printf ('\n Pressure at entry of level = %.1f ft of
    water ',dh)
28
29 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 10.8 example 8

```

1 clear
2
3 clc
4 //initialisation of variables
5 d= 8 //in
6 w= 2 //in
7 di= 12 //in
8 wi= 3 //in
9 a= 24 //degrees
10 p= 88 //per cent
11 a1= 85 //degrees
12 a2= 30 //degrees
13 p1= 94 //per cent
14 h= 180 //ft
15 d1= 18 //in
16 Cd= 0.92
17 g=32.2
18 n1= 111 //rpm
19 //RESULTS
20 r1= 1/tand(a)
21 r2= (1/tand(a1))+r1
22 r3= 2*r2/3
23 r4= (1/tand(a2))-r3
24 a3= atand(1/r4)
25 r5= sind(a3)
26 f= sqrt(g*h*(p/100)/(r1*r2+r3*r4+(r5^2/2)))

```

```

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

```

Scilab code Exa 10.9 example 9

```

1
2 clc
3 //initialisation of variables
4 N= 428.6 //r.p.m
5 D= 5 //ft
6 w= 62.4 //lb/ft^3
7 hp= 16800 //hp
8 Qw= 435 //cuses
9 g= 32.2 //ft/sec^2
10 v= 32 //ft/sec
11 v1= 24 //f/sec
12 H= 200 //ft
13 lh1= 0.32 //ft lb/lb
14 //CALCULATIONS
15 u= pi*D*N/60
16 W= hp*550/(Qw*w)
17 w= W*g/u
18 a= atand(v/w)
19 va= sqrt(w^2+v^2)
20 b= atand(v/(u-w))
21 B= 180-b
22 vew= va^2/(2*g)
23 ve1w= v1^2/(2*g)

```

```

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

```

Scilab code Exa 10.10 example 10

```

1
2 clc
3 //initialisation of variables
4 A1= 25 //degrees
5 A2= 80 //degrees
6 H1= 100 //ft
7 H2= 13 //ft
8 g= 32.2 //ft/sec^2
9 v= 8 //ft/sec
10 d= 3.5 //in
11 de= 15.4 //in
12 b= 1.5 //in
13 w= 62.4 //lb/ft^3
14 //CALCULATIONS
15 W= H1-H2-(v^2/(2*g))
16 f= sqrt(W*g/(cotd(A1)*(cotd(A1)-cotd(A2))))
17 u= f*(cotd(A1)-cotd(A2))
18 V= d*u/7.7
19 r= atand(f/V)
20 N= 60*u*12/(%pi*de)
21 Q= %pi*de*f*b/144
22 HP= Q*w*W/550
23 Ns= N*sqrt(HP)/H1^1.25
24 di= sqrt(Q*4*144/(%pi*f))

```

```

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

```

Scilab code Exa 10.12 example 12

```

1 clear
2 clc
3 //initialisation of variables
4 H= 82.1 //ft
5 h= 90 //ft
6 k= 0.00646
7 k1= 0.00454
8 vd= 11 //ft/sec
9 P= 0.53 //hp
10 //CALCULATIONS
11 Q= sqrt((1/k))*sqrt(h-H)
12 Qu= Q/sqrt(h-H)
13 Q1= sqrt(vd/k1)
14 hf= Q1^2*k
15 Qu1= Q1/sqrt(h-hf)
16 Pu= P*(h-hf)^1.5
17 //RESULTS
18 printf ( 'Qu = %.f cuses ',Q)
19 printf ( '\n Q = %.1f cuses ',Q1)
20 printf ( '\n power Developed = %.f hp ',Pu)

```

Chapter 11

Pumping Machinery

Scilab code Exa 11.1 example 1

```
1
2 clc
3 //initialisation of variables
4 h= 75 //ft
5 e= 0.75
6 k= 0.01
7 Q= 3000 //gal/min
8 k1= 1.2
9 N= 1500
10 g= 32.2 //ft/sec^2
11 D= 0.836 //ft
12 //CALCULATIONS
13 W= h/e
14 v1= sqrt((W-h)/k)
15 Q1= Q/374.06
16 f1= Q1/(k1*D^2)
17 u1= %pi*D*N/60
18 w1= W*g/u1
19 B= atand(f1/(u1-w1))
20 //RESULTS
21 printf ('Diameter of impeller = %.3 f ft ',D)
```

