Scilab Textbook Companion for Modern Physics by B.L.Theraja[1]

Created by
Harshit Bajpai
B.tech
Chemical Engineering
Visvesvaraya National Institute of Technology
College Teacher
Vilas K. Deshpande
Cross-Checked by
Mukul R. Kulkarni

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

ELECTRIC AND MAGNETIC FIELD

Scilab code Exa 1.1 CALCUALTION OF ELECTROSTATIC FORCE

```
clc;clear;
//Example 1.1
//Comparision of electrostatic force of replusion
   between two particles with the gravitational
   forces between them

//given values
q1=3.2*10^-19;
q2=q1;//q1 and q2 are the values of charge on alpha−
   particle in C
d=10^-13;//distance between two alpha−particles in m
m1=6.68*10^-27;
m2=m1;//m1 and m2 are masses of alpha−particles in
   kg
G=6.67*10^-11;//Gravitational constant in N−(m^2)/(
   kg^2)

//calculation
F1=(9*10^9)*(q1*q2)/(d^2);//calculation of
```

```
    electrostatic force
disp(F1,'The electrosatic force(in N) is');
F2=G*(m1*m2)/(d^2);//calculation of electrostatic
    force
disp(F2,'The gravitational force (in N) is')
```

Scilab code Exa 1.2 CALCUALTION OF DISTANCE OF SEPARATION

```
clc;clear;
//Example 1.2
//Calculation of the distance of separation between
    two electrons

// given values
m=9.1*10^-31;//mass of elctron in kg
q=1.6*10^-19;//charge on electron in C
g=9.81;//acceleration due to gravity in m/(s^2)

//calculation
Fg=m*g;//gravitational force in N
d=sqrt((9*10^9*q^2)/Fg);//equating gravitational
    force with electrosatic force for calculating
    distance
disp(d,'The distance of separation(in m) is')
```

Scilab code Exa 1.3 CALCULATE FIELD INTENSITY AND FORCE

```
clc;clear;
//Example 1.3
//Calculation of electric intensity between plates
    and force on proton

//given values
```

```
d=0.02//distance between plates in m
V=400;//potential differnce of plates in V
q=1.6*10^-19;//charge on a proton in C

//calculation
E=V/d;//
disp(E,'The electric field intensity(in V/m) between plates is');
F=q*E;//
disp(F,'The force(in N) on proton is')
```

Scilab code Exa 1.4 CALCULATE MASS OF OIL DROP

```
clc;clear;
//Example 1.4
//calculation of mass of oil drop

//given values
d=0.02//distance between plates in m
q=1.6*10^-19;//charge on oil drop in C
V=6000;//potential differnce of plates in V
g=9.81;//acceleration due to gravity in m/(s^2)

//calculation
E=V/d;//electric field intensity between plates in V/m
F=q*E;//electrostatic force on oil drop in N
m=F/g;//equating the weight of oil drop to the electrostatic force on it
disp(m,'The mass(in kg) of oil drop')
```

Scilab code Exa 1.5 CALCULATE VELOCITY OF ELECTRON

```
clc;clear;
//Example 1.5
//Calculation of velocity of an electron

//given values
V=150;//potential difference between anode and
    cathode in V
m=9.31*10^-31;//mass of an electron in kg
q=1.6*10^-19;//charge on an electron in C

//Calculation
E=q*V;//energy(in J) gained by electron during
    speeding from cathode to anode
vel=sqrt(E*2/m);//equating with kinetic energy of
    electron i.e m(v^2)/2
disp(vel,'The velocity(in m/s) is')
```

Scilab code Exa 1.6 CALCULATE ENERGY

```
clc;clear;
//Example 1.6
//Calculation of energy in eV,MeV,J

//given values
V=5*10^6;//potential differnce through which alpha-
    particle is accelerated
e=1.6*10^-19;//charge on electron in C

//calculation
E1=2*V;//electronic charge on alpha-particle is 2e
    Coulombs
disp(E1,'The energy in eV is');
E2=E1/10^6;//energy in MeV
disp(E2,'The energy in MeV is');
E3=E1*e;//energy in Joules
```

```
disp(E3,'The energy in J is')
```

Scilab code Exa 1.7 CALCULATE TOTAL ENERGY

```
clc;clear;
//Example 1.7
//Calculation of the total energy

//given values
r=0.528*10^-10;//radius of the orbit in m
q=-1.6*10^-19;//charge on electron in C
Q=1.6*10^-19;//charge on Hydrogen nucleus in C
Eo=8.854*10^-12;//permittivity in free space in F/m

//calculation
E=(q*Q)/(8*3.14*Eo*r);//
disp(E,'The total energy(in J) is');
E1=E/(1.6*10^-19);//
disp(E1,'The total energy(in eV) is')
```

Scilab code Exa 1.8 CALCULATE FORCE AND RADIUS

```
clc;clear;
//Example 1.8

//given values
Q=3.2*10^-19;//charge on alpha-particle in C
m=6.68*10^-27;//mass on alpha-particle in kg
B=1.5;//transverse magnetic field of flux density in
    Wb/(m^2)
v=5*10^6;//velocity of alpha-particle in m/s

//Calculation
```

```
F=B*Q*v;//
disp(F,'The force(in N) on particle is');
R=m*v/(Q*B);//
disp(R,'The radius(in m) of its circular path')
```

Chapter 2

THE ELECTRON

Scilab code Exa 2.1 CALCULATE FORCE ACCELERATION AND KINETIC ENERGY

```
clc;clear;
//Example 2.1

//given values
E=2400;//electric field intensity in V/m
V=90;//potential difference in V
e=1.6*10^-19;//the charge on electron in C
m=9.12*10^-31;//mass of electron in kg

//Calculation
F=e*E;
disp(F,'The force(in N) on electron is');
a=F/m;
disp(a,'Its acceleration (in m/s^2)');
KE=e*V;
disp(KE,'The Kinetic Energy(in J) of particle is');
v=sqrt(2*KE/m);
disp(v,'The velocity(in m/s) of the electron')
```

Scilab code Exa 2.2 CALCULATE LINEAR VELOCITY AND RADIUS

```
clc;clear;
//Example 2.2

//given values
V=900;//potential difference in V
B=0.01;//uniform magnetic field in Wb/m^2
em=1.76*10^11;//value of e/m in C/kg

//calculation
v=sqrt(2*em*V);
disp(v,'The linear velocity(in m/s) of electron is');
R=v/(em*B);
disp(R,'The radius(in m) of the circular path is')
```

Scilab code Exa 2.3 CALCULATE MASS

```
clc;clear;
//Example 2.3

//given values
d=6*10^-3;//distance between plates in m
V=900;//potential difference in V
B=0.5;//uniform magnetic field in Wb/m^2
Q=1.6*10^-19;//the charge on electron in C
R=10.6*10^-2;//circular track radius in m

//calculation
v=V/(B*d);
m=R*Q*B/v;
```

```
disp(m,'The mass(in kg) of particle')
```

Scilab code Exa 2.4 CALCULATE RADIUS AND CHARGE ON OIL DROP

```
clc;clear;
//Example 2.4

//given values
V=6920;//potential difference in V
d=1.3*10^-3;//distance between in m
v=1.9*10^-4;//velocity in m/s
p=0.9*10^3;//density of oil in kg/m^3
n=1.81*10^-5;//coefficient of viscosity in N-s/m^2
g=9.81;//accelaration due to gravity in m/s^2
pi=3.14;//standard constant

//calculation
a=sqrt((9*n*v)/(2*g*p));
disp(a,'The radius(in m) of the drop is');
E=V/d;
Q=4*pi*(a^3)*p*g/(3*E);
disp(Q,'The value of charge(in C) on oil drop is')
```

