Scilab Textbook Companion for Fundamental Of Physics by D. Haliday, R. Resnick And J. Walker[1]

Created by
Aman Mangal
B.TECH (pursuing)
Computer Engineering
IIT Bombay
College Teacher
Not Decided
Cross-Checked by
Prashant Dave, IIT Bombay

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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.

Contents

List of Scilab Codes

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Chapter 1

Measurement

Scilab code Exa 1.1 Sample Problem 1

```
//Given that
velocityP = 23 //rides per h
c1 = 4  //from ride to stadia
c2 = 6  //from stadia to plethra
c3 = 30.8 //from plethra to meter
c4 = 10^-3  //from meter to kilometer
c5 = 60 * 60  //from h to sec

//Sample Problem 1-1
printf("**Sample Problem 1-1**\n")
velocityC = velocityP * c1 * c2 * c3 * c4 / c5
printf("The speed is %e km/s", velocityC)
```

Scilab code Exa 1.2 Sample Problem 2

```
//Given that
conv1 = 170.474  //conversion from crans to liters
```

```
conv2 = 48.26  //from covido to cm
V1 = 1255  //in crans

//Sample Problem 1-2
printf("**Sample Problem 1-2**\n")
VC = V1 * conv1 * 10^3 / (conv2^3)
printf("The required declaration is %e cubic covidos", VC)
```

Scilab code Exa 1.3 Sample Problem 3

```
//Given that
//the crossection to be approximately squre
Radius = 2 //in meter
side = 4 * 10^-3  //converted from mm to meter

//Sample Problem 1-3
printf("**Sample Problem 1-3**\n")
//making the volume equal
Length = 4/3 * %pi * Radius^3 / side^2
L_km = Length/10^3
order = round(log(L_km)/log(10)) //will give us order of magnitude
printf("The order of length of string is 10^%d km", order)
```

Scilab code Exa 1.4 Sample Problem 4

```
//Given that
```

```
height = 1.70  //in meter
elapsed_time = 11.1  //in sec

//Sample Problem 1-4
printf("**Sample Problem 1-4**\n")
//the angle between the two radius is
theta = elapsed_time / (24 * 3600) * %pi*2  //in radians
//we also have d^2 = 2 * r *h
//as d is very small hence can be considered as a arc
//d = r * theta
//=> r * theta^2 = 2 * h
radius = 2 * height /theta^2
printf("The radius of earth is %e m", radius)
```

Chapter 2

Motion Along a Straight Line

Scilab code Exa 2.1.a `Sample Problem 1a`

```
//Given that
velocity = 70  //in km/h
distance_covered = 8.4   //in km
next_time = 30  //in min
next_walk = 2  //in km

//Sample Problem 2-1a
printf("**Sample Problem 2-1a**\n")
overall_displacement = distance_covered + next_walk
printf("Overall displacement from begining of the
   drive to the station is %f km",
   overall_displacement)
```

check Appendix AP 13 for dependency:

`Example2_1a.sce`

Scilab code Exa 2.1.b `Sample Problem 1b`

```
exec('Example2_1a.sce', -1)
clc

//Sample Problem 2-1b
printf("\n**Sample Problem 2-1b**\n")
time = distance_covered / velocity  //in hr
delta_t = time  + next_time /60  //in hr
printf("Time interval from the begining of the drive
    to the arrival at the station is %f hr", delta_t
  )
```

check Appendix AP 13 for dependency:

`Example2_1a.sce`

check Appendix AP 12 for dependency:

`Example2_1b.sce`

Scilab code Exa 2.1.c `Sample Problem 1c`

```
exec('Example2_1a.sce', -1)
clc

//Sample Problem 2-1c
printf("\n**Sample Problem 2-1c**\n")
average_velocity = overall_displacement/delta_t
printf("The average velocity over the whole journey
  is %f km/h\n", average_velocity)

//from position v/s time graph
xset('window',1)
xtitle ("position v/s time","time(hr)","position(Km)
  ");
//drawing reference lines
```

```
plot(linspace(delta_t,delta_t,10),linspace(0,overall_displacement,10),'--.x')
plot(linspace(0,delta_t,10),linspace(overall_displacement,overall_displacement,10),'--.o')
plot(linspace(time,time,10),linspace(0,distance_covered,10),'--')
plot(linspace(0,time,10),linspace(distance_covered,distance_covered,10),'--')
//position v/s time graph
x = linspace(0,time,10);
y = linspace(0,distance_covered,10);
plot(x,y,'r');
//average graph
x = linspace(time,delta_t,10);
y = linspace(distance_covered,overall_displacement,10);
plot(x,y,'r');
//slope of this line will give us the average velocity
x = linspace(0,delta_t,10);
y = linspace(0,overall_displacement,10);
plot(x,y,'m');
legend('$\delta x=10.4 km$','time interval=.62hr')
printf("The average velocity from the graph is %f km/h", 10.4/delta_t)
```

check Appendix AP 13 for dependency:

`Example2_1a.sce`

check Appendix AP 12 for dependency:

`Example2_1b.sce`

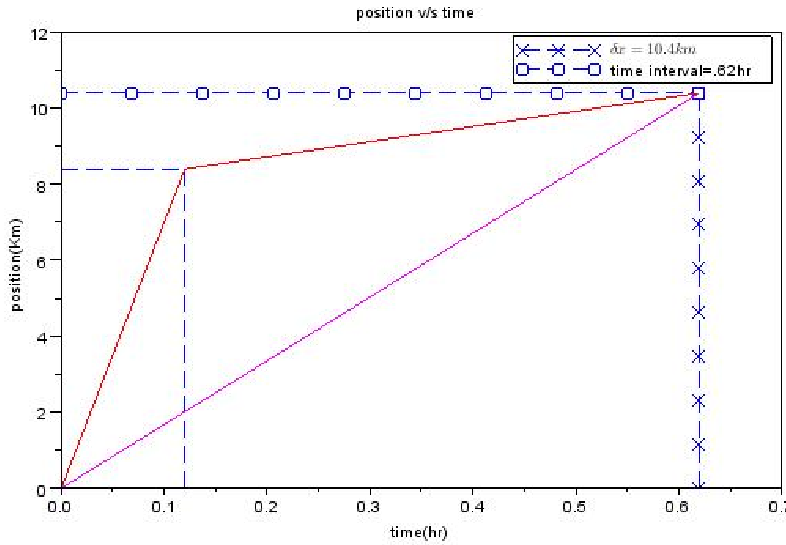

Figure 2.1: Sample Problem 1c

Scilab code Exa 2.1.d `Sample Problem 1d`

```
//Given that
exec('Example2_1a.sce', -1)
exec('Example2_1a.sce', -1)
clc

//Sample Problem 2-1d
printf("\n**Sample Probelm 2-1d**\n")
time_station = 45  //in min
//he trevels 2 km back to the truck
final_displacement = overall_displacement + 2  //in km
final_average_velocity = final_displacement /(delta_t + time_station /60)
```

```
printf("Average velocity from the begining of the
   drive till reaching back to the truck is %f km/h"
   , final_average_velocity)
```

Scilab code Exa 2.2 Sample Problem 2

```
//Sample Problem 2-2
printf("**Sample Problem 2-2**\n")
//we know that v=dx/dt
xset('window',2)
//velocity v/s time graph
subplot(2,1,1);
xtitle ("VELOCITY v/s TIME","time (sec)","velocity (
   m/s)");
plot2d(linspace(0,0,10),linspace(0,0,10),style=3,
   rect=[0,0,10,5]);
//drawing the graph
plot(linspace(0,1,10),linspace(0,0,10),'m');
plot(linspace(1,3,10),linspace(0,4,10),'m');
plot(linspace(3,8,10),linspace(4,4,10),'m');
plot(linspace(8,9,10),linspace(4,0,10),'m');
plot(linspace(9,10,10),linspace(0,0,10),'m');
//dotted lines
plot(linspace(0,3,5),linspace(4,4,5),'--');
plot(linspace(3,3,5),linspace(0,4,5),'--');
plot(linspace(8,8,5),linspace(0,4,5),'--');

//acceleration v/s time graph
subplot(2,1,2);
xtitle("ACCELERATION v/s TIME","time (sec)", "
   acceleration s(m/s^2)")
plot2d(linspace(0,0,10),linspace(0,0,10),style=0,
   rect=[0,-5,10,5]);
```

```
//drawing the graph
plot(linspace(0,1,5),linspace(0,0,5),'m');
plot(linspace(1,1,5),linspace(0,2,5),'m');
plot(linspace(1,3,5),linspace(2,2,5),'m');
plot(linspace(3,3,5),linspace(2,0,5),'m');
plot(linspace(3,8,5),linspace(0,0,5),'m');
plot(linspace(8,8,5),linspace(0,-4,5),'m');
plot(linspace(8,9,5),linspace(-4,-4,5),'m');
plot(linspace(9,9,5),linspace(-4,0,5),'m');
plot(linspace(9,10,5),linspace(0,0,5),'m');
//dotted lines
plot(linspace(1,1,5),linspace(-5,0,5),'--');
plot(linspace(3,3,5),linspace(-5,0,5),'--');
plot(linspace(8,8,5),linspace(-5,-4,5),'-.');
plot(linspace(9,9,5),linspace(-5,-4,5),'-.');
plot(linspace(0,1,5),linspace(2,2,5),'--');
plot(linspace(0,8,5),linspace(-4,-4,5),'--');
plot(linspace(1,3,5),linspace(0,0,5),'--');
plot(linspace(8,9,5),linspace(0,0,5),'--');
```

Scilab code Exa 2.3 `Sample Problem 3`

```
//Given that
t = poly(0,'t');
x = 7.8 + 9.2 * t - 2.1 * t^3;

//Sample Problem 2-3
printf("**Sample Problem 2-3**\n")
v = derivat(x)
velocity = horner(v,3.5)
printf("Velocity at t=3.5 second is equal to %f m/s"
```

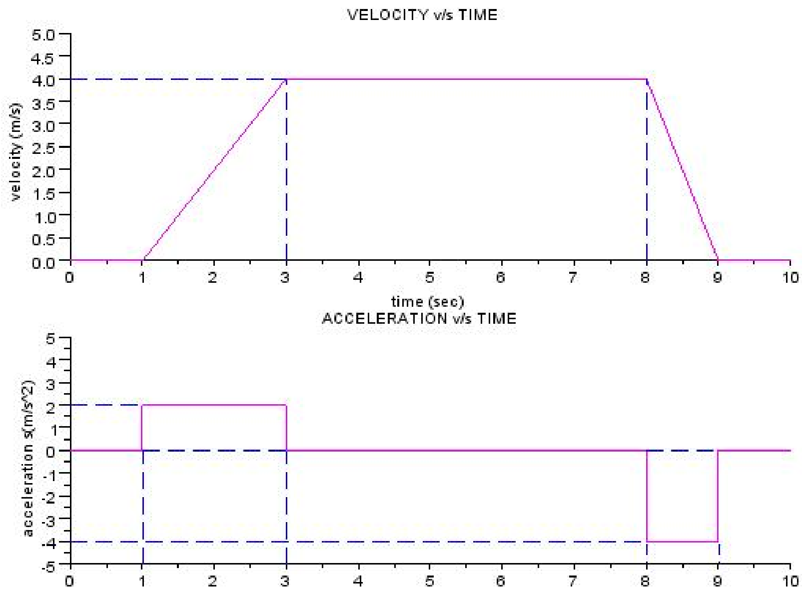

Figure 2.2: Sample Problem 2

```
   , velocity)
```

Scilab code Exa 2.4 `Sample Problem 4`

```
//Given that
t = poly(0,'t')
x = t^3  - 27 * t + 4

//Sample Problem 2-4a
printf("**Sample Problem 2-4a**\n")
velocity = derivat(x)
acceleration = derivat(velocity)
printf("The velocity as a function of time in m/s is
   ")
```

```
disp(velocity)
printf("The acceleration as a function of time in m/s^2 is")
disp(acceleration)

//Sample Problem 2-4b
printf("\n**Sample Problem 2-4b**\n")
v0 = roots(velocity)
printf("velocity of the particle is zero at times in sec")
disp(v0)
```

Scilab code Exa 2.5 Sample Problem 5

```
//Given that
conv = 5/18  //converts velocity from km/h to in m/s
speed_initial = 100 * conv  //in km/h
speed_final = 80 * conv   //in km/h
displacement = 88  //in meter

//Sample Problem 2-5a
printf("**Sample Problem 2-5a\n")
//using newton's 3rd equation of motion
acceleration = (speed_final^2 - speed_initial^2)/(2 * displacement)
printf("The acceleration is equal to %f m/sec^2\n", acceleration)

//Sample Problem2-5b
printf("\n**Sample Problem 2-5a**\n")
//using newton's first equation of motion
time = (speed_final - speed_initial)/acceleration
printf("The time taken to decrease the speed is %f
```

```
sec", time)
```

Scilab code Exa 2.6 Sample Problem 6

```
//Given that
g = -9.8    //in m/sec^2
displacement = -48  //in meter

//Sample Problem 2-6a
printf("**Sample Problem 2-6a**\n")
//using newton's  equation of motion
//displacement = 0 * t + .5 * g * t * t
//displacement = .5 * g * t * t
time = sqrt(displacement/(.5 * g))
printf("The time taken to reach at the ground is %f sec\n", time)

//Sample Problem 2-6b
printf("\n**Sample Problem 2-6b**\n")
t = poly(0,'t');
dis_t = 0 * t + .5 * g *t * t
ds = horner(dis_t,[1,2,3])
printf("The displacements at times 1,2,3 sec in meter is")
disp(ds)

//Sample Problem 2-6c
printf("\n**Sample Problem 2-6c**\n")
//using newton's first equation of motion v = u + a*t
velocity = 0 + g * time
printf("The velocity at water surface is equal to %f km/h\n", velocity)
```

```
//Sample Problem 2-6d
printf("\n**Sample Problem 2-6d**\n")
//using newton's first equation of motion
v_at_time_t = 0 + g * t
velocities = horner(v_at_time_t,[1,2,3])
printf("The velocitis at times 1,2,3 sec in m/s is")
disp(velocities)
```

Scilab code Exa 2.7 Sample Problem 7

```
//Given that
g = -9.8   //in m/sec^2
v_initial = 12  //in m/s
v_final = 0  //at maximum height velocity equal to
   zero

//Sample Problem 2-7a
printf("**Sample Problem 2-7a**\n")
//using newton'd first equation of motion
//  v_final = v_initial + g * t
h_max_time = (v_final - v_initial)/g
printf("After %f sec, the ball will attain its
   maximum height\n", h_max_time)

//Sample Problem 2-7b
printf("\n**Sample Problem 2-7b**\n")
//using newton's second equation of motion
h_max = (v_final^2 - v_initial^2)/(2 * g)
printf("The maximum height reached by the baseball
   is %f m\n", h_max)

//Sample Problem 2-7c
```

```
printf("\n**Sample Problem 2-7c**\n")
displacement = 5
t = poly(0,'t')
quad_t = v_initial * t + .5 * g * t * t -
   displacement
t_5 = roots(quad_t)
printf("At following times in sec, the ball will be
   at height 5m")
disp(t_5)
```

Chapter 3

Vectors

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 3.1 Sample Problem 1

```
exec('degree_rad.sci', -1)

//Given that
a = [2,0]
b = [2 *cos(dtor(30)),2 *sin(dtor(30))]
c = [-1,0]

//Sample Problem 3-1
printf("**Sample Problem 3-1**\n")
poss = [norm(a+b+c) norm(a-b+c), norm(a+b-c), norm(a
   -b-c)]
max_norm = 0
for v = poss
    if v > max_norm  then max_norm = v
    end
end
printf("The maximum possible value is %f m",
   max_norm)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 3.2 Sample Problem 2

```
exec('degree_rad.sci', -1)

//Given that
dis = 215   //in km
position = [dis * cos(dtor(22)), dis * sin(dtor(22))
   ]

//Sample Problem 3-2
printf("**Sample Problem 3-2**\n")
printf("The plane is %f km in the north & %f in the
   east", position(1),position(2))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 3.3 Sample Problem 3

```
exec("degree_rad.sci",-1)

//Given that
displacement_vector = [-2.6,-3.9,.025]    //each in
   km
```

```

//Sample Problem 3-3
printf("**Sample Problem 3-3**\n")
mag = norm(displacement_vector)
sw_angle = atan(displacement_vector(2)/displacement_vector(1))
up_angle = displacement_vector(3)/norm(displacement_vector)
printf("The team displacement vector had a magnitude %f km,\n and was at an angle of %d south of west and\n at an angle of %f upward", mag, rtod(sw_angle), rtod(up_angle))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 3.4 Sample Problem 4

```
exec("degree_rad.sci",-1)

//Given that
a = [4.2,-1.5]
b = [-1.6,2.9]
c = [0,-3.7]

//Sample Problem 3-4
printf("**Sample Problem 3-4**\n")
r = a + b + c
magnitude = norm(r)
angle = rtod(atan(r(2)/r(1)))
printf("The magnitude of the vector is %f m & the angle measured from the x axis is %f", magnitude, (angle) )
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 3.5 Sample Problem 5

```
exec("degree_rad.sci",-1)

//Given that
a = [36,0]    //in km
c = [25 *cos(dtor(135)), 25 *sin(dtor(135))]    //in
    km
d_mag = 62   //in km

//Sample Problem 3-5
printf("**Sample Problem 3-5**\n")
//we have a + b + c = d
//therefore ax = bx + cx + dx
// bx = 0
d_x = a(1) + c(1)
d_y = d_mag * sqrt(1 - (d_x/d_mag)^2)
d = [d_x, d_y]
b = d(2) - a(2) - c(2)
printf("The magnitude of b is equal to %f km", b)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 3.6 Sample Problem 6

```
exec("degree_rad.sci",-1)

//Given that
a = [3,-4,0]
b = [-2,0,3]

//Sample Problem 3-6
printf("**Sample Problem 3-6**\n")
angle_ab = acos(-norm(a*b')/(norm(a) * norm(b)))
printf("The angle between given vectors is %f
    degress", rtod(angle_ab))
```

---

check Appendix AP 7 for dependency:

`cross_product.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 3.7 Sample Problem 7

```
exec("degree_rad.sci",-1)
exec("cross_product.sci",-1)

//Given that
a = [18 * cos(dtor(250)), 18 * sin(dtor(250)),0]
b = [0,0,12]

//Sample Problem 3-7
printf("**Sample Problem 3-7**\n")
cross_ab = crossproduct(a,b)
angle_x = acos(cross_ab(1)/norm(cross_ab))
```

```
printf("The magnitude of cross product of given
    vectors is %f \n and angle  with the x axis in
    degrees is %f", norm(cross_ab),rtod(angle_x))
```

check Appendix AP 7 for dependency:

`cross_product.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 3.8 `Sample Problem 8`

```
exec("degree_rad.sci",-1)
exec("cross_product.sci",-1)

//Given that
a = [3,-4,0]
b = [-2,0,3]

//Sample Problem 3-8
printf("**Sample Problem 3-8**\n")
cross_ab = crossproduct(a,b)
printf("The cross product of given vectors is ")
disp(cross_ab)
```

Chapter 4

Motion in Two and Three Dimesions

Scilab code Exa 4.1 Sample Problem 1

```
//Given that
r_initial = [-3,2,5]    //in meter
r_final = [9,2,8]    //in meter

//Sample Problem 4-1
printf("**Sample Problem 4-1**\n")
dis_v = r_final - r_initial
printf("The displacement vector of the particle in
    meter is")
disp(dis_v)
```

Scilab code Exa 4.2.a Sample Problem 2a

```
exec("degree_rad.sci",-1)
```

```
//Given that
t = poly(0,'t')
x = -0.31 *t^2 + 7.2 *t +28  //in meter
y = 0.22 *t^2 - 9.1 *t + 30  //in meter

//Sample Problem 4-2a
printf("**Sample Problem 4-2a**\n")
time_t =15  //in sec
position_r = [horner(x,time_t),horner(y,time_t)]
printf("The position vector of the rabbit at t=15sec in meter is")
disp(position_r)
printf("The magnitude of the position vector is %f m\n", norm(position_r))
printf("The angle made by the position vector with the x axis in degrees at the same time %f", rtod(atan(position_r(2)/position_r(1))))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 11 for dependency:

`Example4_2a.sce`

Scilab code Exa 4.2.b `Sample Problem 2b`

```
exec("Example4_2a.sce",-1)
clc

//Sample Problem 4-2b
printf("**Sample Problem 4-2b**\n")
xx = horner(x, [0:2:25])
```

```
yy = horner(y, [0:2:25])
xset('window',3)
xtitle ("Y v/s X [t=0sec to t=25sec]","X (m)","Y (m)");
plot2d(linspace(0,0,10),linspace(0,0,10),style=3,rect=[0,-80,80,40]);
//plotting grid
plot(linspace(10,10,5),linspace(-80,40,5),'--')
plot(linspace(20,20,5),linspace(-80,40,5),'--')
plot(linspace(30,30,5),linspace(-80,40,5),'--')
plot(linspace(40,40,5),linspace(-80,40,5),'--')
plot(linspace(50,50,5),linspace(-80,40,5),'--')
plot(linspace(60,60,5),linspace(-80,40,5),'--')
plot(linspace(70,70,5),linspace(-80,40,5),'--')
plot(linspace(80,80,5),linspace(-80,40,5),'--')
plot(linspace(0,80,5),linspace(-60,-60,5),'--')
plot(linspace(0,80,5),linspace(-40,-40,5),'--')
plot(linspace(0,80,5),linspace(-20,-20,5),'--')
plot(linspace(0,80,5),linspace(0,0,5),'--')
plot(linspace(0,80,5),linspace(20,20,5),'--')
plot(linspace(0,80,5),linspace(40,40,5),'--')
//plotting graph
plot(xx,yy,'m.<-')
```

check Appendix AP 11 for dependency:

`Example4_2a.sce`

Scilab code Exa 4.3 `Sample Problem 3`

```
exec("Example4_2a.sce",-1)
clc
```

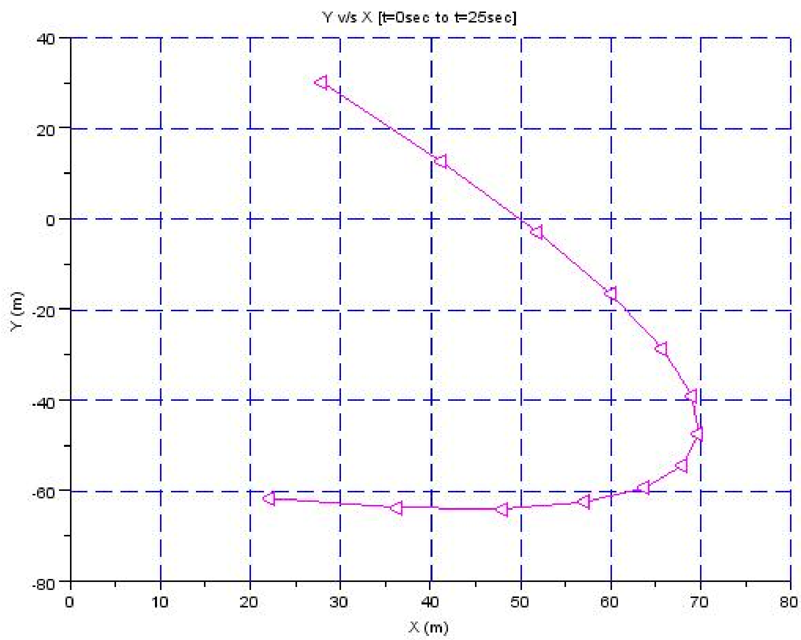

Figure 4.1: Sample Problem 2b

```
//Sample Problem 4-3
printf("\n**Sample Problem 4-3**\n")
velocity_v_x = derivat(x)
velocity_v_y = derivat(y)
v_time_t = [horner(velocity_v_x,time_t),horner(velocity_v_y,time_t)]
printf("The velocity vector of the rabbit at t=15sec in m/s is")
disp(v_time_t)
printf("The magnitude of the velocity vector is %f m/s\n", norm(v_time_t))
printf("The angle made by the velocity vector with the x axis in degrees at the same time %f", rtod(atan(v_time_t(2)/v_time_t(1))))
```

---

check Appendix AP 10 for dependency:

`Example4_3.sce`

Scilab code Exa 4.4 `Sample Problem 4`

```
exec("Example4_3.sce",-1)
clc

//Sample Problem 4-4
printf("\n**Sample Problem 4-4**\n")
acceler_x = derivat(velocity_v_x)
acceler_y = derivat(velocity_v_y)
a_time_t = [horner(acceler_x,time_t),horner(acceler_y,time_t)]
printf("The acceleration vector of the rabbit at t=15sec in m/sec^2 is")
disp(a_time_t)
```

```
printf("The magnitude of the acceleration vector is
    %f m/sec^2\n", norm(a_time_t))
printf("The angle made by the acceleration vector
    with the x axis in degrees at the same time %f",
    rtod(atan(a_time_t(2)/a_time_t(1))))
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 4.5 Sample Problem 5

```
exec("degree_rad.sci",-1)

//Given that
velocity_v0 = [-2,4]   //in m/s
acceler_a = [3 *cos(dtor(130)), 3 *sin(dtor(130))]
      //in m/sec^2
time_t = 5   //in sec

//Sample Problem 4-5
printf("**Sample Problem 4-5**\n")
//using newton's first equation of motion v = u + a
    *t
velocity_t = velocity_v0 + acceler_a * time_t
printf("The velocity vector of the particle at t=5
    sec in m/s is")
disp(velocity_t)
printf("The magnitude of the velocity vector is %f m
    /s\n", norm(velocity_t))
printf("The angle made by the velocity vector with
    the x axis in degrees at the same time %f", rtod(
    atan(velocity_t(2)/velocity_t(1))))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 4.6 Sample Problem 6

```
exec("degree_rad.sci",-1)

//Given that
v_rescue = [55,0]    //in m/s
dis_y = -500     //in m
g = -9.8     //in m/s^2

//Sample Problem 4-6a
printf("**Sample Problem 4-6a**\n")
//using newton's second equation of motion
time = sqrt(2 *dis_y /g)
dis_x = v_rescue(1) *time
printf("The angle of the piliots line of sight to the victim %f degrees\n",rtod(atan(-dis_x/dis_y)))

//Sample Problem 4-6b
printf("\n**Sample Problem 4-6b**\n")
u_initial = v_rescue
//using newton's first equation of motion
v_final = u_initial + [0,g] * time
printf("The velocity vector of the capsule near water in m/s is")
disp(v_final)
printf("The magnitude of the velocity vector is %f m/s\n", norm(v_final))
```

```
printf("The angle made by the velocity vector with
    the x axis in degrees at the same time %f", rtod(
    atan(v_final(2)/v_final(1))))
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 4.7 Sample Problem 7

```
exec("degree_rad.sci",-1)

//Given that
range_x = 560    //in m
v0_mag = 82      //in m/sec
g = -9.8     //in m/s^2

//Sample Problem 4-7a
printf("**Sample Problem 4-7a**\n")
theta = .5 *asin(-g* range_x/v0_mag^2)
printf("The angle at which the ball be fired to hit
    the ship is %f degrees or %f\n", rtod(theta), (90
     - rtod(theta)))

//Sample Problem 4-7b
printf("\n**Sample Problem 4-7b**\n")
//Range is maximum when theta = 45 degree
R_max = -v0_mag^2/g
printf("The maximum possible range is %f m", R_max)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 4.8 Sample Problem 8

```
exec("degree_rad.sci",-1)

//Given that
gr_height = 3   //in m
theta = dtor(53)
g = -9.8   //in m/s^2
v0 = 26.5   //in m/s
tower_height = 18   //in m

//Sample Problem 4-8a
printf("**Sample Problem 4-8a**\n")
x = poly(0,'x')
y = x * tan(theta) + g * x * x /(2* v0^2) * sec(theta)^2
y_tower1 = horner(y,23)
if y_tower1<0 then printf("No, It does not clear the first Ferris wheel\n")
    else printf("Yes, It clears the first Ferris wheel\n")
end

//Sample Proble, 4-8b
printf("\n**Sample Problem 4-8b**\n")
y_max = horner(y,34.5)
printf("The balls clearance above middle tower is %f m\n", y_max + gr_height - tower_height)

//Sample Problem 4-8c
printf("\n**Sample Problem 4-8c**\n")
Range = -v0^2 * sin(2*theta)/g
printf("The centre of the net should be placed at a diastance of %f m form the cannon", Range)
```

Scilab code Exa 4.9 Sample Problem 9

```
//Given that
g = 9.8     //in m/s^2
v = 694    //in m/s
r = 5800     //in m

//Sample Problem 4-9
printf("**Sample Problem 4-9**\n")
cent_a = v^2 / (r *g)
printf("Centripetal acceleration of the pilot is %f*
    g m/s^2", cent_a)
```

Scilab code Exa 4.10 Sample Problem 10

```
//To convert velocity m/s from km/h
conv = 5/18

//Given that
v_BA = 52    //in km/hr
v_PA = -78   //in km/hr

//Sample Problem 4-10a
printf("**Sample Problem 4-10a**\n")
//using concept of relative velocity
v_PB = v_PA - v_BA
printf("The velocity of P as measured by Barbara is
    %d km/hr\n",v_PB)
```

```

//Sample Problem 4-10b
printf("\n**Sample Problem 4-10b**\n")
//In frame of Alex
delta_t = 10  //in sec
a_PA = (0 - v_PA)* conv/delta_t
printf("The accleration of P in frame of Alex is %f
   m/s^2\n", a_PA)

//Sample Problem 4-10c
printf("\n**Sample Problem 4-10c**\n")
a_BA = 0
a_PB = a_PA - a_BA
printf("The acceleration of P as measured by B is %f
    m/s^2", a_PB)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 4.11 Sample Problem 11

```
exec("degree_rad.sci",-1)

//Given that
v_WG = [65 * sin(dtor(20)),65 * cos(dtor(20))]   //
    in km/h
v_PG_y = 0
v_PW_mag = 215  //in km/h

//Sample Problem 4-11
printf("**Sample Problem 4-11**\n")
//therefore in direction
v_PW_y = v_PG_y - v_WG(2)
```

```
v_PW_x = sqrt(v_PW_mag^2 - v_PW_y^2)
v_PG_x = v_PW_x + v_WG(1)
printf("The magnitude of velocity of plane relative
   to ground is %f km/h", v_PG_x)
```

Chapter 5

Force and Motion I

check Appendix AP 2 for dependency:

```
degree_rad.sci
```

Scilab code Exa 5.1 `Sample Problem 1`

```
exec("degree_rad.sci",-1)

//Given that
m = .20    //in kg
F_1 = 4 * [1,0]
F_2 = 2 * [-1,0]
F_3 = 1 * [cos(dtor(30)),sin(dtor(30))]