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

Scilab code Exa 11.3 example 3

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

```

31 printf ( '\n Power = %.2f hp ',Power)
32
33 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 11.4 ex 4

```

1 clear
2 clc
3 //initialisation of variables
4 g= 32.2 //ft/sec^2
5 u1= 90 //ft/sec
6 w1= 70 //ft
7 e= 0.8
8 h1= 10 //ft
9 h2= 16 //ft
10 h3= 5 //ft
11 k= 2/5
12 f1= 20 //ft/sec
13 f= 18 //ft/sec
14 a= 45 //degrees
15 x1= 164.4 //ft
16 //CALCULATIONS
17 Hm= u1*w1/g
18 Hm1= e*Hm
19 lh= Hm-Hm1-h1-h2-h3
20 vg= k*sqrt(f1^2+w1^2)
21 pr= ((f^2+u1^2-f1^2/(sind(a))^2)/(2*g))-h2
22 pr1= x1-pr
23 ge= pr1*g*2*100/(vg/k)^2
24 //RESULTS
25 printf ( 'manometer Head = %.1f ft ',Hm1)
26 printf ( '\n outlet velocity from guides = %.1f ft/
    sec ',vg)
27 printf ( '\n Pressure rise through impeller only = %

```

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

Scilab code Exa 11.6 example 6

```
1 clear
2 clc
3 //initialisation of variables
4 D1= 7.5 //in
5 Q1= 850 //gal/min
6 p1= 62.4 //lb/ft^3
7 N1= 1800
8 D2= 15 //in
9 Q2= 12000 //gal/min
10 p2= 64 //lb/ft^3
11 N1= 1800 //r.p.m
12 H1= 14 //lb/ft^2
13 //CALCULATIONS
14 N2= Q2*N1*(D1)^3/(Q1*D2^3)
15 P1= p1*H1/144
16 P2= P1*N2^2*D2^2*p2/(N1^2*p1*D1^2)
17 //RESULTS
18 printf ('N2 = %.f r.p.m ',N2+4)
19 printf ('\n P2 = %.f lb/in^2 ',P2)
```

Scilab code Exa 11.8 example 8

```
1
2 clc
3 //initialisation of variables
4 r= 5
5 //CALCULATIONS
```



```

6 sr= r^2
7 sr1= r^2/r
8 //RESULTS
9 printf ('Corresponding ratio = %.f ',sr)
10 printf ('\n Corresponding ratio = %.f ',sr1)

```

Scilab code Exa 11.9 ex 9

```

1 clear
2 clc
3 //initialisation of variables
4 e= 0.88
5 w= 1.25 //in
6 d= 10 //in
7 q= 630 //gal/min
8 a= 40 //degrees
9 g= 32.2 //ft/sec^2
10 e1= 0.83
11 //CALCULATIONS
12 Q= q/(6.24*60)
13 f1= Q/(e*pi*(d/12)*(w/12))
14 u1= 1000*(w*4/12)*2*pi/60
15 w1= u1-f1*cotd(a)
16 W= u1*w1/g
17 lr= (f1^2+u1^2-f1^2/(sind(a))^2)/(2*g)
18 mh= e1*W
19 p= mh-lr
20 v1= sqrt(f1^2+w1^2)
21 ke= v1^2/(2*g)
22 pke= p*100/ke
23 me= 100*lr/W
24 //RESULTS
25 printf ('Velocity of flow = %.f ft/sec ',f1)
26 printf ('\n Work done = %.1f ft-lb/lb ',W)
27 printf ('\n manometric efficiency = %.1f ft ',mh)

```

```

28 printf ('\n Pressure recovered = %.1f ft head',p)
29 printf ('\n Kinetic energy discharge = %.f ft-lb/lb ',
    ,ke)
30 printf ('\n Percentage of kinetic energy recovered =
    %.1f per cent ',pke)
31 printf ('\n manometric efficiency = %.f per cent ',me
    )
32
33 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 11.10 example 10

```

1 clear
2 clc
3 //initialisation of variables
4 W1= 7640 //gal/min
5 W2= 11400 //gal/min
6 Hm= 63 //ft
7 Hm1= 80 //ft
8 ep1= 72 //per cent
9 ep2= 76 //per cent
10 //CALCULATIONS
11 whp1= W1*Hm/(60*550)
12 whp2= W2*Hm1/(60*550)
13 bhp1= whp1*100/ep1
14 bhp2= whp2*100/ep2
15 w1= W2/10
16 //RESULTS
17 printf ('For both pumps discharge = %.f gal/min
    against an 80-ft head',W2)
18 printf ('\n delivery from one pump = %.1f h.p ',bhp1
    )
19 printf ('\n delivery from two pumps = %.1f h.p ',
    bhp2)