Chapter 3

THE ATOMIC STRUCTURE

Scilab code Exa 3.1 CALCULATE DISTANCE OF CLOSEST APPROACH

```
clc;clear;
//Example 3.1

//given values
Z=79;//atomic number of gold
e=1.6*10^-19;//electron charge in C
Eo=8.854*10^-12;//absolute permitivity of free space
    in F/m
K=7.68*1.6*10^-13;//kinectic energy in J
pi=3.14;//standard constant

//calculations
D=(2*Z*e^2)/(4*pi*Eo*K);
disp(D,'The closest distance(in m) of approach is')
```

Scilab code Exa 3.2 CALCULATE VELOCITY RADIUS TIME TAKEN AND RYDBERG CONST

```
clc;clear;
//Example 3.2

//given values
Z=1;//atomic number of hydrogen
e=1.6*10^-19;//electron charge in C
pi=3.14;//standard constant
h=6.625*10^-34;//plank's constant in J-s
m=9.1*10^-31;//mass of an electron in kg
Eo=8.854*10^-12;//absolute permitivity of free space
    in F/m
c=3*10^8;//speed of light in m/s
n=1;//ground state

//calculation
v=9*10^9*(2*pi*Z*e^2)/(n*h);
disp(v,'velocity(in m/s) of ground state');
r=(Eo*n^2*h^2)/(pi*m*e^2);
disp(r,'radius(in m) of Bohr orbit in ground state')
t=(2*pi*r)/v;
disp(t,'time taken(in s) by electron to traverse the
    bohr first orbit');
R=(m*e^4)/(8*Eo^2*h^3*c);
disp(R,'Rhydberg contstant (in  m^-1)')
```

Scilab code Exa 3.3 CALCULATE FREQUENCY

```
clc;clear;
//Example 3.3

//given values
B=2.179*10^-16;//a constant in J
h=6.625*10^-34;//plank's constant in J-s

//calculation
```

```
E3=-B/3^2;
E2=-B/2^2;
f=(E3-E2)/h;
disp(f,'frequency(in Hz) of radiation')
```

Scilab code Exa 3.4 CALCULATE FREQUENCY IN FIRST ORBIT

```
clc;clear;
//Example 3.4

//given values
Z=1;//atomic number of hydrogen
e=1.6*10^-19;//electron charge in C
h=6.625*10^-34;//plank's constant in J-s
m=9.1*10^-31;//mass of an electron in kg
Eo=8.854*10^-12;//absolute permitivity of free space
    in F/m
n=1;//ground state

//Calculations
f=(m*Z^2*e^4)/(4*Eo^2*h^3);
disp(f,'the frequency(in Hz) is')
```

Scilab code Exa 3.5 AT WHAT SPEED MUST ELECTRON

```
clc;clear;
//Example 3.5

//given data
Z=1;
n=1;
e=1.6*10^-19;//the charge on electron in C
h=6.625*10^-34;//Plank's constant
```

```
Eo=8.854*10^-12;//absolute permitivity of free space
    in F/m
m=9.12*10^-31;//mass of electron in kg

//calculations
v=Z*e^2/(2*Eo*n*h);
disp(v,'velcocity in m/s');
E=-m*Z^2*e^4/(8*(Eo*n*h)^2);
disp(E,'energy of hydrogen atom in J');
f=m*Z^2*e^4/(4*Eo^2*(n*h)^3);
disp(f,'frequecy in Hz')
```

Scilab code Exa 3.8 CALCULATE PRINCIPAL QUANTUM NO AND WAVELENGTH

```
clc;clear;
//Example 3.8

//given data
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s
E1=10.2;//in eV energy
E2=12.09;//in eV energy
e=1.6*10^-19;//the charge on electron in C

//calcualtion
//principal quantum no are 2 & 3 respectively
W=c*h/(E1*e)*10^10;
disp(W,'wavelength in angstrom is for 10.2 eV');
W=c*h/(E2*e)*10^10;
disp(W,'wavelength in angstrom is for 12.09 eV')
```

Scilab code Exa 3.9 CALCULATE WAVELENGTH FOR LYMAN SERIES

```
clc;clear;
//Example 3.9

//given data
R=10967700;//Rydberg constant in 1/m

//calculation
W1=4/(3*R);//as n1=1 and n2=2
disp((W1*10^10),'Long wavelength in angstrom');
W2=1/R;//as n1=1 and n2=infinity
disp((W2*10^10),'Short wavelength in angstrom')
```

Chapter 4

CRYSTALLOGRAPHY

Scilab code Exa 4.2 CALCULATE DISTANCE BETWEEN ADJACENT ATOMS

```
clc;clear;
//Example 4.2

//given data
d=2180;//density of NaCl
M=23.5+35.5;//Molecular weight
Na=6.02*10^26;//Avgraodo no. in 1/kg mole
n=4;//for f.c.c

//calculations
a=(n*M/(Na*d))^(1/3);
d=a/2;
disp((d*10^10),'distance between to adajcent atoms
    in angstrom')
```

Scilab code Exa 4.3 CALCULATE SPACING

```
clc;clear;
//Example 4.3

//given data
d=2.163;//density in gm/cm^3
M=58.45;
Na=6.02*10^23;//Avgraodo no. in 1/gm mole

//calcualtions
n=Na/M;//no. of molecules/gram
n=n*d;//no. of molecules/cm^3
n=2*n;//no. of atom/cm^3;
n=n^(1/3);//no. of atoms in a row 1cm long
d1=1/n;
disp((d1*10^8),'Spacing in angstrom')
```

Scilab code Exa 4.4 CALCULATE DENSITY OF Cu

```
clc;clear;
//Example 4.4

//given data
r=1.278;//radius in A.U
n=4;//structure is f.c.c
M=63.54;
Na=6.02*10^23;//Avgraodo no. in 1/gm mole

//calculations
a=4*r/(sqrt(2));
V=a^3;
d=n*M/(Na*V);
disp((d*(10^8)^3),'Density in g/cm^3')
```

Scilab code Exa 4.10 CALCULATION OF INTERPLANAR SPACING

```
clc;clear;
//Example 4.10

//given data
r=1.746;//atomic radius in angstrom

//calulations
a=4*r/sqrt(2);
//for (i)
h=2;k=0;l=0;
d=a/sqrt(h^2+k^2+l^2);
disp(d,'distace for (200) in A.U');
//for (ii)
h=2;k=2;l=0;
d=a/sqrt(h^2+k^2+l^2);
disp(d,'distace for (220) in A.U ')
//for (iii)
h=1;k=1;l=1;
d=a/sqrt(h^2+k^2+l^2);
disp(d,'distace for (111) in A.U')
```

Scilab code Exa 4.11 CALCULATION OF ANGLE BETWEEN PAIR OF PLANES

```
clc;clear;
//Example 4.11

//calculations
//for (i)
l=1;m=0;n=0;
p=0;q=1;r=0;
d=acosd((l*p+m*q+n*r)/(sqrt(l^2+m^2+n^2)*sqrt(p^2+q
    ^2+r^2)));
```

```
disp(d,'angle b/w pair of miller incdices in (i)');
//for (ii)
l=1;m=2;n=1;
p=1;q=1;r=1;
d=acosd((l*p+m*q+n*r)/(sqrt(l^2+m^2+n^2)*sqrt(p^2+q
    ^2+r^2)));
disp(d,'angle b/w pair of miller incdices in (ii)')
```