//Sample Problebb   nmkn nm 5-1
printf("**Sample Problem 5-1**\n")
acceleration_a = F_1(1)/m
acceleration_b = F_2(1)/m
acceleration_c = (F_2(1) + F_3(1))/m
printf("The acceleration of puck in case a is %d m/s^2\n",acceleration_a)
printf("The acceleration of puck in case b is %d m/s^2\n",acceleration_b)
```

```
printf("The acceleration of puck in case c is %f m/s^2\n",acceleration_c)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 5.2 Sample Problem 2

```
exec("degree_rad.sci",-1)

//Given that
mass = 2  //in kg
acceleration = 3 * [cos(dtor(50)),sin(dtor(50))]  //in m/s^2
F1 = 10 * [cos(dtor(180+30)),sin(dtor(180+30))]   //in N
F2 = 20 * [0,1]    //in N

//Sample Problem 5-2
printf("**Sample Problem 5-2**\n")
//from newton's first law
//F1 + F2 + F3 = mass * acceleration
F3 =  mass * acceleration - F2 - F1
printf("The third Force vector F3 in N is")
disp(F3)
printf("The magnitude F3 is %f m/s\n", norm(F3))
printf("The angle made by F3 with the x axis in degrees %f", rtod(atan(F3(2)/F3(1))))
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 5.3 Sample Problem 3

```
exec("degree_rad.sci",-1)

//GIven that
F_A = 220 * [cos(dtor(180-47)),sin(dtor(180-47))] //in N
F_B_dir =  [0,-1]
F_C_mag = 170  //in N

//Sample Problem 5-3
printf("**Sample Problem 5-3**\n")
//net sum of three forces must be zero
phi = acos(- F_A(1) / F_C_mag)
F_B_mag = F_C_mag * sin(phi) + F_A(2)
printf("The magnitude of Bettys force is %f N", F_B_mag)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 5.4 Sample Problem 4

```
exec("degree_rad.sci",-1)

//Given that
g = 10  //in m/s^2
mass = 80  //in kg
theta = 30  //in degrees
```

```
Force_applied = 2.5 * mass * g * [cos(dtor(theta)), sin(dtor(theta))]
W_car = 7 * 10^5  //in N
distance = 1  //in meter

//Sample Problem 5-4
printf("**Sample Problem 5-4**\n")
//using Newtons first law
acceleration = Force_applied(1) / (W_car /g)
//using newtons third equation of motion
v_final = sqrt(2 * acceleration * distance)
printf("The velocity after trevelling 1 m distance is %f m/s", v_final)
```

Scilab code Exa 5.5 Sample Problem 5

```
//Given that
g = 9.8  //in m/s^2
M = 3.3  //in kg
m = 2.1 //in kg

//Sample Problem 5-5
printf("**Sample Problem 5-5**\n")
//from FBD1
//both will have common acceleration
//mg - T = ma
//T = Ma
//adding -> mg = (M+m)a
a = m * g /(M + m)
T = m *g - m *a
printf("The acceleration of both the blocks is %f m/s^2\n", a)
printf("The tension in the string is %f N", T)
```

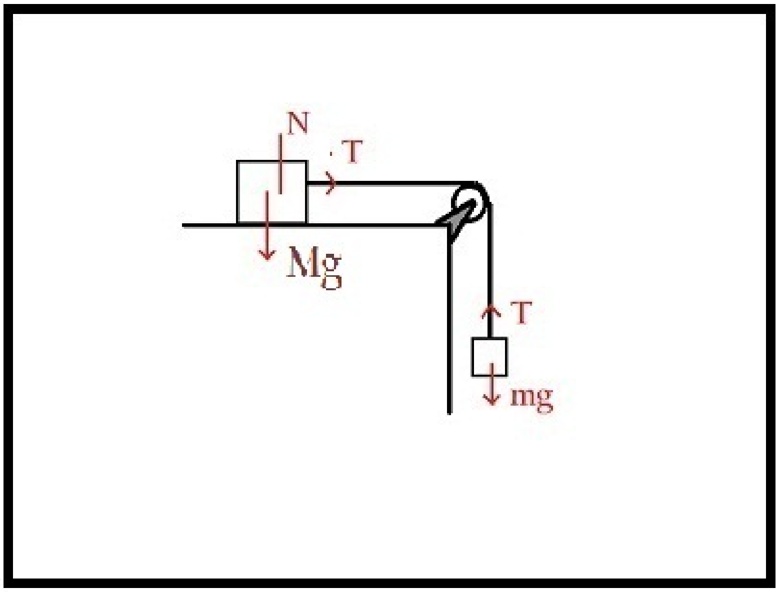

Figure 5.1: Sample Problem 5

---

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 5.6 `Sample Problem 6`

```
exec("degree_rad.sci", -1)

//Given that
```

```
g = 9.8  //in m/s^2
m = 15  //in kg
//from FBD
T = m *g

//Sample Problem 5-6
printf("**Sample Problem 5-6**\n")
//we have-
//T1cos(28) - T2cos(47) = 0
//T1sin(28) + T2sin(47) = T
//therefore
mat_1 = [cos(dtor(28)),-cos(dtor(47));sin(dtor(28)),
    sin(dtor(47))]
mat_2 = [0 ; T]
//wr have -> mat_1 * ans = mat_2
mat_ans = inv(mat_1) * mat_2
printf("The tension in the first chord is %f N\n",
    mat_ans(1,1))
printf("The tension in the second chord is %f N\n",
    mat_ans(2,1))
printf("The tension in the third chord is %f N", T)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 5.7 `Sample Problem 7`

```
exec("degree_rad.sci", -1)

//Given that
m = 15  //in kg
```

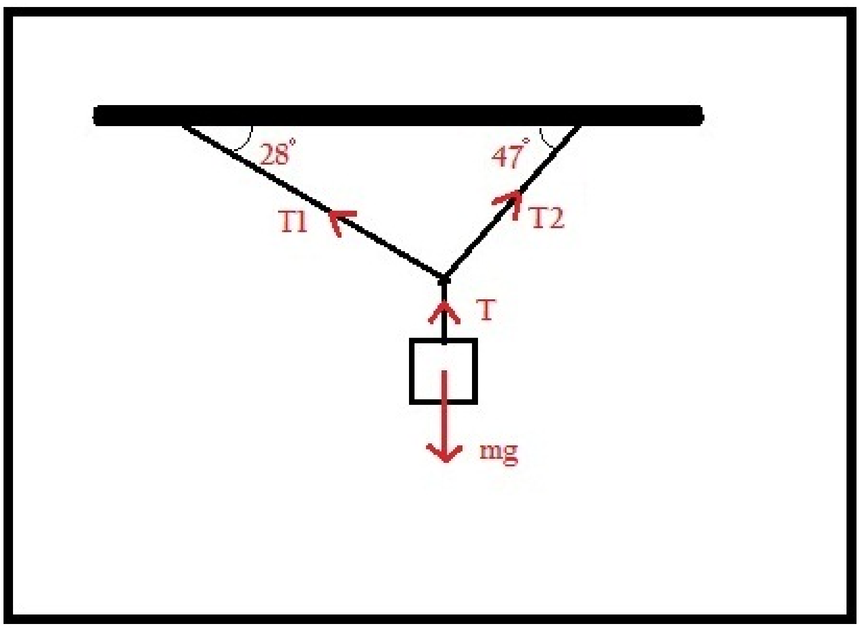

Figure 5.2: Sample Problem 6

```
g = 9.8  //in m/s^2
T = m* g* sin(dtor(27))
N = m* g* cos(dtor(27))

//Sample Problem 5-7a
printf("**Sample Problem 5-7a**\n")
printf("The tension in the chord is %f N\n", T)
printf("The Normal force is %f N\n", N)

//Sample Problem 5-7b
printf("\n**Sample Problem 5-7b**\n")
a = g * sin(dtor(27))
printf("The acceleration of block after cutting the chord is %f m/s^2", a)
```

Scilab code Exa 5.8 Sample Problem 8

```
//Given that
g = 9.8  //in m/s^2
m = 72.2  //in kg

//Sample Problem 5-8a
printf("**Sample Problem 5-8a**\n")
scale_read_b = m *g
printf("The reading of the scale in case a is %f ", scale_read_b)

//Sample Problem 5-8b
printf("**Sample Problem 5-8b**\n")
//N - mg = ma
a_U = 3.2  //in m/s^2
```

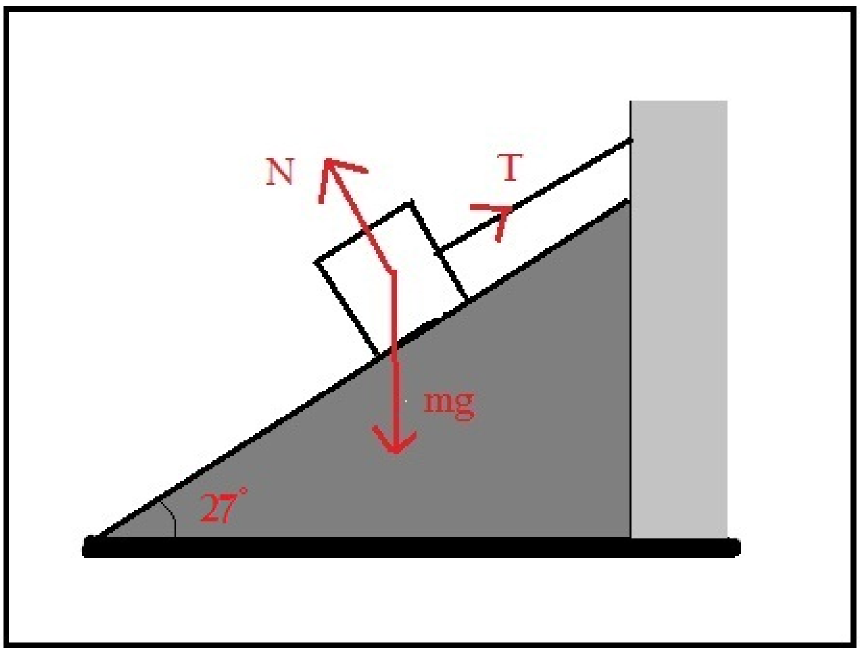

Figure 5.3: Sample Problem 7

```
scale_read_c_U = m * (g + a_U)
printf("The reading of the scale in case b if cab moves upaward is %f\n", scale_read_c_U)
a_D = -3.2  //in m/s^2
scale_read_c_D = m * (g + a_D)
printf("The reading of the scale in case b if cab moves downaward is %f\n", scale_read_c_D)

//Sample Problem 5-8b
printf("\n**Sample Problem 5-8b**\n")
//using newtons second law => net force = mass * acceleration
F_net = m *a_U
printf("The net force on passenger during upward journey is %f N\n", F_net)
printf("The acceleration of passenger in the frame if cab is 0")
```

Scilab code Exa 5.9 `Sample Problem 9`

```
//Sample Problem 5-9a
F_ap = 20  //in N
m_A = 4  //in kg
m_B = 6  //in kg

//Sample Problem 5-9a
printf("**Sample Problem 5-9a**\n")
ac = F_ap /(m_A + m_B)
printf("The comon acceleration of the blocks is %f m/s^2\n", ac)

```

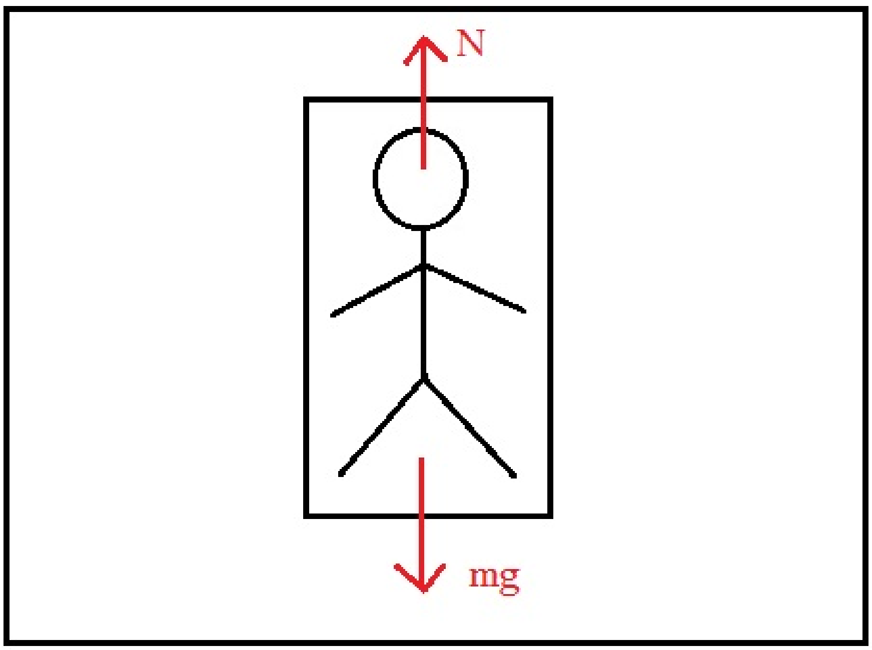

Figure 5.4: Sample Problem 8

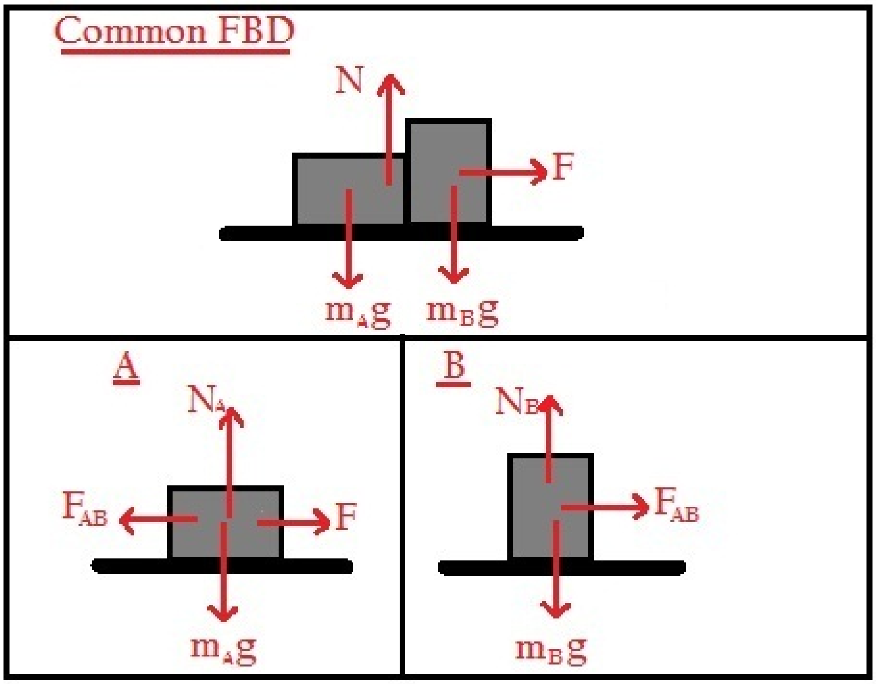

Figure 5.5: Sample Problem 9

```
//Sample Problem 5-9b
printf("\n**Sample Problem 5-9b**\n")
//from FBD of A
//F - F_AB = m_A * a
F_AB = F_ap - m_A *ac
printf("The force on block B by Block A is %f N",
   F_AB)
```

Chapter 6

Force and Motion ll

Scilab code Exa 6.1 Sample Problem 1

```
//Given that
mu_k = 0.6
d = 290  //in meter
g = 9.8 //in m/s^2
v_final = 0

//Sample Problem 6-1
printf("**Sample Problem 6-1**\n")
//using newton's 3rd equation of motion
ac = - mu_k * g  //due to friction hence a negative
    sign
v_initial = sqrt(v_final^2 - 2 * ac * d)
printf("The inital velocity of that car would have
    been %f m/s", v_initial)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 6.2 Sample Problem 2

```
exec("degree_rad.sci",-1)

//GIven that
g = 9.8  //in /s^2
mass = 75  //in kg
mu_k = 0.10
phi = dtor(42)

//Sample Problem 6-2a
printf("**Sample Problem 6-2a**\n")
//T * cos(phi)- mu_k * N = 0
//T * sin(phi) + N = mass * g
mat_A = [cos(phi),-mu_k;sin(phi),1]
mat_B = [0 ;mass * g]
F = inv(mat_A) * mat_B
printf("The Tension in the string is %f N\n", F(1))

//Sample Problem 6-2b
printf("\n**Sample Problem 6-2b**\n")
printf("The force of friction will not change")
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 6.3 Sample Problem 3

```
exec("degree_rad.sci",-1)

//Given that
```

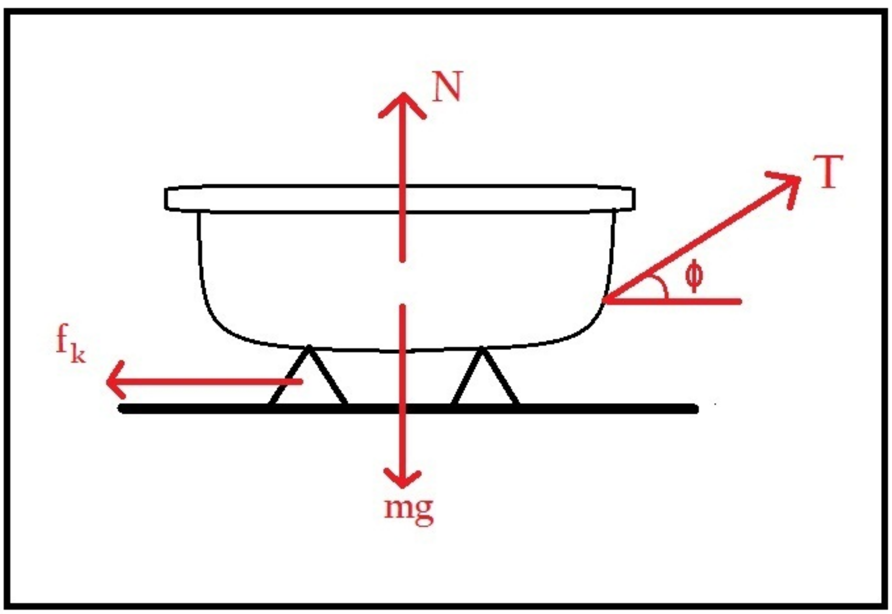

Figure 6.1: Sample Problem 2

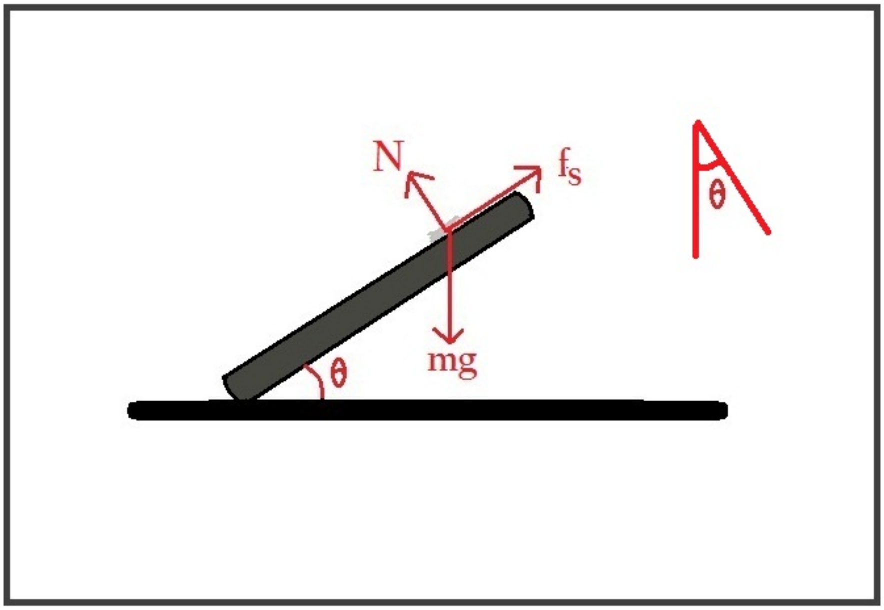

Figure 6.2: Sample Problem 3

```
theta = dtor(13)

//Sample Problem 6-3
printf("**Sample Problem 6-3**\n")
//N = mg cos(theta)
//f_s = mg sin(theta)
//dividing ->
//f_s/N = tan(theta)
mu_s = tan(theta)
printf("The value of coefficient of static friction is %f", mu_s)
```

Scilab code Exa 6.4 Sample Problem 4

```
//Given that
v1 = 97  //in km/hr
//Assuming
A1 = 1
//therefore
A2 = 2

//Sample Problem 6-4
printf("**Sample Problem 6-4**\n")
//the terminal velocity is inversly proportional to squre root of area
v2 = v1 * sqrt(A1/A2)
printf("The final velocity of cat will be %f km/hr", v2)
```

Scilab code Exa 6.5 Sample Problem 5

```
//Given that
g = 9.8  //in m/s^2
Radius = 1.5 * 10^-3  //in meter
height = 1200  //in meter
C_drag = 0.60
density_water = 1000  //in kg/m^3
density_air = 1.2  //in kg/m^3

//Sample Problem 6-5a
```

```
printf("**Sample Problem 6-5a**\n")
//v_t = sqrt(2*F_g/(C*density*A))
volume_drop = 4/3*%pi*Radius^3
mass_drop = density_water *volume_drop
Area_drop = %pi *Radius^2
v_terminal = sqrt(2*mass_drop*g/(C_drag*density_air*Area_drop))
printf("The terminal velocity will be %f m/s\n", v_terminal)

//Sample Problem 6-5b
printf("\n**Sample Problem 6-5b**\n")
v_without_drag = sqrt(2 *g * height)
printf("The velocity just before the impact if there were no drag force would be %f m/s", v_without_drag)
```

Scilab code Exa 6.6 `Sample Problem 6`

```
//Given that
Radius_earth = 6.37 * 10^6
h_alti = 520 * 10^3  //in meter
velocity = 7.6 * 10^3  //in m/s converted from km/s
mass = 79  //in kg

//Sample Problem 6-6a
printf("**Sample Problem 6-6a**\n")
acce = velocity^2/(h_alti + Radius_earth)
printf("The acceleration is equal to %f m/s^2\n", acce)

//Sample Problem 6-5b
printf("\n**Sample Problem 6-6b**\n")
```

```
Force_total  = mass * acce
printf("The net force is equal ro %f N", Force_total)
```

Scilab code Exa 6.7 Sample Problem 7

```
//Given that
g = 9.8  //in m/s^2
Radius = 2.7  //in meter

//Sample Problem 6-7
printf("**Sample Problem 6-7**\n")
//The velocity at highest point is equal to sqrt(gR)
velocity_topmost = sqrt(g * Radius)
printf("The velocity of ball at the topmost point would be %f m/s", velocity_topmost)
```

Scilab code Exa 6.8 Sample Problem 8

```
//Given that
g = 9.8  //in m/s^2
R = 2.1  //in m
mu_s = 0.40

//Sample Problem 6-8a
printf("**Sample Problem 6-8a**\n")
//N = mv^2/R
//mg = mu_s * N
//mg = mu_s * m*v^2/R
```

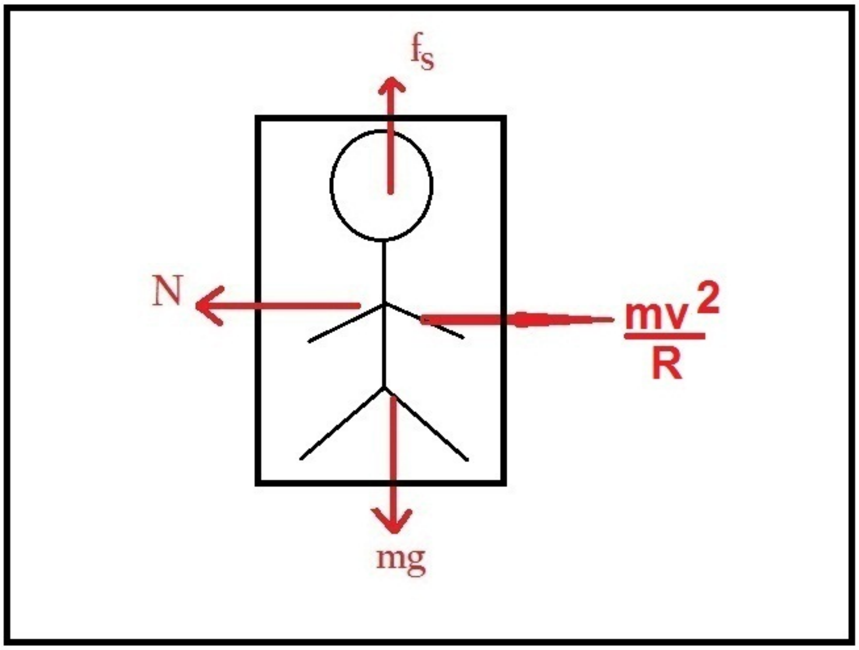

Figure 6.3: Sample Problem 8

```
//v = sqrt(g*R/mu_s)
v_min = sqrt(g*R/mu_s)
printf("The minimum spped of the cylender should be
   %f m/s\n", v_min)

//Sample Problem 6-8b
printf("\n**Sample Problem 6-8b**\n")
mass = 49  //in kg
c_force = mass * v_min^2/R
printf("The Centripetal force on the rider would be
   %f N", c_force)
```

Scilab code Exa 6.9 Sample Problem 9

```
//Given that
g = 9.8  //in m/s^2
mass = 1600  //in kg
v_cons = 20  //in m/s
R_track = 190  //in meter

//Sample Problem 6-9
printf("**Sample Problem 6-9**\n")
N = mass * g
f_s = mass * v_cons^2 /R_track
mu_s = f_s/N
printf("The coefficient of static friction for the
   given surface is %f", mu_s)
```

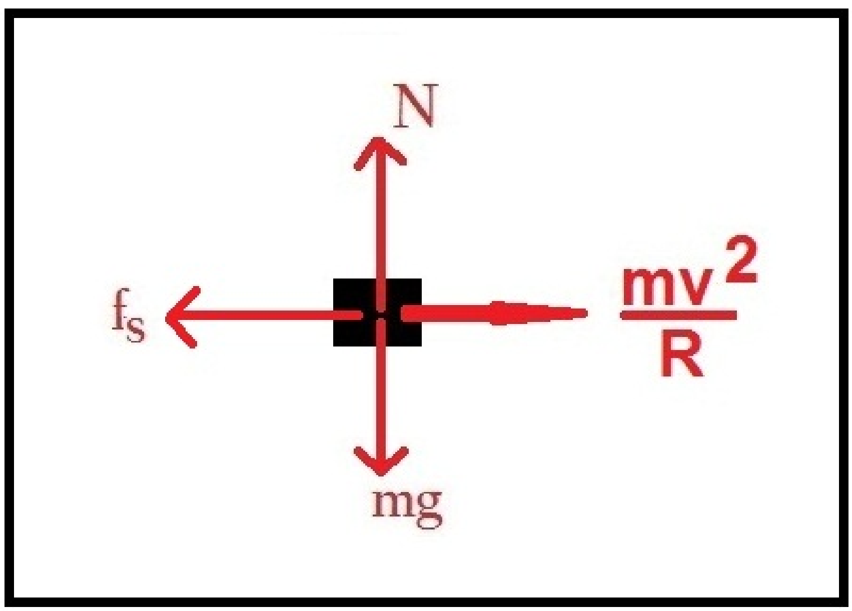

Figure 6.4: Sample Problem 9

Chapter 7

Kinetic Energy and Work

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 7.1 Sample Problem 1

```
exec("degree_rad.sci",-1)

//Given that
weight_locomotive = 1.2 * 10^6 //Ng = 9.8  //in m/s^2
acceleration = 0.26 //m/s^2
v_final = 0  //m/s
distance = 3.2 * 10^3  //m
g = 9.8  //in m/s^2

//Sample Problem 7-1
printf("**Sample Problem 7-1**\n")
//using newton's second equation of motion
v_initial = sqrt(v_final^2 + 2 * acceleration * distance)
total_kinetic_energy = 2 * .5 * weight_locomotive/g * v_initial^2
```

```
printf("The total kinetic energy of two locomotive
    just before the collision is %e J",
    total_kinetic_energy)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 7.2 Sample Problem 2

```
exec("degree_rad.sci",-1)

//Given that
mass = 225  //in kg
displacement = 8.5  //in meter
F1 = 12  //in N
Theta1 = dtor(30)  //in rad
F2 = 10  //in N
Theta2 = dtor(40)  //in rad

//Sample Problem 7-2a
printf("**Sample Problem 7-2a**\n")
//form the definition of Work done
W1 = F1 * displacement * cos(Theta1)
W2 = F2 * displacement * cos(Theta2)
//The net work done
W = W1 + W2
printf("The spies transfer %eJ amount of energy
    during the given displacement\n", W)

//Sample Problem 7-2b
printf("\n**Sample Problem 7-2b**\n")
printf("Work done by the normal in the process is 0J
    \n")
```

```
printf("Work done by the gravity in the process is 0
    J\n")

//Sample Problem 7-2c
printf("\n**Sample Problem 7-2c**\n")
//Using Work Energy theorem
//W = Kf - Ki
//Ki = 0
v_final = sqrt(2* W/mass)
printf("The final velocity of the safe is equal to
    %e", v_final)
```

Scilab code Exa 7.3 Sample Problem 3

```
//Given that
d = [-3, 0]   //in meter
F = [2, -6]   //in N

//Sample Problem 7-3a
printf("**Sample Problem 7-3a**\n")
W = F * d'
printf("The work done is equal to %dJ\n", W)

//Sample Problem 7-3b
printf("\n**Sample Problem 7-3b**\n")
Ki = 10  //in J
//Using work energy theorem
Kf = Ki + W
printf("The final kinetic energy of the crate is %dJ
    ", Kf)
```

Scilab code Exa 7.4 Sample Problem 4

```
//Given that
mass = 260  //in kg
d = 2  //in meter
g = 9.8  //on m/^2

//Sample Problem 7-4a
printf("**Sample Problem 7-4a**\n")
//Using definition of work done
Wg = mass* g * (-1) * d
printf("The work done by the force of gravity is %dJ\n", Wg)

//Sample Problem 7-4b
printf("\n**Sample Problem 7-4b**\n")
//Using work energy theorem
Wc = -1 * Wg
printf("The work done by Chemerkins force is %dJ\n", Wc)

//Sample Problem 7-4c
printf("\n**Sample Problem 7-4c**\n")
printf("The Work done in helding the object stationary is 0, as the dispacement is 0\n")

//Sample Problem 7-4d
printf("\n**Sample Problem 7-4d**\n")
Weight = 27900  //in N
d = 1 * 10^-2  //in meter
Wg = Weight * d
printf("The work done by the gravity is %dJ", Wg)
```

