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

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# Book Description

**Title:** Fundamental Of Physics

**Author:** D. Haliday, R. Resnick And J. Walker

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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

# List of Figures

# 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 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 1.2** Sample Problem 2

**Scilab code Exa 1.4**

```
//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)
```

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)
```

**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)
```

**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)
```

# Chapter 2

# Motion Along a Straight Line

# Chapter 3

# Induction and Inductance

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

**Scilab code Exa 31.1**

```
//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)
```

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 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)
```

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
   )
```

# Chapter 4

# Motion Along a Straight Line

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

**Scilab code Exa 31.12**
```
//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)
```

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)
```

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

**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 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
   )
```

---

**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)
```

check Appendix AP 13 for dependency:

`Example2_1a.sce`

check Appendix AP 12 for dependency:

Example2_1b.sce

check Appendix AP 13 for dependency:

Example2_1a.sce

check Appendix AP 12 for dependency:

Example2_1b.sce

**Scilab code Exa 31.5** **Scilab code Exa 2.1.d** Sample Problem 1c

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

```
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)
```

Sample Problem 5

```
//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)
```

```
//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 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 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)
```

check Appendix AP 13 for dependency:

`Example2_1a.sce`

check Appendix AP 12 for dependency:

`Example2_1b.sce`

**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 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 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 31.8** Sample Problem 8

```
//Given that
```

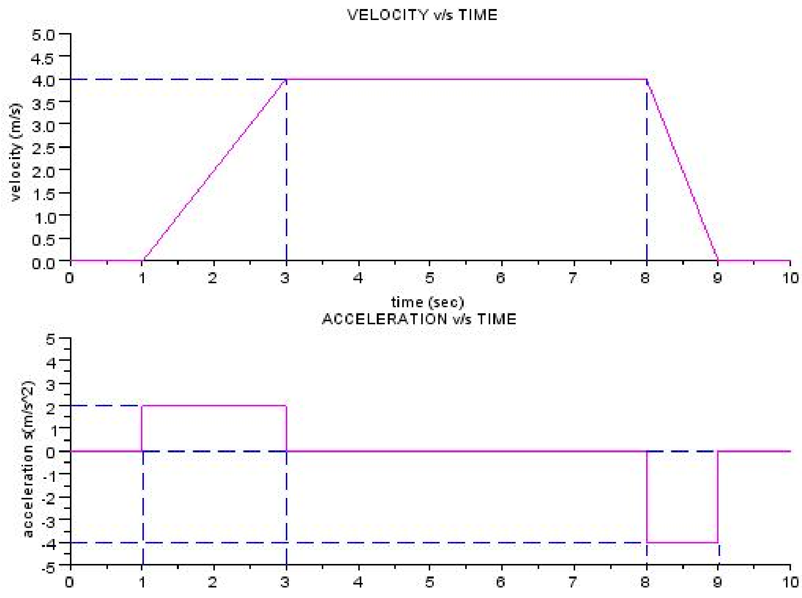


Figure 4.3: Sample Problem 2

```
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 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", velocity)
```

**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", velocity)
```

**Scilab code Exa 31.9** Sample Problem 9

**Scilab code Exa 2.4**

```
//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)
```

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 2.4** 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)
```

# Chapter 5

# Magnetism of Matter Maxwell Equation

**Scilab code Exa 2.5** **Scilab code Exa 2.5** Sample Problem 5 Sample Problem 1

```
//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)
```

```
//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 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 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 2.6** Sample Problem 6

**Scilab code Exa 2.6**
```
//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 2.6** Sample Problem 6
Sample Problem 3

```
//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)
```

```
//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)
```

**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 6

# 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 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 7

# Vectors

check Appendix AP 2 for dependency:

```
degree_rad.sci
```

**Scilab code Exa 3.1** **Scilab code Exa 33.2** 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)
```

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)
```

# Chapter 8

# 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 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 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 3.2** 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`

check Appendix AP 2 for dependency:

degree_rad.sci

**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 33.4** 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))
```

**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))
```

**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)
```

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`

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) )
```