Scilab code Exa 4.13 CALCUALTION OF NO OF ATOMS PER SQMM

```
clc;clear;
//Example 4.13

//given data
a=3.61*10^-7;//lattice constant in mm

//calcualtions
//for (i) plane (100)
SA=a*a;
tamc=2;//total atoms included according to sketch
ans=tamc/SA;
disp(ans,'atoms per mm^2 for (i)');
//for (ii) plane (110)
A=a*(sqrt(2)*a);
tamc=2;//total atoms included according to sketch
ans=tamc/A;
disp(ans,'atoms per mm^2 for (ii)');
//for (iii) plane (111)
A=0.866*a*a;
tamc=2;//total atoms included according to sketch
ans=tamc/A;
disp(ans,'atoms per mm^2 for (iii)')
```

Chapter 5

QUANTUM THEORY

Scilab code Exa 5.1 CALCULATE ENERGY

```
clc;clear;
//Example 5.1

//given values
W1=4;//wavelength in Angstrom
W2=1;//wavelength in Angstrom
e=1.6*10^-19;//the charge on electron in C
m=9.12*10^-31;//mass of electron in kg

//calculation
disp("Part (i)");
E=12400/W1;
disp(E,'The energy in eV is');
v=sqrt(E*e*2/m);
disp(v,'The velocity in m/s is');
disp("Part (ii)");
E=12400/W2;
disp(E,'The energy in eV is');
v=sqrt(E*e*2/m);
disp(v,'The velocity in m/s is')
```

Scilab code Exa 5.2 HOW MANY PHOTONS

```
clc;clear;
//Example 5.2

//given values
f=880*10^3;//frequency in Hz
P=10*10^3;//Power in W
h=6.625*10^-34;//Plank's constant

//calculation
E=h*f;
n=P/E;
disp(n,'The number of photons emitted per second are
   ')
```

Scilab code Exa 5.3 HOW MANY LIGHT QUANTA

```
clc;clear;
//Example 5.3

//given values
P=200;//power in W
W=6123*10^-10;//wavelength in m
c=3*10^8;//speed of light in m/s
h=6.625*10^-34;//Plank's constant

//calculation
Op=0.5*P;//radiant o/p
E=h*c/W;
n=2/E;
disp(n,'No. of Quanta emitted/s')
```

Scilab code Exa 5.4 FIND THE NO OF PHOTOELECTRONS

```
clc;clear;
//Example 5.4

//given values
N=5*10^4;//no. of photons
W=3000*10^-10;//wavelength in A
J=5*10^-3;//senstivity for W in A/W
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s
e=1.6*10^-19;//the charge on electron in C

//calculation
E=h*c/W;//energy content of each photon
TE=N*E;//total energy
I=J*TE;//current produced
n=I/e;
disp(n,'no. photoelectrons emitted are')
```

Scilab code Exa 5.5 HOW MANY PHOTONS AND AT WHAT RATE

```
clc;clear;
//Example 5.5

//given values
W=5*10^-7;//wavelength in m
F=10^-5;//force in N
h=6.625*10^-34;//Plank's constant
m=1.5*10^-3;//mass in kg
c=3*10^8;//speed of light in m/s
```

```
S=0.1//specific heat

//calculation
n=F*W/h;
disp(n,'no. of photons');
E=F*c/4200;//in kcal/s
T=E/(m*S);
disp(T,'the rate of temperature rise')
```

Scilab code Exa 5.6 HOW MANY PHOTONS EMITTED BY LAMP

```
clc;clear;
//Example 5.6

//given values
W=4500*10^-10;//wavelength in m
V=150;//rated voltage in W
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s

//calculation
P=V*8/100;//lamp power emitted
E=h*c/W;
n=P/E;
disp(n,'No. photons emitted/s')
```

Scilab code Exa 5.7 CALCULATE NUMBER OF PHOTONS

```
clc;clear;
//Example 5.7

//given values
f=1*10^12;//frequency in Hz
```

```
h=6.625*10^-34;//Plank's constant

//calculation
E=h*f;
n=E/6.625;
disp(n,'the no. of photons required')
```

Scilab code Exa 5.8 WITH WHAT VELOCITY

```
clc;clear;
//Example 5.8

//given values
W=5200*10^-10;//wavelength in m
h=6.625*10^-34;//Plank's constant
m=9.12*10^-31;//mass of electron in kg

//calculations
p=h/W;
v=p/m;
disp(v,'the velocity in m/s')
```

Scilab code Exa 5.9 CALCULATE THRESHOLD FREQUENCY

```
clc;clear;
//Example 5.9

//given data
v=7*10^5;//maximum speed in m/sec
f=8*10^14;//frequency in Hz
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s
m=9.12*10^-31;//mass of electron in kg
```

```
//calulations
E=0.5*m*v*v;
fo=f-(E/h);
disp(fo,'the threshold frequency in Hz is')
```

Scilab code Exa 5.10 CALCULATE MAXIMUM ENERGY AND WORK FUNCTION

```
clc;clear;
//Example 5.10

//given data
Wo=2300*10;//threshold wavelength in Angstrom
W=1800*10;//incident light wavelength in Angstrom

//calculations
w=124000/Wo;
disp(w,'The work function in eV is');
E=124000*((1/W)-(1/Wo));
disp(E,'The maximum energy in eV')
```

Scilab code Exa 5.11 WHAT IS THRESHOLD WAVELENGTH

```
clc;clear;
//Example 5.11

//given data
W=6000;//wavelegth in Angstrom
v=4*10^5;//velocity in m/sec
m=9.12*10^-31;//mass of electron in kg
e=1.6*10^-19;//the charge on electron in C

```

```
//calculations
KE=0.5*m*v^2/e;
disp(KE,'The Kinetic energy in eV is');
WF=12400/W;
Wo=12400/(WF-KE);
disp(Wo,'The threshold wavelength in Angstrom is')
```

Scilab code Exa 5.12 CALCULATE THRESHOLD FREQUENCY

```
clc;clear;
//Example 5.12

//given data
Wo=4.8;//work function in eV
W=2220;//wavelength in angstrom

//calculations
E=12400/W;
Emax=E-Wo;
disp(Emax,'The maximum Kinetic energy in eV is')
```

Scilab code Exa 5.13 WHEN VIOLET LIGHT

```
clc;clear;
//Example 5.13

//given data
W=4000*10^-10;//wavelength in m
Vs=0.4;//retarding potential in eV
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s
e=1.6*10^-19;//the charge on electron in C

```

```
//calculations
f=c/W;
disp(f,'The light frequency in Hz');
E=h*f/e;
disp(E,'The photon energy in eV');
Wo=E-Vs;
disp(Wo,'The work function in eV');
fo=Wo/h*e;
disp(fo,'The threshold frequency in Hz');
NE=(E-Wo)*e;
disp(NE,'The net energy in J')
```

Scilab code Exa 5.14 CALCULATE THRESHOLD WAVELENGTH AND PLANKS CONSTANT

```
clc;clear;
//Example 5.14

//given data
W1=3310*10^-10;//photon wavelength in m
W2=5000*10^-10;//photon wavelength in m
E1=3*10^-19;//electron energy in J
E2=0.972*10^-19;//electron energy in J
c=3*10^8;//speed of light in m/s

//given values
h=(E1-E2)*(W1*W2)/(c*(W2-W1));
disp(h,'the plancks const in Js');
Wo=c*h/E1;
disp(Wo,'The threshold wavelength in m')
```