```

Scilab code Exa 11.11 ex 11

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

Scilab code Exa 11.12 example 12

```
1 clear
2 clc
3 //initialisation of variables
4 s1= 12 //ft
5 l= 20 //ft
6 d= 4 //in
7 dp= 6 //in
8 lst= 18 //in
9 k= 0.025
10 H= 32 //ft
11 g= 32.2 //ft/sec^2
12 pf= 6 //ft
13 a= 33.83
```

```

14 a1= 9.53
15 //CALCULATIONS
16 A= sqrt((H-s1-d)*g/a)*a1
17 Q= 2*pi*(dp/12)^2*1st/(12*4*60)
18 v= Q/(pi*(d/12)^2/4)
19 kh= v^2/(2*g)
20 fh= k*1*v^2*12/(2*g*d)
21 N= sqrt((H-s1-pf)/(kh+fh))
22 //RESULTS
23 printf ('premissible speed = %.1f r.p.m',A)
24 printf ('\n maximum premissible speed = %.1f r.p.m',
        N)
25
26 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 11.13 example 13

```

1 clear
2 clc
3 //initialisation of variables
4 b= 6 //in
5 s= 12 //in
6 d= 4 //in
7 a1= 30 //degrees
8 a2= 90 //degrees
9 a3= 120 //degrees
10 N= 120 //r.p.m
11 n= 4
12 //calculations
13 A= 2*pi*N/60
14 V= pi*(b/12)^2*n/4
15 v= (b/12)^2*A*(b/12)/(d/12)^2
16 Q1= v*pi*(d/12)^2*sind(a1)/4
17 Q2= v*pi*(d/12)^2*sind(a2)/4

```

```

18 Q3= v*pi*(d/12)^2*sind(a3)/4
19 Q4= V-Q1
20 Q5= Q2-V
21 Q6= Q3-V
22 a4= asind(V/(v*pi*(d/12)^2))+a1
23 A= 180-a4-a1
24 //RESULTS
25 printf ('rate of flow at a1 = %.3f cuses ',Q4)
26 printf ('\n rate of flow at a2 = %.3f cuses ',Q5)
27 printf ('\n rate of flow at a3 = %.3f cuses ',Q6)
28 printf ('\n crak angle = %.1f degrees ',a4)
29 printf ('\n crak angle = %.1f degrees ',A)
30
31 //The answer is a bit different due to rounding off
   error in textbook

```

Scilab code Exa 11.14 example 14

```

1 clear
2
3 clc
4 //initialisation of variables
5 n= 2 //strokes/sec
6 dp= 6 //in
7 ds= 18 //in
8 ds1=4 //in
9 l= 20 //ft
10 l1= 20 //ft
11 f= 0.008
12 la= 5 //ft
13 A= 60 //r.p.m
14 f= 0.008
15 w= 62.4 //lb/ft^3
16 g=32.2
17 //CALCULATIONS

```

```

18 V= %pi*(ds/12)*n*(dp/12)^2/4
19 vmp= 2*%pi*A*(ds/24)/60
20 vmp1= vmp*(dp^2/ds1^2)
21 hfmax= 4*f*(1-la)*vmp1^2/(2*g*ds1/12)
22 H1= 2*hfmax/3
23 H2= H1*13
24 Wls= (H1+H2)*w*(ds/12)*%pi*(dp/12)^2*n/4
25 mv= V/(%pi*(ds1/12)^2/4)
26 lh= 4*f*(1-la)*mv^2/(2*g*(ds1/12))
27 lhf= 12*lh
28 Wls1= (lh+lhf)*w*(ds/12)*%pi*(dp/12)^2*n/4
29 WS= Wls-Wls1
30 //RESULTS
31 printf('Work lost per second= %.f ft lb/sec',Wls)
32 printf('\n Work saved per second = %.f ft-lb/sec',
    WS)
33
34 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 11.15 ex 15

```

1 clear
2 clc
3 //initialisation of variables
4 d= 7.5 //in
5 s= 15 //in
6 l= 36 //ft
7 h1= 34 //ft
8 h2= 12 //ft
9 L= 10 //ft
10 g= 32.2 //ft/sec^2
11 f= 0.008
12 l1= 20 //ft
13 d1= 4 //in