Scilab code Exa 7.5 Sample Problem 5

```
//Given that
mass = 15  //in kg
L = 5.7  //in meter
h = 2.5  //in meter
g = 9.8

//Sample Problem 7-5a
printf("**Sample Problem 7-5a**\n")
//Using the definition of work done
Wg = - mass * g * h
printf("The work done by the gravity is during the
   pull is %eJ\n", Wg)

//Sample Problem 7-5b
printf("\n**Sample Problem 7-5b**\n")
//Using Work-Energy theorem
//as there is no change in kinetic energy
Wt = - Wg
printf("The work done by the tension during the pull
    is %eJ", Wt)
```

Scilab code Exa 7.6 Sample Problem 6

```
//Given that
g = 9.8  //in m/s^2
m = 500  //in kg
```

```
Vi = 4  //in m/s
a = g/5  //in m/s
d = 12  //in meter

//Sample Problem 7-6a
printf("**Sample Problem 7-6a**\n")
//Using the definition of the work done
Wg = m * g * d
printf("The work done by the gravity during the fall is %eJ\n", Wg)

//Sample Problem 7-6b
printf("\n**Sample Problem 7-6b**\n")
//from Example7-6_FBD
//m*g - T = m*a
T = m * (g - a)
Wt = - T * d
printf("The work done by the tension is %eJ\n", Wt)

//Sample Problem 7-6c
printf("\n*Sample Problem 7-6c**\n")
Wnet = Wt + Wg
printf("The net work done is %eJ\n", Wnet)

//Sample Problem 7-6d
printf("\n**Sample Problem 7-6d**\n")
//Using work energy theorem
//Kf - Ki = Wnet
Kf = Wnet + .5 * m * Vi^2
printf("The final kinetic energy of the cab is %eJ", Kf)
```

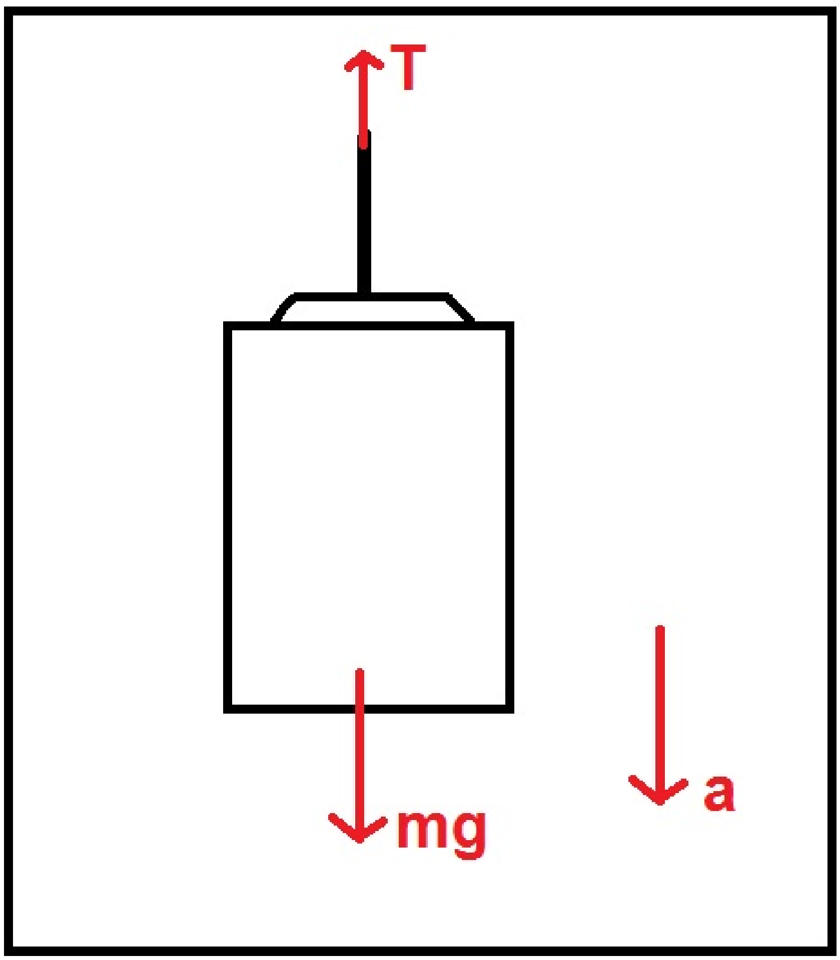

Figure 7.1: Sample Problem 6

Scilab code Exa 7.7 Sample Problem 7

```
//Given that
Fa = 4.9  //in N
x1 = 12 * 10^-3  //in meter
x2 = 17 * 10^-3  //in meter
x3 = -12 * 10^-3  //in meter

//Sample Problem 7-7a
printf("**Sample Problem 7-7a**\n")
//k * x1 = Fa
//Spring constant
k = Fa/x1
Ws1 = -.5* k * x2^2
printf("The work done by the spring force is %fJ\n",
    Ws1)

//Sample Problem 7-7b
printf("\n**Sample Problem 7-7b**\n")
Ws2 = .5 * k * (x2^2 - x3^2)
printf("The work done by the spring is %fJ", Ws2)
```

Scilab code Exa 7.8 Sample Problem 8

```
//Given that
m=.4  //in kg
Vi = .5  //in m/s
k = 750  //in N/m

//Sample Problem 7-8
printf("**Sample Problem 7-8**\n")
//Using work energy theorem
//Wnet = Kf - Ki
```

```
//Kf = 0
//.5*k*x^2 = Ki
x = sqrt(m*Vi^2/k)
printf("The compression in the spring is %em", x)
```

Scilab code Exa 7.9 Sample Problem 9

```
//Sample Problem 7-9
printf("**Sample Problem 7-9**\n")
W = integrate('3*x^2', 'x', 2, 3) + integrate('4', '
   x', 3, 0)
printf("The net work done is %dJ", W)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 7.10 Sample Problem 10

```
exec("degree_rad.sci",-1)

//Given that
//taking right direction as positive direction
F1 = [-2, 0]  //in N
v = [3, 0]  //in m/s
mag = [4,6]

//Sample Problem 7-10a&b
Qnum = ['a', 'b']
```

```
count = 1
for x = mag
    printf("\n**Sample Problem 7-10%s**\n", Qnum(count))
    F2 = [x*cos(dtor(60)), x*sin(dtor(60))]  //in N
    //from the definition of the power
    P1 = F1 * v'
    P2 = F2 * v'
    Pnet = P1 + P2
    printf("The power transferred by F1 is %dW\n", P1)
    printf("The power transferred by F2 is %dW\n", P2)
    printf("The net power transferred is %dW\n", Pnet)
    Pnet = round(Pnet)
    if Pnet == 0
        printf("The Kinetic energy is not changing\n")
    else
        printf("The Kinetic Energy is changing\n")
    end
    count = count + 1
end
```

Chapter 8

Potential and Conservation of Energy

Scilab code Exa 8.1 Sample Problem 1

```
//Given that
h = 0.8  //in meter
l = 2.0  //in meter
m = 2  //in kg
g = 9.8  //in m/s^2

//Sample Problem 8-1
printf("**Sample Problem 8-1**\n")
//Using the definition of
Wg = m* g* h
printf("The work done by the gravity is %eJ", Wg)
```

Scilab code Exa 8.2 Sample Problem 2

```
//Given that
mass = 2  //in kg
y1 = 5  //in meter
g = 9.8  //in m/s^2
ref = [0, 3, 5, 6]

//Sample Problem 8-2a
printf("**Sample Problem 8-2a**\n")
for x = ref
    U = mass* g* (y1 - x)
    printf("The potential energy at y1 is %dJ if reference is assumed to be at y=%d\n", U, x)
end

//sample Probelm 8-2b
printf("\n**Sample Problem 8-2b**\n")
y2 = 0
//The change in potential energy doesn't depend on choice of reference
deltaY = y2 - y1
//because the deltaY doesn't depend upon the choice of references
deltaU = mass* g* deltaY
printf("The change in potential energy is %dJ same for all the references", deltaU)
```

Scilab code Exa 8.3 Sample Problem 3

```
//Given that
h = 8.5  //in meter\
g = 9.8  //in m/s^2

//Sample Problem 8-3
```

```
printf("**Sample Problem 8-3**\n")
//Using conservation of energy
//Change in Potential energy = Change in Kinetic
    energy
//m* g* h = .5* m* v^2
v = sqrt(2* g * h)
printf("The velocity of child at the bottom will be
    %fm/s", v)
```

Scilab code Exa 8.4 Sample Problem 4

```
//Given that
m = 61  //in kg
Hi = 45  //in meter
L = 25  //in meter
k = 160  //in N/m
g = 9.8  //in m/s^2

//Sample Problem 8-4
printf("**Sample Problem 8-4**\n")
//Assume that the jumper goes x meter down the
    bridge
//Using energy conservation energy
s=poly(0,"s")
p = .5*k*(s-25)^2 - m*g*s  //equal to 0
x = roots(p)
printf("The height fell down is %fm", x(2))
```

Scilab code Exa 8.5 Sample Problem 5

```
//Given that
n = 25
Ms = 9000  //in kg
Mm = 80  //in kg
d = [45, 10000]  //in meter
t = 2  //in minute
g = 9.8  //in m/s^2

//Sample Problem 8-5
count = 0
for x = d
    //Sample Problem 8-5a
    if count == 0 then
        printf("**Sample Problem 8-5a**\n")
        count = count + 1
    end
    //We can assume that the force applied by each of man is equal to twice his weight
    Wnet = n * (2* Mm * g) * x
    printf("The total work done is equal to %eJ\n", Wnet)

    //Sample Problem 8-5b
    if count == 1 then
        printf("\n**Sample Problem 8-5b**\n")
        count = count + 1
    end
    //All the work done must be converted into thermal energy
    TE = Wnet
    printf("The total thermal energy generated is equal to %eJ\n", TE)

    //Sample Problem 8-5c
    if count == 2 then
        printf("\n**Sample Problem 8-5c**\n")
        count = count + 1
    end
```

```
end
```

Scilab code Exa 8.6 `Sample Problem 6`

```
//Given that
m = 14  //in kg
F = 40  //in N
d = 0.50  //in meter
Vo = 0.60  //in m/s
V = 0.20  //in m/s

//Sample Problem 8-6a
printf("**Sample Problem 8-6a**\n")
//Using the definition of Work done
Wf = F* d
printf("The work done by the force F is equal to %dJ\n", Wf)

//Sample Problem 8-6b
printf("\n**Sample Problem 8-6b**\n")
//Using Work-Energy theorem
//TE = decrease in Kinetic Energy + Work done by the force F
TE = .5*m*(Vo^2 - V^2) + Wf
printf("The incrase in the thermal energy is equal to %fJ", TE)
```

Scilab code Exa 8.7 `Sample Problem 7`

```
//Given that
mass = 2.0  //in kg
v1 = 4.0  //in m/s^2
Ff = 15  //in N
k = 10^4  //in N/m

//Sample Problem 8-7
printf("**Sample Problem 8-7**\n")
//Using energy conservation
//Ki = Uf + TEf
Ki = .5* mass* v1^2
//Uf = .5*k*x^2
//TEf = Ff* x
s=poly(0,"s")
p = .5*k*s^2 + Ff* s - Ki
x = roots(p)
printf("The compression in the spring is equal to
    %fcm", x(1)*100)
```

Scilab code Exa 8.8 Sample Problem 8

```
//Given that
m = 6.0  //in kg
Vo = 7.8  //in m/s
Yo = 8.5  //in meter
Y = 11.1  //in meter
g = 9.8  //in m/s^2

//Sample Problem 8-8
printf("**Sample Problem 8-8**\n")
//initial mechanical energy
Mi = .5* m* Vo^2 + m* g* Yo
//final mechanical energy
```

```
Mf = 0 + m* g* Y
Eth = Mi - Mf
printf("The thermal energy generated is equal to %fJ
   ", Eth)
```

Chapter 9

System of Particles

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 9.1 Sample Problem 1

```
exec("degree_rad.sci",-1)

//Given that
m1 = 1.2  //in kg
m2 = 2.5  //in kg
m3 = 3.4  //in kg
a = 140  //in cm

//Sample Problem 9-1
printf("**Sample Problem 9-1**\n")
r1 = [0, 0]
r2 = [a, 0]
r3 = [a*cos(dtor(60)), a*sin(dtor(60))]
Rc = (m1*r1 + m2*r2 + m3*r3)/(m1 + m2 + m3)
printf("The co-ordinate of center of mass are (%f,
    %f)", Rc(1), Rc(2))
```

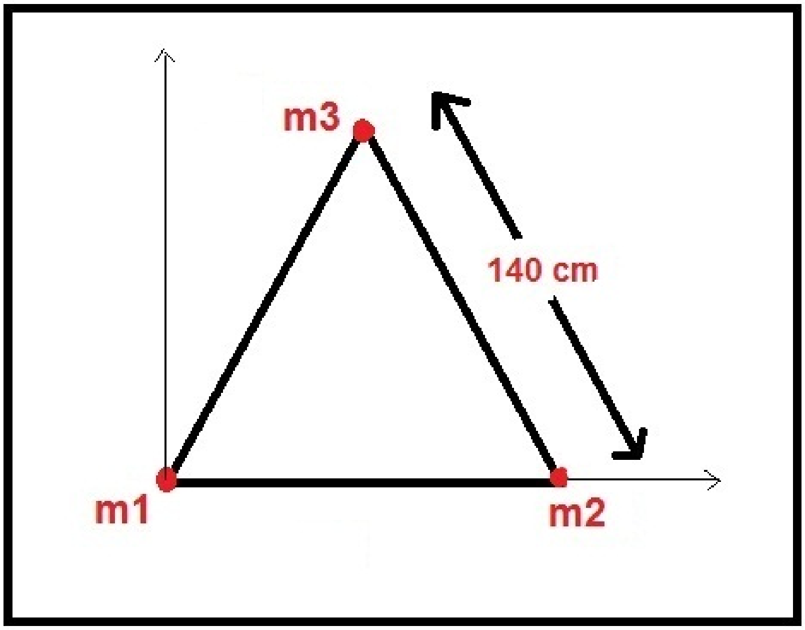

Figure 9.1: Sample Problem 1

Scilab code Exa 9.2 `Sample Problem 2`

```
//Sample Problem 9-2
printf("**Sample Problem 9-2**\n")
R = poly(0, 'R')
//Mass is proportinal to area
Aw = %pi* (2*R)^2
Ac = %pi* R^2
```

```
//& the x-co-ordinate of the masses
CMw = 0
CMc = -R
CMf = pdiv((Aw*CMw - Ac*CMc), (Aw - Ac))
printf("The CM is located at a distace of %fR to the
    right of the center", horner(CMf, 1))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 9.3 Sample Problem 3

```
exec("degree_rad.sci",-1)

//Given that
m1 = 4  //in kg
m2 = 8  //in kg
m3 = 4  //in kg
F1 = [-6, 0]
F2 = [12*cos(dtor(45)), 12*sin(dtor(45))]
F3 = [14, 0]

//Sample Problem 9-3
printf("**Sample Problem 9-3**\n")
aC = (F1 + F2 + F3)/(m1 + m2+ m3)
printf("The acceleration of center of mass is %fm/s
   ^2 at \nan angle of %f degrees to the positive x-
   axis", norm(aC), rtod(atan(aC(2)/aC(1))))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 9.4 Sample Problem 4

```
exec("degree_rad.sci",-1)

//Given that
m = 2.0   //in kg
v1 = [0, -0.50]
v2 = [0.40, 0]

//Sample Problem 9-4
printf("**Sample Problem 9-4**\n")
deltaP = m* (v2 - v1)
printf("The change in mometum vactor in kg.m/sec is %1.1fi + %1.1fj", deltaP(1), deltaP(2))
```

Scilab code Exa 9.5 Sample Problem 5

```
//Given that
//Before collision
m = 6   //in kg
v = 4   //in m/sec
//After collision
m1 = 2   //in kg

//Sample Problem 9-5
printf("**Sample Problem 9-5**\n")
m2 = m - m1
v1 = 8.0   //in m/s
v2 = (m*v - m1*v1)/m2
```

```
printf("The velocity of peiece having mass m2 is %dm
    /s", v2)
```

Scilab code Exa 9.6 Sample Problem 6

```
//Given that
M = 1  //(say)to get the answer directly
Vi = 2100  //in km/h
//initial momentum
Pi = M* Vi
Vrel = 500  //in km/h

//Sample Problem 9-6
printf("**Sample Problem 9-6**\n")
//Assuming Vf as the final velocity of the hauler
Vf = poly(0, 'Vf')
Pf = 0.20*M*(Vf - Vrel) + (M - 0.20*M)*Vf
p = Pi - Pf
Vf = roots(p)
printf("The final velocity of the hauler is %dkm/h",
    Vf)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 9.7 Sample Problem 7

```
exec("degree_rad.sci",-1)
```

```

//Given that
M = 1  //(say) to directly get the answer
Mc = 0.30*M
Vc = [5*cos(dtor(40)), 5*sin(dtor(40))]
Mb = 0.20*M
Ma = 0.50*M

//Sample Problem 9-7
printf("**Sample Problem 9-7**\n")
deff('[f] = eq_maker(V)', 'f = Ma*V(1)*[cos(dtor(140)),sin(dtor(140))] + Mb*V(2)*[0,-1] + Mc*Vc')
V= fsolve([0,0], eq_maker)
printf("The velocity of A is %dm/s & velocity of B is %fm/s after the collision in the given directions", V(1), V(2))
```

Scilab code Exa 9.8 Sample Problem 8

```
//Given that
Mi = 850  //in kg
R = 2.3  //kg/s
Vrel = 2800  //in kg

//Sample Problem 9-8a
printf("**Sample Problem 9-8a**\n")
T = R*Vrel
printf("The Thrust force rocket engine provide is equal to %dN\n", T)

//Sample Problem 9-8b
printf("\n**Sample Problem 9-8b**\n")
a = T/Mi
```

```
printf("The initial acceleration of rocket is %fm/s^2\n", a)

//Sample Problem 9-8c
printf("\n**Sample Problem 9-8c**\n")
Mf = 180  //in kg
Vf = Vrel * log(Mi/Mf)
printf("The final velocity of the rocket is %fm/s", Vf)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 9.9 Sample Problem 9

```
//Given that
m = 4.0* 10^-6  //in kg
l = 0.77 * 10^-3  //in meter
h = 0.30  //in m
g = 9.8  //in m/s^2

//Sample Problem 9-9
printf("**Sample Problem 9-9**\n")
//Using Work-Energy theorem
//F * l = mgh
F = m* g* h/l
printf("The external force on the betal is %fN", F)
```

Chapter 10

Collisions

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 10.1 Sample Problem 1

```
exec("degree_rad.sci",-1)

//Given that
m = 140 * 10^-3  //in kg
Vi = -39  //in m/s
Vf = 39  //in m/s

//Sample Problem 10-1a
printf("**Sample Problem 10-1a**\n")
//J = Pf - Pi
J = m *(Vf - Vi)
printf("The magnitude of impulse acted on the ball
   from bat is equal to %fN-s\n", J)

//Sample Problem 10-1b
printf("\n**Sample Problem 10-1b**\n")
t = 1.20* 10^-3  //in sec
```

```
Favg = J/t
printf("The average force during the collision is %fN\n", Favg)

//Sample Problem 10-1c
printf("\n**Sample Problem 10-1c**\n")
Vf = 45* [cos(dtor(30)), sin(dtor(30))]
Vi = [-39, 0]
J = m* (Vf - Vi)
printf("The magnitude of new inpulse is %fN-s\n", norm(J))
printf("The new impulse makes an angle of %f degress with the horizontal", rtod(atan(J(2)/ J(1))))
```

Scilab code Exa 10.2 Sample Problem 2

```
//Given that
M = 5.4  //in kg
m = 9.5* 10^-3  //in kg
g = 9.8  //in m/s^2
h = 6.3* 10^-2  //in meter

//Sample Problem 10-2
printf("**Sample Problem 10-2**\n")
//Mechanical energy conservation-
//0.5*(M+m)*Va^2 = (M+m)*g*h
Va = sqrt(g*h/0.5)
//Momentum conservation for the collision
Vb = (M+m)*Va/m
printf("The velocity of the bullet before collision is %fm/s", Vb)
```

Scilab code Exa 10.3 Sample Problem 3

```
//Given that
m1 = 0.70  //in kg
m = [0.14, 3.2]  //in kg
k = [4.1* 10^4, 2.6* 10^6]  //in N/m
d = [16* 10^-3, 1.1* 10^-3]  //in meter

//Sample Problem 10-3a
printf("**Sample Problem 10-3a**\n")
name = ['board', 'block']
U = zeros(2,1)
for count = 1:2
    U(count) = 0.5* k(count)* d(count)^2
    printf("The energy stored in %s is %fJ\n", name(
       count), U(count))
end

//Sample Problem 10-3b
printf("\n**Sample Problem 10-3b**\n")
for count = 1:2
    //Energy conservation
    Vf = sqrt(U(count)/(0.5*(m1+m(count))))
    //Momentum conservation
    Vi = (m1 + m(count))*Vf/m1
    printf("The minimum velocity required to break
       the %s is %fm/s\n", name(count), Vi)
end
```

check Appendix AP 9 for dependency:

`collision.sci`

Scilab code Exa 10.4 Sample Problem 4

```
exec('collision.sci', -1)

//Given that
m1 = 30*10^-3  //in kg
h1 = 8*10^-2  //in m
m2 = 75*10^-3  //in kg
g = 9.8  //in m/s^2
e = 1

//Sample Problem 10-4
printf("**Sample Problem 10-4**\n")
//velocity just before collision
Vi = zeros(1,2)
Vi(1) = sqrt(2*g*h1)
Vi(2) = 0
Vf= fsolve([0,0], collision)
printf("The velocity of m1 after collision is %fm/s"
    , abs(Vf(1)))
```

Scilab code Exa 10.5 Sample Problem 5

```
//Given that
Ma = 83  //in kg
Va = [6.2, 0]  //in km/h
Mb = 55  //in kg
Vb = [0, 7.8]  //in km/h

```

```
//Sample Problem 10-5a
printf("**Sample Problem 10-5a**\n")
Vf = (Ma*Va + Mb*Vb)/(Ma+Mb)
printf("The common velocity after the collision is
   %fm/s\n", norm(Vf))

//Sample Problem 10-5b
printf("\n**Sample Problem 10-5**\n")
printf("The velocity of center of mass is not
   altered due to collision")
```

Chapter 11

Rotation

Scilab code Exa 11.1 Sample Problem 1

```
//Given that
t = poly(0, 't')
A = -1.00-0.600*t+0.250*t^2

//Sample Problem 11-1a
printf("**Sample Problem 11-1a**\n")
Ts = [-3:0.5:6]
As = horner(A, Ts)
xset('window', 1)
xtitle( 'angular variable for the disk v/s time', 'time(sec)', 'Y-axis')
plot(Ts, As, 'm-o')

//Sample Problem 11-1b
printf("\n**Sample Problem 11-1b**\n")
To = roots(derivat(A))
printf("At t=%fsec, theta approaches its minimum value equal to %f\n", To, horner(A, To))

//Sample Problem 11-1c
printf("\n**Sample Problem 11-1c**\n")
```

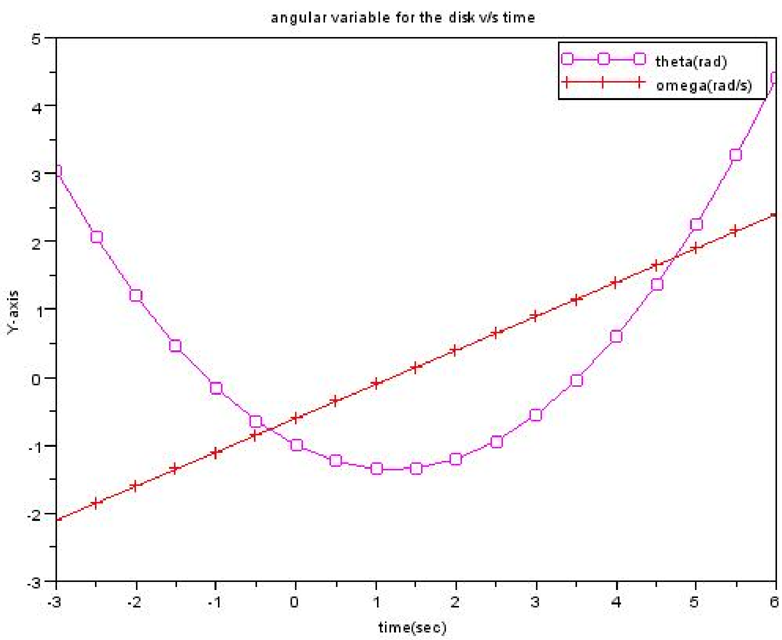

Figure 11.1: Sample Problem 1

```
Os = horner(derivat(A), Ts)
plot(Ts, Os, 'r-+')
legend('theta(rad)', 'omega(rad/s)')
```

Scilab code Exa 11.2 Sample Problem 2

```
//Given that
alpha = 0.335  //in rad/s^2
Wo = -4.6  //in rad/s
```

```
Ao = 0  //in rad
Af = 5* 2*%pi  //in rad

//Sample Problem 11-2a
printf("**Sample Problem 11-2a**\n")
//Using newton's second equation of motion
t = poly(0, 't')
p = Ao + Wo*t + 0.5*alpha*t^2 - Af
to = roots(p)
printf("At time equal to %fsec, the reference line will be at given position\n", to(2))

//Sample Problem 11-2c
printf("\n**Sample Problem 11-2c**\n")
p = Wo + alpha*t
ts = roots(p)
printf("At time equal to %fsec, the disk momentarily stops", ts)
```

Scilab code Exa 11.3 Sample Problem 3

```
//Given that
W1 = 3.40  //in rad/s
W2 = 2.00  //in rad/s
rev_taken = 20

//Sample Problem 11-3a
printf("**Sample Problem 11-3a**\n")
angle_traversed = 2*%pi*rev_taken
//Using newton's third equation of motion
//Wf^2 = Wi^2 + 2*alpha*theta
alpha = (W2^2 - W1^2)/(2*angle_traversed)
printf("The angular acceleration during the stop is
```

```
    %frads^2\n", alpha)

//Sample Problem 11-3b
printf("\n**Sample Problem 11-3b**\n")
//Using newton's first equation of motion
time_taken = (W2 - W1)/alpha
printf("The time taken in decreasing the speed is
    %fsec", time_taken)
```

Scilab code Exa 11.4 Sample Problem 4

```
//Given that
r = 15  //in meter
g = 9.8  //in m.s^2
a = 11 * g  //in m.s^2

//Sample Problem 11-4a
printf("**Sample Problem 11-4a**\n")
w = sqrt(a/r)
printf("The angular speed should be %frad/s\n", w)

//Sample Problem 11-4b
printf("\n**Sample Problem 11-4b**\n")
t = 120  //in sec
alpha = w/t
at = alpha*r
printf("The tangential acceleration will be %fm/s^2"
    , at)
```

Scilab code Exa 11.6 Sample Problem 6

```
//Given that
M = 272  //in kg
R = 38*10^-2  //in meter
w = 14000* 2*%pi/60  //in rad/s

///Sample Problem 11-6
printf("**Sample Problem 11-6**\n")
I = 0.5* M* R^2
E = 0.5* I* w^2
printf("The energy released during the explosion is
   %eJ", E)
```

Scilab code Exa 11.7 Sample Problem 7

```
//Given that
M = 2.5  //in kg
R = 0.20  //i meter
m = 1.2  //in kg
g = 9.8  //in m/s^2
I = 0.5*M*R^2

//Sample Problem 11-7
printf("**Sample Problem 11-7**\n")
//mg - T = ma
//T*R = I*a/R
//T = I*a/R^2
//on adding =>
a = m*g/(m+I/R^2)
T = m*(g-a)
alpha = a/R
printf("The acceleration of the block is %fm/s^2\n",
```

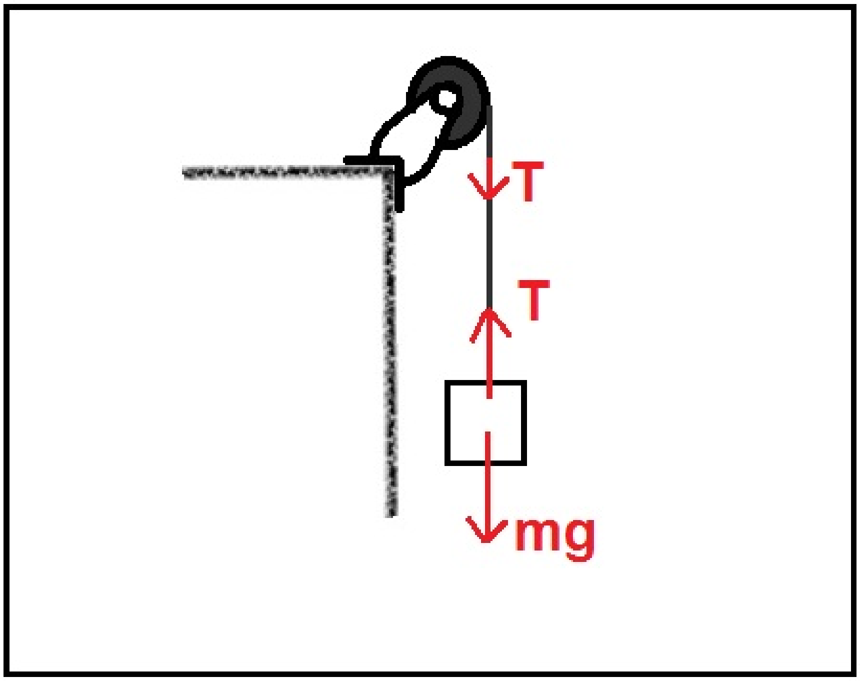

Figure 11.2: Sample Problem 7

```
    a)
printf("The angular acceleration of the pulley is
   %frad/s^2\n", alpha)
printf("The tension in the string is %fN", T)
```

Scilab code Exa 11.8 `Sample Problem 8`

```
//Given that
M = 80  //in kg
d1 = 0.30  //in meter
alpha = 6  //in rad/s^2
I = 15  //in kg.m^2
g = 9.8  //in m/s^2

//Sample Problem 11-8a
printf("**Sample Problem 11-8a**\n")
F = I*alpha/d1
printf("The magnitude of F is %fN\n", F)

//Sample Problem 11-8b
printf("\n**Sample Problem 11-8b**\n")
d2 = 0.12  //in meter
//F*d1 - M*g*d2 = I*alpha
F = I*alpha + M*g*d2
F = F/d1
printf("The magnitude of F in second case is %fN", F
   )
```

check Appendix AP 8 for dependency:

`Example11_7.sce`

Scilab code Exa 11.9 `Sample Problem 9`

```
exec('Example11_7.sce', -1)
clc

//Given that
t = 2.5  //in sec

//Sample Problem 11-9
```

```
printf("\n**Sample Problem 11-9**\n")
w = 0 + alpha*t
RE = 0.5* I* w^2
printf("The rotational kinetic energy of the disk
    will be %fJ", RE)
```

Scilab code Exa 11.10 Sample Problem 10