Scilab code Exa 5.15 A CERTAIN METAL

```
clc;clear;
//Example 5.15

//given data
W=6525;//wavelength in angstrom

//calcualation
Vo=12400*((1/4000)-(1/W));
disp(Vo,'Stopping potential in (a) in volts');
Vo=12400*((1/2000)-(1/W));
disp(Vo,'Stopping potential in (b) in volts');
Vo=12400*((1/2000)-(2/W));
disp(Vo,'Stopping potential in (c) in volts')
```

Scilab code Exa 5.16 FIND UNKNOWN WAVELENGTH

```
clc;clear;
//EXample 5.16

//given data
Wo=5000;//wavelength in angstrom
V=3.1;//stopping potential in V

//calcualtion
W=1/((V/12400)+(1/Wo));
disp(W,'The unknown wavelength in Angstrom')
```

Scilab code Exa 5.17 LIGHT OF WAVELENGTH 2000 ANGSTROM

```
clc;clear;
//Example 5.17

//given values
```

```
W=2000;//wavelength in Angstrom
Vs=4.2;//Work Function in eV
e=1.6*10^-19;//the charge on electron in C

//calculations
E=12400/W;
Emax=(E-Vs)*e;
disp(Emax,'KE of fastest photoelectron in J');
Emin=0;
disp(Emin,'KE of slowest moving electron in J');
Vo=Emax/e;
disp(Vo,'Stopping potential in V');
Wo=12400/Vs;
disp(Wo,'The cutoff wavelength in Angstrom')
```

Scilab code Exa 5.18 CALCULATE PLANKS CONSTANT

```
clc;clear;
//Example 5.18

//given values
Vs1=4.6;//Stopping Potential in V
Vs2=12.9;//Stopping Potential in V
f1=2*10^15;//frequency in Hz
f2=4*10^15;//frequency in Hz
e=1.6*10^-19;//the charge on electron in C

//calculations
h=((Vs2-Vs1)*e)/(f2-f1)
disp(h,'The Plancks const in Js')
```

Chapter 7

CLASSIFICATION OF SOLIDS

Scilab code Exa 7.1 CALCULATE ENERGY GAP

```
clc;clear;
//Example 7.1

//given data
W=11000;//wavelength in angrstrom

//calcuations
Eg=W/12400;
disp(Eg,'Energy Gap in eV')
```

Scilab code Exa 7.2 FIND MOBILITY OF ELECTRONS

```
clc;clear;
//Example 7.2

//given data
```

```
p=1.7*10^-6;//resistivity in ohm-cm
d=8.96;//density in gm/cc
W=63.5;
Na=6.02*10^23;//Avgraodo no. in 1/g mole
e=1.6*10^-19;//the charge on electron in C

//calcualtions
n=8.96*Na/W;
ue=1/(p*e*n);
disp(ue,'mobilty of electrons in cm^2/V-s');
```

Scilab code Exa 7.3 FIND RESISTIVITY

```
clc;clear;
//Example 7.3

//given data
d1=2.5*10^19;//density of charge carries in 1/m^3
d2=4.2*10^28;//density of germanium atoms
ue=0.36;//mobilty of electrons in m^2/V-s
Na=6.02*10^23;//Avgraodo no. in 1/g mole
e=1.6*10^-19;//the charge on electron in C

//calcualtions
Nd=d2/10^6;
cn=Nd*e*ue;
pn=1/cn;
disp(pn,'resistivity of doped germanium in ohm-m')
```

Scilab code Exa 7.4 CALCULATE WAVELENGTH

```
clc;clear;
//Example 7.4
```

```
//given data
Eg=0.75;//energy gap in eV

//calcualtions
W=12400/Eg;
disp(W,'wavelength in angstrom')
```

Chapter 8

X RAYS

Scilab code Exa 8.1 CALCULATE WAVELENGTH

```
clc;clear;
//Example 8.1

//given data
V=60000;//working voltage in V

//calculation
Wmin=12400/V;
disp(Wmin,'Wavelength emitted in Angstrom')
```

Scilab code Exa 8.2 CALCULATE NUMBER OF ELECTRONS STRIKING PER SECOND

```
clc;clear;
//Example 8.2

//given data
V=12400;//Volatage applied in V
```

```
I=0.002;//current drop in A
e=1.6*10^-19;//the charge on electron in C

//calculations
n=I/e;
disp(n,'No. of electrons');
v=(5.93*10^5)*(sqrt(V));
disp(v,'the speed with which they strike in m/s');
Wmin=12400/V;
disp(Wmin,'shortest wavelength in Angstrom')
```

Scilab code Exa 8.3 CALCULATE MIN APPLIED POTENTIAL

```
clc;clear;
//Example 8.3

//given values
Wmin=1;//shortest wavelength in Angstrom

//calculations
V=(12400/Wmin)/1000;
disp(V,'The minimum applied voltage in kV')
```

Scilab code Exa 8.4 CALCULATE MAX SPEED

```
clc;clear;
//Exmaple 8.4

//given data
I=0.005;//current in A
V=100000;//potential difference in V

//calcualtions
```

```
v=(5.98*10^5)*(sqrt(V));
disp(v,'Maximum speed in m/s');
IP=V*I;//incident power in W
P=.999*IP;//power converted into heat in W
H=P/4.18;
disp(H,'The heat produced/second in cal/s');
```

Scilab code Exa 8.5 CALCULATE PLANKS CONSTANT

```
clc;clear;
//Example 8.5

//given data
V=30000;//potential difference in V
Wmin=0.414*10^-10;//short wavelength limit in m
e=1.602*10^-19;//the charge on electron in C
c=3*10^8;//speed of light in m/s

//calcualtions
h=(e*V*Wmin)/c;
disp(h,'The Plancks const in Js')
```

Scilab code Exa 8.6 CALCULATE SCREENING CONST

```
clc;clear;
//Example 8.6

//given data
W=1.43*10^-10;//wavelength in m
Z=74;//atomic no
R=10.97*10^6;//Rydberg constant in 1/m

//calcualation
```

```
b=74-sqrt(36/(5*R*W));//Transition from to M to L
disp(b,'the screening const.')
```

Scilab code Exa 8.9 CALCULATE LINEAR ADSORPTION COEFF

```
clc;clear;
//Example 8.9

//given data
um=0.6;//mass adsoption coeffcient in cm^2/g
p=2.7;//density of aluminium in g/cm^3

//calculations
u=p*um;
disp(u,'linear adsorption coefficent of aluminium in 1/cm');
T=0.693/u
disp(T,'the hvl in cm');
x=(log(20))*(1/u);
disp(x,'the thickness in cm')
```

Scilab code Exa 8.10 CALCULATE ANGLE OF THIRD ORDER REFLECTION NOTE CALCUALTION MISTAKE IN BOOK

```
    clc;clear;
//Example 8.10

//given values
D=12;//glancing angle in Degree
n=1;
d=3.04*10^-10;//grating space in m

//calculation
```

```
W=(2*d*sind(D));
disp((W/(10^-10)),'the wavelength in Angstrom');
D3=asind((3*W)/(2*d));
disp(D3,'the angle for third order reflection in
    degrees')
```

Scilab code Exa 8.11 HOW MANY ORDERS OF BRAGG RELFLECTION

```
clc;clear;
//Example 8.11

//given data
d=1.181;//distance of seperation in Angstrom
W=1.540;//wavelength in Angstrom

//calculations
n=2*d/W;//sin(D) = 1 for max value
disp(n,'the orders of bragg reflection')
```