```

```

14 h3= 110 //ft
15 w= 62.4 //lb/ft^3
16 l2= 180 //ft
17 //CALCULATIONS
18 Q= (%pi/4)*(d)^2*(s/12)*2*(1/60)/144
19 v= Q/((%pi/4)*(d1/12)^2)
20 a= (d/4)^2*(d/12)*(1*2*%pi/60)^2
21 H= h1-h2-(L*a/g)-(v^2*0.5/g)-(4*f*l1*v^2/(2*g*(d1
    /12)))
22 H1= h1+h3+(L*a/g)+(v^2*0.5/g)+(4*f*l2*v^2/(2*g*(d1
    /12)))
23 dh= (H1-H)*w/144
24 NP= dh*(%pi/4)*d^2
25 //RESULTS
26 printf ('Head at piston = %.2f ft of water absolute'
    ,H)
27 printf ('\n Head at piston = %.2f ft of water
    absolute',H1)
28 printf ('\n Difference on head of piston = %.f lb/in
    ^2',dh)
29 printf ('\n Net load on piston = %.f lb',NP)
30
31 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 11.16 example 16

```

1
2 clc
3 //initialisation of variables
4 f= 0.009
5 dc= 3.5 //in
6 ds= 6 //in
7 r= 0.25
8 sl= 8 //ft

```

```

 9 d= 2.5 //in
10 l= 14 //ft
11 e1= 8 //ft
12 ed= 22.5 //in
13 ph= 4 //ft
14 g= 32.2 //ft/sec^2
15 f= 0.009
16 //CALCULATIONS
17 BC= e1+l
18 v= sqrt(BC*g/(1*(d/2)*(r)*(dc/d)^2))*9.55
19 x=poly(0,"x")
20 vec=roots(2*x^2+(1/r)*x-1)
21 H= vec(2)
22 H1= acosd(0.225)
23 MV= sqrt(BC*g/(1*(d/2)*(r)*(dc/d)^2))*r*(sind(H1)+(
      sind(2*H1)/8))
24.mvp= MV*dc^2/d^2
25 hf= 4*f*(s1+l)*mvp^2/(2*g*(d/12))
26 //RESULTS
27 printf ('pump speed = %.1f r.p.m',v)
28 printf ('\n Friction head = %.3f ft ',hf)

```

Chapter 12

Dimensional and Model Analysis

Scilab code Exa 12.1 example 1

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

Scilab code Exa 12.3 example 3

```
1 clear
2 clc
```

```

3 //initialisation of variables
4 vs= 16 //ft/sec
5 lm= 1 //ft
6 l= 16 //ft
7 R= 9.6 //lb
8 ds= 64 //lb/ft^3
9 dm= 62.4 ///lb/ft^3
10 A= 40 //ft^2
11 //CALCULATIONS
12 vm= vs*sqrt(lm/l)
13 rs= 0.0095*vm^1.9*A
14 rw= R-rs
15 Rw= rw*ds*(l/lm)^3/dm
16 Rs= 0.009*vs^1.85*A*l^2
17 R1= Rw+Rs
18 //RESULTS
19 printf ('speed = %.f b ft/sec ',vm)
20 printf ('\n Total resistance = %.f lb ',R1)
21
22 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 12.4 example 4

```

1 clc
2 //initialisation of variables
3 H2= 0.75 //ft
4 v1= 1 //ft/sec
5 v2= 6 //ft/sec
6 k= 1.433
7 //CALCULATIONS
8 H1= H2*(v1/v2)^(2/3)
9 Q1= k*H1^2.47
10 Q2= Q1*(H2/H1)^2.5
11 //RESULTS