```
//Given that
m = 1   //(say)
R = 0.15   //in meter
L = 2.0 * R
g =  9.8   //in m/s^2

//Sample Problem 11-10
printf("**Sample Problem 11-10**\n")
I = 0.5*m*R^2 + m*L^2/12 + m*(L/2+R)^2
deltaU = m* g* (L + 2*R)
//deltaK = 0.5*I*w^2
//therefore-
w = sqrt(deltaU/(0.5*I))
printf("The angular speed is equal to %frad/s", w)
```

Chapter 12

Rolling Torque and Angular Momentum

Scilab code Exa 12.1 Sample Problem 1

```
//Given that
M = 1.4  //in kg
R = 8.5*10^-2  //in meter
v = 15*10^-2  //in meter

//Sample Problem 12-1
printf("**Sample Problem 12-1**\n")
I = 0.5*M*R^2
w = v/R
K = 0.5*M*v^2 + 0.5*I*w^2
printf("The total kinetic energy of the disk is %fJ"
  , K)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 12.2 `Sample Problem 2`

```
exec('degree_rad.sci', -1)

//Given that
M = 6  //in kg
A = 30  //in degrees
h = 1.20  //in meter
g = 9.8  //in m/s^2
//Radius of the disk is equal to R

//Sample Problem 12-2a
printf("**Sample Problem 12-2a**\n")
//using mechanical energy conservation
//M*g*h = 0.5*I*w^2 + 0.5*M*v^2
//w = v/R
//I = (2/5)M*R^2
v = sqrt(M*g*h/(0.5*M*(2/5) + 0.5*M))
printf("The speed of the disk at the bottom is %fm/s\n", v)

//Sample Problem 12-2b
printf("\n**Sample Problem 12-2b**\n")
//at bottom
a = -g*sin(dtor(A))/(1+(2/5)*M/M)
fs = -(2/5)*M*a
printf("The frictinal force on the disk is equal to %fN", fs)
```

check Appendix AP 7 for dependency:

`cross_product.sci`

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 12.3 Sample Problem 3

```
exec('degree_rad.sci', -1)
exec('cross_product.sci', -1)

//Given that
A = dtor(30)  //in rad
r = 3*[cos(A), 0, sin(A)]
F1 = 2*[1, 0, 0]
F2 = 2*[0, 0, 1]
F3 = 2*[0, 1, 0]

//Sample Problem 12-3
printf("**Sample Problem 12-3**\n")
T1 = crossproduct(r, F1)
T2 = crossproduct(r, F2)
T3 = crossproduct(r, F3)
printf("The torque due to F1 is equal to %fN.m\n",
    norm(T1))
printf("The torque due to F2 is equal to %fN.m\n",
    norm(T2))
printf("The torque due to F3 is equal to %fN.m",
    norm(T3))
```

Scilab code Exa 12.4 Sample Problem 4

```
//Given that
p1 = 5  //in kg.m/s
d1 = 2.0  //in meter
```

```
p2 = 2  //in kg.m/s
d2 = 4.0  //in meter

//Sample Problem 12-4
printf("**Sample Problem 12-4**\n")
L = p1*d1 - p2*d2  //the direction of L2 is opposite
    to L1
printf("The net angular momentum of the two particle
    system is %dkg.m/s^2", L)
```

Scilab code Exa 12.6 Sample Problem 6

```
//Given that
R = 38  //in meter
Mc = 1.1 *10^4  //in kg
Mw = 6.0* 10^5  //in kg
Mp = 70  //in kg
Nc = 36  //number of cars
Np = 60*Nc  //total number of person
Wf = 2*%pi/(2*60)  //in rad/s

//Sample Problem 12-6a
printf("**Sample Problem 12-6a**\n")
Mpc = Mc*Nc + Mp*Np
Ipc = Mpc*R^2
Iw = (Mw/2)*R^2  //considering the mometum due to
    only the outer hoop
It = Ipc+Iw
L = It*Wf
printf("The angular momentum is %ekg.m/s^2\n", L)

//Sample Problem 12-6b
printf("\n**Sample Problem 12-6b**\n")
```

```
//Using the definiiton of the torque
deltat  = 5.0  //in sec
Tavg = L/deltat
printf("The magnitude of average torque is %eN.m",
   Tavg)
```

Scilab code Exa 12.7 Sample Problem 7

```
//Given that
Iwh = 1.2  //in kg.m/s^2
Wwh = 3.9*2*%pi  //in rad/s
Ib = 6.8  //in kg.m/s^2

//Sample Problem 12-7
printf("**Sample Problem 12-7**\n")
//angular momentum conservation along the axis of
   rotation of the system
//Ib*Wb  - Iwh*Wwh = Iwh*Wwh
Wb = 2*Iwh*Wwh/Ib
printf("The angular speed of the composite system is
    %frev/s", Wb/(2*%pi))
```

Scilab code Exa 12.8 Sample Problem 8

```
//Given that
t = 1.87  //in sec
I1 = 19.9  //in kg.m^2
I2 = 3.93  //in kg.m^2
//From the figure
```

```
A1 = 0.5*2*%pi  //in rad
A2 = 3.5*2*%pi  //in rad

//Sample Problem 12-8
printf("**Sample Problem 12-8**\n")
//w1 = I2*w2/I1
//w1*t1 = A1
//w2*t2 = A2
//t = t1 + t2
//t = A1/w1 + A2/w2
//t = A1/(I2*w2/I1) + A2/w2
w2 = (1/t) * (A1*I1/I2 + A2)
printf("The angular speed during the tuck should be
   %frev/s", w2/(2*%pi))
```

Scilab code Exa 12.9 Sample Problem 9

```
exec('degree_rad.sci', -1)

//Given that
M = 1  //(say)
d = 0.50  //in meter
Wi = -2  //in rad/s
m = 1/3*M
Vi = 12  //in m/s
A = dtor(60)  //in rad

//Sample Problem 12-9
printf("**Sample Problem 12-9**\n")
//initial angular momentum
Ii = M*d^2/3 * 4
Lti = Ii*Wi  //of the turnstile
Lbi = m* Vi * d * cos(A)
```

```
//final angular momentum
//Lf = Itotal * Wf
Itotal = Ii + m*d^2
//Using angular momentum conservation
Wf = (Lti + Lbi)/Itotal
printf("The final angular velocity of the ball-
    turnstile is %frad/s", Wf)
```

Chapter 13

Equilibrium and Elasticity

Scilab code Exa 13.1 `Sample Problem 1`

```
//Given that
L = 1  //(say)
m = 1.8  //in kg
M = 2.7  //in kg
d = L/4
g = 9.8  //in m/s^2

//Sample Problem 13-1
printf("**Sample Problem 13-1**\n")
//From the figure
//Balancing torque from A
//N2*L = M*g*L/4 + m*g*L/2
N2 = M*g/4 + m*g/2
//similarly
N1 = M*g*(3/4) + m*g/2
printf("The Normal from point A is %fN\n", N1)
printf("The Normal from point B is %fN", N2)
```

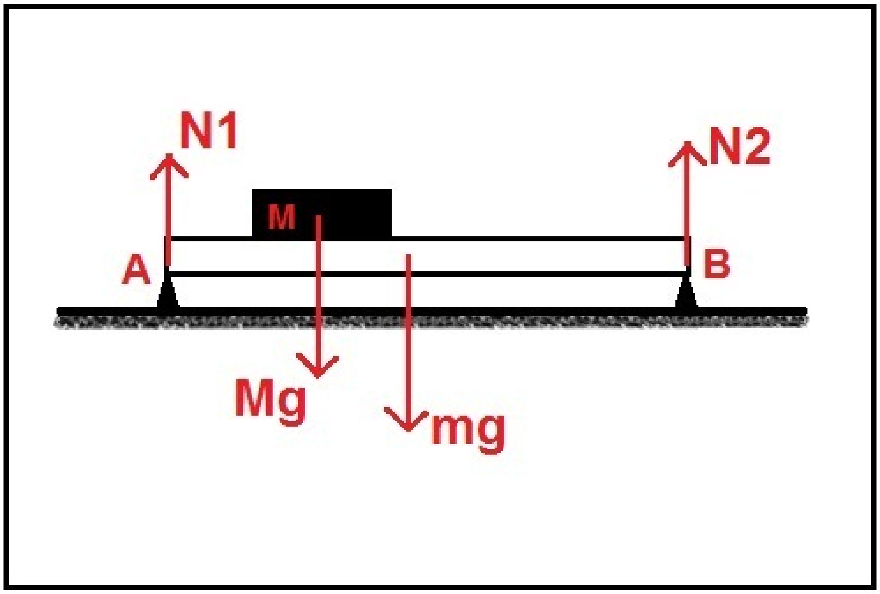

Figure 13.1: Sample Problem 1

Scilab code Exa 13.2 Sample Problem 2

```
//Given that
L = 12  // in meter
m = 45 //in kg
h = 9.3  //in meter
M = 72  //in kg
g = 9.8  //in m/s^2

//Sample Problem 13-2
printf("**Sample Problem 13-2**\n")
//From the figure
```

```
N2 = (M+m)*g
A = asin(h/L)
//Balancing torque from the bottom point of the
   ladder
N1 = (m*g*L/3*cos(A)+M*g*L/2*cos(A))/(L*sin(A))
f = N1
printf("The normal force from the wall is equal to
   %fN\n", N1)
printf("The normal force from the pavement is equal
   to %fN\n", N2)
printf("The frictional force from the pavement is
   equal to %fN", f)
```

Scilab code Exa 13.3 Sample Problem 3

```
//Given that
M = 430  //in kg
a = 1.9  //in meter
b = 2.5  //in meter
m = 85  //in kg
g = 9.8  //in m/s^2

//Sample Problem 13-3a
printf("**Sample Problem 13-3a**\n")
Tr = M*g
//Balancing torque from the hinge
Tc = (m*g*b/2 + Tr*b)/a
printf("The magntude of force on the beam from the
   cable is %fN\n", Tc)

//Sample Problem 13-3b
```

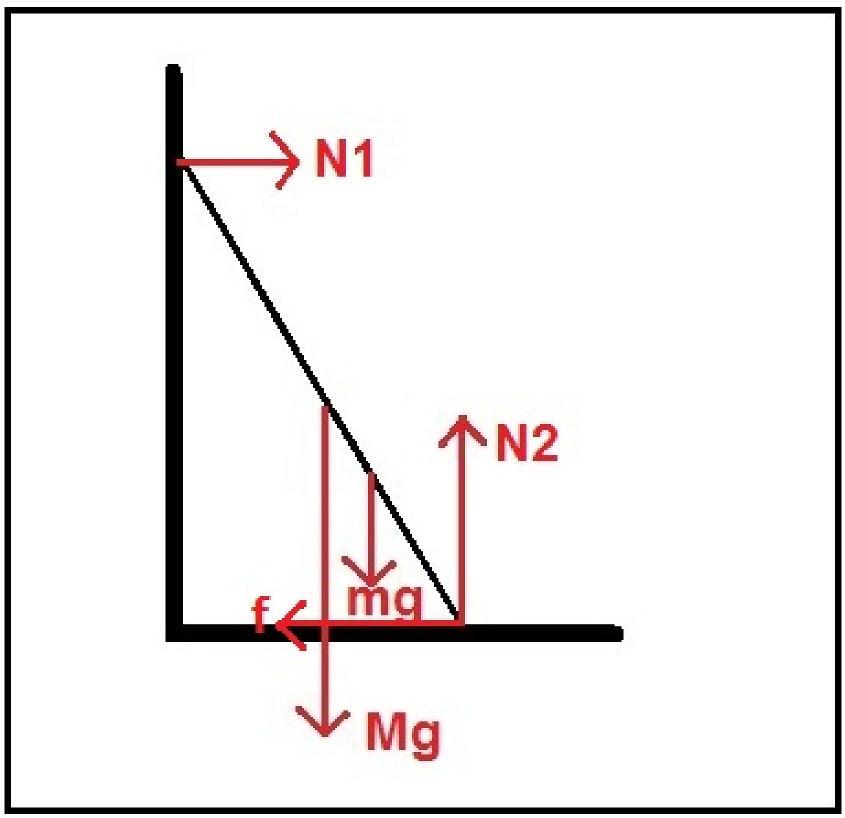

Figure 13.2: Sample Problem 2

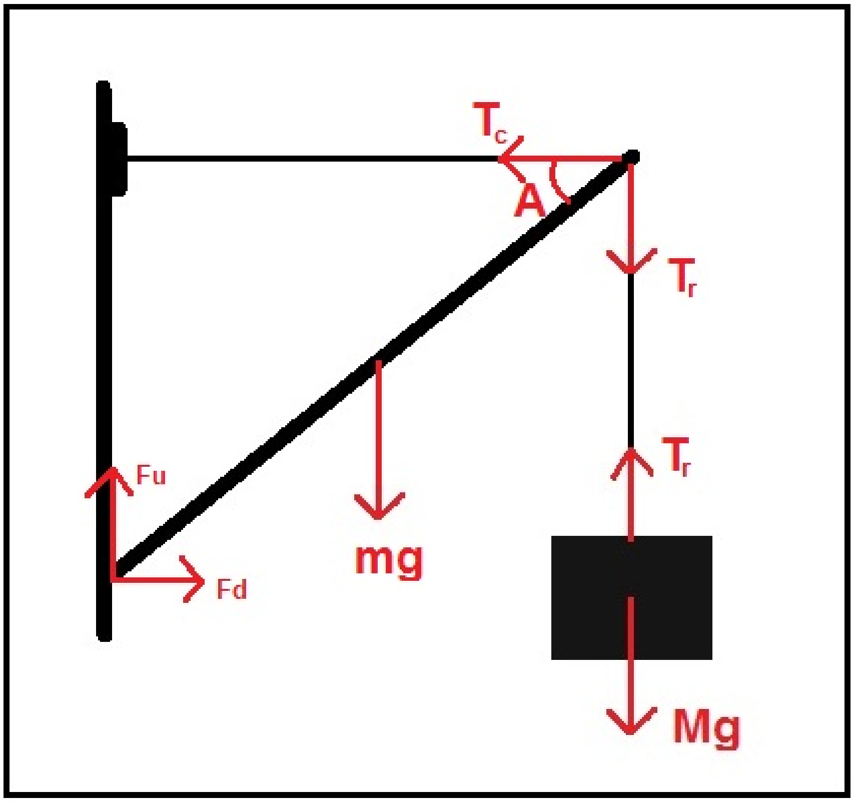

Figure 13.3: Sample Problem 3

```
printf("\n**Sample Problem 13-3b**\n")
Fu = Tr + m*g
Fd = Tc
printf("The magnitude of force on the beam from the
    hinge is %fN", sqrt(Fu^2+Fd^2))
```

Scilab code Exa 13.4 Sample Problem 4

```
//Given that
m = 55  //in kg
w = 1  //in meter
d = 0.20  //in meter
u1 = 1.1
u2 = 0.70
g = 9.8  //in m/s^2

//Sample Problem 13-4a
printf("**Sample Problem 13-4a**\n")
//From the figure
//fr + fl = m*g
//Nr = Nl
//u1*Nr + u2*Nl = m*g
Nr = m*g/(u1+u2)
Nl = Nr
fr = u2*Nr
fl = u1*Nl
printf("The minimum horiontal push on the wall
    should be %fN\n", Nr)

//Sample Problem 13-4b
printf("\n**Sample Problem 13-4b**\n")
//balancing torque from the shoulder side wall
l = (fl*w - m*g*d)/Nl
printf("The vertical distance between her shoulder
    and her feet should be %fm", l)
```

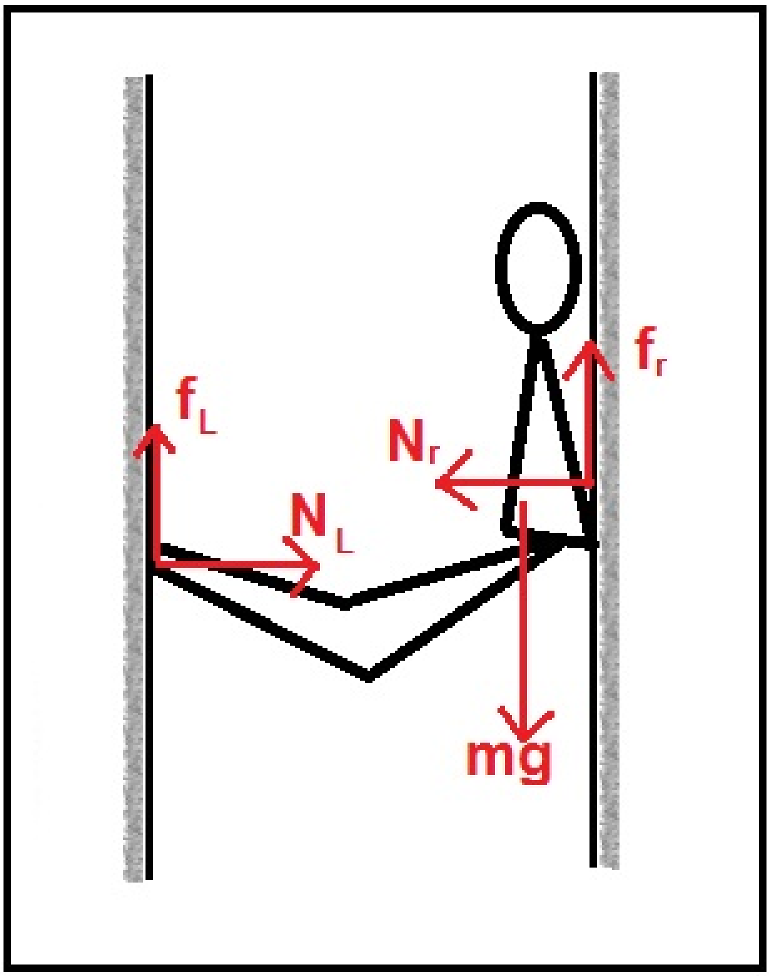

Figure 13.4: Sample Problem 4

Scilab code Exa 13.5 `Sample Problem 5`

```
//Given that
R = 9.5*10^-3   //in meter
L = 81*10^-2   //in meter
F = 62*10^3   //in N
Y = 2*10^11   //in N/m^2

//Sample Problem 13-5
printf("**Sample Problem 13-5**\n")
//From the definition of stress, strain & hook's law
sigma = F/(%pi*R^2)
strain = sigma/Y
deltaL = strain*L
printf("The stress in the rod is %eN/m^2\n", sigma)
printf("The strain in the rod is %e\n", strain)
printf("The elongation in the rod is %em", deltaL)
```

Scilab code Exa 13.6 `Sample Problem 6`

```
//Given that
M = 290   //in kg
A = 1*10^-4   //in m^2
Y = 1.3*10^10   //in N/m^2
l = 0.50*10^-3   //in meter
g = 9.8   //in m/s^2
L = 1.00   //in meter

```

```
//Sample Problem 13-6
printf("**Sample Problem 13-6**\n")
//We know F = A*Y*(delataL/L)
l1 = poly(0,'l1')
p = M*g - 3*(A*Y*(l1/L)) - (A*Y*((l1+l)/L))
l1 = roots(p)
F3 = A*Y*(l1/L)
F1 = (A*Y*((l1+l)/L))
printf("The force on the leveled legs is %fN\n", F3)
printf("The force on the unleveled legs is %fN", F1)
```

Chapter 14

Gravitation

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 14.1 `Sample Problem 1`

```
exec ("Gravitation.sci",-1)

//Given that
m1 = 6 //kg
m2 = 4 //kg
m3 = 4 //kg
a = 2 * (10^-2)

//Sample Problem 14-1
printf("**Sample Problem 14-1**\n")
//F1 = F12 + F13
F12 = [0,-GForce(m1,m2,a)]
F13 = [GForce(m1,m3,2*a),0]
F1 = F12 + F13
printf("The magnitude of net force is approximately
    equal to %e N", norm(F1))
```

check Appendix AP 3 for dependency:

Gravitation.sci

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 14.2 Sample Problem 2

```
exec('Gravitation.sci',-1)
exec('degree_rad.sci', -1)

//Given that
//masses in kg
m1 = 8
m2 = 2
m3 = 2
m4 = 2
m5 = 2
a = 2*(10^-2); //in meter
Theta = dtor(30) //in radians

//Sample Problem 14-2
printf("**Sample Problem 14-2**\n")
//The net force will be equal to the vector eum of
    all the forces acting on the particle due to the
    rest of the particles i.e F1 = F12 + F13 + F14 +
    F15
F12 = [GForce(m1,m2,(2*a))*sin(Theta), GForce(m1,m2
    ,(2*a))*cos(Theta)]
F13 = [GForce(m1,m3,a)*sin(Theta), -GForce(m1,m3,a)*
    cos(Theta)]
```

```
F14 = [-GForce(m1,m4,(2*a))*sin(Theta), -GForce(m1,m4,(2*a))*cos(Theta)]
F15 = [-GForce(m1,m5,a)*sin(Theta),-GForce(m1,m5,a)*cos(Theta)]
F1 = F12 + F13 + F14 + F15
printf("The net force on particle 1 is approimately equal to %e N", norm(F1))
```

Scilab code Exa 14.3.a Sample Problem 3a

```
exec ("Gravitation.sci",-1)

//Given that
r = 6.77 * 10^6  //in meter
dr = 1.7 //in meter

//Sample Problem 3a
printf("**Sample Problem 3a**\n")
dg = -2 * G * Me * dr /(r^3)
printf("The difference in acceleration is approximately equal to  %e  m/sec*sec", dg)
```

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 14.3.b Sample Problem 3b

```
exec ("Gravitation.sci",-1)
```

```
//variavles with their values
Mh = 1.99 * 10^31    //in kg
R = 6.77 * 10^6 //in meter
DR = 1.7 //in meter

//Sample Problem 3b
printf("**Sample Problem 3b**\n")
//the difference in gravitational acceleration is
   given by
DG = -2 * G * Mh * DR /(R^3)
printf("The difference in acceleration is
   approximately equal to  %em/s^2", DG)
```

check Appendix AP 3 for dependency:

`Gravitation.sci`

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 14.5 `Sample Problem 5`

```
exec ("Gravitation.sci",-1)

//Given that
Vi = 1.2 * 10^4 //in m/sec
d = 10*Re;
m = 10 //let say it will mass cancel out later

//Sample Problem 5
printf("**Sample Problem 5**\n")
//we know that E(initial) = E(final)
//=> Ki + Ui = Kf + Uf
```

```
//K = .5*m*Vi*Vi (Kinetic Energy)
//U = gravitational potential (Potential Energy)
Ki = .5*m*Vi*Vi;
Ui = GPotential(m,Me,d);
Uf = GPotential(m,Me,Re);
Kf = Ki + Ui -Uf;
Vf = sqrt(2*Kf/m);
printf("The final velocity of the asteroid is equal to %e m/sec", Vf)
```

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 14.6 `Sample Problem 6`

```
exec ("Gravitation.sci",-1)

//Given that
T = 76 * 365 * 24 * 60 * 60 //time period in seconds (converting from years)

//Sample Problem 6a
printf("**Sample Problem 6a**\n")
//We know that Ra + Re  = 2*a
Rp = 8.9 * 10^10 //in meter
a = KeplerRadius(Ms,T)
//therefore
Ra = 2*a -Rp //in meter
printf("The Aphelion distance is equal to %em\n", Ra)

//Sample Problem 6b
printf("\n**Sample Problem 6b**\n")
```

```
//we know that e*a = a - Rp
e = 1 - Rp/a
printf("The eccentricity of the path is %e ", e)
```

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 14.7 `Sample Problem 7`

```
exec ("Gravitation.sci",-1)

//Given that
//Both the stars are moving around the centre of
    mass of the two particale system
//m1 = mass of visible star
//m2 = mass of invisible star
//r1 = distance of m1 from center of mass
//r2 = distance of m2 from center of mass
//r = r1+r2 distance between both the stars
//we have G*m1*m2/(r*r) = m1*v1*v1/r1 = m2*v2*v2/r2
    ....1
v1 = 270*10^3 //in meter/sec
T = 1.7 * 24 * 60 * 60 //in s
m1 = 6* Ms

//Sample Problem 7
printf("**Sample Problem 7**\n")
//m2 = ?
//using definition of center of mass
// we have r = r1 * (m1 + m2)/m2   ....2
//& 2*pi*r1/v1 = T   ....3
//therefore
r1 = v1*T/(2*%pi);  //from equation 3
```

```
//from equation 1 & 2
//G*(m2^3)/((r1*(m1+m2))^2) = v1*v1/r1
//we have a polynomial equation in order 3
//(m2^3)/(m1+m2)^2 = v1*v1*r1/G
temp = v1*v1*r1/G; //say
//=> -m2^3 + temp*m2^2 + 2*m1*temp*m2+ m1*m1*temp
solpoly = (poly([-m1*m1,-2*m1,-1,1/temp],'x','c'));
sol = roots(solpoly,'e');
printf("The mass of the invisible star is equal to %e kg\n", sol(1))
printf("The mass of the invisible star is equal to %f times the mass of Sun", sol(1)/Ms)
```

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 14.8 Sample Problem 8

```
exec ("Gravitation.sci",-1)

//Given that
m = 7.20 //in kg
h = 350 * 10^3 //altitude in meter

//Sample Problem 8a
printf("**Sample Problem 8a**\n")
//mechanical energy E = K + U
//E = - G * M * m /(2* r)
E = .5*GPotential(m,Me,(h+Re))
printf("The total energy at the given altitude is %e joule\n",E)


```

```
//Sample Problem 8b
printf("\n**Sample Problem 8b**\n")
//here the k = 0
E0 = GPotential(m,Me,Re)
printf("The total energy on the launchpad is %e joule\n",E0)
deltaE = E - E0;
printf("The differencein both the energy %e joule",deltaE)
```

Chapter 15

Fluids

Scilab code Exa 15.1 Sample Problem 1

```
//Given that
l = 3.5  //in meter
b = 4.2  //in meter
h = 2.4  //in meter
g = 9.8  //in m/s^2

//Sample Problem 15-1a
printf("**Sample Problem 15-1a**\n")
P = 1.0*1.01*10^5  //in N/m^2
density_air = 1.21  //in kg/m^3 at 1atm pressure
V = l*b*h  //Volume of the air
W = density_air*V*g  //Weight of the air
printf("The weight of the air in the room is equal
   to %fkg\n", W)

//Sample Problem 15-1b
printf("\n**Sample Problem 15-1b**\n")
A = l*b
F = P*A
printf("The magnitude of atmosphere force on the
   floor of the room is %eN\n", F)
```

Scilab code Exa 15.2 Sample Problem 2

```
//Given that
deltaP = 9.3*10^3  //in N/m^2
density_water = 998  //in kg/m^3
g = 9.8  //in m/s^2

//Sample Problem 15-2
printf("**Sample Problem 15-2**\n")
//deltaP = density_water*g*L
//therefore
L = deltaP/(density_water*g)
printf("The diver started at a depth of %fm", L)
```

Scilab code Exa 15.3 Sample Problem 3

```
//Given that
density_water = 998  //in kg/m^3
l = 135*10^-3  //in meter
d = 12.3*10^-3  //in meter
g = 9.8  //in m/s^2

//Sample Problem 15-3
printf("**Sample Problem 15-3**\n")
d_oil = density_water*g*l/(g*(l+d))  //pressure at
    same height should be same
printf("The density of the oil is %fkg/m^3", d_oil)
```

Scilab code Exa 15.4 Sample Problem 4

```
//Given that
density_ice = 917  //in kg/m^3
density_seawater = 1024  //in kg/m^3

//Sample Problem 15-4
printf("**Sample Problem 15-4**\n")
//Using archimedies principle
//density_seawater*Vs*g = density_ice*Vt*g
//fractoin of non-visible part 'f' is
f = density_ice/density_seawater  //Vs/Vt
printf("The fraction of the visible part is equal to
    %f", (1-f))
```

Scilab code Exa 15.5 Sample Problem 5

```
//Given that
R = 12.0  //in meter
m = 196  //in kg
density_He = 0.160  //in kg/m^3
density_air = 1.25  //in kg/m^3
g = 9.8  //in m/s^2

//Sample Problem 15-5
printf("**Sample Problem 15-5**\n")
Vb = 4/3*%pi*R^3
```

```
PayLoad = (density_air*Vb*g - (density_He*Vb*g + m*g))/g
printf("The maximum mass attached can be %fkg", PayLoad)
```

Scilab code Exa 15.6 Sample Problem 6

```
//Given that
Ao = 3*10^-4  //in m^2
Vo = 30*10^-2  //in m/s
A = 3*10^-7*10^-4  //in m^2
V = 0.05*10^-2  //in m/s

//Sample Problem 15-6
printf("**Sample Problem 15-6**\n")
n = (Ao*Vo)/(A*V)
printf("Number of capillaries a person should have %e", n)
```

check Appendix AP 6 for dependency:

`Bernauli.sci`

Scilab code Exa 15.7 Sample Problem 7

```
exec('Bernauli.sci', -1)

//Given that
Ao = 1.2*10^-4  //in m^2
```

```
A = 0.35*10^-4   //in m^2
h = 45*10^-3   //in m
density_water = 998   //in kg/m^3

//Sample Problem 15-7
printf("**Sample Problem 15-7\n")
A = [A, Ao]
deltaP = 0   //in N/m^2
density = density_water
V = fsolve([0,0], Bernauli)
FlowRate = A(1)*V(1)
printf("The volume flow rate from the tap is equal
    to %fcm^3/s", FlowRate*10^6)
```

check Appendix AP 6 for dependency:

`Bernauli.sci`

Scilab code Exa 15.8 `Sample Problem 8`

```
exec('Bernauli.sci', -1)

//Given that
density_Ethanol = 791   //in kg/m^3
A1 = 1.20*10^-3   //in m^2
A2 = A1/2
//Pressure in narrower section is lesser
deltaP = -4120   //in N/m^2

//Sample Problem 15-8
printf("**Sample Problem 15-8**\n")
A = [A1, A2]
density = density_Ethanol
h = 0
```

```
V = fsolve([0, 1], Bernauli)
printf("The volume flow rate is %e m^3/s", abs(A1*V
    (1)))
```

Chapter 16

Oscillation

Scilab code Exa 16.1 Sample Problem 1

```
//Given that
m = 680*10^-3  //in kg
k = 65  //in N/m
x = 11*10^-2  //in meter

//Sample Problem 16-1a
printf("**Sample Problem 16-1a**\n")
w = sqrt(k/m)
f = 2*%pi/w
T = 1/f
printf("  Angular Frequency  -  %f rad/s\n", w)
printf("  Frequency\t    -  %f Hz\n", f)
printf("  Time Period\t    -  %f s\n", T)

//Sample Problem 16-1b
printf("\n**Sample Problem 16-1b**\n")
A = x
printf("The amplitude of oscillation is %fcm\n", A
   *100)

//Sample Problem 16-1c
```

```
printf("\n**Sample Problem 16-1c**\n")
Vmax = A*w
printf("The maximum speed of the block is %fm/s\n", Vmax)

//Sample Problem 16-1d
printf("\n**Sample Problem 16-1d**\n")
aMAX = Vmax*w
printf("The maximum acceleration of the block is %fm/s^2\n", aMAX)

//Sample Problem 16-1e
printf("\n**Sample Problem 16-1e**\n")
//at t=0 x = A
phi = acos(x/A)
printf("The phase constant for the SHM x=Acos(w*t+phi) is 2*n*pi + %d where n is an integer", phi)
```