Scilab code Exa 8.12 CALCULATE INTERPLANAR SPACING

```
clc;clear;
//Example 8.12

//given data
W=0.6;//wavelength in angstrom
D1=6.45;
D2=9.15;
D3=13;//angles in degree

//calculation
d=W/(2*sind(D1));
```

```
disp(d,'interplanar spacing for (a) in angstrom');
d=W/(2*sind(D2));
disp(d,'interplanar spacing for (b) in angstrom');
d=W/(2*sind(D3))*2;//n=2 for (c)
disp(d,'interplanar spacing for (c) in angstrom')
```

Scilab code Exa 8.13 DETERMINE THE SPACING

```
clc;clear;
//Example 8.13

//given data
W=3*10^-10;//wavelength in m
D=40;//angle in degree
n=1;

//calculation
d=n*W/(2*sind(D));
disp((d/10^-10),'spacing in AU')
a=2*d;
v=a^3;
disp(v,'the volumne in m^3 is')
```

Scilab code Exa 8.14 DETERMINE THE TYPE OF CRYSTAL POSSESED

```
clc;clear;
//Example 8.14

//given data
D1=5.4;
D2=7.6;
D3=9.4;//angles in degree
```

```

//calcualtion
d1=1/(2*sind(D1));
d2=1/(2*sind(D2));
d3=1/(2*sind(D3));
m=min(d1,d2,d3);
d1=d1/m;
d2=d2/m;
d3=d3/m;
disp(d1,d2,d3,'d1:d2:d3 =')
```

Scilab code Exa 8.15 CALCULATE SHORT WAVELENGTH AND GALNCING ANGLE

```
clc;clear;
//Example 8.15

//given data
V=50000;//applied voltage in V
p=1.99*10^3;//density in kg/m^3
n=4;
Na=6.02*10^26;//Avgraodo no. in 1/kg mole
M=74.6;//molecular mass
W=0.248*10^-10;//wavelength in m

//calculation
Wmin=12400/V;
disp(Wmin,'short wavelength limit');
a=(n*M/(Na*p))^(1/3);
d=a/2;
D=asind(W/(2*d));
disp(D,'glancing angle in degree')
```

Scilab code Exa 8.16 CALCULATE LATTICE SPACING OF NaCl

```
clc;clear;
//Example 8.16

//given data
W=1.54;//wavelength in angstrom
D=15.9;//angle in degree
M=58.45//molecular weight
p=2164*10^3;//density in kg/m^3
n=2;//for NaCl molecule

//calculation
d=W/(2*sind(D));
disp(d,'lattice spacing in angstrom');
d=d*10^-10;
Na=M/(2*d^3*p);
disp(Na,'Avogrado number in 1/gm mole')
```

Scilab code Exa 8.17 WHAT IS PRIMARY WAVELENGTH

```
clc;clear;
//Example 8.17

//given data
D=60;//angle in degree
W=0.254;//wavelength in angstrom

//calcualtion
dW=0.024*(1-cosd(D));
W1=W-dW;
disp(W1,'primary X-ray wavelength in angstrom')
```

Scilab code Exa 8.18 WHAT IS LATTICE PARAMETER

```
clc;clear;
//Example 8.18

//given data
D=32;//angle in degree
W=1.54*10^-10;//wavelength in angstrom
h=2;k=2;l=0;//lattice consts

//calcualtions
d=W/(2*sind(D));
a=d*sqrt(h^2+k^2+l^2);
disp(a,'lattice parameter in m');
r=sqrt(2)*a/4;
disp(r,'radius of atom in m')
```

Chapter 9

WAVES AND PARTICLES

Scilab code Exa 9.1 WHAT IS DE BROGLIE WAVELENGTH

```
clc;clear;
//Example 9.1

//given data
V=20000;//applied voltage in V

//calculation
W=12.25/(sqrt(V));
disp(W,'de broglie wavelength in angstrom')
```

Scilab code Exa 9.2 CALCULATE MOMENTUM DE BROGLIE WAVELENGTH AND WAVE NUMBER

```
clc;clear;
//Example 9.2

//given data
V=5000;//applied voltage in V
```

```
e=1.602*10^-19;//the charge on electron in C
m=9.12*10^-31;//mass of electron in kg
d=2.04*10^-10;//distance in m

//calculations
p=sqrt(2*m*e*V);
disp(p,'momentum in kg-m/s^2');
W=12.25/sqrt(V);
disp(W,'de broglie wavelength in angstrom');
v=1/(W*10^-10);
disp(v,'the wave number in m');
D=asind((W*10^-10)/(2*d));
disp(D,'the Bragg angle in degrees')
```

Scilab code Exa 9.3 AN ELECTRON INTIALLY AT REST

```
clc;clear;
//Example 9.3

//given data
V=54;//applied voltage in V
e=1.602*10^-19;//the charge on electron in C
m=9.12*10^-31;//mass of electron in kg
h=6.625*10^-34;//Plank's constant

//calcualtions
v=sqrt(2*e*V/m);
disp(v,'velocity of electron in m/s');
W=12.25/sqrt(V);
disp(W,'de broglie wavelength in angstrom');
u=h/(2*m*W*10^-10);
disp(u,'phase velocity in m/s')
```

Scilab code Exa 9.4 COMPUTE DE BROGLIE WAVELENGTH

```
clc;clear;
//Example 9.4

//given data
e=1.6*10^-19;//the charge on electron in C
m=9.12*10^-31;//mass of electron in kg
c=3*10^8;//speed of light in m/s
h=6.625*10^-34;//Plank's constant

//calculations
E=m*c^2;
mp=1836*m;
//(0.5*m*v^2)=E
mv=sqrt(E*2*mp);
W=h/mv;
disp((W/10^-10),'de broglie wavelength in Angstrom')
```

Scilab code Exa 9.5 WHAT IS DE BROGLIE WAVELENGTH OF NEUTRON

```
clc;clear;
//Example 9.5

//given data
e=1.6*10^-19;//the charge on electron in C
m=1.676*10^-27;//mass of neutron in kg
c=3*10^8;//speed of light in m/s
h=6.625*10^-34;//Plank's constant

//calculations
E=1;//in eV
E=1*e;//in V
mv=sqrt(2*E*m);
```

```
W=h/mv;
disp((W/10^-10),'de broglie wavelength in Angstrom')
```

Scilab code Exa 9.6 CALCULATE THE SCATTERED WAVELENGTH

```
clc;clear;
//Example 9.6

//calculations
W=0.09;//wavelength in Angstrom
D=54;//scattering angle in degree
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s
e=1.6*10^-19;//the charge on electron in C

//calculations
dW=0.0243*(1-cosd(D));
W1=W+dW;
disp(W1,'wavelegth of scattered X-ray in Angstrom');
E=h*c/(W*10^-10);
disp((E/(e*10^6)),'Energy of incident photon in MeV');
E=h*c/(W1*10^-10);
disp((E/(e*10^6)),'Energy of scattered photon in MeV')
```

Scilab code Exa 9.7 COMPUTE ENERGY DIFFERENCE

```
clc;clear;
//Example 9.7

//given data
h=6.625*10^-34;//Plank's constant
```

```
m=9.12*10^-31;//mass of electron in kg

//calculations
//for (a)
nx=1;
ny=1;
nz=1;
L=1;
E=h^2*(nx^2+ny^2+nz^2)/(8*m*L^2);
disp(E,'energy in first quantum state in J');
//for (b) (nx^2+ny^2+nz^2)=6
L=1;
E=h^2*6/(8*m*L^2);
disp(E,'energy in second quantum state in J')
```