**Scilab code Exa 33.6**

Sample Problem 6

**Scilab code Exa 3.5**

```
//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)
```

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

**Scilab code Exa 3.7**

```
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))
```

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)
```

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`

check Appendix AP 7 for dependency:

`cross_product.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 33.8** **Scilab code Exa 33.8** 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))
```

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 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 3.7** 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 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 %1.2
    eA\n", Rs)
```

**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)
```

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 9

# 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)
```

# Chapter 10

# 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)
```

# Chapter 11

# Motion in Two and Three Dimesions

check Appendix AP 2 for dependency:

Gravitation.sci

**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))))
```

**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))
```

**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 2 for dependency:

`degree_rad.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 11 for dependency:

`Example4_2a.sce`

**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)
```

**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.<-')
```

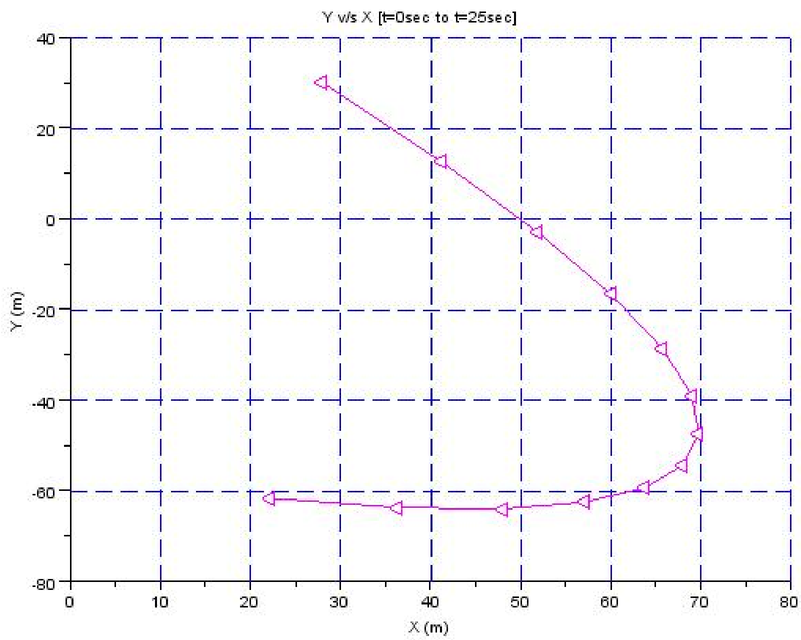


Figure 11.1: Sample Problem 2b

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 11 for dependency:

`Example4_2a.sce`

**Scilab code Exa 4.3** Sample Problem 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))))
```

---

check Appendix AP 11 for dependency:

`Example4_2a.sce`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 4.3** Sample Problem 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 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)
```

check Appendix AP 10 for dependency:

`Example4_3.sce`

# Chapter 12

# Images

check Appendix AP 10 for dependency:

`Example4_3.sce`

**Scilab code Exa 4.4 Scilab code Exa 4.4** Sample Problem 4 Sample Problem 1

```
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))))
```

```
//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 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 4.5** Sample Problem 5

**Scilab code Exa 35.2**

```
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))))
```

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)
```

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))))
```

**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)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 35.4** **Scilab code Exa 35.4** Sample Problem 4 Sample Problem 7

```
//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)
```

```
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)
```

**Scilab code Exa 35.4** 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))))
```

# Chapter 13

# 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")
```

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)
```

**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`

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 4.8** Sample Problem 8

**Scilab code Exa 4.8**

```
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)
```

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 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** **Scilab code Exa 4.9** Sample Problem 4 Sample Problem 9

```
//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)
```

```
//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 4.9** 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 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 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/sˆ2", a_PB)
```

**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/sˆ2\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)
```

**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)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

# Chapter 14

# Diffraction

check Appendix AP 2 for dependency:

degree_rad.sci

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)
```

**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)
```

**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)
```

# Chapter 15

# Force and Motion l

check Appendix AP 2 for dependency:

```
degree_rad.sci
```

# Chapter 16

# Force and Motion l

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)
```

**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 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 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 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 5.2** 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`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 5.3** **Scilab code Exa 5.3** Sample Problem 3 Sample Problem 4