Scilab code Exa 16.2 Sample Problem 2

```
//Given that
x0 = -8.50*10^-2  //in m
v0 = -0.920  //in m/s
a0 = 47  //in m/s^2
exec('degree_rad.sci', -1)

//Sample Problem 16-2a
printf("**Sample Problem 16-2a**\n")
w = sqrt(-a0/x0)
printf("The angular frequency of SHM is equal to %frad/s\n", w)

//Sample Problem 16-2b
```

```
printf("\n**Sample Problem 16-2b**\n")
phi = atan(-(v0/x0)/w)
A = x0/cos(phi)
printf("The value of phi is %f degrees\n", rtod(phi)
    )
printf("The maximum value of displacement is equal
    to %fcm\", A*100)
```

Scilab code Exa 16.3 Sample Problem 3

```
//Sample Problem 16-3a
printf("**Sample Problem 16-3a**\n")
k = 65  //in N/m
A = 11*10^-2  //in meter
v = 0  //in m/s
E = 0.5*k*A^2 + 0
printf("The mechanical energy of the block is %fJ\n"
    , E)

//Sample Problem 16-3b
printf("\n**Sample Problem 16-3b**\n")
x = A/2
U = 0.5*k*x^2
K = E-U
printf("The potential energy at that position is %fJ
    \n", U)
printf("The kinetic energy of the block is %fJ", K)
```

Scilab code Exa 16.4 Sample Problem 4

```
//Given that
L = 12.4*10^-2  // in meter
m = 135*10^-3  //in kg
Ta = 2.53  //in sec
Tb = 4.76  //in sec

//Sample Problem 16-4
printf("**Sample Problem 16-4**\n")
//Time period is directly proportional to the squre
   root of rotational inertial
Ia = m*L^2/12
I = Ia*(Tb/Ta)^2
printf("The rotational inertail of X is %ekg.m^2", I
   )
```

Scilab code Exa 16.5 Sample Problem 5

```
//Given that
L = 1.0  //in meter
g = 9.8  //in m/s^2

//Sample Problem 16-5a
printf("**Sample Problem 16-5a**\n")
//(say)
m = 1
I = (1/3)*m*L^2
T = 2*%pi*sqrt(I/(m*g*(L/2)))
printf("The time period of SHm is %fs\n", T)

//Sample Problem 16-5b
printf("\n**Sample Problem 16-5b**\n")
Lo = (T/(2*%pi))^2*g
printf("The distance of center of oscillation from
```

```
    the pivot is %fcm", Lo*100)
```

Scilab code Exa 16.6 Sample Problem 6

```
//Given that
L = 2.0  //in meter
m = 12  //in kg
k = 1300  //in N/m

//Sample Problem 16-6
printf("**Sample Problem 16-6**\n")
//I*a/L = -k*x*L
I = m*L^2/3
w = sqrt(k*L*L/I)
T = 2*%pi/w
printf("The time period of oscillation is %fs", T)
```

Scilab code Exa 16.7 Sample Problem 7

```
//Given that
m = 250*10^-3  //in kg
k = 85  //in N/m
b = 70*10^-3  //in kg/s\
g = 9.8  //in m/s^2

//Sample Problem 16-7a
printf("**Sample Problem 16-7a**\n")
```

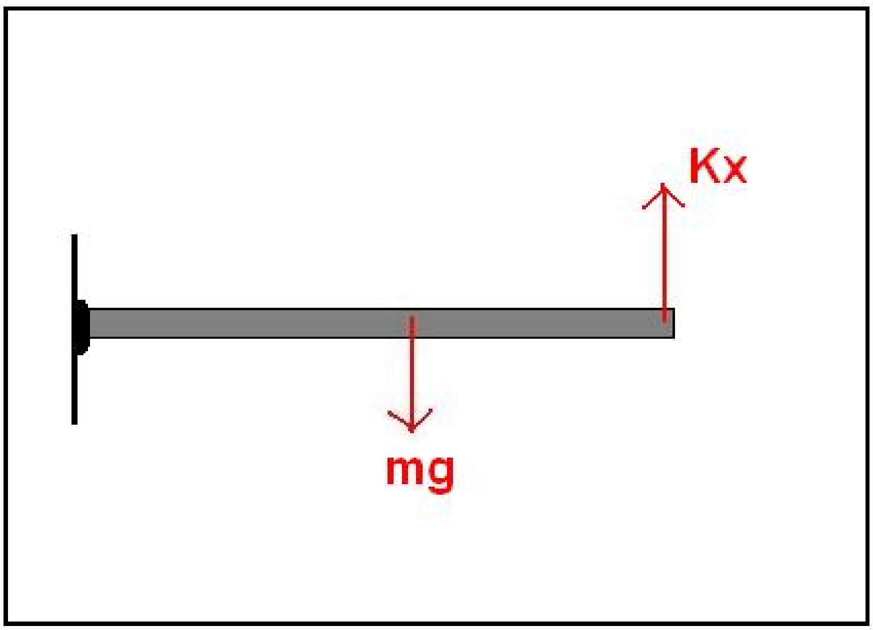

Figure 16.1: Sample Problem 6

```
T = 2*%pi*sqrt(m/k)
printf("The time period of oscillation is %fs\n", T)

//Sample Problem 16-7b
printf("\n**Sample Problem 16-7b**\n")
//b*t/(2*m) = log(2)
t = log(2)*2*m/b
printf("The time taken to drop the amplitude half of its value is %fs\n", t)

//Sample Problem 16-7c
printf("\nb**Sample Problem 16-7c**\n")
//amplitude should drop to A/sqrt(2) from A
tE = t/2
printf("The time taken to drop the mechanical energy half of its initial value is %fs", tE)
```

Chapter 17

Waves I

Scilab code Exa 17.1 `Sample Problem 1`

```
//Given that
funcprot(0)
deff('[y] = wave(t, x)', 'y = 0.00327*sin(72.1*x - 2.72*t)')
//Comparing the given equation with the standard wave equation
A = 0.00327  //in m
k = 72.1  //in rad/s
w = 2.72  //in rad/s

//Sample Problem 17-1a
printf("**Sample Problem 17-1a**\n")
printf("The amplitude of the wave is %fm\n", A)

//Sample Problem 17-1b
printf("\n**Sample Problem 17-1b**\n")
lambda = 2*%pi/k
printf("  wavelength = %fm\n", lambda)
T = 2*%pi/w
printf("  period     = %fs\n",T)
f = 1/T
```

```
printf("   frequency   = %fHz\n", f)

//Sample Problem 17-1c
printf("\n**Sample Problem 17-1c**\n")
v = w/k
printf("The velocity of the wave is %fm/s\n", v)

//Sample Problem 17-1d
printf("\n**Sample Problem 17-1d**\n")
y = wave(18.9, 22.5*10^-2)
printf("Displacement of the wave is %fm", y)
```

check Appendix AP 5 for dependency:

`Example17_1.sce`

Scilab code Exa 17.2 `Sample Problem 2`

```
exec('Example17_1.sce', -1)
clc

//Sample Problem 17-2a
printf("\n\n**Sample Problem 17-2a**\n")
v = numdiff(list(wave, 22.5*10^-2), 18.9)
printf("The velocity of the particle is %fm/s\n", v)

//Sample Problem 17-2b
printf("\n**Sample Problem 17-2b**\n")
dx = 0.001
a = (numdiff(list(wave, 22.5*10^-2), 18.9+dx) - numdiff(list(wave, 22.5*10^-2), 18.9))/dx
printf("The acceleration of the particle is %fm/s^2", a)
```

Scilab code Exa 17.3 Sample Problem 3

```
//Given that
u1 = 1.4*10^-4  //in kg/m
u2 = 2.8*10^-4  //in kg/m
L1 = 3.0  //in m
L2 = 2.0  //in m
T = 400  //in N

//Sample Problem 17-3
printf("**Sample Problem 17-3**\n")
v1 = sqrt(T/u1)
v2 = sqrt(T/u2)
t1 = L1/v1
t2 = L2/v2
if t1<t2 then
    printf("The pulse on string1 will reach the knot
        first")
else
    printf("The pulse on string2 will reach the knot
        first")
end
```

Scilab code Exa 17.4 Sample Problem 4

```
//Given that
u = 525*10^-3  //in kg/m
T = 45  //in N
```

```
f = 120   //in Hz
Ym = 8.5*10^-3   //in meter

//Sample Problem 17-4
printf("**Sample Problem 17-4**\n")
v = sqrt(T/u)
w = 2*%pi*f
Pavg = 0.5*u*v*w^2*Ym^2
printf("The average power transfered is equal to %fW
   ", Pavg)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 17.5 Sample Problem 5

```
exec('degree_rad.sci', -1)

//Given that
Ym = 9.8*10^-3   //in meter
phi = dtor(100)   //in degrees

//Sample Problem 17-5a
printf("**Sample Problem 17-5a**\n")
Yn = 2*Ym*cos(phi/2)
printf("The amplitude of resultant wave is %fmm\n",
   Yn*10^3)

//Sample Problem 17-5b
printf("\n**Sample Problem 17-5b**\n")
Y = 4.9*10^-3   //in meter
phi = 2*acos(Y/(2*Ym))
printf("The phase difference required is %frad", phi
   )
```

Scilab code Exa 17.6 Sample Problem 6

```
//Given that
Ym1 = 4.0*10^-3   //in meter
Ym2 = 3.0*10^-3   //in meter
phi1 = 0   //in rad
phi2 = %pi/3   //in rad

//Sample Problem 17-6
printf("**Sample Problem 17-6**\n")
//For horizontal component
Ymh = Ym1*cos(phi1) + Ym2*cos(phi2)
//For vertical component
Ymv = Ym1*sin(phi1) + Ym2*sin(phi2)
Ym = sqrt(Ymv^2 + Ymh^2)
beta = atan(Ymv/Ymh)
printf("The amplitude of the resultant wave is equal
    to %fmm\n", Ym*10^3)
printf("The phase constant for the wave is %frad\n",
    beta)
printf("The equation of wave is %f*sin(k*x - w*t +
   %frad)",Ym, beta)
```

Scilab code Exa 17.7 Sample Problem 7

```
//Given that
L = 1.2   //in meter
```

```
u = 1.6*10^-3  //in kg/m
f = 120  //in Hz
g = 9.8  //in m/s^2

//Sample Problem 17-7a
printf("**Sample Problem 17-7a**\n")
n = 4
//T = m*g
//v = sqrt(m*g/u)
//f = n*v/(2*L)
m = (2*L*f)^2*u/(g*n^2)
printf("The value of m should be %fkg\n", m)

//Sample Problem 17-7b
printf("\n**Sample Problem 17-7b**\n")
M = 1  //in kg
n = sqrt((2*L*f)^2*u/(g*M))
if abs(n - round(n)) < 0.01 then
    printf("The allowed wave mode is %d", n)
else
    printf("No wave mode will be allowed")
end
```

Chapter 18

Waves ll

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 18.1 Sample Problem 1

```
exec('degree_rad.sci', -1)

//Given that
Vs = 1482  //in m/s
Vw = 343  //in m/s

//Sample Problem 18-1
printf("**Sample Probelm 18-1**\n")
//deltaT = d/V = D*sin(theta)/V
//D*sin(90)/Vs = D*sin(theta)/Vw
theta = rtod(asin(Vw/Vs))
printf("The actual angle at which source is present,
    is %fdegree", theta)
```

Scilab code Exa 18.2 Sample Problem 2

```
//Given that
deltaPm = 28  //in N/m^2
density = 1.21  //in kg/m^3
f = 1000  //in Hz
v = 343  //in m/s

//Sample Problem 18-2
printf("**Sample Problem 18-2**\n")
w = 2*%pi*f
Sm = deltaPm/(v*density*w)
printf("The amplitude of sound will be %em", Sm)
```

Scilab code Exa 18.3 Sample Problem 3

```
//Given that
D = 1.5  //times wavelength

//Sample Problem 18-3a
printf("**Sample Problem 18-3a**\n")
deltaL = 0
printf("Waves undergo constructive interference at
    P1\n")

//Sample Problem 18-3b
printf("\n**Sample Problem 18-3b**\n")
deltaL = D
deltaPhi = 1.5*2*%pi
if modulo((deltaPhi/%pi), 2)==0 then
    printf("Waves undergo constructive interference
        at P2\n")
else
```

```
    printf("Waves undergo desstructive interference
       at P2")
end
```

Scilab code Exa 18.4 Sample Problem 4

```
//Given that
L = 10  //in meter
Ps = 1.6*10^4

//Sample Problem 18-4a
printf("**Sample Problem 18-4a**\n")
r = 12  //in meter
I = Ps/(2*%pi*r*L)
printf("The intensity of the sound at a distance %dm
    is equal to %fW/m^2\n", r, I)

//Sapmle Problem 18-4b
printf("\n**Sample Problem 18-4b**\n")
Ad = 2*10^-4  //in m^2
Pd = I*Ad
printf("The sound energy intercepted by the acoustic
    detector is %eW", Pd)
```

Scilab code Exa 18.5 Sample Problem 5

```
//Given that
B2 = 120  //in dB
B1 = 92  //in dB
```

```

//Sample Problem 18-5
printf("**Sample Problem 18-5**\n")
//B2 = 10 * log(I2/Io)
//B1 = 10 * log(I1/Io)
r = 10^((B2 - B1)/10)  //The ratio
printf("The Ratio of the intensities is %f", r)
```

Scilab code Exa 18.6 `Sample Problem 6`

```
//Given that
L = 67*10^-2  //in cm
Vs = 343  //in m/s

//Sample Problem 18-6a
printf("**Sample Problem 18-6a**\n")
//Open Ends
f = Vs/(2*L)
printf("The frequency of sound in case of open end
    is %fHz\n", f)

//Sample Problem 18-6b
printf("\n**Sample Problem 18-6b**\n")
//cloes end
fo = Vs/(4*L)
printf("The frequency of sound in case of open ends
    is %fHz", fo)
```

Scilab code Exa 18.8 `Sample Problem 8`

```
//Given that
v = 242  //in m/s
f = 1250  //in Hz
Vs = 343  //in m/s

//Sample Problem 18-8a
printf("**Sample Problem 18-8a**\n")
F = (Vs/(Vs-v))*f
printf("The frequency measured by the detector on
   the pole is %fHz\n", F)

//Sample Problem 18-8b
printf("\n**Sample Problem 18-8b**\n")
Fe = (Vs+v)/Vs*F
printf("The frequency measured by the detector on
   the rocket is %fHz", Fe)
```

Chapter 19

Temprature Heat and the First Law of Thermodynamic

Scilab code Exa 19.1 Sample Problem 1

```
//Given that
Bz = 65  //in degree Z
Fz = -14  //in degree Z
Tz = -98  //in degree Z
Bf = 212  //in degree F
Ff = 32  //in degree F

//Sample Problem 19-1
printf("**Sample Problem 19-1**\n")
Tf = (Tz - Fz)/(Bz - Fz) * (Bf - Ff) + Ff
printf("-98 degree Z is equal to %f degree Forenheit
   ", Tf)
```

Scilab code Exa 19.2 Sample Problem 2

```
//Given that
V = 37*10^3  //in Litre
b = 9.50*10^-4  //in /degree C
deltaT = -23  //in degree C

//Sample Problem 19-2
printf("**Sample Problem 19-2**\n")
deltaV = V* b* deltaT
Vd = V + deltaV
printf("The amount of oil delievered is %dL", Vd)
```

Scilab code Exa 19.3 Sample Problem 3

```
//Given that
m = 720*10^-3  //in kg
Ti = -10  //in degree C
Tw = 15  //in degree C
Si = 2220  //in J/kg.K
L = 333*10^3  //in J/Kg
Sw = 4190  //in J/kg.K

//Sample Problem 19-3a
printf("**Sample Problem 19-3a**\n");
//When ice comes to temprature 0 degree celcius
deltaTi = 0 - Ti
Q1 = m*Si*deltaTi
//When ice melts to water
Q2 = m*L
//when water comes to temprature 15 degree celcius
deltaTw = Tw - 0
Q3 = m*Sw*deltaTw
Q = Q1 + Q2 + Q3
printf("The heat absorbed by the ice is %fKJ\n", Q
```

```
    *10^-3)

//Sample Problem 19-3b
printf("\n**Sample Problem 19-3b**\n")
Qg = 210*10^3 //in J
//Energy left after the ice comes to 0 degree C
Qleft = Qg - Q1
//the mass of ice left aftr all the heat is consumed
Mleft = Qleft/L
printf("The mass of ice left is equal to %fg", Mleft
    *10^3)
```

Scilab code Exa 19.4 Sample Problem 4

```
//Given that
Mc = 75 //in g
To = 312  //in degree C
Mw = 220  //in g
Cb = 45  //in cal/K
Ti = 12  //in degree C
Sc = 0.0923  //in cal/g.K
Cb = 45  //in cal/K
Sw = 1  //in cal/g.K

//Sample Problem 19-4
printf("**Sample Problem 19-4**\n")
Tf = (Sc*Mc*To + Cb*Ti + Sw*Mw*Ti)/(Sw*Mw + Cb + Sc*
    Mc)
printf("The final temprature of the system is %f
    degree C", Tf)
```

Scilab code Exa 19.5 Sample Problem 5

```
//Given that
M = 1.00  //in kg
T = 100  //in degree C
P = 1.01*10^5  //in Pascal
Vi = 1.00*10^-3  //in m^3
Vf = 1.671  //in m^3
Lv = 2256*10^3  //in J/kg

//Sample Problem 19-5a
printf("**Sample Problem 19-5a**\n")
W = P*(Vf - Vi)
printf("The work done by the system during the process is %fkJ\n", W*10^-3)

//Sample Problem 19-5b
printf("\n**Sample Problem 19-5b**\n")
Q = Lv*M
printf("The heat supplied to the system is equal to %eJ\n", Q)

//Sample Problem 19-5c
printf("\n**Sample Problem 19-5c**\n")
deltaE = Q - W
printf("The change in internal energy is equal to %eJ", deltaE)
```

Scilab code Exa 19.6 Sample Problem 6

```
//Given that
La = 1  //(say)
Ld = 2.0*La
ka = 1  //(say)
kd = 5.0*ka
T1 = 25  //in degree C
T2 = 20  //in degree C
T5 = -10 //in degree C

//Sample Problem 19-6
printf("**Sample Problem 19-6**\n")
//The rate of thermal conduction will be same
    through (a) & (d)
//ka*A*(T2-T1)/La = kd*A*(T5-T4)/Ld
T4 = T5 - ka*(T2-T1)/La * (Ld/kd)
printf("The T4 is equal to %d degree C", T4)
```

Scilab code Exa 19.7 Sample Problem 7

```
//Given that
R = 2*10^-2  //in meter
n = 500  //number of bees
t = 20*60  //in sec
e = .80
T1 = 35 + 273  //in K
T2 = 47 + 273  //in K
sigma = 5.67*10^-8  //in W/m^2

//Sample Problem 19-7
printf("**Sample Problem 19-7**\n")
A = 4*%pi*R^2
```

```
Eaddi = sigma*e*A*(T2^4 - T1^4)*t  //for n bees
E = Eaddi/n
printf("The additional energy produced by each bee
   is equal to %fJ", E)
```

Chapter 20

The Kinetic Theory of Gases

Scilab code Exa 20.1 Sample Problem 1

```
//Given that
Vi = 12  //in L
Ti = 20+273  //in K
Pi = 15  //in atm
Tf = 35+273  //in K
Vf = 8.5  //in L
R = .0821  //in atm.lit/(mol.K)

//Sample Problem 20-1
printf("**Sample Problem 20-1**\n")
Pf = (Pi*Vi/(R*Ti))/(Vf/(R*Tf))
printf("The final pressure of the gas is %fatm", Pf)
```

Scilab code Exa 20.2 Sample Problem 2

```
//Given that
n = 1  //in mole
```

```
T = 310   //in K
Vi = 12   //in L
Vf = 19   //in L
R = .0821   //in atm.lit/(mol.K)

//Sample Probelm 20-2
printf("**Sample Problem 20-2**\n")
W = n*R*T*log(Vf/Vi)   //in atm.lit
printf("The work done by the gas is equal to %fJ", W
    *1.0125*10^5*10^-3)
```

Scilab code Exa 20.3 `Sample Problem 3`

```
//Given that
n = [5, 11, 32, 67, 89]

//Sample Probelm 20-3a
printf("**Sample Problem 20-3a**\n")
navg = sum(n)/length(n)
printf("The average value of numbers is %2.2f\n",
    navg)

//Sample Probelm 20-3b
printf("\n**Sample Problem 20-3b**\n")
nrms = sqrt(sum(n.*n)/5)
printf("The rms value of numbers is %2.2f", nrms)
```

Scilab code Exa 20.4 `Sample Problem 4`

```
//Given that
R = 8.31  //in J/mol.K
Na = 6.023*10^23  //in /mol
K = R/Na

//Sample Problem 20-4a
printf("**Sample Problem 20-4a**\n")
T = 300  //in K
P = 1*1.0125*10^5  //in pa
d = 290*10^-12  //in meter
lambda = K*T/(sqrt(2)*%pi*d^2*P)
printf("The mean free path is equal to %em\n", lambda)

//Sample Problem 20-4b
printf("\n**Sample Problem 20-4b**\n")
v = 450  //in m/s
t = lambda/v
printf("The time between two collisions is %esec\n", t)
f = 1/t
printf("The frequency of collision is %eHz", f)
```

Scilab code Exa 20.5 Sample Problem 5

```
//Given that
T = 300  //in K
v1 = 599  //m/s
v2 = 601  //in m/s
M = 0.0320  //in kg/mol
R = 8.31  //J/(mol.K)

//Sample Problem 20-5
```

```
printf("**Sample Problem 20-5**\n")
v = (v1+v2)/2
deltav = v2 - v1
f = 4*%pi*(M/(2*%pi*R*T))^(3/2)*v^2*%e^(-M*v^2/2/R/T
    )*deltav
printf("The fraction of molecules having speed in
    given range is %e", f)
```

Scilab code Exa 20.6 Sample Problem 6

```
//Given that
M = 0.0320  //in kg/mol
T = 300  //in K
R = 8.31  //in J/mol.cal

//Sample Problem 20-6a
printf("**Sample Problem 20-6a**\n")
Vavg = sqrt(8*R*T/%pi/M)
printf("The average speed of molecule is %fm/s\n",
    Vavg)

//Sample Problem 20-6b
printf("\n**Sample Problem 20-6b**\n")
Vrms = sqrt(3*R*T/M)
printf("The rms speed of molecule is %fm/s\n", Vrms)

//Sample Problem 20-6c
printf("\n**Sample Problem 20-6c**\n")
Vmps = sqrt(2*R*T/M)
printf("The most probable speed of molecule is %fm/s
    ", Vmps)
```

Scilab code Exa 20.7 Sample Problem 7

```
//Given that
n = 5.00  //in mol
deltaT = 20
R = 8.31  //in J/mol.K

//Sample Problem 20-7a
printf("**Sample Problem 20-7a**\n")
//For Helium
Cv = 3/2*R
Cp = Cv + R
Q = n*Cp*deltaT
printf("The heat added to the bubble is equal to %fJ
   \n", Q)

//Sample Problem 20-7b
printf("\n**Sample Problem 20-7b**\n")
deltaEint = n*Cv*deltaT
printf("The change in internal energy is equal to
   %fJ\n", deltaEint)

//Sample Problem 20-7c
printf("\n**Sample Problem 20-7c**\n")
W = Q - deltaEint
printf("The work done by the system is equal to %fJ"
   , W)
```

Scilab code Exa 20.9 Sample Problem 9

```
//Given that
n = 1  //in mol
Ti = 310  //in K
Vi = 12  //in L
Vf = 19  //in L

//Sample Probelm 20-9a
printf("**Sample Problem 20-9a**\n")
gama = 7/5  //for diatomic gases
Tf = Ti*(Vi/Vf)^(gama-1)
printf("The final temprature of the gas is %fK\n", Tf)

//Sample Probelm 20-9b
printf("\n**Sample Problem 20-9b**\n")
Tf = Ti  //Temprature does not change in free expansion
Pi = 2  //in Pa
Pf = Pi*Vi/Vf
printf("The final pressure of the gas is %fPa\n", Pf)
printf("The final temprature of the gas is %fK", Tf)
```

Chapter 21

Entropy and the Second Law of Thermodynamics

Scilab code Exa 21.1 Sample Problem 1

```
//Given that
n = 1  //in mol
Vi = 1  //(say)
Vf = 2*Vi
R = 8.31  //in J/mol.K
T = 1  //(say)

//Sample Problem 21-1
printf("**Sample Problem 21-1**\n")
Q = n*R*T*log(Vf/Vi)
deltaS = Q/T
printf("The change in entropy for the irreversible
    process is equal to %fJ/K", deltaS)
```

Scilab code Exa 21.2 Sample Problem 2

```
//Given that
m = 1.5  //in kg
TiL = 60 + 273  //in K
TiR = 20 + 273  //in K
Tf = 40 + 273  //in K
Sc = 386  //in J/kg.K

//Sample Problem 21-2
printf("**Sample Problem 21-2**\n")
SL = m*Sc*integrate('1/T', 'T', TiL, Tf)
SR = m*Sc*integrate('1/T', 'T', TiR, Tf)
Srev = SR + SL
printf("The net entropy change in the reversible
   process is equal to %fJ/K", Srev)
```

Scilab code Exa 21.3 Sample Problem 3

```
//Given that
TH = 850  //in K
TL = 300  //in K
W = 1200  //in J
t = 0.25  //in sec

//Sample Problem 21-3a
printf("**Sample Problem 21-3a**\n")
eta = 1 - (TL/TH)
printf("The efficiency of the cycle is equal to %f\n
   ", eta)

//Sample Problem 21-3b
printf("\n**Sample Problem 21-3b**\n")
```

```
P = W/t
printf("The average power of the cycle is %fW\n", P)

//Sample Problem 21-3c
printf("\n**Sample Problem 21-3c**\n")
QH = W/eta
printf("The heat extracted from the reservoir is
   equal to %fJ\n", QH)

//Sample Problem 21-3d
printf("\n**Sample Problem 21-3d**\n")
QL = W - QH
printf("The heat delivered to the reservoir is equal
    to %fJ\n", QL)

//Sample Problem 21-3e
printf("\n**Sample Problem 21-3e**\n")
S = QH/TH + QL/TL
printf("The net entropy change for the cycle is %fJ/
   k", S)
```

Scilab code Exa 21.4 Sample Problem 4

```
//Given that
eta = 0.75
TH = 100 + 273
TL = 0 + 273

//Sample Problem 21-5
printf("**Sample Problem 21-5**\n")
etaMAX = 1 - TL/TH
if eta < etaMAX then
    printf("It is possible")
```

```
else
    printf("It is not possible")
end
```

Scilab code Exa 21.5 Sample Problem 5

```
//Given that
n = 100

//Sample Problem 21-5a
printf("**Sample Problem 21-5a**\n")
n1 = 50
n2 = 50
W = factorial(n)/(factorial(n1)*factorial(n2))
printf("The total number of possible configuration
   is %e\n", W)

//Sample Problem 21-5b
printf("\n**Sample Problem 21-5b**\n")
n1 = 100
n2 = 0
W = factorial(n)/(factorial(n1)*factorial(n2))
printf("The total number of possible configuration
   is %e", W)
```

Chapter 22

Electric Charge

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 22.1 `Sample Problem 1`

```
exec('electrostatics.sci', -1)
exec('degree_rad.sci', -1)

//Given that
q1 = 1.60*10^-19  //in C
q2 = 3.20*10^-19  //in C
R = 0.0200  //in meter

//Sample Problem 22-1a
printf("**Sample Problem 22-1a**\n")
F12 = coulomb(q1, q2, R)
printf("The coulombic force between the charged
    particle is %eN\n", F12)

```

```
//Sample Problem 22-1b
printf("\n**Sample Problem 22-1b**\n")
q3 = -3.20*10^-19   //in C
R13 = 3/4*R
F1 = coulomb(q1, q3, R13) + F12
printf("The net force on particle 1 is equal to %eN\n", abs(F1))

//Sample Problem 22-1c
printf("\n**Sample Problem 22-1c**\n")
q4 = -3.20*10^-19   //in C
R14 = 3/4*R
theta = dtor(60)
F14 = coulomb(q1, q4, R14)
F1net = [F12+F14*cos(theta), F14*sin(theta)]
printf("The net force on particle 1 is equal to %eN", norm(F1net))
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 22.2 `Sample Problem 2`

```
exec('electrostatics.sci', -1)

//Given that
q = 1   //(say)
q1 = 8*q
q2 = -2*q
L = 1   //(say)
x = L

//Sample Problem 22-2
```

```
printf("**Sample Problem 22-2**\n")
//let the distance of proton from q1 is y
//We know that y>L
y = poly(0, 'y')
F1 = coulomb(q1, e, y)
F2 = coulomb(q2, e, y-L)
p = F1 + F2
r = roots(denom(inv(p)))
printf("the proton should be placed at a distance %1
    .1fL from q1", r(2))
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 22.3 `Sample Problem 3`

```
exec('electrostatics.sci', -1)

//Given that
Q = 1  //(say)
q1 = Q
q2 = 0
a = 1  //(say)

//Sample Problem 22-3a
printf("**Sample Problem 22-3a**\n")
q1 = (q1 + q2)/2
q2 = q1
F = coulomb(q1, q2, a)
printf("The net force between the two sphere is %eQ
    ^2/a^2\n", F)


```

```
//Sample Problem 22-3b
printf("\n**Sample Problem 22-3b**\n")
q1 = 0
F = coulomb(q1, q2, a)
printf("The net force between the two sphere is %fN"
    , F)
```

check Appendix AP 3 for dependency:

`Gravitation.sci`

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 22.4 `Sample Problem 4`

```
exec('electrostatics.sci', -1)
exec('gravitation.sci', -1)

//Given that
r = 4*10^-15  //in meter
n = 26
mp = 1.67*10^-27  //in kg

//Sample Problem 22-4a
printf("**Sample Problem 22-4a**\n")
Fpp = coulomb(e, e, r)
printf("The force of repulsion is %eN\n", Fpp)

//Sample Problem 22-4b
printf("\n**Sample Problem 22-4b**\n")
Fg = GForce(mp, mp, r)
printf("The magnitude of gravitational force between
    two proton is %eN", Fg)
```

Chapter 23

Electric Fields

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 23.2 Sample Problem 2