Scilab code Exa 9.8 CALCULATE THE LOWEST THREE PREMISSIBLE ENERGIES

```
clc;clear;
//Example 9.8

//given data
h=6.625*10^-34;//Plank's constant
m=9.12*10^-31;//mass of electron in kg
L=2.5*10^-10;
e=1.6*10^-19;//the charge on electron in C

//calcualtions
n=1;
E1=n^2*h^2/(8*m*L^2*e);
disp(E1,'E1 in eV');
n=2;
E2=4*E1;
disp(E2,'E2 in eV');
n=3;
```

```
E3=9*E1;
disp(E3,'E3 in eV');
```

Chapter 10

THE ATOMIC NUCLEUS

Scilab code Exa 10.1 COMPARE DENSITIES OF WATER AND NUCLEUS

```
clc;clear;
//Example 10.1

//given data
R=1.2*10^-15;//radius in A^(1/3)—m *A is mass number
mp=1.008;
mn=mp;//mass of proton and neutron in a.m.u
pi=3.14;//const
Dw=1000;///density of water in kg/m^3

//calculation
Vn=4/3*pi*R^3;
mp=mp*1.66*10^-27;//conversion in kg
mn=mp;
m=mn;//m is combined mass in A—kg
Dn=m/Vn;
R=Dn/Dw;
disp(R,'the ratio is')
```

Scilab code Exa 10.2 CALCULATE ENERGY EQUIVALENCE FOR MeV

```
clc;clear;
//Example 10.2

//calculations
amu=1.66*10^-27;//1 amu in kg
c=3*10^8;//speed of light in m/s
m=amu;
E=m*c^2;
kWh=1.6*10^-13;//conversion of kWh in J
E=E/kWh;
disp(E,'energy equivalence in MeV')
```

Scilab code Exa 10.3 CALCULATE ENERGY EQUIVALENCE FOR kWh

```
clc;clear;
//Example 10.3

//calculations
gm=10^-3;//1 gram in kg
m=gm;
c=3*10^8;//speed of light in m/s
E=m*c^2;
kWh=36*10^5;//1 kWh in J
EE=E/kWh;
disp(EE,'energy equivalence in kWh')
```

Scilab code Exa 10.4 CALCULATE BINDING ENERGY

```
clc;clear;
//Example 10.4

//given data
mn=1.00893;//mass of neutron in a.m.u
mp=1.00813;//mass of proton in a.m.u
md=2.01473;//mass of deuteron in a.m.u
ma=4.00389;//mass of alpha-particle in a.m.u

//calculations
dm=md-(mn+mp);
disp((-dm*931),'binding energy in MeV');
dm=ma-2*(mn+mp);
disp((-dm*931),'binding energy in MeV')
```

Scilab code Exa 10.5 CALCULATE BINDING ENERGY OF 17Cl35

```
clc;clear;
//Example 10.5

//given data
m1=1.008665;//mass of 0n1 in a.m.u
m2=1.007825;//mass of 1H1 in a.m.u
m3=34.9800;//mass 17Cl35 in a.m.u
n=17+18;

//calculations
dm=(17*m2)+(18*m1)-m3;
Q=dm*931;
disp(Q,'Binding energy in MeV');
BEn=Q/n;
disp(BEn,'Binding energy per nucleon in MeV')
```

Scilab code Exa 10.6 CALCULATE BINDING ENERGY FOR LITHIUM NUCLEUS

```
clc;clear;
//Example in 10.6

//given data
m1=1.00814;//mass of proton in a.m.u
m2=1.00893;//mass of neutron in a.m.u
m3=7.01822;//mass of lithium in a.m.u

//calculations
dm=(3*m1)+(4*m2)-m3;
Q=dm*931;
disp(Q,'Binding energy in MeV')
```

Chapter 11

NATURAL RADIOACTIVTIY

Scilab code Exa 11.1 CALCUALTE HOW MUCH RADIUM

```
clc;clear;
//Example 11.1

//given data
ttg=8378-1898;//total time gap in yrs
hf=1620;//half life in yrs
n=ttg/hf;//no of half-periods
Mo=200;//amt of radium in mg

//calculations
M=Mo*(0.5)^n;
disp(M,'radium left in mg')
```

Scilab code Exa 11.2 CALCULATE RADIOACTIVE DISINTEGRATING CONST

```
clc;clear;
//Example 11.2
```

```

//given data
hf=30;//half life in days
//M is intial conc.

//calcualtions
k=0.693/hf;
disp(k,'radioactive disintegration constant in 1/day
    ');
//M/4 is left
t=-log(1/4)/k;
disp(t,'time taken for (ii) in days');
//M/8 is left
t=-log(1/8)/k;
disp(t,'time taken for (iii) in days')
```

Scilab code Exa 11.3 COMPUTE DECAY CONST AND HALF LIFE

```
clc;clear;
//Example 11.3

//given data
No=4750;
N=2700;//rate in counts/minute
t=5;//time in minutes

//calculation
k=log(No/N)/t;
disp(k,'radioactive disintegration constant in 1/min
    ');
hf=0.693/k;
disp(hf,'half life in minutes')
```

Scilab code Exa 11.4 ESTIMATE HALF LIFE OF PLUTONIUM

```
clc;clear;
//Example 13.4

//given data
m=4.00387;//mass of alpha particle in a.m.u
M=10^-6;//mass of Pu-239 in kg

//calculations
m=m*1.66*10^-24;//conversion in gm
Mo=2300*m;
k=(Mo/1)/M;
hf=0.693/k;
hf=hf/(365*24*3600);//conversion in yrs
disp(hf,'half life in yrs')
```

Scilab code Exa 11.5 CALCULATE ACTIVITY

```
clc;clear;
//Example 11.5

//given data
hf=2.48*10^5;//half life in yrs
k=8.88*10^-14//decay const in 1/s
Mo=4;//intial mass in mg
Na=6.02*10^23;//Avgraodo no. in 1/gm mole

//calculations
kt=0.693/hf*62000;
M=Mo*(exp(-kt));
disp(M,'mass remain unchanged in mg');
N=M*10^-3*Na/234;
A=k*N;
disp(A,'Activity in disintegrations/second ')
```

Scilab code Exa 11.6 HALF LIFE OF RADIUM IS 1620 YRS

```
clc;clear;
//Example 11.6

//given data
hf=1620;//half life in yrs
Mo=1/100;//mass in gm

//calculations
k=0.693/hf;
M=(1-Mo);
t=log(1/M)/k;
disp(t,'time reqd for (i) in yrs');
M=Mo;
t=log(1/M)/k;
disp(t,'time reqd for (ii) in yrs')
```

Chapter 12

ARTIFICAL RADIOACTIVTIY

Scilab code Exa 12.1 ESTIMATE ITS AGE

```
clc;clear;
//Example 12.1

//given data
r=0.5;//ratio of mass of Pb206 and mass of U238
t=4.5*10^9;//half life in years

//calculation
T=(log(1+r))*(t/0.693);
disp(T,'age in years')
```