```
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)
```

```
//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)
```

**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)
```

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)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

**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)
```

---

**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)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

# Chapter 17

# Relativity

**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)
```

**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)
```

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)
```

**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)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

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
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 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 5.7** Sample Problem 7

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

//Given that
m = 15  //in kg
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 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 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
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 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 38.5** 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
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 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 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)

//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)
```

---

**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)

//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)
```

**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
```

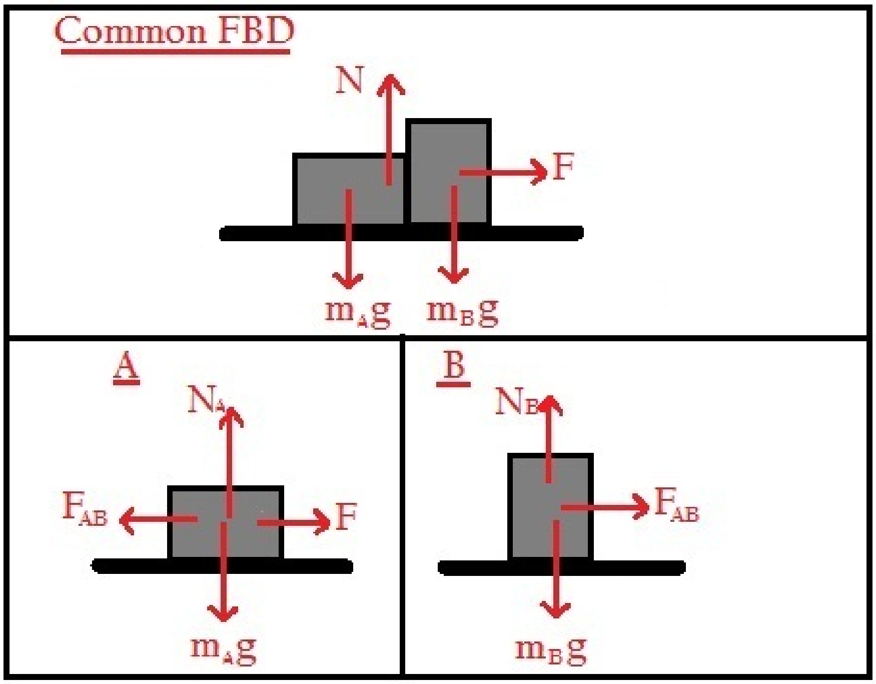


Figure 17.2: Sample Problem 9

```
printf("The time taken in reference frame of proton
    is %1.2fs", deltaTp)
```

# Chapter 18

# 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)
```

# Chapter 19

# Force and Motion ll

# Chapter 20

# 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)
```

---

**Scilab code Exa 39.2** Sample Problem 2

**Scilab code Exa 6.1**

```
//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)
```

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`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 6.2 Scilab code Exa 6.2** Sample Problem 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")
```

**Scilab code Exa 39.3**

```
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")
```

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)
```

check Appendix AP 2 for dependency:

degree_rad.sci

check Appendix AP 2 for dependency:

degree_rad.sci

**Scilab code Exa 6.3** Sample Problem 3

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

//Given that
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 6.3** Sample Problem 3

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

//Given that
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 39.6** Sample Problem 6

**Scilab code Exa 6.1**

```
//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
```

**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)
```