```
exec('electrostatics.sci', -1)
exec('degree_rad.sci', -1)

//Given that
Q = 1  //(say)
q1 = +2*Q
q2 = -2*Q
q3 = -4*Q
d = 1  //(say)
theta = dtor(30)

//Sample Problem 23-2
printf("**Sample Problem 23-2**\n")
E1 = coulomb(q1, 1, d)*[cos(theta), sin(theta)]
```

```
E2 = coulomb(q2, 1, d)*[-cos(theta), sin(theta)]
E3 = coulomb(q3, 1, d)*[-cos(theta), -sin(theta)]
E = E1 + E2 + E3
printf("The net electric field at origin is equal to
    %eQ/d^2 N/C", norm(E))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 23.3 `Sample Problem 3`

```
exec('electrostatics.sci', -1)
exec('degree_rad.sci', -1)

//Given that
Q = 1  //(say)
A = dtor(120)
r = 1  //(say)

//Sample Problem 23-3
printf("**Sample Problem 23-3**\n")
Eunit_angle = coulomb(Q/A, 1, r)
//overall only x-component will survive
E = integrate('Eunit_angle*cos(theta)', 'theta', -A
    /2, A/2)
printf("The electric field due to arc at point P is
    equal to %eQ/r^2 N/C", E)
```

Scilab code Exa 23.4 Sample Problem 4

```
//Given that
m = 1.3*10^-10  //in kg
Q = 1.5*10^-13  //in C
Vx = 18  //in m/s
L = 1.6*10^-2  //in meter
E = 1.4*10^6  //in N/C

//Sample Problem 23-4
printf("**Sample Problem 23-4**\n")
a = E*Q/m
t = L/Vx
dv = 0.5*a*t^2  //vertical drop
printf("The vertical drop of the drop is equal to
    %fmm", dv*10^3)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 23.5 Sample Problem 5

```
exec('degree_rad.sci', -1)

//Given that
P = 6.2*10^-30  //in C.m

//Sample Problem 23-5a
```

```
printf("**Sample Problem 23-5a**\n")
q = 10*e
l = P/q
printf("The effective ditance between the positive &
    negative center is %em\n", l)

//Sample Problem 23-5b
printf("\n**Sample Problem 23-5b**\n")
E = 1.5*10^4  //in N/C
T = 2*E*q*l/2
printf("The net torque on the dipole is %eN.m\n", T)

//Sample Problem 23-5c
printf("\n**Sample Problem 23-5c**\n")
W = -(P*E*(cos(dtor(180)) - cos(0)))
printf("The work done by the external agent is equal
    to %eJ", W)
```

Chapter 24

Gauss Law

check Appendix AP 2 for dependency:

```
degree_rad.sci
```

Scilab code Exa 24.1 Sample Problem 1

```
exec('degree_rad.sci', -1)

//Given that
R = 1  //(say)
E = 1  //(say)
A = 1  //cuve surface area of cylinder(say)

//Sample Problem 24-1
printf("**Sample Problem 24-1**\n")
flux = E*A + (-E*A) + E*A*cos(dtor(90))
printf("The net flux passing through the cylinder is
    equal to %fN.m^2/C", flux)
```

Scilab code Exa 24.2 Sample Problem 2

```
//Given that
x = poly(0, 'x')
E = [3*x, 4, 0]
x1 = 1.0  //in m
x2 = 3.0  //in m
y1 = 0.0  //in m
y2 = 2.0  //in m
z1 = 0.0  //in m
z2 = 2.0  //in m

//Sample Problem 24-2
printf("**Sample Problem 24-2**\n")
//top face
A = [0; 2; 0] //area per unit x
Phi_top = integrate('[3*x, 4, 0]*A', 'x', x1, x2)
printf("The flux through the top face is equal to
    %fN.m^2/C\n", Phi_top)
//left face
A = [-2*2; 0; 0]
Phi_left = horner(E, x1)*A
printf("The flux through the left face is equal to
    %fN.m^2/C\n", Phi_left)
//Right face
A = [2*2; 0; 0]
Phi_right = horner(E, x2)*A
printf("The flux through the right face is equal to
    %fN.m^2/C", Phi_right)
```

check Appendix AP 4 for dependency:

electrostatics.sci

Scilab code Exa 24.3 Sample Problem 3

```
exec('electrostatics.sci', -1)

//Given that
q1 = +3.1*10^-9  //in C
q4 = q1
q2 = -5.9*10^-9  //in C
q5 = q2
q3 = -3.1*10^-9  //in C

//Sample Problem 24-3
printf("**Sample Problem 24-3**\n")
//Using gauss law
flux = (q1+q2+q3)/Eo
printf("The flux through the surface is equal to %fN
    .m^2/C", flux)
```

Scilab code Exa 24.4 Sample Problem 4

```
//Given that
q = -5  //in micro coulomb

//Sample Problem 24-4
printf("**Sample Problem 24-4**\n")
qin = -q
qout = -qin
printf("Charge on the inner surface is equal to
    %dmicroCoulomb\n", qin)
printf("Charge on the outer surface is equal to
    %dmicroCoulom", qout)
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 24.5 Sample Problem 5

```
exec('electrostatics.sci', -1)

//Given that
lambda = -1*10^-3  //in C/m
Eb = 3*10^6  //in N/C

//Sample Problem 24-5
printf("**Sample Problem 24-5**\n")
r = lambda/(2*%pi*Eo*Eb)
printf("The radius of the column is equal to %fm",
   abs(r))
```

---

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 24.6 Sample Problem 6

```
exec('electrostatics.sci', -1)

//Given that
sigmaP = 6.8*10^-6  //in C.m^2
sigmaN = 4.3*10^-6  //in C.m^2
```

```

Ep = sigmaP/(2*Eo)  //field due to positive plate
En = sigmaN/(2*Eo)  //field due to negative plate
//Sample Problem 24-6a
printf("**Sample Problem 24-6a**\n")
El = En - Ep
printf("Electric field on the left of the sheets is equal to %eN/C\n", El)

//Sample Problem 24-6b
printf("\n**Sample Problem 24-6b**\n")
Eb = En + Ep
printf("Field in between is equal to %eN/C\n", Eb)

//Sample Problem 24-6c
printf("\n**Sample Problem 24-6c**\n")
Er = -En + Ep
printf("Field in between is equal to %eN/C", Er)
```

Chapter 25

Electric Potential

check Appendix AP 4 for dependency:

electrostatics.sci

Scilab code Exa 25.1 Sample Problem 1

```
exec('electrostatics.sci', -1)

//Given that
E = 150  //in N/C
d = -520  //in meter

//Sample Problem 25-1
printf("**Sample Problem 25-1**\n")
W = E*(-e)*d
deltaU = -W
printf("The change in potential energy is %eJ",
   deltaU)
```

---

check Appendix AP 4 for dependency:

electrostatics.sci

Scilab code Exa 25.3 Sample Problem 3

```
exec('electrostatics.sci', -1)

//Given that
d = 1.3  //in meter
q1 = 12*10^-9  //in C
q2 = -24*10^-9  //in C
q3 = +31*10^-9  //in C
q4 = 17*10^-9  //in C

//Sample Problem 25-3
printf("**Sample Problem 25-3**\n")
V = EPotential(q1+q2+q3+q4, d/sqrt(2))
printf("The electric potential at point P is equal
    to %eV", V)
```

---

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 25.4 Sample Problem 4

```
exec('electrostatics.sci', -1)

//Given that
n = 12
qT = -n*e
R = 1  //(say)

```

```
//Sample Problem 25-4a
printf("**Sample Problem 25-4a**\n")
V = EPotential(qT, R)
printf("The electric potential at the center is
    equal to %e/R Volts", V)

//Sample Problem 25-4b
printf("**Sample Problem 25-4b**\n")
printf("It does not change in this configuration")
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 25.6 `Sample Problem 6`

```
exec('electrostatics.sci', -1)

//Given that
d = 12*10^-2   //in cm
q = 150*10^-9    //in C
q1 = +q
q2 = -4*q
q3 = +2*q

//Sample Problem 25-6
printf("**Sample Problem 25-6**\n")
U = EPotential(q1, d)*q2 + EPotential(q2, d)*q3 +
    EPotential(q3, d)*q1
printf("The electric potential energy of the system
    is equal to %eJ", U)
```

Chapter 26

Capacitance

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 26.1 `Sample Problem 1`

```
exec('electrostatics.sci', -1)

//Given that
C = 55*10^-15   //in F
V = 5.3   //in V

//Sample Problem 26-1
printf("**Sample Problem 26-1**\n")
Q = C*V
n = Q/e
printf("The number of excess electron is equal to %e
    ", n)
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 26.2 Sample Problem 2

```
exec('electrostatics.sci', -1)

//Given that
C1 = 12  //in uF
C2 = 5.30  //in uF
C3 = 4.50  //in uF
V = 12.5  //in Volts

//Sample Problem 26-2a
printf("**Sample Problem 26-2a**\n")
C12 = C1 + C2  //in series
C123 = C12*C3/(C12 + C3)  //in parallel
printf("The equivalent capacitance for the given
    circuit is %fuF\n", C123)

//Sample Problem 26-2b
printf("\n**Sample Problem 26-2b**\n")
Q123 = C123*V
Q12 = Q123  //in series
Q1 = Q12*C1/(C1+C2)
printf("The charge on the capacitor C1 is equal to
    %fuC", Q1)
```

Scilab code Exa 26.3 Sample Problem 3

```
//Given that
C1 = 3.55  //in uF
```

```
Vo = 6.30  //in Volts
C2 = 8.95  //in uF

//Sample Problem 26-3
printf("**Sample Problem 26-3**\n")
qT = C1*Vo  //Total charge
q1 = qT*C1/(C1+C2)  //in parallel
V = q1/C1
printf("The final potential difference between each
   capacitor is equal to %fV", V)
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 26.4 `Sample Problem 4`

```
exec('electrostatics.sci', -1)

//Given that
R = 6.85*10^-2  //in m
q = 1.25*10^-9  //in C

//Sample Problem 26-4a
printf("**Sample Problem 26-4a**\n")
C = 4*%pi*Eo*R
U = q^2/(2*C)
printf("The electric energy stored is equal to %eJ\n
   ", U)

//Sample Problem 26-4b
printf("\n**Sample Problem 26-4b**\n")
E = coulomb(q, 1, R)
u = 1/2*Eo*E^2
printf("The energy density is equal to %eJ/m^3", u)
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 26.5 Sample Problem 5

```
exec('electrostatics.sci', -1)

//Given that
C = 13.5*10^-12   //in F
V = 12.5   //in Volts
x = 6.50

//Sample Problem 26-5
printf("**Sample Problem 26-5**\n")
q = C*V
Ui = q^2/(2*C)
printf("The initial stored energy is equal to %eJ\n"
    , Ui)
C = x*C
Uf = q^2/(2*C)
printf("The energy stored after the slab is inserted
    is equal to %eJ", Uf)
```

check Appendix AP 4 for dependency:

`electrostatics.sci`

Scilab code Exa 26.6 Sample Problem 6

```
exec('electrostatics.sci', -1)

//Given that
A = 115*10^-4  //in m^2
d = 1.24*10^-2  //in meter
Vo = 85.5  //in Volts
b = 0.780*10^-2  //in meter
x = 2.61

//Sample Problem 26-6a
printf("**Sample Problem 26-6a**\n")
Co = A*Eo/d
printf("The capacitance of the plates before the
    dielectric slab is inserted is equal to %fpF\n",
    Co*10^12)

//Sample Problem 26-6b
printf("\n**Sample Problem 26-6b**\n")
Q = Co*Vo
printf("Free charge on the plates is equal to%fpC\n"
    , Q*10^12)

//Sample Problem 26-6c
printf("\n**Sample Problem 26-6c**\n")
E = Q/(A*Eo)
printf("The electric field is equal to %fV/m\n", E)

//Sample Problem 26-6d
printf("\n**Sample Problem 26-6d**\n")
E1 = Q/(A*Eo*x)
printf("The electric field in dielectric slab is
    equal to %fV/m\n", E1)

//Sample Problem 26-6e
printf("\n**Sample Problem 26-6e**\n")
V = E*(d-b) + E1*b
printf("The new potential difference is equal to %fV
    \n", V)
```

```
//Sample Problem 26-6f
printf("\n**Sample Problem 26-6f**\n")
C = Q/V
printf("The new capacitance is equal to %fpF", C
    *10^12)
```

Chapter 27

Current and Resistance

Scilab code Exa 27.1 Sample Problem 1

```
//Given that
rate = 450*10^-6  //in m^3/s
e = 1.6*10^-19
Na = 6.023*10^23
M = 18*10^-3  //in kg/mol
density = 1000  //in kg/m^3

//Sample Problem 27-1
printf("**Sample Problem 27-1**\n")
n = 10
i = e*n*Na/M*density*rate
printf("The current of negative charge is equal to
   %eA", i)
```

Scilab code Exa 27.2 Sample Problem 2

```
//Given that
R = 2*10^-3  //in meter
J = 2*10^5  //in A/m^2

//Sample Problem 27-2a
printf("**Sample Problem 27-2a**\n")
//As current density is uniform
A = %pi*(R^2 - (R/2)^2)
I = J*A
printf("The current flowing through the outer portion is %fA\n", I)

//Sample Problem 27-2b
printf("\n**Sample Problem 27-2b**\n")
a = 3*10^11  //in SI unit
Iv = integrate('a*r^2*2*%pi*r', 'r', R/2, R)
printf("Now the current will be %fA", Iv)
```

Scilab code Exa 27.3 Sample Problem 3

```
//Given that
r = 900*10^-6  //in m
i = 17*10^-3  //in A
e = 1.6*10^-19  //in C
densityCopper = 8.96*10^3  //in kg/m^3
M = 63.54*10^-3  //in kg/mol
Na = 6.023*10^23

//Sample Problem 27-3
printf("**Sample Problem 27-3**\n")
A = %pi*r^2
J = i/A
n = densityCopper/M*Na
```

```
Vd = J/(n*e)
printf("The drift speed is %em/s", Vd)
```

Scilab code Exa 27.4 Sample Problem 4

```
//Given that
l = 1.2*10^-2  //in meter
b = 1.2*10^-2  //in meter
h = 15*10^-2  //in meter
resistivityIron = 9.68*10^-8  //in ohm.m

//Sample Problem 27-4(1)
printf("**Sample Problem 27-4(1)**\n")
R1 = resistivityIron*h/(l*b)
printf("The resistance of the block is equal to %eOhm\n", R1)

//Sample Problem 27-4(2)
printf("\n**Sample Problem 27-4(2)**\n")
R2 = resistivityIron*l/(b*h)
printf("The resistance of the block is equal to %eOhm", R2)
```

Scilab code Exa 27.5 Sample Problem 5

```
//Given that
e = 1.6*10^-19  //in C
Re = 1.69*10^-8  //in Ohm.m
n = 8.49*10^28
```

```
m = 9.1*10^-31  //mass of electron in kg
Veff = 1.6*10^6  //in m/s

//Sample Problem 27-5a
printf("**Sample Problem 27-5a**\n")
//resistivity = m/(n*e^2*t)
t = m/(n*e^2*Re)
printf("The mean free time between two collision is %es\n", t)

//Sample Problem 27-5b
printf("\n**Sample Problem 27-5b**\n")
lambda = Veff*t
printf("The mean free path is equal to %em", lambda)
```

Scilab code Exa 27.6 Sample Problem 6

```
//Given that
R = 72  //in Ohm
V = 120  //in volts

//Sample Problem 27-6
printf("**Sample Problem 27-6**\n")
H1 = V^2/R
printf("The Power dissipated in first case is equal to %dW\n", H1)
H2 = V^2/(R/2) * 2
printf("The Power dissipated in second case is equal to %dW\n", H2)
```

Chapter 28

Circuits

Scilab code Exa 28.1 Sample Problem 1

```
//Given that
E1 = 4.4  //in Volts
E2 = 2.1  //in olts
r1 = 2.3  //in Ohm
r2 = 1.8  //in Ohm
R = 5.5  //in Ohm

//Sample Problem 28-1a
printf("**Sample Problem 28-1a**\n")
i = poly(0, 'i')
p = E1 - E2 - i*r2 - i*R - i*r1
i = roots(p)
printf("The current in the circuit is equal to %fA\n
   ", i)

//Sample Problem 28-1b
printf("\n**Sample Problem 28-1b**\n")
Ve1 = E1 - i*r1
printf("The potential difference between the
   terminal of the battery is equal to %fV", Ve1)
```

Scilab code Exa 28.2 `Sample Problem 2`

```
//Given that
R1 = 20  //in Ohm
R2 = 20  //in Ohm
R3 = 30  //in Ohm
R4 = 8  //in Ohm
E = 12  //in Volts

//Sample Problem 28-2a
printf("**Sample Problem 28-2a**\n")
R23 = R2*R3/(R2+R3)
Req = R1 + R23 + R4
i = poly(0, 'i')
i = E/Req
printf("The current through the battery is %fA\n", i
  )

//Sample Problem 28-2b
printf("\n**Sample Problem 28-2b**\n")
i2 = i*R23/R2
printf("The current through R2 is %fA\n", i2)

//Sample Problem 28-2c
printf("\n**Sample Problem 28-2c**\n")
i3 = i2*R2/R3
printf("The current through R3 is %fA", i3)
```

Scilab code Exa 28.3 Sample Problem 3

```
//Given that
E1 = 3.0  //in Volts
E2 = 6.0  //in Volts
R1 = 2.0  //in Ohm
R2 = 4.0  //in Ohm

//Sample Problem 28-3
printf("**Sample Problem 28-3**\n")
function [f] = circuit(i)
    f = zeros(2, 1)
    //Using KVL in both the loops
    f(1) = -i(1)*R1 - E1 - i(1)*R1 + E2 + i(2)*R2
    f(2) = E2 + i(2)*R2 + (i(1)+i(2))*R1 - E2 + (i(1)+i(2))*R1
endfunction
i = fsolve([0,0], circuit)
printf("i1 = %fA\n", i(1))
printf("i2 = %fA\n", i(2))
printf("i3 = %fA", sum(i))
```

Scilab code Exa 28.4 Sample Problem 4

```
//Given that
rows = 140
n = 5000
E = 0.15  //in Volts
r = 0.25  //in Ohm
Rw = 800  //in Ohm

//Sample Problem 28-4a
printf("**Sample Problem 28-4a**\n")
```

```
Rrow = n*r
Req = Rrow/rows
Erow = n*E
Eeq = (Erow/Rrow * rows)/(rows/Rrow)
I = Eeq/(Rw + Req)
printf("The magnitude of current produced in the
    water is %fA\n", i(1))

//Sample Problem 28-4b
printf("\n**Sample Problem 28-4b**\n")
Irow = I/rows
printf("Current in each row is equal to %fA", Irow)
```

Scilab code Exa 28.5 Sample Problem 5

```
//Given that
C = 1 //(say)
R = 1  //(say)

//Sample Problem 28-5a
printf("**Sample Problem 28-5a**\n")
//q = qo*e^(-t/(R*C))
//q = qo/2 when t = Tq
Tq = log(2)*R*C
printf("At t=%fT, the capacitor will be half charged
    \n", Tq)

//Sample Problem 28-5b
printf("\n**Sample Problem 28-5b**\n")
//U = Uo*e^(-2*t(R*C))
//U = Uo/2 When t = Tu
Tu = log(2)/2*R*C
printf("At t=%fT, the enrgy stored will be half of
```

```
its MAX value", Tu)
```

Chapter 29

Magnetic fields

Scilab code Exa 29.1 Sample Problem 1

```
//Given that
B = 1.2*10^-3  //in T
e = 1.6*10^-19  //in C
K = 5.3*10^6*e  //in J
m = 1.6*10^-27  //in kg

//Sample Problem 29-1
printf("**Sample Problem 29-1**\n")
v = sqrt(2*K/m)
F = e*v*B
printf("The magnitude of magnetic force acting on
   the proton is %eN", F)
```

Scilab code Exa 29.2 Sample Problem 2

```
//Given that
d = 1.5*10^-2  //in meter
```

```
v = 4.0  //in m/s
B = 0.050  //in T

//Sample Problem 29-2a
printf("**Sample Problem 29-2a**\n")
//force is in right direction
printf("The right surface will be at high potential\n")

//Sample Problem 29-2b
printf("\n**Sample Problem 29-2b**\n")
F = v*B  //force per unit charge
deltaU = d*F  //energy per unit charge = potential difference
printf("The potential difference between the two surface is %1.1eV", deltaU)
```

Scilab code Exa 29.3 Sample Problem 3

```
//Given that
B = 80*10^-3  //in T
V = 1000.0  //in V
q = 1.6022*10^-19  //in C
x = 1.6254  //in m
conv = 1.6605*10^-27  //in kg/u

//Sample Problem 29-3
printf("**Sample Problem 29-3**\n")
m = poly(0, 'm')
r = x/2
//r = m*v/(q*B)
//v  = q*B*r/m
m = 0.5*(q*r*B)^2/V/q
```

```
printf("The mass of the particle is %ekg", m)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 29.4 Sample Problem 4

```
exec('degree_rad.sci', -1)

//Given that
e = 1.6*10^-19
K = 22.5*e  //in J
B = 4.55*10^-4  //in T
theta = dtor(65.5)
m = 9.11*10^-31  //in kg

//Sample Problem 29-4
printf("**Sample Problem 29-4**\n")
q = e
v = sqrt(2*K/m)
r = m*v*sin(theta)/(q*B)
T = 2*%pi*r/(v*sin(theta))
p = v*cos(theta)*T
printf("The pitch of the electron is equal to %fm",
    p)
```

Scilab code Exa 29.5 Sample Problem 5

```
//Given that
f = 12*10^6  //in Hz
R = 53*10^-2  //in m
q = 1.6*10^-19  //in C
m = 3.34*10^-27  //in kg

//Sample Problem 29-5a
printf("**Sample Problem 29-5a**\n")
B = 2*%pi*m*f/q
printf("The magnitude of magnetic field should be
    %fT\n", B)

//Sample Problem 29-5b
printf("\n**Sample Problem 29-5b**\n")
v = q*B*R/m
K = 0.5*m*v^2
printf("The kinetic energy of the deuteron will be
    %eJ", K)
```

Scilab code Exa 29.6 Sample Problem 6

```
//Given that
i = 28  //in A
LD = 46.6*10^-3  //in kg/m
g = 9.8  //in m/s^2

//Sample Problem 29-6
printf("**Sample Problem 29-6**\n")
L = 1  //(say)
m = LD*L
B = m*g/i/L
printf("The minimum magnetic field required to
    suspend the wire is equal to %eT", B)
```

Scilab code Exa 29.7 Sample Problem 7

```
//Given that
h = 2.1*10^-2  //in m
w = 1.2*10^-2  //in m
n = 250
B = 0.23  //in T
i = 100*10^-6  //in A
theta = 28  //in degree

//Sample Problem 29-7
printf("**Sample Problem 29-7**\n")
A = h*w
T = B*i*n*A
k = T/theta
printf("The value of constant k is equal to %eN.m/
   degree", k)
```

Scilab code Exa 29.8 Sample Problem 8

```
//Given that
n = 250
A = 2.52*10^-4  //in m^2
i = 100*10^-6  //in A
B = 0.85  //in T

//Sample Problem 29-8
```

```
printf("**Sample Problem 29-8**\n")
mu = n*i*A
U1 = -mu*B*cos(%pi/2)
U2 = -mu*B*cos(0)
W = U1 - U2
printf("Work done is equal to %eJ", W)
```

Chapter 30

Magnetic fields due to Current

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 30.2 Sample Problem 2

```
exec('degree_rad.sci', -1)

//Given that
i1 = 15  //in A
i2 = 32  //in A
d = 5.3*10^-2  //in m
uo = 4*%pi*10^-7  //in SI unit

//Sample Problem 30-2
printf("**Sample Problem 30-2**\n")
R = d/sqrt(2)
B1 = uo*i1/(2*%pi*R)
B2 = uo*i2/(2*%pi*R)
theta = atan(B1/B2)
B = sqrt(B1^2 + B2^2)
printf("The magnitude of net magnetic field is %eT\n
    ", B)
```

```
printf("The angle made by the net magnetic field by
    the positive x-axis is %fdegrees", rtod(theta)
    +45)
```

Scilab code Exa 30.3 Sample Problem 3

```
//Given that
a = 2*10^-2  //in meter
b = 4*10^-2  //in meter
r = 3*10^-2  //in meter
c = 3*10^6  //in A/m^4
uo = 4*%pi*10^-7  //in SI unit

//Sample Problem 30-3
printf("**Sample Problem 30-3**\n")
//Using gauss law
//B*L = uo*I
Ienc = integrate('c*x^2*2*%pi*x', 'x', a, r)
L = 2*%pi*r
B = uo*Ienc/L
printf("The magnetic field at x=r is %eT", B)
```

Scilab code Exa 30.4 Sample Problem 4

```
//Given that
L = 1.23  //in meter
d = 3.55*10^-2  //in meter
i = 5.57  //in A
n = 850*5
```

```
uo = 4*%pi*10^-7   //in SI unit

//Sample Problem 30-4
printf("**Sample Problem 30-4**\n")
B = uo*n/L*i
printf("The magnetic field inside the solenoid is
   %eT", B)
```

Chapter 31

Induction and Inductance

Scilab code Exa 31.1 Sample Problem 1

```
//Given that
i = 1.5  //in A
D = 3.2*10^-2  //in meter
N = 220/10^-2  //in turns/m
n = 130
d = 2.1*10^-2  //in meter
deltaT = 25*10^-3  //in s
uo = 4*%pi*10^-7  //in SI unit

//Sample Problem 31-1
printf("**Sample Problem 31-1**\n")
A = %pi*(d/2)^2
deltaPhi = uo*N*i*A
E = n*deltaPhi/deltaT
printf("The emf induced is equal to %eV", E)
```

Scilab code Exa 31.2 Sample Problem 2

```
//Given that
r = 0.20  //in meter
t = poly(0, 't')
B = 4.0*t^2 + 2.0*t + 3.0
E = 2.0  //in Volts
R = 2  //in Ohm

//Sample Problem 31-2a
printf("**Sample Problem 31-2a**\n")
t = 10  //in sec
flux = B*%pi*r^2/2
Et = derivat(flux)
E1 = horner(Et, t)
printf("The Emf induced is equal to %fV\n", E1)

//Sample Problem 31-2b
printf("\n**Sample Problem 31-2b**\n")
I = (E1-E)/R
printf("The induced current is equal to %fA", I)
```

Scilab code Exa 31.3 Sample Problem 3

```
//Given that
t = poly(0, 't')
//B = 4*t^2*x^2
W = 3.0  //in meter
H = 2.0  //in meter
t1 = 0.10  //in sec

//Sample Problem 31-3
printf("**Sample Problem 31-3**\n")
flux = integrate('4*x^2*H', 'x', 0, W)
E = derivat(flux*t^2)
```

```
E1 = horner(E, t1)
printf("The induced emf is equal to %fV", E1)
```

Scilab code Exa 31.4 Sample Problem 4

```
//Given that
R = 8.5*10^-2    //in meter
Rb = 0.13   //in T/s
r = 5.2*10^-2   //in meter

//Sample Problem 31-4a
printf("**Sample Problem 31-4a**\n")
//Using Faraday's law
Rf = Rb*%pi*r^2
E = Rf/(2*%pi*r)
printf("The induced electric field is equal to %eV/m
   \n", E)

//Sample Problem 31-4b
printf("\n**Sample Problem 31-4b**\n")
r = 12.5*10^-2  //in meter
Rf = Rb*%pi*R^2
E = Rf/(2*%pi*r)
printf("The induced electric field is equal to %eV/m
   ", E)
```

Scilab code Exa 31.5 Sample Problem 5

```
//Given that
```

```
R = 9.0  //in Ohm
L = 2*10^-3  //in Henery
E = 18  //in Volts

//Sample Problem 31-5a
printf("**Sample Problem 31-5a**\n")
//As soon as switch is closed the inductor will act like current barrier
Io = E/R
printf("The current as soon as qwitch is closed is equal to %1.2fA\n", Io)

//Sample Problem 31-5b
printf("\n**Sample Problem 31-5b**\n")
//After long time inductor will act like short circuit
Req = R/3
If = E/(R/3)
printf("The current through the battery after long time will be %1.2fA", If)
```

Scilab code Exa 31.6 `Sample Problem 6`

```
//Given that
L = 53*10^-3  //in H
R = 0.37  //in Ohm

//Sample Problem 31-6
printf("**Sample Problem 31-6**\n")
//i = io(1-e^(t/T))
//ln2 = t/T
T = L/R
t = T*log(2)
```

```
printf("The time taken to rach the current to half
    of its stedy state value is %fs", t)
```

Scilab code Exa 31.7 Sample Problem 7

```
//Given that
L = 53*10^-3  //in H
R = 0.35  //in Ohm
V = 12  //in Volts

//Sample Problem 31-7a
printf("**Sample Problem 31-7a**\n")
i = V/R  //in steady state
E = 1/2*L*i^2
printf("The Energy stored in the inductor in steady
    state is %fJ\n", E)

//Sample Problem 31-7b
printf("\n**Sample Problem 31-7b**\n")
Et = E/2
//hence It = Io/sqrt(2)
f = log(1-1/sqrt(2))  //the number of times of time
    constant
printf("After t=%1.1fT, the energy stored in the
    inductor will be half of tis steady state value",
     f)
```

Scilab code Exa 31.8 Sample Problem 8

```
//Given that
a = 1.2*10^-3  //in meter
b = 3.5*10^-3  //in meter
i = 2.7  //in Amp
l = 1  //in meter(say)
uo = 4*%pi*10^-7

//Sample Problem 31-8
printf("**Sample Problem 31-8**\n")
B = uo*i/(2*%pi)  //divided by r
Ul = B^2/(2*uo)  //divided by r^2
//Energy as a funtion of r
U = Ul*2*%pi*l  //divided by r by r
Energy = integrate('U/r', 'r', a, b)
printf("Energy per unit length is equal to %1.2eJ/m"
    , Energy)
```

Scilab code Exa 31.9 Sample Problem 9

```
//Given that
N1 = 1200   //turns
N2 = N1
R2 = 1.1*10^-2  //in meter
R1 = 15*10^-2  //in meter
uo = 4*%pi*10^-7

//Sample Problem 31-9
printf("**Sample Problem 31-9**\n")
//let's assume
i = 1  //in amp
B1 = uo*N1*i/(2*R1)
phi2 = B1*%pi*R2^2*N2
M = phi2/i
```

```
printf("The mutual inductance of the two coil is
    equal to %1.2eH", M)
```

Chapter 32

Magnetism of Matter Maxwell Equation

Scilab code Exa 32.1 Sample Problem 1