```

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

Scilab code Exa 12.5 example 5

```
1 clear
2 clc
3 //initialisation of variables
4 nm= 360
5 d= 1.5 //in
6 n= 100
7 dp= 12 //in
8 vm= 4.8 //ft/sec
9 Tm= 52 //sec
10 T= 16 //lb-ft
11 t= 133 //lb ft
12 //CALCULATIONS
13 vp= n*dp*vm/(nm*d)
14 Tp= Tm*dp^2*vp^2/(d^2*vm^2)
15 N= Tm*vm*6080*100/(T*2*pi*nm*60)
16 W= Tp*vp*65000/10.67
17 T1= W/(N*2*pi*n*60)-t
18 //RESULTS
19 printf ( 'Speed of advance = %.2f knots ',vp)
20 printf ( '\n Thrust = %.f lb ',Tp)
21 printf ( '\n Efficiency = %.f per cent ',N)
22 printf ( '\n Torque = %.f lb ft ',T1)
23
24 //The answer is a bit different due to rounding off
    error in textbook
```

Scilab code Exa 12.6 example 6

```
1 clc
```

```

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

```

Scilab code Exa 12.7 example 7

```

1 clc
2 //initialisation of variables
3 dtp= 120 //in
4 dpd= 48 //in
5 vim= 1.25 //ft/sec
6 vip= 5 //ft/sec
7 lp = 600 //ft
8 lm= 40 //ft
9 //CALCULATIONS
10 Rm= (dtp/dpd)^2/((lp/lm)*(vim/vip)^2)
11 d= sqrt(4*Rm)
12 //RESULTS
13 printf ( 'Diameter = %.2f in ',d)

```

Chapter 13

Miscellaneous Problems

Scilab code Exa 13.1 example 1

```
1
2 clc
3 //initialisation of variables
4 W= 5000 //lb
5 vr= 6
6 e= 0.95
7 ep = 0.75
8 d= 9 //in
9 D= 45 //ft
10 t= 2 //min
11 v= 4.5 //ft/sec
12 //CALCULATIONS
13 L= W*vr/(e*ep)
14 Pr= L/(%pi*d^2/4)
15 s= D/vr
16 V= s*%pi*ep^2/(4*t*60)
17 T= D/v
18 V1= s*%pi*ep^2/4
19 V2= V*T
20 V3= V1-V2
21 //RESULTS
```

```

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

```

Scilab code Exa 13.2 example 2

```

1
2 clc
3 //initialisation of variables
4 P1= 1100 //lb/in^2
5 P2= 85 //lb/in^2
6 f= 0.01
7 g= 32.2 //ft/sec^2
8 l= 1600 //ft
9 r= 1/8
10 W= 2500 //lb
11 d= 6 //in
12 //CALCULATIONS
13 L= W*d
14 P= L*2.31/(%pi*(d/2)^2)
15 s1= P1*2540/1100
16 s2= P2*196/85
17 vp= sqrt((s1-s2-P)/(4*f*l/(2*g*r)))
18 V= vp/16
19 V1= V*d
20 Vp= sqrt((s1/3)/(4*f*l/(2*g*r)))
21 v1= Vp*d/16
22 Hr= s1-(s1/3)-s2
23 Lr= Hr*%pi*(d/2)^2/(2.31*d)
24 //RESULTS
25 printf("In case 1, velocity of load = %.2f ft/sec",
      V1)
26 printf("\n In case 2, velocity of load = %.2f ft/sec
      ",v1)

```

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

Scilab code Exa 13.3 example 3

```
1 clc
2 //initialisation of variables
3 bhp= 1500 //h.p
4 e= 0.86
5 h1= 300 //ft
6 h2= 15 //ft
7 w= 62.4 //lb/ft^3
8 t= 30 //days
9 t1= 10 //hr
10 t2= 3 //months
11 f= 0.005
12 l= 1000 //ft
13 //CALCULATIONS
14 WHP= bhp/e
15 Ha= h1-h2
16 W= WHP*550
17 Q= W/(Ha*w)
18 Qt= Q*36009*t1*t*t2
19 Qp= Qt/(3600*t*45)
20 d= (f*l*(Q/2)^2/(t1*h2))^(1/5)
21 //RESULTS
22 printf ('Diameter = %.2f ft ',d)
```