Chapter 13

NUCLEAR REACTIONS

Scilab code Exa 13.1 CALCULATE THE ENERGY AVAILABLE

```
clc;clear;
//Example 13.1

//given data
m1=7.0183;//mass of 3Li7 in a.m.u
m2=4.0040;//mass of 2He4 in a.m.u
m3=1.0082;//mass of 1H1 in a.m.u
Na=6.02*10^26;//Avgraodo no. in 1/kg mole
//rxn = 3Li7 + 1H1 = 2He4 + 2He4

//calculations
dm=m1+m3-(2*m2);
E=dm*931;
n=0.1*Na/7;//no of atoms in 100 gm of lithium
TE=n*E;
disp(TE,'Total energy available in MeV')
```

Scilab code Exa 13.2 CALCULATE THE ENERGY RELEASED

```
clc;clear;
//Example 13.2

//given data
m1=6.015126;//mass of 3Li7 in a.m.u
m2=4.002604;//mass oh 2He4 in a.m.u
m3=1.00865;//mass of 0n1 in a.m.u
m4=3.016049;//mass of 1H3 in a.m.u
//rxn = 3Li7 + 0n1 = 2He4 + 1H3 + Q

//calcualtions
dm=m1+m3-(m2+m4);
Q=dm*931;
disp(Q,'energy released in MeV')
```

Scilab code Exa 13.3 WHAT IS THE Q VALUE OF THE REACTION

```
clc;clear;
//Example 13.3

//given data
m1=14.007515;//mass of 7N14 in a.m.u
m2=4.003837;//mass oh 2He4 in a.m.u
m3=17.004533;//mass of 8O17 in a.m.u
m4=1.008142;//mass of 1H1 in a.m.u
//rxn = 7N14 + 2He14 = 8O17 + 1H1

//calculations
dm=m3+m4-(m1+m2);
Q=dm*931;
disp(Q,'energy released in MeV')
```

Scilab code Exa 13.4 FIND THE MASS

```
clc;clear;
//Example 13.3

//given data
m1=14.007520;//mass of 7N14 in a.m.u
m2=1.008986;//mass oh 0n1 in a.m.u
//m3=mass of 6C14 in a.m.u
m4=1.008145;//mass of 1H1 in a.m.u
//rxn = 7N14 + 0n1 = 6C14 + 1H1 + 0.55 MeV

//calculations
Q=0.55;
dm=Q/931;
m3=dm+m1+m2-m4;
disp(m3,'mass of 6C14 in a.m.u')
```

Scilab code Exa 13.6 EXPLAIN MASS DEFECT

```
clc;clear;
//Example 13.6

//given data
m0=11.01280;//mass 5B11 in a.m.u
m1=4.00387;//mass of alpha particle in a.m.u
m2=14.00752;//mass of 7N14 in a.m.u
//m3=mass of neutron
E1=5.250;//energy of alpha particle in MeV
E2=2.139;//energy of 7N14 in MeV
E3=3.260;//energy of 0n1 in MeV

//calculations
m3=(m0*931)+((m1*931)+E1)-((m2*931)+E2)-E3;
disp((m3/931),'mass of neutron in a.m.u')
```

Chapter 14

NUCLEUR FISSION AND FUSION

Scilab code Exa 14.1 COMPUTE FISSION ENERGY

```
clc;clear;
//Example 14.1

//given data
E1=7.8;//avg. B.E per nucleon in MeV
E2=8.6;//for fissin fragments in MeV

//calculations
FER=(234*E2)-(236*E1);
disp(FER,'Fission energy released in MeV')
```

Scilab code Exa 14.2 FIND ELEMENTARY PARTICLES RELEASED IN BINARY FISSION OF 92U235

```
clc;clear;
//Example 14.2
```

```
//given data
m1=235.044;//mass of 92U235 in a.m.u
m2=97.905;//mass of 42Mo98 in a.m.u
m3=135.917;//mass of 54Xe136 in a.m.u
//rxn = 0n1 + 92U235 = 42Mo98 + 54Xe136 + 4 -1e0 + 2
    0n1

//calculation
LHSm=1.009+m1;
RHSm=m2+m3+(4*0.00055)+(2*1.009);
dm=LHSm-RHSm;
disp(dm,'mass defect in a.m.u');
E=dm*931;
disp(E,'energy released in MeV')
```

Scilab code Exa 14.3 HOW MUCH HYDROGEN MUST BE CONVERTED INTO HELIUM

```
clc;clear;
//Example 14.3

//given data
m1=1.00813;//mass of 1H1 in a.m.u
m2=4.00386;//mass of 2He4 in a.m.u
SC=1.35;//solar constant in kW/m^2
d=1.5*10^11;//dist b/w earth and sum in m
e=1.6*10^-19;//the charge on electron in C
Na=6.02*10^26;//Avgraodo no. in 1/kg mole
pi=3.14;//const
//rxn = 4 1H1 = 2He4 + 2 1e0

//calculations
dm=(4*m1)-m2
E=dm*931;//energy produced in MeV
```

```
EP=E/4;//energy produced per atom
EP=EP*10^6*e;//conversion in J
EPkg=EP*Na;//energy produced by 1 kg of hydrogen
SC=SC*1000;//conversion in J/s-m^2
SA=4*pi*d^2;//surface area of sphere
ER=SC*SA;//energy recieved per second
m=ER/EPkg;
disp((m/10^3),'mass of hydrogen consumed in tonnes/
    second')
```

Scilab code Exa 14.4 CALCULATE THE ENERGY LIBERATED

```
clc;clear;
//Example 14.4

//given data
m1=2.01478;//mass of 1H2 in a.m.u
m2=4.00388;//mass of 2He4 in a.m.u
//rxn 1H2 + 1H2 = 2He4 + Q

//calculations
Q=2*m1-m2;
Q=Q*931;//conversion in MeV
disp(Q,'energy liberated in MeV')
```

Chapter 15

NUCLEUR ENERGY SOURCES

Scilab code Exa 15.1 CALCULATE THE MAXIMUM FRACTION OF THE KE

```
clc;clear;
//Example 15.1

//given data
ma=1;
Ma=2;
mb=1;
Mb=12;
mc=1;
Mc=238;//m is mass of neutron and M is mass of other
    neucleus

//calculation
n=(4*ma*Ma/(ma+Ma)^2)*100;
disp(n,'Maximum fraction of KE lost by a neutron for
    (a)');
n=(4*mb*Mb/(mb+Mb)^2)*100;
disp(n,'Maximum fraction of KE lost by a neutron for
```

```
    (a)');
n=(4*mc*Mc/(mc+Mc)^2)*100;
disp(n,'Maximum fraction of KE lost by a neutron for
    (a)')
```

Scilab code Exa 15.2 CALCULATE THE FISSION RATE

```
clc;clear;
//Example 15.2

//given data
E=200;//energy released per fission in MeV
e=1.6*10^-19;//the charge on electron in C
Na=6.02*10^26;//Avgraodo no. in 1/kg mole

//calculations
CE=E*e*10^6;//conversion in J
RF=1/CE;
disp(RF,'fission rate of one watt in fissions/second
    ');
Ekg=CE*Na/235;
disp(Ekg,'Energy realeased in complete fission of 1
    kg in J')
```

Scilab code Exa 15.3 HOW MANY KG OF U 235

```
clc;clear;
//Example 15.3

//given data
R=3*10^7;//rate of energy development in J s
E=200;//energy released per fission in MeV
e=1.6*10^-19;//the charge on electron in C
```

```
t=1000;//time is hours
Ekg=8.2*10^13;//energy released per kg of U-235

//calculation
CE=E*e*10^6;//conversion in J
n=R/CE;
disp(n,'no of atoms undergo fission/second ');
TE=R*t*3600;//energy produced in 1000 hours
MC=TE/Ekg;
disp(MC,'mass consumed in kg')
```