```
//Given that
T = 300  //in K
B = 1.5  //in T
ub = 9.27*10^-24  //in J/T
mu = 1.0*ub
K = 1.38*10^-23  //in J/K
e = 1.6*10^-19  //in coulomb

//Sample Problem 32-1
printf("**Sample Problem 32-1**\n")
K = 3/2*K*T
deltaU = 2*ub*B
printf("The average translation kinetic energy of
   the atoms is %1.2eeV\n", K/e)
printf("The difference between the energy of the two
    arrangement is %1.2eeV", deltaU/e)
```

Scilab code Exa 32.2 Sample Problem 2

```
//Given that
density = 7900  //in kg/m^3
L = 3*10^-2  //in meter
w = 1*10^-3  //in meter
t = 0.50*10^-3  //in meter
MFe = 2.1*10^-23  //in J/T
f = 10/100
M = 55.847*10^-3  //in kg/mol
Na = 6.023*10^23  //in /mol

//Sample Problem 32-2
printf("**Sample Problem 32-2**\n")
N = density*L*w*t/M * Na
MD = N*f*MFe
printf("The needles magnetic dipole moment is %1.2eJ
    /T", MD)
```

Scilab code Exa 32.3 Sample Problem 3

```
//Given that
r = 11.0*10^-3  //in meter
R = 5*r
Edot = 1.50*10^12  //in V/m.s
uo = 4*%pi*10^-7
Eo = 8.85*10^-12  //in C^2/N.m^2

```

```
//Sample Problem 32-3
printf("**Sample Problem 32-3**\n")
//for r=R/5
B = uo*Eo*R^2/(2*r)*Edot
printf("The magnetic field is at r=R/5 is equal to %1.2eT", B)
```

Chapter 33

Electromagnetic Oscillations and Alternating Current

Scilab code Exa 33.1 Sample Problem 1

```
//Given that
C = 1.5*10^-6  //in F
V = 57  //in volts
L = 12*10^-3  //in H

//Sample Problem 33-1
printf("**Sample Problem 33-1**\n")
Imax = V*sqrt(C/L)
printf("The maximum current in the circuit is %1.2eA
    ", Imax)
```

Scilab code Exa 33.2 Sample Problem 2

```
//Given that
```

```
C = 1.5*10^-6   //in F
V = 57   //in volts
L = 12*10^-3   //in H

//Sample Problem 33-2a
printf("**Sample Problem 33-2a**\n")
//V(accross Inductor) = V(accross Capacitor)
//-L*(dI/dt) = V
//I = C*(dV/dt)
//L*C*(d^2V/dt^2) = -V
//at t=0, Potential difference = V
w = 1/sqrt(L*C)
printf("The potential defference accross the
   inductor is V=%d*cos(%d*t)\n", V, w)

//Sample Problem 33-2b
printf("\n**Sample Problem 33-2b**\n")
MaxRate = abs(-V/L)
printf("The maximum rate of change in current is %1
   .2famp/s", MaxRate)
```

Scilab code Exa 33.3 Sample Problem 3

```
//Given that
L = 12*10^-3   //in H
C = 1.6*10^-6   //in F
R = 1.5   //in ohm

//Sample Problem 33-3a
printf("**Sample Probelm 33-3a**\n")
//Q/2 = Q*e^(-R*t/(2*L))
t = -2*L/R*log(0.50)
printf("At time t=%1.2esec, the amplitude of charge
```

```
    oscillation is half of the maximum value\n", t)

//Sample Problem 33-3b
printf("\n**Sample Probelm 33-3b**\n")
w = 1/sqrt(L*C)
T = (2*%pi)/w
n = t/T
printf("The number of oscillation are %1.2f till t=
    %1.2e", n, T)
```

Scilab code Exa 33.4 `Sample Problem 4`

```
//Given that
R = 200  //in Ohm
Em = 36  //in volts
fd = 60  //in Hz
t = poly(0, 't')
w = 2*%pi*fd
//V = Em*sin(w*t)

//Sample Problem 33-4a
printf("**Sample Problem 33-4a**\n")
//Vr = Emax*sin(w*t)
printf("The voltage drop across the resistor is Vr=
    %1.2f*sin(%1.2f*t)\n", Em, w)

//Sample Problem 33-4b
printf("\n**Sample Problem 33-4b**\n")
Ir = Em/R
printf("The current in the resistor as a function of
     time is Ir=%1.2f*sin(%1.2f*t)", Ir, w)
```

Scilab code Exa 33.5 Sample Problem 5

```
//Given that
C = 15*10^-6  //in Farad
Em = 36.0  //in volts
fd = 60.0  //in Hz

//Sample Problem 33-5a
printf("**Sample Problem 33-5a**\n")
//Vc = Emax*sin(w*t)
printf("The voltage drop across the capacitor is Vc=%1.2f*sin(%1.2f*t)\n", Em, w)

//Sample Problem 33-5b
printf("\n**Sample Problem 33-5b**\n")
//I = -C*(dV/dt)
IcMAX = abs(w*C*Em)
printf("The current in the capacitor as a function of time is Ic=%1.2f*cos(%1.2f*t)", IcMAX, w)
```

Scilab code Exa 33.6 Sample Problem 6

```
//Given that
L = 230*10^-3  //in Farad
Em = 36.0  //in volts
fd = 60.0  //in Hz

//Sample Problem 33-6a
```

```
printf("**Sample Problem 33-6a**\n")
//Vc = Emax*sin(w*t)
printf("The voltage drop across the inductor is Vi=%1.2f*sin(%1.2f*t)\n", Em, w)

//Sample Problem 33-6b
printf("\n**Sample Problem 33-6b**\n")
//V = -L*(dI/dt)
IcMAX = abs(Em/(w*L))
printf("The current in the inductor as a function of time is Ic=-%1.2f*cos(%1.2f*t)", IcMAX, w)
```

Scilab code Exa 33.7 Sample Problem 7

```
//Given that
R = 200  //in ohm
C = 15*10^-6  //in F
L = 230*10^-3  //in H
Em = 36.0  //in volts
fd = 60.0  //in Hz

//Sample Problem 33-7a
printf("**Sample Problem 33-7a**\n")
w = 2*%pi*fd
Xl = w*L
Xc = 1/(w*C)
Z = sqrt(R^2 + (Xl - Xc)^2)
Imax = Em/Z
printf("The amplitude of current in the circuit is %1.2fA, Imax\n", Imax)

//Sample Problem 33-7b
printf("\n**Sample Problem 33-7a**\n")
```

```
phi = atan((Xl-Xc)/R)
printf("The phase constant is equal to %fdegrees", phi)
```

Scilab code Exa 33.8 Sample Problem 8

```
//Given that
Erms = 120  //in volts
fd = 60  //in Hz
R = 200  //in ohm
Xl = 80.0  //in ohm
Xc = 150  //in ohm

//Sample Problem 33-8a
printf("**Sample Problem 33-8a**\n")
Z = sqrt(R^2 + (Xl - Xc)^2)
pf = R/Z
printf("The power factor for the circuit is %.3f\n", pf)

//Sample Problem 33-8b
printf("\n**Sample Problem 33-8b**\n")
Irms = Erms/R
Pavg = Erms*Irms*pf
printf("The average rate of disscipation of energy is equal to %1.2fW\n", Pavg)

//Sample Problem 33-8c
printf("\n**Sample Problem 33-8c**\n")
Xc = Xl
w = 2*%pi*fd
Cnew = 1/Xc/w
printf("The new capacitance should be %1.2eF", Cnew)
```

Scilab code Exa 33.9 Sample Problem 9

```
//Given that
Vp = 8.5*10^3   //in Volts
Vs = 120   //in volts
P = 78*10^3   //in W

//Sample Problem 33-9a
printf("**Sample Problem 33-9a**\n")
ratio = Vp/Vs
printf("The turn ratio is equal to %.3f\n", ratio)

//Sample Problem 33-9b
printf("\n**Sample Problem 33-9b**\n")
Is = P/Vs
Ip = P/Vp
printf("The current in primary circuit is %1.2eA\n", Ip)
printf("The current in secondary circuit is %1.2eA\n", Is)

//Sample Problem 33-9c
printf("\n**Sample Problem 33-9c**\n")
Rs = Vs/Is
Rp = Vp/Ip
printf("The resistance in primary circuit is %1.2eA\n", Rp)
printf("The resistance in secondary circuit is %1.2eA\n", Rs)
```

Chapter 34

Electromagnetic Waves

Scilab code Exa 34.1 `Sample Problem 1`

```
//Given that
d = 1.8  //in meter
P = 250  //in W
c = 3*10^8  //in m/s
mu = 4*%pi*10^-7  //in SI unit

//Sample Problem 34-1
printf("**Sample Problem 34-1**\n")
Erms = sqrt(P*c*mu/(4*%pi*d^2))
Brms = Erms/c
printf("The rms value of electric field is equal to
    %1.2eV/m\n", Erms)
Brms = printf("The rms value of magnetic field is
    equal to %1.2eT", Brms)
```

---

check Appendix AP 3 for dependency:

`Gravitation.sci`

Scilab code Exa 34.2 Sample Problem 2

```
exec('Gravitation.sci', -1)

//Given that
density = 3.5*10^3  //in kg/m^3
c = 3*10^8  //in m/s
d = 1  //(say)
Ps = 3.9*10^26  //in W

//Sample Problem 34-2
printf("**Sample Problem 34-2**\n")
R = poly(0, 'R')
A = %pi*R^2
Ad = 4*%pi*d^2
I = Ps/Ad
Fr = I*A/c
V = 4/3*%pi*R^3
m = density*V
Fg = GForce(m, Ms, d)
R = roots(Fr-Fg)
printf("The radius of the dust particle is %1.3em",
    R(1))
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 34.3 Sample Problem 3

```
exec('degree_rad.sci', -1)

//Given that
theta1 = dtor(60)
```

```
theta2 = dtor(90-60)
I = 1  //(say)

//Sample Problem 34-3
printf("**Sample Problem 34-3**\n")
//half of the original intensity, from the one-half rule
I1 = I/2
I2 = I1*cos(theta1)^2
I3 = I2*cos(theta2)^2
printf("The ratio of the initial inensity to the final intensity of the light is %.4f", I3)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 34.4 Sample Problem 4

```
exec('degree_rad.sci', -1)

//Given that
n1 = 1.33
n2 = 1.77
n3 = 1.00
theta1 = 50  //in degrees

//Sample Problem 34-4a
printf("**Sample Problem 34-4a**\n")
AORl = 90 - theta1
AORr = rtod(asin(n1/n2*sin(dtor(AORl))))
printf("The angle of reflection is %1.2fdegrees\n", AORl)
```

```
printf("The angle of refraction is %1.2fdegrees\n",
    AORr)

//Sample Problem 34-4b
printf("\n**Sample Problem 34-4b**\n")
Af = rtod(asin(n2/n3*sin(dtor(AORr))))
printf("The final angle of refraction is %1.2
    fdegrees", Af)
```

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 34.5 Sample Problem 5

```
exec('degree_rad.sci', -1)

//Given that
e = 45   //in degrees

//Sample Problem 34-5
printf("**Sample Problem 34-5**\n")
//For extrem case
n = 1/sin(dtor(e))
printf("The index of refraction should be at least
    %1.1f", n)
```

Chapter 35

Images

Scilab code Exa 35.1 Sample Problem 1

```
//Given that
h = 1  //(say)
f = 40  //in cm
hdash = .20*h

//Sample Problem 35-1a
printf("**Sample Problem 35-1a**\n")
printf("The image is virtual & on the opposite side
    of mirror because of having same orientation\n")

//Sample Problem 35-1b
printf("\n**Sample Problem 35-1b**\n")
printf("The height of image is smaller than the
    object. Therefore, the mirror is concave\n")
```

Scilab code Exa 35.2 Sample Problem 2

```
//Given that
n1 = 1.6
n2 = 1.00
R  = -3.0  //in mm
i = -5.0  //in mm

//Sample Problem 35-2
printf("**Sample Problem 35-2**\n")
//n1/d + n2/i = (n2-n1)/R
d = n1/(- n2/i + (n2-n1)/R)
printf("The real depth of the mosquito is %1.2fmm", d)
```

Scilab code Exa 35.3 `Sample Problem 3`

```
//Given that
Xo = -20  //in cm
m = -0.25
n = 1.65

//Sample Problem 35-3a
printf("**Sample Problem 35-3a**\n")
printf("The image is real real because m<0 as well as m<1\n")
printf("The mens is converging because magnification is negative for real image\n")
printf("The object is outside the focal length because m<1\n")
printf("The image is on the opposite side of the image from the lens\n")
printf("The image is erect\n")

//Sample Problem 35-3b
```

```
printf("\n**Sample Problem 35-3b**\n")
f = Xo*m*Xo/(Xo-m*Xo)
R = (n-1)*2*f
printf("The radius of curvature of the lens is %1.2
    fcm", f)
```

Scilab code Exa 35.4 Sample Problem 4

```
//Given that
L= 10  //in cm
f1 = 24  //in cm
f2 = 9  //in cm
xo = -6  //in cm

//Sample Problem 35-4
printf("**Sample Problem 35-4**\n")
xi1 = xo*f1/(xo+f1)
xo2 = xi1 - L
xi2 = xo2*f2/(xo2+f2)
printf("The final image will be at a distance of
    %dcm from the second mirror", xi2)
```

Chapter 36

Interference

Scilab code Exa 36.1 Sample Problem 1

```
//Given that
l = 550*10^-9  //in meter
n2 = 1.60
n1 = 1.00
t = 2.6*10^-6  //in meter

//Sample Problem 36-1a
printf("**Sample Problem 36-1a**\n")
deltaPHI = t/l*(n2 - n1)*360
printf("The phase difference is equal to %1.2
   fdegrees\n", deltaPHI)

//Sample Problem 36-1b
printf("\n**Sample Problem 36-1b**\n")
printf("The interference produced would be
   constructive")
```

Scilab code Exa 36.2 Sample Problem 2

```
//Given that
l = 546*10^-9  //in meter
d = 12*10^-5  //in meter
D = 55*10^-2  //in meter

//Sample Problem 36-2
printf("**Sample Problem 36-2**\n")
beeta = l*D/d
printf("The difference between two adjacent maxima
   is %1.2em", beeta)
```

---

check Appendix AP 2 for dependency:

degree_rad.sci

Scilab code Exa 36.3 Sample Problem 3

```
exec('degree_rad.sci', -1)

//Given that
Eo = 1  //(say)
E1 = Eo
E2 = Eo
E3 = Eo
phi1 = dtor(0)
phi2 = dtor(60)
phi3 = dtor(-30)

//Sample Problem 36-3
printf("**Sample Problem 36-3**\n")
Eh = E1*cos(phi1) + E2*cos(phi2) + E3*cos(phi3)
Ev = E1*sin(phi1) + E2*sin(phi2) + E3*sin(phi3)
```

```
Er = sqrt(Ev^2 + Eh^2)
theta = rtod(atan(Ev/Eh))
printf("The resultant electric field is E=%1.2f*Eo*
   sin(w*t + %1.2f)", Er, theta)
```

Scilab code Exa 36.4 Sample Problem 4

```
//Given that
lmin = 400  //in nm
lmax = 690  //in nm
n2 = 1.33
L = 320  //in nm

//Sample Problem 36-4
printf("**Sample Problem 36-4**\n")
flag = 1
odd_number = 1
while flag == 1
    lambda = 4*L*n2/odd_number
    if lambda > lmin & lambda < lmax then
        flag = 0
    end
    odd_number = odd_number + 2
end
printf("The wavelength of the light is %1.2enm",
   lambda)
```

Scilab code Exa 36.5 Sample Problem 5

```
//Given that
n1 = 1.38
n2 = 1.50
lambda = 550  //in nm

//Sample Problem 36-5
printf("**Sample Problem 36-5**\n")
Lmin = lambda/4/n1
printf("The minimum value of wavelength possible is
   %1.2fnm", Lmin)
```

Scilab code Exa 36.6 Sample Problem 6

```
//Given that
lambda = 632.8*10^-9  //in meter
i = 0  //in rad
dFringes = 6
bFringes = 5

//Sample Problem 36-6
printf("**Sample Problem 36-6**\n")
//Assume the difference in thickness is 't'
//then the path difference will be 2*L
//hence
deltaL = bFringes/2*lambda
printf("The difference in thickness is equal to %fnm
   ", deltaL*10^9)
```

Chapter 37

Diffraction

check Appendix AP 2 for dependency:

```
degree_rad.sci
```

Scilab code Exa 37.1 Sample Problem 1

```
exec('degree_rad.sci', -1)

//Given that
lambda = 650*10^-9  //in meter
theta = dtor(15)  //in radians

//Sample Problem 37-1a
printf("**Sample Problem 37-1a**\n")
//We know that [a*sin(theta) = m*lambda] for m= Integer
m = 1
a = m*lambda/sin(theta)
printf("The slit width is equal to %fnm\n", a*10^9)

//Sample Problem 37-1b
printf("\n**Sample Problem 37-1b**\n")
m = 3/2  //for first side maxima
```

```
lambdaDESH = a*sin(theta)/ m
printf("The wavelength of the light is equal to %fnm
    ", lambdaDESH*10^9)
```

Scilab code Exa 37.2 Sample Problem 2

```
//Sample Problem 37-2
printf("**Sample Problem 37-2**\n")
I = [];
for m = 1:3
   theta = (m+.5)*%pi
      I = [I, (sin(theta)/theta)^2]
end
printf("The intensities of secondary maximas
    relative to intensity of CBF is-\n")
printf("\tI1/Im = %.4f\n", I(1))
printf("\tI2/Im = %.4f\n", I(2))
printf("\tI3/Im = %.4f", I(3))
```

Scilab code Exa 37.3 Sample Problem 3

```
//Given that
d = 32*10^-3   //in meter
f= 24*10^-2  //in meter
lam = 550*10^-9   //in meter

//Sample Problem 37-3a
printf("**Sample Problem 37-3a**\n")
theta = 1.22*lam/d
```

```
printf("Angular sepration should be equal to %erad\n", theta)

//Sample Problem 37-3b
printf("\n**Sample Problem 37-3b**\n")
deltaX = f*theta
printf("The sepration between the two images is %em", deltaX)
```

Scilab code Exa 37.4 `Sample Problem 4`

```
//Given that
l = 405*10^-9  //in meter
d = 19.44*10^-6  //in meter
a = 4.050*10^-6  //in meter

//Sample Problem 37-4a
printf("**Sample Problem 37-4a**\n")
n = floor(d/a)
printf("The number of bright fringes are %d\n", 2*n+1)

//Sample Problem 37-4b
printf("\n**Sample Problem 37-4b**\n")
num = ceil(2*d/a)
printf("The number of bright fringes within either of the first side peak is %d", num/2 - 1)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 37.5 `Sample Problem 5`

```
exec('degree_rad.sci', -1)

//Given that
N = 1.26*10^4
w = 25.4*10^-3  //in meter
l1 = 589*10^-9  //in meter
l2 = 589.59*10^-9  //in meter

//Sample Problem 37-5a
printf("**Sample Problem 37-5a**\n")
d = w/N
m = 1
theta = asin(m*l1/d)
theta = rtod(theta)
printf("The first order maxima occurs at an angle of %fdegree from the center\n", theta)

//Sample Problem 37-5b
printf("\n**Sample Problem 37-5b**\n")
theta = rtod(theta)
D = m/(d*cos(theta))
deltaL = l2-l1
deltaTHETA = D*deltaL
printf("The anglar sepration between the two first orderlines is %erad\n", deltaTHETA)

//Sample Problem 37-5c
printf("\n**Sample Problem 37-5c**\n")
Lavg = (l1+l2)/2
R = Lavg/(m*deltaL)
N = R/m
printf("The least number of rulings a grating can
```

have is %d", N)

Chapter 38

Relativity

Scilab code Exa 38.1 Sample Problem 1

```
//Given that
r = 0.9990
t = 10  //in years

//Sample Problem 38-1
printf("**Sample Problem 38-1**\n")
y = 1/sqrt(1-r^2)
tEarth = t*y
T = 2*tEarth
printf("The time as measured from the earth is %1.2
   fy", T)
```

Scilab code Exa 38.2 Sample Problem 2

```
//Given that
Tl = 0.1237*10^-6  //in sec
c = 3*10^8  //in m/s
```

```
r = 0.990

//Sample Problem 38-2
printf("**Sample Problem 38-2**\n")
y = 1/sqrt(1-r^2)
Tb = Tl*y  //in laboratory frame
v = r*c
d = v*Tb
printf("The kaon can go till %dm", d)
```

Scilab code Exa 38.3 Sample Problem 3

```
//Given that
Lp = 230  ///in meter
t = 3.57*10^-6  //in meter
c = 3*10^8  //in m/s

//Sample Problem 38-3
printf("**Sample Problem 38-3**\n")
//y = 1/sqrt(1-r^2)
//L = Lp/y
//L = r*c*t
//solving -
r = Lp/sqrt((c*t)^2 + Lp^2)
printf("The relative velocoty is equal to %.3fc m/s"
   , r)
```

Scilab code Exa 38.4 Sample Problem 4

```
//Given that
deltaT = 1.10  //in sec
x = 4.00*10^8  //in meter
c = 3*10^8 //in m/s
r = 0.980

//Sample Problem 38-4
printf("**Sample Problem 38-4**\n")
y = 1/sqrt(1-r^2)
Xe = y*(x - r*c*deltaT)
printf("The distance in earth frame is %1.2em\n", Xe
    )
Te = y*(deltaT - r*x/c)
printf("The time interval in earth frame is %1.2f",
    Te)
```

Scilab code Exa 38.5 Sample Problem 5

```
//Given that
lp1 = 499.8*10^-9  //in meter
lp2 = 501.6*10^-9  //in meter
c = 3*10^8  //in m/s
Ms = 1.99*10^30  //in kg
G = 6.67*10^-11  //in SI unit
R = 100  //in light year
conv = 9.46*10^15  //conversion factor from light
    year to sec

//Sample Problem 38-5a
printf("**Sample Problem 38-5a**\n")
lo = lp1 + lp2
lo = lo/2
deltaL = abs(lp1 - lo)
```

```
v = deltaL/lo * c
printf("The speed of gas relative to us is %1.2em/s\n", v)

//Sample Problem 38-5b
printf("\n**Sample Problem 38-5b**\n")
//G*M*m/r^2 = m*v^2/r
r = R*conv
M = v^2*r/G
ratio = M/Ms
printf("The mass of galaxy is %1.2e*Ms", ratio)
```

Scilab code Exa 38.6 Sample Problem 6

```
//Given that
K = 2.53  //in Mev
Me = 9.109*10^-31  //in kg
c = 3*10^8  //in m/s
conv = 1.6*10^-19*10^6  //Mev to joule conversion factor

//Sample Problem 38-6a
printf("**Sample Problem 38-6a**\n")
Eactual = Me*c^2/conv + K
printf("The actual energy of the elctron is %1.2fMev\n", Eactual)

//Sample Problem 38-6b
printf("\n**Sample Problem 38-6b**\n")
p = sqrt(Eactual^2 - (Me*c^2))
printf("The momentum of the electron is %1.2fMev/c", p)
```

Scilab code Exa 38.7 Sample Problem 7

```
//Given that
K = 3.0*10^20*1.6*10^-19  //in J
Mp = 1.67*10^-27  //in kg
c = 3*10^8  //in m/s
conv = 9.46*10^15  //conversion factor from light
   year to sec
D = 9.8*10^4  //in light year

//Sample Problem 38-7a
printf("**Sample Problem 38-7a**\n")
Erm = (Mp*c^2)
y = (K + Erm)/Erm
r = sqrt(1 - (1/y)^2)
printf("The velocity is approximately equal to %1.2f
   *c\n", r)

//Sample Problem 38-7b
printf("\n**Sample Problem 38-7b**\n")
deltaT = D  //in year
printf("The time taken is %1.1ey\n", deltaT)

//Sample Problem 38-7c
printf("\n**Sample Problem 38-7c**\n")
deltaTp = deltaT/y * 365*24*3600
printf("The time taken in reference frame of proton
   is %1.2fs", deltaTp)
```

Chapter 39

Photons and Matter Waves

Scilab code Exa 39.1 Sample Problem 1

```
//Given that
P = 100  //in W
lambda = 590*10^-9  //in meter
h = 6.62*10^-34  //in J.s
c = 3*10^8  //in m/s

//Sample Problem 39-1
printf("**Sample Problem 39-1**\n")
Ep = h*c/lambda  //Energy of each photon
N = P/Ep
printf("The rate at which photons are absorbed is %1
    .2e/s", N)
```

Scilab code Exa 39.2 Sample Problem 2

```
//Given that
r = 3.5  //in meter
```

```
P = 1.5   //in W
phi = 2.2   //in ev
conv = 1.6*10^-19   //ev to Joule to conversion
    factor
R = 5.0*10^-11   //in meter

//Sample Problem 39-2
printf("**Sample Problem 39-2**\n")
I = P/(4*%pi*r^2)
A = %pi*R^2
deltaT = phi*conv/(I*A)
printf("The time taken in ejecting electron is %ds",
     deltaT)
```

Scilab code Exa 39.3 `Sample Problem 3`

```
//Given that
h = 6.62*10^-34   //in J.s
fo = 5.5*10^14   //in Hz
conv = 1.6*10^-19   //ev to J conversion factor

//Sample Problem 39-3
printf("**Sample Problem 39-3**\n")
phi = h*fo/conv   //in ev
printf("The work function of sodium is %1.2fev", phi
    )
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

Scilab code Exa 39.4 Sample Problem 4

```
exec('degree_rad.sci', -1)

//Given that
lambda =  22*10^-12  //in meter
conv = 1.6*10^-19  //ev to J conversion factor
E = 56*10^3*conv
theta = dtor(85)  //in rad
h = 6.62*10^-34  //in J.s
Me = 9.1*10^-31  //in kg
c = 3*10^8  //in m/s

//Sample Problem 39-4a
printf("**Sample Problem 39-4a**\n")
deltaL = h/(Me*c)*(1 - cos(theta))
printf("compton shift is equal to %1.2fpm\n", deltaL
   *10^12)

//Sample Problem 39-4b
printf("\n**Sample Problem 39-4b**\n")
frac = deltaL/(lambda + deltaL)
printf("The fraction of energy transfered is %1.3f",
    frac)
```

Scilab code Exa 39.5 Sample Problem 5

```
//Given that
K = 120*1.6*10^-19  //in J
Me = 9.11*10^-31  //in kg
h = 6.62*10^-34  //in J.s

//Sample Problem 39-5
```

```
printf("**Sample Problem 39-5**\n")
p = sqrt(2*K*Me)
lambda = h/p
printf("The wavelength of the electon is %dpm",
   lambda*10^12)
```

Scilab code Exa 39.6 Sample Problem 6

```
//Given that
v = 2.05*10^6  //in m/s
h = 6.62*10^-34  //in J.s
hC = h/(2*%pi)
precision = .50/100
Me = 9.109*10^-31  //in kg

//Sample Problem 39-6
printf("**Sample Probelm 39-6**\n")
Px = Me*v
deltaPx = precision*Px
deltaX = hC/deltaPx
printf("The error in measuring x is %dnm", deltaX
   *10^9)
```

Scilab code Exa 39.7 Sample Problem 7

```
//Given that
conv = 1.6*10^-19  //ev to J conversion factor
E = 5.1*conv  //in ev
Uo = 6.8*conv  //in ev
```

```
L = 750*10^-12  //in m
h = 6.62*10^-34  //in J.s
Me = 9.11*10^-31  //in kg

//Sample Problem 39-7a
printf("**Sample Problem 39-7a**\n")
k = sqrt(8*%pi^2*Me*(Uo-E)/h^2)
T = %e^(-2*k*L)
printf("The transmission coefficient is %e", T)
```

Chapter 40

More About Matter waves

check Appendix AP 1 for dependency:

`quantum.sci`

Scilab code Exa 40.1 `Sample Problem 1`

```
exec('quantum.sci', -1)

//Given that
L = 100*10^-12  //in m

//Sample Problem 40-1a
printf("**Sample Prblem 40-1a**\n")
n = 1  //for min energy
Emin = Ediff(n, 0, Me, L)
printf("The least possible energy is %1.2fev\n",
   Emin/conv)

//Sample Problem 40-1b
printf("\n**Sample Prblem 40-1b**\n")
n2 = 3
n1 = 1
deltaE13 = Ediff(n2, n1, Me, L)
```

```
printf("The energy to be transferred is %1.2fev\n", deltaE13/conv)

//Sample Problem 40-1c
printf("\n**Sample Prblem 40-1c**\n")
lambda = wavelength(deltaE13)
printf("The wavelength of photon is %1.2fnm\n", lambda*10^9)

//Sample Problem 40-1d
printf("\n**Sample Prblem 40-1d**\n")
deltaE12 = Ediff(2, 1, Me, L)
lambda1 = wavelength(deltaE12)
deltaE23 =  Ediff(3, 2, Me, L)
lambda2 = wavelength(deltaE23)
printf("The possible wavelength of photon is :\n")
printf("\t %1.2fnm\n", lambda*10^9)
printf("\t %1.2fnm\n", lambda1*10^9)
printf("\t %1.2fnm", lambda2*10^9)
```

Scilab code Exa 40.3 `Sample Problem 3`

```
//Given that
L = 100*10^-12  //in m

//Sample Problem 40-3a
printf("**Sample Prblem 40-3a**\n")
P = integrate('2/L*(sin(%pi/L*x))^2', 'x', 0, L/3)
printf("The probability is equal to %1.2f\n", P)

//Sample Problem 40-3b
printf("\n**Sample Prblem 40-3b**\n")
P = integrate('2/L*(sin(%pi/L*x))^2', 'x', L/3, 2*L
```

```
/3)
printf("The probability is equal to %1.2f\n", P)
```

check Appendix AP 1 for dependency:

`quantum.sci`

Scilab code Exa 40.4 Sample Problem 4

```
exec('quantum.sci', -1)

//Given that
L = 100*10^-12  //in m
Uo = 450*conv  //in ev
l = 2*10^-9  //in m

//Sample Problem 40-4a
printf("**Sample Prblem 40-4a**\n")
E1 = Ediff(1, 0, Me, L)
E = Uo - E1
lambda = wavelength(E)
printf("The wavelength of the free electron is %1.2fnm\n", lambda*10^9)

//Sample Problem 40-4b
printf("\n**Sample Prblem 40-4b**\n")
E2 = Energy(l)
K = E2 - E
printf("The electron energy is %1.2fev", K/conv)
```

check Appendix AP 1 for dependency:

`quantum.sci`

Scilab code Exa 40.6 Sample Problem 6

```
exec('quantum.sci', -1)

//Sample Problem 40-6a
printf("**Sample Prblem 40-6a**\n")
//lyman series : least energetic photon => 2 to 1
   transition
deltaE21 = -(13.6) * (1/2^2 - 1/1^2)*conv
lambda = wavelength(deltaE21)
printf("The wavelength of the least energetic photon
    in lyman series is %1.2fnm\n", lambda*10^9)