Scilab code Exa 13.4 example 4

```
1 clear
2 clc
3 //initialisation of variables
4 l= 140 //ft
```

```

5 P= 70 //percent
6 V= 3*10^8 //ft^3
7 w= 62.4 //lb/ft^3
8 SBD= 4.9*10^8 //ft^3
9 Q= 162 //cuses
10 s= 12.2*10^6 //ft^3/day
11 //CALCULATIONS
12 O= Q*w*1*(P/1000)/550
13 //RESULTS
14 printf ('Size of reservoir= %.2e ft^3 ',SBD)
15 printf ('\n output = %.f h.p ',O)
16 printf ('\n output = %.f h.p ',Q)

```

Scilab code Exa 13.5 example 5

```

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

```

Scilab code Exa 13.6 example 6


```

1 clear
2 clc
3 //initialisation of variables
4 P= 10 //lb/in^2
5 r1= 0.5 //ft
6 r= 0.25 //ft
7 f= 42.3 //ft/sec
8 b= 1/40
9 Tt= 1400 //lb
10 //CALCULATIONS
11 Q= 2*pi*r*b*f
12 p1= 34+P
13 Fu= p1*pi*(r-(r/4))*144/2.3
14 Fr= Fu-Tt
15 //RESULTS
16 printf ('Quantity = %.2f cusecs ',Q)
17 printf ('\n Resultant force on the plate = %.f lb ',
    Fr)
18
19 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 13.7 example 7

```

1
2 clc
3 //initialisation of variables
4 r= 0.5 //ft
5 N= 300
6 w= 62.4 //lb/ft^3
7 g= 32.2 //ft/sec^2
8 //CALCULATIONS
9 A= N*2*pi/60
10 Ft= pi*A^2*r^4*w/(4*g)
11 //RESULTS

```

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

Scilab code Exa 13.8 example 8

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

Scilab code Exa 13.10 example 10

```
1
2 clc
3 //initialisation of variables
4 P= 14.7 //lb/in^2
5 T= 15 //C
6 v= 350 //ft/sec
7 R= 0.714
8 //CALCULATIONS
9 P1= P*144
10 r= 3091*(273+T)
```

```

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

```

Scilab code Exa 13.11 example 11

```

1
2 clc
3 //initialisation of variables
4 T= 27 //C
5 P=33 //lb/in^2
6 p1= 14.7 //lb/in^2
7 w= 250 //lb
8 g= 32.2 //ft/sec^2
9 Cd= 0.99
10 r= 1.4
11 //CALCULATIONS
12 w1= P*144/(96*(273+T))
13 d= p1*144/(96*(273+T))
14 W= d*w/60
15 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
16 //RESULTS
17 printf ('Diameter = %.3f in ',d)

```

Scilab code Exa 13.12 example 12

```

1 clear
2 clc
3 //initialisation of variables
4 sp= 13.6
5 hm= 800 //mm
6 d= 3 //in
7 r= 1.4
8 R= 1385 //ft-lb/lb/C
9 w= 62.4 //lb/ft^3
10 T= 15 //C
11 hm1= 765 //mm
12 r1= 9
13 g= 32.2 //ft/sec^2
14 //CALCULATIONS
15 p1= hm*sp*w/304.8
16 r2= (273+T)*R
17 w1= p1/r2
18 k= hm/hm1
19 v1= sqrt((2*g*r*r2*(1-k^0.286))/((1-r)*(r1^2*k
    ^1.43-1)))
20 W= v1*w1*3600*(%pi/64)
21 //RESULTS
22 printf ('Weight flowing = %.1f lb/hr ',W)
23
24 //The answer is a bit different due to rounding off
    error in textbook

```

Scilab code Exa 13.13 example 13

```

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

```

```

7 R= 96
8 V= 120 //ft^3
9 f= 0.004
10 a= 60*%pi
11 l= 10560 //ft
12 g= 32.2 //ft/sec^2
13 //CALCULATIONS
14 p1= p*144
15 w1= p*144/(R*(273+T))
16 v1= V*36/a
17 p2= sqrt(p1^2-((2*4*f*p1*w1*v1^2*l)/(2*g*d)))/144
18 v2= p*v1/p2
19 //RESULTS
20 printf ( ' pressure = %.1f lb/in^2 ',p2)
21 printf ( '\n velocity = %.1f ft/sec ',v2)
22
23 //The answer is a bit different due to rounding off
    error in textbook

```