---

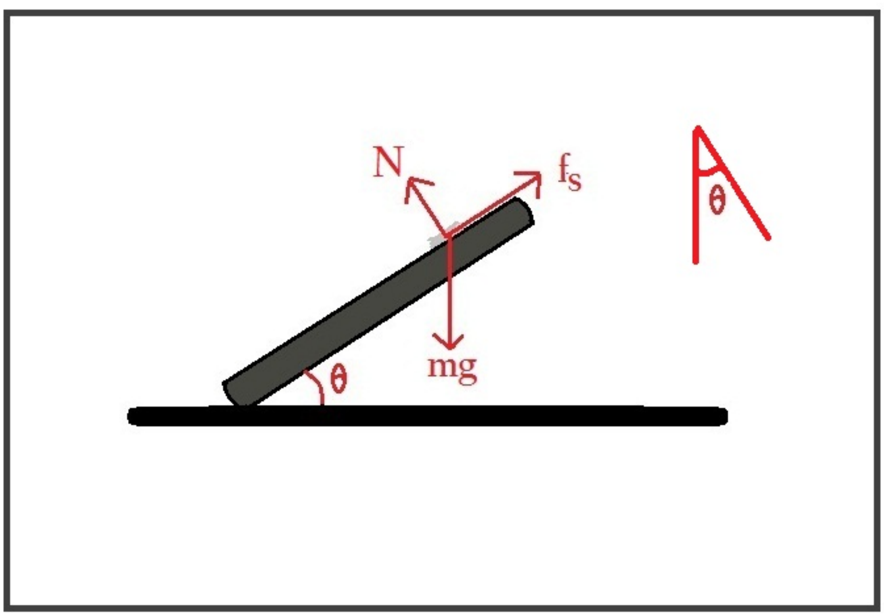


Figure 20.1: Sample Problem 3

```

//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)
```

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 6.4** 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 Scilab code Exa 6.5** Sample Problem 5 Sample Problem 7

```
//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)
```

```
//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 21

# More About Matter waves

check Appendix AP 1 for dependency:

`quantum.sci`

**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

**Scilab code Exa 40.1**

```
//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
   )
```

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

**Scilab code Exa 6.6**

```
//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)
```

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
   )
```

check Appendix AP 1 for dependency:

`quantum.sci`

**Scilab code Exa 40.4** Sample Problem 4

**Scilab code Exa 6.7 Scilab code Exa 6.7**

```
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(1)
K = E2 - E
printf("The electron energy is %1.2fev", K/conv)
```

Sample Problem 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)
```


```
//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)
```

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 6.8** Sample Problem 8

**Scilab code Exa 40.8 Scilab code Exa 40.1**

```
//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
//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)
```

Sample Problem 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)
```

---

```
//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
//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)
```

---

# Chapter 22

# 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 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

```

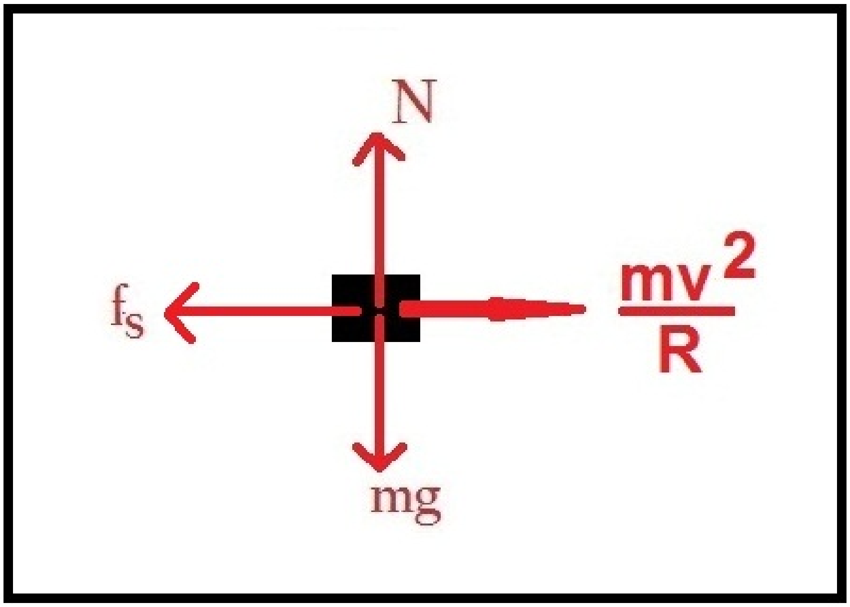


Figure 22.2: Sample Problem 9