//Sample Problem 40-6b
printf("\n**Sample Prblem 40-6b**\n")
//lyman series limit  => 1 to infinity transition
deltaE = -(13.6) * (0 - 1/1^2)*conv
lambda = wavelength(deltaE)
printf("The wavelength of the lyman series limit is
   %1.2fnm\n", lambda*10^9)
```

Scilab code Exa 40.8 Sample Problem 8

```
//Given that
p = 0.90

//Sample Problem 40-8
printf("**Sample Prblem 40-8**\n")
funcprot(0)
function [P] = f(x)
```

```
    P = 1 - (%e^(-2*x))*(1 + 2*x + 2*x^2) - p
endfunction
p = fsolve(1, f)
printf("The possible value of radius is %1.2f*a", p)
```

Chapter 41

All About Atoms

Scilab code Exa 41.1 Sample Problem 1

```
//Given that
Bdot = 1.4/10^-3  //in T/m
w = 3.5*10^-2  //in m
v = 750  //in m/s
M = 1.8*10^-25  //in kg
u = 9.27*10^-24  //in J/T

//Sample Problem 41-1
printf("**Sample Problem 41-1**\n")
Fz = u*Bdot
a = Fz/M
t = w/v
d = 0.5*a*t^2
printf("The atoms have been deflected %e m", d)
```

Scilab code Exa 41.2 Sample Problem 2

```
//Given that
B = 1.80   //in T
Uz  =1.41*10^-26   //in J/T
h = 6.62*10^-34   //in J-s
c = 3*10^8   //in m/s

//Sample Problem 42-2
printf("**Sample Problem 42-2**\n")
f = 2*Uz*B/h
printf("The frequency of the alternating field is %e
    Hz\n", f)
lambda = c/f
printf("The wavelength of the field is %fm", lambda)
```

Scilab code Exa 41.3 Sample Problem 3

```
//Sample Problem 41_3
printf("Sample Problem 42_3")
```

Scilab code Exa 41.4 Sample Problem 4

```
//Given that
K = 35*10^3   //in ev
e = 1.6*10^-19   //in coulomb
h = 6.62*10^-34   //in J-s
c = 3*10^8   //in m/s

```

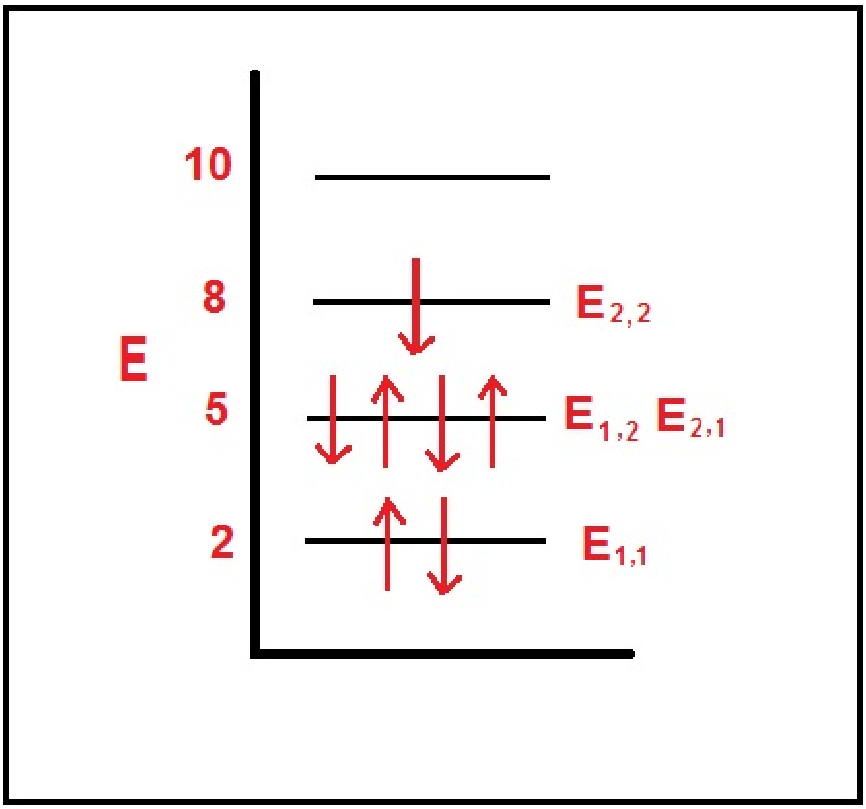

Figure 41.1: Sample Problem 3

```
//Sample Problem 41-4
printf("**Sample Problem 41-4**\n")
lambdaMin = h*c/(K*e)
printf("The cutoff wavelength is %em", lambdaMin)
```

Scilab code Exa 41.5 Sample Problem 5

```
//Given that
Kalpha = 178.9*10^-12  //in m
Kimpure = 143.5*10^-12  //in m
Z = 27

//sample Problem 41-5
printf("**Sample Problem 41-5**\n")
Zx = sqrt(Kalpha/Kimpure)*(Z-1) + 1
printf("The proton number of the impurity is %d", Zx
    )
```

Scilab code Exa 41.6 Sample Problem 6

```
//Given that
lambda = 550*10^-9  //in m
T = 300  //in K room temprature
h = 6.62*10^-34  //in J-s
c = 3*10^8  //in m/s
e = 1.6*10^-19
K = 8.62*10^-5*e

//Sample Problem 41-6a
```

```
printf("**Sample Problem 41-6a**\n")
deltaE = h*c/lambda
ratio = %e^(-(deltaE)/(K*T))
printf("The ratio is equal to %e\n", ratio)

//Sample Problem 41-6b
printf("\n**Sample Problem 41-6b**\n")
ratio = 0.5
T = -deltaE/K/log(ratio)
printf("The temprature required for the given ratio
    is equal to %fK", T)
```

Chapter 42

Conduction of Electricity in Solids

Scilab code Exa 42.1 Sample Problem 1

```
//Given that
T = 300  //in K
e = 1.6*10^-19  //in coulomb
Eg = 5.5*e  //in J
K = 8.62*10^-5*e  //in J/K

//Sample Problem 42-1
printf("**Sample Problem 42-1**\n")
P = %e^(-Eg/(K*T))
printf("The probability is equal to %e", P)
```

Scilab code Exa 42.2 Sample Problem 2

```
//Given that
```

```
n = 2
V = 2*10^-6  //in m^3
density = 1.738*10^3  //in kg/m^3
M = 24.312*10^-3  //in kg/m^3
Na = 6.023*10^23

//Sample Problem 42-2
printf("**Sample Problem 42-2**\n")
num = density*V*Na/M
electrons = n*num
printf("The number of electrons is equal to %e",
   electrons)
```

Scilab code Exa 42.3 Sample Problem 3

```
//Given that
E = 7  //in ev
V = 2*10^-9  //in m^3
density = 2*10^28  //in m^3/ev
deltaE = 3*10^-3  //in ev

//Sample Problem 42-3a
printf("**Sample Problem 42-3a**\n")
n = density*V
printf("The number of states are equal to %1.2e per
   ev\n", n)

//Sample Problem 42-3b
printf("\n**Sample Problem 42-3b**\n")
n = n*deltaE
printf("The number of states are equal to %1.2e per
   ev\n", n)
```

Scilab code Exa 42.4 Sample Problem 4

```
//Given that
E = 0.10  //in ev
T = 800  //in K
k = 8.62*10^-5  //Boltzman constant

//Sample Problem 42-4a
txt = mopen('Example42_4_result.txt','wt')
mfprintf(txt, '**Sample Problem 42-4a**\n')
expo = E/(k*T)
P = 1/(%e^expo + 1)
mfprintf(txt, 'The probability of occupying the
    given energy state is equal to %f\n', P)

//Sample Problem 42-4b
Pbelow = 1/(1 + %e^-expo)
mfprintf(txt, '\n**Sample Problem 42-4**\n')
mfprintf(txt, 'The probability of occupying the
    given energy state is equal to %f', Pbelow)
mclose(txt)
```

Scilab code Exa 42.5 Sample Problem 5

```
//Given that
E = 7.0  //in ev
density = 2*10^28  //density of states
V = 2*10^-9  //in m^3
```

```
//Sample Problem 42-5
txt = mopen('Example42_5_result.txt', 'wt')
mfprintf(txt, '**Sample Problem 42-5**\n')
P = 0.50
No = density * P * V
mfprintf(txt, 'Number of occupied states per eV at 7
    ev is equal to %e', No)
mclose(txt)
```

Scilab code Exa 42.6 Sample Problem 6

```
//Given that
No = 10^16  //number per m^3
T = 298  //in K
fac = 10^6
density = 2330  //in kg/m^3
Na = 6.023*10^23
M = 28.1*10^-3  //in kg/mol

//Sample Problem 42-6
pt = mopen('Example42_6_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 42-6**\n')
Np = fac*No + No
NSi = density*Na/M
fraction = Np/NSi
mfprintf(pt, 'The fraction of Phosphorus atoms with
    Silicon atoms is equal to %e', fraction)
mclose(pt)
```

Scilab code Exa 42.7 Sample Problem 7

```
//Given that
Egap = 1.9  //in eV

//Sample Problem 42-7
pt = mopen('Example42_7_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 42-7**\n')
lambada = 1242/Egap
mfprintf(pt, 'The wavelength emitted is equal to %dnm', lambada)
mclose(pt)
```

Chapter 43

Nuclear Physics

Scilab code Exa 43.1 Sample Problem 1

```
//Given that
e = 1.6*10^-19  //ev to joule conversion
E = 5.30*10^6*e  //in Joules
n = 79  //number of protons

//Sample Problem 43-1
txt = mopen('Example43_1_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-1**\n')
K = 9*10^9  //in SI unit
q1 = 2*e
q2 = n*e
//K*q1*q2/d = E
d = K*q1*q2/E
mfprintf(txt, 'The distance of the alpha particles
    from gold nucleus is equal to %em', d)
mclose(txt)
```

Scilab code Exa 43.2 Sample Problem 2

```
//Sample Problem 43-2
txt = mopen('Example43_2_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-2**\n')
A = 1  //say for the purpose of calculation
Mp = 1.67*10^-27
Mass = A*Mp
Rnot = 1.2*10^-15
r = Rnot*A^(1/3)
Volume = 4/3*%pi*r^3
density = Mass/Volume
mfprintf(txt, 'The density of nucleus is %eKg/m^3',
    density)
mclose(txt)
```

Scilab code Exa 43.3 Sample Problem 3

```
//Given that
Nn = 70
Np = 50
A = Nn+Np

//Sample Problem 43-3
txt = mopen('Example43_3_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-3**\n')
Msn = 119.902199  //in Atomic mass unit
uCsqure = 931.5  //in Mev
Mp = 1.007825  //in Atomic mass unit
Mn = 1.008625  //in Atomic mass unit
deltaE = (Np*Mp + Nn*Mn - Msn)*uCsqure/A
mfprintf(txt, 'The binding energy per nucleon of Sn
    is %fMev/nucleon', deltaE)
```

```
mclose(txt)
```

Scilab code Exa 43.4 Sample Problem 4

```
//Sample Problem 43-4
txt = mopen('Example43_4_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-4**\n')
slope = (0-6.2)/(225-0)
lambda = -slope
mfprintf(txt, 'The disintegration constant for the
    radionuclide is %fmin-1\n', lambda)
Th = log(2)/lambda
mfprintf(txt, 'The half life is equal to %dmin', Th)
mclose(txt)
```

Scilab code Exa 43.5 Sample Problem 5

```
//Given that
M = 2.71   //in g
R = 4490   //in Bq
fraction = 1.17/100
Mo = 74.555   //gm/mol
Na = 6.023*10^23   //n /mol

//Sample Problem 43-5
txt = mopen('Example43_5_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-5**\n')
Nk = Na * M * fraction/Mo
Th = log(2)*Nk/R
```

```
mfprintf(txt, 'The half life of the substance is
   %eSec', Th)
```

Scilab code Exa 43.6 Sample Problem 6

```
//Given that
uCsqure = 931.5  //in Mev
M_H = 1.007825  //in Atomic mass unit
M_U  = 238.05079  //in Atomic mass unit
M_Th = 234.04363  //in Atomic mass unit
M_He = 4.00260  //in Atomic mass unit
M_Pa = 237.05121  //in Atomic mass unit

txt = mopen('Example43_6_result.txt','wt')
//Sample Problem 43-6a
mfprintf(txt, '**Sample Problem 43-6a**\n')
Q = (M_U - (M_Th + M_He)) * uCsqure
mfprintf(txt, 'Energy released during alpha decay of
    uranium is %fMev\n', Q)

//Sample Problem 43-6b
mfprintf(txt, '\n**Sample Problem 43-6b**\n')
Q = (M_U - (M_Pa + M_H)) * uCsqure
if(Q<0)
    mfprintf(txt, 'It cannot emit a proton
       spontaneously')
else
    mfprintf(txt, 'It can emit proton spontaneously'
       )
end
mclose(txt)
```

Scilab code Exa 43.7 Sample Problem 7

```
//Given that
M_P = 31.97391  //in u
M_S = 31.97207 //in u
uCsqure = 931.5  //in Mev

//Sample Problem 43-7
txt = mopen('Example43_7_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-7**\n')
Q = -(M_S - M_P)*uCsqure
mfprintf(txt, 'The disintegration energy for the
    beta decay of Phosphorus is %fMev', Q)
mclose(txt)
```

Scilab code Exa 43.8 Sample Problem 8

```
//Given that
ratio = 10.3
Th = 1.25*10^9  //in years

//Sample Problem 43-8
txt = mopen('Example43_8_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-8**\n')
t = Th * log(1 + ratio)/log(2)
mfprintf(txt, 'The life of rock is %eyears', t)
mclose(txt)
```

Scilab code Exa 43.9 Sample Problem 9

```
//Given that
dose = 3  //in J/kg
c = 4180  //in J.kg/K
m = 1  //(say)

//Sample problem 43-9
txt = mopen('Example43_9_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-9**\n')
deltaT = (dose/m)/c
mfprintf(txt, 'The change in temprature of the body
    is %eK', deltaT)
mclose(txt)
```

Scilab code Exa 43.10 Sample Problem 10

```
//Given that
e = 1.6*10^-19  //conversion from electron volt to
    Joule
deltaE = 0.20*e
h = 6.62*10^-34  //in J.s

//Sample Problem 43-10
txt = mopen('Example43_10_result.txt','wt')
mfprintf(txt, '**Sample Problem 43-9**\n')
Tavg = h/(2*%pi)/deltaE
```

```
mfprintf(txt, 'The average life of the compound is
    %esec', Tavg)
mclose(txt)
```

Chapter 44

Energy from the Nucleus

Scilab code Exa 44.1 Sample Problem 1

```
//Given that
M_U = 235.0439  //in Atomic mass unit
M_Ce = 139.9054  //in Atomic mass unit
M_Zr = 93.9063  //in Atomic mass unit
M_n = 1.00867  //in Atomic mass unit
uCsqure = 931.5  //in Mev

//Sample Problem 44-1
txt = mopen('Example44_1_result.txt','wt')
mfprintf(txt, '**Sample Problem 44-1**\n')
Q = -((M_Ce + M_Zr + M_n) - M_U) * uCsqure
mfprintf(txt, 'The disintegration energy is %dMev',
   Q)
mclose(txt)
```

Scilab code Exa 44.2 Sample Problem 2

```
//Given that
c = 3*10^8  //in m/s
e = 1.6*10^-19
conv = 3600*24  //day to sec conversion
Pgen = 3400*10^6  //in W
Pused = 1100*10^6  //in W
fuel = 8.60*10^4  //in kg
Q = 200*10^6*e  //in J
Uinitial = 8.6*10^4  //in kg
M_u = 3.90*10^-25   //in kg/atom
N = 5.70*10^4
p = 3/100

txt = mopen('Example44_2_result.txt','wt')
//Sample Problem 44-2a
mfprintf(txt, '**Sample Problem 44-2a**\n')
eff = Pused/Pgen*100
mfprintf(txt, 'The efficiency of the power plant is
    %d\%\n', eff)

//Sample Problem 44-2b
mfprintf(txt, '\n**Sample Problem 44-2b**\n')
R = Pgen/Q
mfprintf(txt, 'The fissions in the reactor per
    second is %e\n', R)

//Sample Proble 44-2c
mfprintf(txt, '\n**Sample Problem 44-2c**\n')
RateDay = (1+0.25)*R*M_u*conv
mfprintf(txt, 'The uranium use in a day is equal to
    %fkg/day\n', RateDay)

//Sample Problem 44-2d
mfprintf(txt, '\n**Sample Problem 44-2d**\n')
T = fuel*p/RateDay
mfprintf(txt, 'The U will long for %ddays\n', T)

//Sample Problem 44-2e
```

```
mfprintf(txt, '\n**Sample Problem 44-2e**\n')
MassConvRate = Pgen/c^2
mfprintf(txt, 'The mass conversion rate is %ekg/s',
    MassConvRate)
mclose(txt)
```

Scilab code Exa 44.3 Sample Problem 3

```
//Given that
ratio = 0.0072
T = 2.0*10^9  //in years
Th1 = 7.04*10^8  //in years
Th2 = 44.7*10^8  //in years

//Sample Problem 44-3
txt = mopen('Example44_3_result.txt','wt')
mfprintf(txt, '**Sample Problem 44-3**\n')
l1 = log(2)/Th1
l2 = log(2)/Th2
ratioEarlier = ratio*%e^((l1 - l2)*T)
mfprintf(txt, 'The earlier ratio is equal to %f',
    ratioEarlier)
mclose(txt)
```

Scilab code Exa 44.4 Sample Problem 4

```
//Given that
R = 10^-15  //in meter
e = 1.6*10^-19  //in coloumb
```

```
q1 = e
k = 9*10^9  //in SI unit
B = 1.38*10^-23  //in J/K

txt = mopen('Example44_4_result.txt','wt')
//Sample Problem 44-4a
mfprintf(txt, '**Sample Problem 44-4a**\n')
K = k*q1^2/(2*R)/2
mfprintf(txt, 'The initial kinetic energy is equal
    to %dKev\n', K/e/10^3)

//Sample Problem 44-4b
mfprintf(txt, '\n**Sample Problem 44-4b**\n')
T = 2*K/(3*B)  //B is Boltzman constant
mfprintf(txt, 'The temprature required to achieve
    that energy equal to %eK', T)
mclose(txt)
```

Scilab code Exa 44.5 Sample Problem 5

```
//Sample Problem 44-5
txt = mopen('Example44_5_result.txt','wt')
mfprintf(txt, '**Sample Problem 44-5**\n')
MassRate = 4*1.67*10^-27/(4.20*10^-12)  //mass of
    proton required to produce 1 unit of energy
Ps = 3.90*10^26  //in W
Rate = MassRate*Ps
mfprintf(txt, 'The rate at which hydrogen is
    consumed is %ekg/s', Rate)
mclose(txt)
```

Scilab code Exa 44.6 Sample Problem 6

```
//Given that
d = 200  //in kg/m^3
fac = 10^3
Na = 6.023*10^23
Mt = 3*10^-3  //in kg/mol
Md = 2*10^-3  //in kg/mol

txt = mopen('Example44_6_result.txt','wt')
//Sample Problem 44-6a
mfprintf(txt, '**Sample Problem 44-6a**\n')
n = 2*fac *d *Na /(Mt + Md)
mfprintf(txt, 'The number of particle in unit volume is %em^-3\n', n)

//Sample Problem 44-6b
mfprintf(txt, '\n**Sample Problem 44-6b**\n')
TauMin = 10^20/n
mfprintf(txt, 'The duration of time, pallet can maintain is of the order of %esec', TauMin)
mclose(txt)
```

Chapter 45

Quarks Leptons and the Big Bang

Scilab code Exa 45.1 Sample Problem 1

```
//Given that
Rpi = 139.6  //in Mev
Rmu = 105.7  //in Mev
c = 3*10^8  //in m/s

//Sample Problem 45-1
pt = mopen('Example45_1_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 45-1**\n')
Kmu = poly(0, 'Kmu')
//CONSERVATION OF ENERGY
//Rpi + Kpi = Rmu + Kmu + Rv + Kv
//putting Rv(as mass is 0) & Kpi equal to 0
//Rpi = Rmu + Kmu + Kv
SUM = Rpi - Rmu  //sum of Kmu & Kv
Kv = SUM - Kmu
//for neutrino
Pv = Kv/c
//CONSERVATION OF LINEAR MOMENTUM
//Ppi = Pmu + Pv
```

```
//putting Ppi equal to 0
Pmu = - Pv
//for pion
P = Kmu + 2*Kmu*Rmu - (Pmu*c)^2
Kmu = roots(P)
Kmu = Kmu(2)
mfprintf(pt, 'The kinetic energy of the antimuon is %fMev\n', Kmu)
mfprintf(pt, 'The kinetic energy of the neutrino is %fMev\n', SUM - Kmu)
mclose(pt)
```

Scilab code Exa 45.2 Sample Problem 3

```
//Given that
Epi = 139.6  //in Mev
Ek = 493.7  //in Mev
Ep = 983.3  //in Mev
Es = 1189.4  //in Mev

//Sample Problem 45-2
pt = mopen('Example45_2_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 45-2**\n')
Q = Epi + Ep - Ek - Es
mfprintf(pt, 'The energy of the reaction is %dMev', Q)
mclose(pt)
```

Scilab code Exa 45.3 Sample Problem 3

```
//Given that
Ep = 938.3  //in Mev
Epi = 135.0  //in Mev
Epip = 139.6  //in Mev

//Sample Problem 45-3
pt = mopen('Example45_3_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 45-3**\n')
Q = Ep - Epi - Epip
if (Q > 0) then
    mfprintf(pt, 'The proton can decay according to
       given scheme')
else
    mfprintf(pt, 'The proton cannot decay according
       to the given scheme')
end
mclose(pt)
```

Scilab code Exa 45.6 Sample Problem 6

```
//Given that
v = 2.8*10^8  //in m/s
H = 19.3*10^-3  //in m/s.ly

//Sample Problem 45-6
pt = mopen('Example45_6_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 45-6**\n')
r = v/H
mfprintf(pt, 'The quasar is approx at a distance of
   %ely', r)
mclose(pt)
```

Scilab code Exa 45.7 Sample Problem 7

```
//Given that
w = 1  //(say)
W = 1.1*w
c = 3*10^8  //in m/s
H = 19.3*10^-3  //in m/s.ly

//Sample Problem 45-7
pt = mopen('Example45_7_result.txt', 'wt')
mfprintf(pt, '**Sample Problem 45-7**\n')
deltaW = W - w
r = c/H * deltaW/w
mfprintf(pt, 'The galaxy is at a distance of %ely',
   r)
mclose(pt)
```

Appendix

Scilab code AP 1 Modern Physics

```
//Sone universal constant
h = 6.62*10^-34  //in J.s
c = 3*10^8  //in m/s
Me = 9.11*10^-31  //in kg
conv = 1.6*10^-19  //ev to Joule conversion factor

//calculates the energy difference between the two
   Energy levels n1 & n2
//M = mass of the particle
//L = width of the region
function [E] = Ediff(n2, n1, M, L)
    E = (n2^2-n1^2)*h^2/(8*M*L^2)
endfunction

//calculates the palnck's wavelength
//E = energy of the particle
function [lambda] = wavelength(E)
    lambda = h*c/E
endfunction

//calculates the palnck's energy
//w = wavelength of the particle
function [E] = Energy(w)
    E = h*c/w
endfunction
```

Scilab code AP 2 `degree_rad`

```
//degrees to radian conversion
function [radians] = dtor(degrees)
    radians = degrees*(%pi/180);
endfunction

//radian to degrees conversion
function [degrees] = rtod(radian)
    degrees = radian*(180/%pi);
endfunction
```

Scilab code AP 3 `gravitation`

```
//Universal constant G
G = 6.67*(10^-11)
//Radius of earth
Re = 6.37* 10^6 //in meter
//mass of earth
Me = 5.98 * 10^24; //in kg
//Mass of Sun
Ms = 1.99 * 10^30 //in kg

//calculates the gravitational force
//m1&m2 = mass of the particle
//d = distanece between m1 & m2
function [Force] = GForce(m1,m2,d)
    Force = G*m1*m2/(d*d)
endfunction

//calculates the gravitational potential
//m1&m2 = mass of the particle
//d = distanece between m1 & m2
function [Potential]  = GPotential(m1,m2,d)
    Potential = - G*m1*m2/d;
endfunction

//Kepler's Law
```

```
//M = mass
//T = time period
function [radius] = KeplerRadius (M,T)
    radius = (G*M*T*T/(4*%pi*%pi))^(1/3)
endfunction
```

Scilab code AP 4 electrostatic

```
//permitivity constant
Eo = 8.85*10^-12  //in C^2/N.m^2
//electric consatnt
k = 1/(4*%pi*Eo)
//charge on proton
e = 1.6*10^-19  //in C

//calculates coloumb force on two charged particle having charge q1, q2 seprated by distance equal to r
function [F] = coulomb(q1, q2, r)
    F = k*q1*q2/r^2
endfunction

//calculates the potential due to a particle having charge q at a distance d from the particle
function [V] = EPotential(q, r)
    V = k*q/r
endfunction
```

Scilab code AP 5 Example 17-1

```
//Given that
funcprot(0)
deff('[y] = wave(t, x)', 'y = 0.00327*sin(72.1*x - 2.72*t)')
//Comparing the given equation with the standard wave equation
A = 0.00327  //in m
k = 72.1  //in rad/s
```

```
w = 2.72  //in rad/s

//Sample Problem 17-1a
printf("**Sample Problem 17-1a**\n")
printf("The amplitude of the wave is %fm\n", A)

//Sample Problem 17-1b
printf("\n**Sample Problem 17-1b**\n")
lambda = 2*%pi/k
printf("  wavelength = %fm\n", lambda)
T = 2*%pi/w
printf("  period     = %fs\n",T)
f = 1/T
printf("  frequency  = %fHz\n", f)

//Sample Problem 17-1c
printf("\n**Sample Problem 17-1c**\n")
v = w/k
printf("The velocity of the wave is %fm/s\n", v)

//Sample Problem 17-1d
printf("\n**Sample Problem 17-1d**\n")
y = wave(18.9, 22.5*10^-2)
printf("Displacement of the wave is %fm", y)
```

Scilab code AP 6 Bernauli's Equation

```
//function to calculate the water flow rate
//V(1) = water flow rate at 1 in m/s
//V(2) = water flow rate at 2 in m/s
//**Already defined variables**
//A(1) = cross-sectional area 1 in m^2
//A(2) = cross-sectional area 2 in m^2
//h = vertical height difference in water level in m
    (h(2)-h(1))
//deltaP = difference in pressure in N/m^2 (P(2)-P
    (1))
//density = density of fluid in kg/m^3
```

```
g = 9.8 //acceleration due to gravity in m/s^2
function [f] = Bernauli (V)
    f = zeros(2,1)
    //equation of continuity
    f(1) = A(1)*V(1) - A(2)*V(2)
    //Bernauli's equation
    f(2) = (V(2)^2 - V(1)^2) + 2*g*h + 2*deltaP/density
endfunction
```

Scilab code AP 7 Cross Product

```
//Vector Product of two given vectors
function [val] = crossproduct(A, B)
    val = [A(2) * B(3) - A(3) * B(2),
    A(3) * B(1) - A(1) * B(3),
    A(1) * B(2) - A(2) * B(1)]
endfunction
```

Scilab code AP 8 Example 11-7

```
//Given that
M = 2.5  //in kg
R = 0.20  //i meter
m = 1.2  //in kg
g = 9.8  //in m/s^2
I = 0.5*M*R^2

//Sample Problem 11-7
printf("**Sample Problem 11-7**\n")
//mg - T = ma
//T*R = I*a/R
//T = I*a/R^2
//on adding =>
a = m*g/(m+I/R^2)
T = m*(g-a)
alpha = a/R
```

```
printf("The acceleration of the block is %fm/s^2\n", a)
printf("The angular acceleration of the pulley is %frad/s^2\n", alpha)
printf("The tension in the string is %fN", T)
```

Scilab code AP 9 `collision`

```
//To calculate velocities after a two particle head on collision
//Vf = velocities after collision
//**Already defined variables**
//e = newton's constant for collision
//m1&m2 = masses of the particles
//Vi = initial velocities of the particle
function [f] = collision(Vf)
    f=zeros(2,1);
    //newton's equation for collision
    f(2)= e*(Vi(1)-Vi(2))-(Vf(2)-Vf(1));
    //Momentum conservation
    f(1)=(m1*Vi(1)+m2*Vi(2))-(m1*Vf(1)+m2*Vf(2))
endfunction
```

Scilab code AP 10 `Example 4-3`

```
exec("Example4_2a.sce",-1)
clc

//Sample Problem 4-3
printf("\n**Sample Problem 4-3**\n")
velocity_v_x = derivat(x)
velocity_v_y = derivat(y)
v_time_t = [horner(velocity_v_x,time_t),horner(velocity_v_y,time_t)]
printf("The velocity vector of the rabbit at t=15sec in m/s is")
disp(v_time_t)
```

```
printf("The magnitude of the velocity vector is %f m/s\n", norm(v_time_t))
printf("The angle made by the velocity vector with the x axis in degrees at the same time %f", rtod(atan(v_time_t(2)/v_time_t(1))))
```

Scilab code AP 11 Example 4-2a

```
exec("degree_rad.sci",-1)

//Given that
t = poly(0,'t')
x = -0.31 *t^2 + 7.2 *t +28  //in meter
y = 0.22 *t^2 - 9.1 *t + 30  //in meter

//Sample Problem 4-2a
printf("**Sample Problem 4-2a**\n")
time_t =15  //in sec
position_r = [horner(x,time_t),horner(y,time_t)]
printf("The position vector of the rabbit at t=15sec in meter is")
disp(position_r)
printf("The magnitude of the position vector is %f m\n", norm(position_r))
printf("The angle made by the position vector with the x axis in degrees at the same time %f", rtod(atan(position_r(2)/position_r(1))))
```

Scilab code AP 12 Example 2-1b

```
exec('Example2_1a.sce', -1)
clc

//Sample Problem 2-1b
printf("\n**Sample Problem 2-1b**\n")
time = distance_covered / velocity  //in hr
delta_t = time  + next_time /60  //in hr
```

```
printf("Time interval from the begining of the drive
    to the arrival at the station is %f hr", delta_t
   )
```

Scilab code AP 13 Example 2-1a

```
//Given that
velocity = 70  //in km/h
distance_covered = 8.4   //in km
next_time = 30  //in min
next_walk = 2  //in km

//Sample Problem 2-1a
printf("**Sample Problem 2-1a**\n")
overall_displacement = distance_covered + next_walk
printf("Overall displacement from begining of the
   drive to the station is %f km",
   overall_displacement)
```