```
//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)
```

**Scilab code Exa 41.3** Sample Problem 3

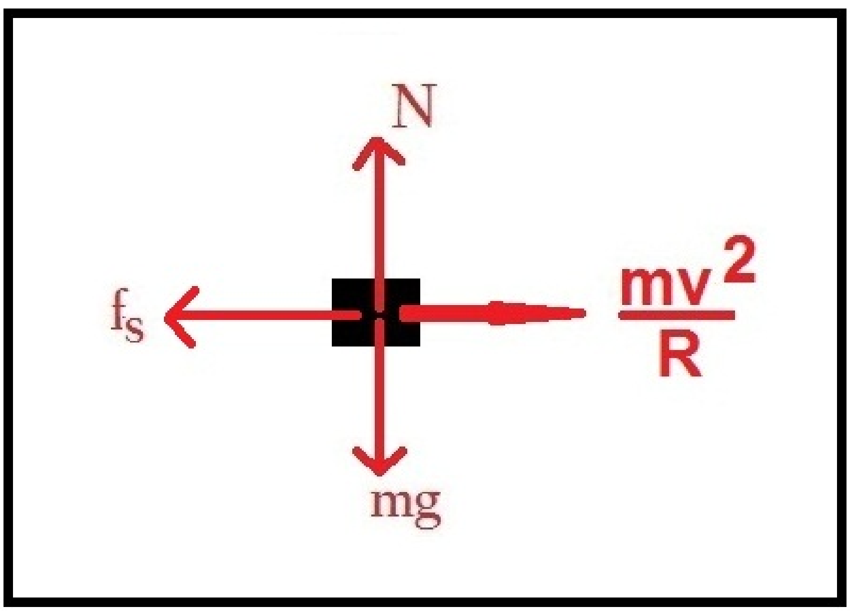


Figure 22.3: Sample Problem 9

```
//Sample Problem 41_3
printf("Sample Problem 42_3")
```

# Chapter 23

# Kinetic Energy and Work

# Chapter 24

# Kinetic Energy and Work

check Appendix AP 2 for dependency:

`degree_rad.sci`

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)
```

---

**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)
```

---

**Scilab code Exa 41.4** Sample Problem 4

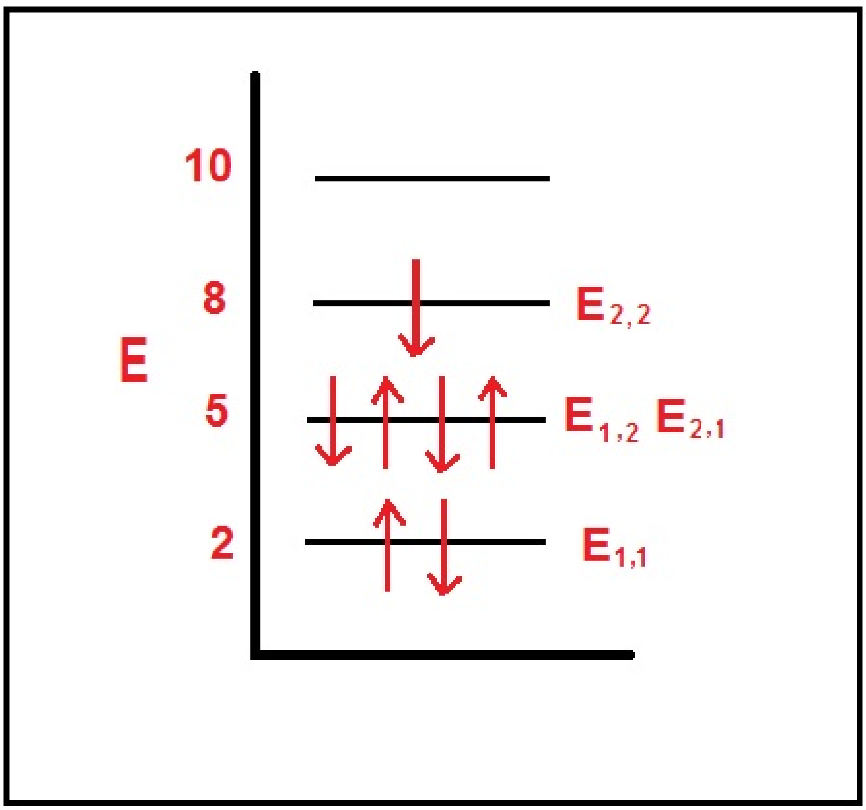


Figure 24.1: Sample Problem 3

```
//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

//Sample Problem 41-4
printf("**Sample Problem 41-4**\n")
lambdaMin = h*c/(K*e)
printf("The cutoff wavelength is %em", lambdaMin)
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

check Appendix AP 2 for dependency:

`degree_rad.sci`

**Scilab code Exa 7.2** Sample Problem 2

**Scilab code Exa 41.5**

```
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)
```

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 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 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 25

# Conduction of Electricity in Solids

**Scilab code Exa 7.3** **Scilab code Exa 7.3** Sample Problem 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)
```

```
//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 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 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 7.4** 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** **Scilab code Exa 7.5** Sample Problem 2 Sample Problem 5

**Scilab code Exa 7.5**

```
//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)
```

```
//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)
```

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** **Scilab code Exa 7.6** Sample Problem 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)
```

---

```
//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)
```

**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** **Scilab code Exa 42.4** Sample Problem 7 Sample Problem 4

```
//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)
```

```
//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 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 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 7.8** Sample Problem 8

**Scilab code Exa 7.9**

```
//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)
```

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 42.6** Sample Problem 6

**Scilab code Exa 7.9**

```
//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)
```

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)
```

**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
```

check Appendix AP 2 for dependency:

`degree_rad.sci`

# Chapter 26

# Potential and Conservation of Energy

**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)
```

---

**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
```

---

**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)
```

# Chapter 27

# 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)
```

# Chapter 28

# Potential and Conservation of Energy

**Scilab code Exa 8.2 Scilab code Exa 8.2 Scilab code Exa 8.2** Sample Problem 1 Sample Problem 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)
```

```
//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)
```

---

```
//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 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 43.3** **Scilab code Exa 43.3** Sample Problem 4

**Scilab code Exa 8.2** Sample Problem 3

```
//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))
```

Sample Problem 2

```
//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)
```

---

```
//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 43.4** **Scilab code Exa 43.4** Sample Problem 5

**Scilab code Exa 8.3** Sample Problem 4

```
//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
```

Sample Problem 3

```
//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)
```

```
//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 8.6** Sample Problem 6

**Scilab code Exa 43.15**

```
//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)
```

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 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 8.7** 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 8.5 Scilab code Exa 8.8** Sample Problem 5 Sample Problem 8

```
//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
```

```
//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)
```

**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)
```

# Chapter 29

# 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))
```

**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 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 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 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 43.9** Sample Problem 9

**Scilab code Exa 8.17**

```
//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)
```

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 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))))
```

**Scilab code Exa 43.10** **Scilab code Exa 8.8** Sample Problem 10 Sample Problem 8

```
//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)
```

```
//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)
```

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))
```

# Chapter 30

# 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 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 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)
```

# Chapter 31

# System of Particles

**Scilab code Exa 9.6** **Scilab code Exa 9.6** check Appendix AP 2 for dependency:

`degree_rad.sci`

Sample Problem 3 Sample Problem 6

```
//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)
```

```
//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)
```

**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))
```

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 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 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)
```

**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 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 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)
```

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))))
```

**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 32

# Collisions

check Appendix AP 2 for dependency:

degree_rad.sci

check Appendix AP 2 for dependency:

degree_rad.sci

# Chapter 33

# Quarks Leptons and the Big Bang

**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 10.1** 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 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 10.2** Sample Problem 2

**Scilab code Exa 9.5**

```
//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)
```

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 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 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 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 10.5** **Scilab code Exa 10.5** Sample Problem 6 Sample Problem 5

```
//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)
```

---

```
//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")
```

**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)
```

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))
```

# Chapter 34

# Rotation

**Scilab code Exa 11.1** Sample Problem 1

**Scilab code Exa 45.7 Scilab code Exa 9.18**

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

Sample Problem 7

Sample Problem 8

```
//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)
```

```
//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)
```

# 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$_{r}ad$

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 AP 2** 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
```

# Chapter 35

# Collisions

**Scilab code AP 5** check Appendix AP 2 for dependency:

degree_rad.sci

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 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 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)
```