Scilab code Exa 15.4 HOW MUCH U 235 WOULD BE CONSUMED IN THE RUN

```
clc;clear;
//Example 15.4

//given data
EPF=180;//Energy consumed per disintegration in MeV
E=1200;//average power in kW
t=10;//time in hours
Na=6.02*10^26;//Avgraodo no. in 1/kg mole
e=1.6*10^-19;//the charge on electron in C

//calculation
TE=E*t;//energy consumed in kWh
TE=TE*36*10^5;//conversion in J
EE=TE/0.2;//efficient energy
CE=EPF*e*10^6;//conversion in J
n=EE/CE;
m=235*n/Na*1000;
disp(m,'mass consumed in gram')
```

Scilab code Exa 15.5 NUCLEUR REACTOR PRODUCES 200MW

```
clc;clear;
//Example 15.5

//given data
OE=200;//o/p power in MW
E=200;//energy released per fission in MeV
WF=3.1*10^10;//fission rate in fissions/second
Na=6.02*10^26;//Avgraodo no. in 1/kg mole

//calculations
IE=OE/0.3*10^6;//reactor input in W
TFR=WF*IE;
n=TFR*24*3600;//no. of U-235 for one day
m=235*n/Na;
disp((m*100/0.7),'amt of natural uranium conumed/day
    in kg')
```

Scilab code Exa 15.6 A CITY REQUIRES 100 MW

```
clc;clear;
//Example 15.6

//given data
AE=100;//electrical power in MW
E=200;//energy released per fission in MeV
e=1.6*10^-19;//the charge on electron in C
Na=6.02*10^26;//Avgraodo no. in 1/kg mole

//calculations
TE=AE*10^6*24*3600;//energy consumed in city in one
    day in J
EE=TE/0.2;
CE=E*e*10^6;//conversion in J
```

```
n=EE/CE;
m=235*n/Na;
disp(m,'amt of fuel required in kg')
```

Scilab code Exa 15.7 BOMBAY REQUIRES 300 MWh

```
clc;clear;
//Example 15.7

//given data
OE=3000;//output power in MWh
E=200;//energy released per fission in MeV
e=1.6*10^-19;//the charge on electron in C
Na=6.02*10^26;//Avgraodo no. in 1/kg mole

//calculations
IE=OE/0.2;
TE=IE*36*10^8;//conversion in J
CE=E*e*10^6;//conversion in J
n=TE/CE;
m=235*n/Na;
disp(m,'daily fuel requirement in kg')
```

Scilab code Exa 15.8 THE MOTOR OF AN ATOMIC ICE BREAKER

```
clc;clear;
//Example 15.8

//given data
OP=32824;//o/p power in kW
E=200;//energy released per fission in MeV
Ekg=8.2*10^13;//energy released per kg of U-235

```

```
//calculations
DOP=OP*1000*24*3600;//daily o/p power in J
IP=DOP/0.2;
DFC=IP/Ekg;//daily fuel cosumption
disp(DFC,'daily fuel cosumption in kg');
DI=DOP/(0.8*4186);//daily input at 80% efficiency
Crqd=DI/(7*10^3);
disp(Crqd,'Coal reqd/day in tonnes')
```

Chapter 16

PARTICLE ACCELERATORS

Scilab code Exa 16.1 WHAT MUST BE THE FLUX DENSITY

```
clc;clear;
//Example 16.1

//given data
fo=9*10^6;//frequency in Hz
m=6.643*10^-27;//mass in kg
pi=3.14;//constant
e=1.6*10^-19;//the charge on electron in C

//calculations
Q=2*e;
B=fo*2*pi*m/Q;
disp(B,'magnetic flux density in Wb/m^2')
```

Scilab code Exa 16.2 WHAT IS FREQUENCY OF ALTERNATING POTENTIAL

```
clc;clear;
```

```
//Example 16.2

//given data
B=0.7;//magnetic flux intensity in Wb/m^2
m=3.34*10^-27;//mass in Kg
e=1.6*10^-19;//the charge on electron in C
pi=3.14;//const

//calculations
Q=e;
fo=B*Q/(2*pi*m*10^6);
disp(fo,'The cyclotron frquency in MHz ')
```

Scilab code Exa 16.3 A CYCLOTRON OF DEES OF RADIUS 2 METERES

```
clc;clear;
//Example 16.3

//given data
B=0.75;//magnetic flux intensity in Wb/m^2
m1=1.67*10^-27;//mass in Kg
m2=3.31*10^-27;//mass in Kg
e=1.6*10^-19;//the charge on electron in C
Rm=2;//radius in m

//calculations
Q=e;
Emax=3.12*10^12*B^2*Q^2*Rm^2/m1;
disp(Emax,'Maximum energies in Mev for proton');
Emax=3.12*10^12*B^2*Q^2*Rm^2/m2;
disp(Emax,'Maximum energies in Mev for deuteron')
```

Scilab code Exa 16.4 CALCULATE THE RATIO

```
clc;clear;
//Example 16.4

//given data
mo=9.1*10^-31;//mass of electron in kg
m=1.67*10^-27;//mass of proton in kg
c=3*10^8;//speed of light in m/s
E=1;//given energy in MeV

//calculations
Eo=mo*c^2/(1.6*10^-13);
mbymo=1+(E/Eo);
disp(mbymo,'Ratio for electron');
Eo=m*c^2/(1.6*10^-13);
mbymo=1+(E/Eo);
disp(mbymo,'Ratio for proton')
```

Scilab code Exa 16.5 IN A CERTAIN BETATRON

```
clc;clear;
//Example 16.5

//given data
B=0.5;//magnetic field in Wb/m^2
d=1.5;//diameter in m
f=59;//frequency in Hz
e=1.6*10^-19;//the charge on electron in C
c=3*10^8;//speed of light in m/s
pi=3.14;//const

//calculations
R=d/2;
N=c/(4*(2*pi*50)*R);
```

```
E=B*e*R*c/(1.6*10^-13);
disp(E,'final energy in MeV');
AE=E/N*10^6;
disp(AE,'average energy in eV')
```

Scilab code Exa 16.6 CALCULATE MASS AND VELOCITY OF ELCTRONS

```
clc;clear;
//Example 16.6

//given data
E=0.51;//kinetic energy in MeV
R=0.15;//radius in m
e=1.6*10^-19;//the charge on electron in C
mo=9.12*10^-31;//mass of electron in kg
c=3*10^8;//speed of light in m/s

//calculation
Eo=E;
m=mo*(1+(E/Eo));
b=sqrt(1-(mo/m)^2);
v=b*c;
B=mo*v/(e*R);
disp(B,'magnetic field intensity')
```

Scilab code Exa 16.7 DETERMINE THE FREQUENCY OF GENERATOR

```
clc;clear;
//Example 16.7

//given data
E=4;//applied voltage in MeV
```

```
m=3.334*10^-27;//mass of deuteron in kg
R=0.75;//radius in m
pi=3.14;//const
e=1.6*10^-19;//the charge on electron in C

//calcualtions
E=4*10^6*e;
fo=sqrt(E/(2*m))/(pi*R);
disp(fo,'frequnecy of generator in Hz')
```

Scilab code Exa 16.8 WHAT WOULD BE THE ENERGY OF ELECTRON

```
clc;clear;
//Example 16.8

//given data
roi=15;//rate of increase in Wb/s
tr=10^6;//total revolutions

//calcualtion
IE=roi*10^-6;//increased energy in MeV
FE=IE*tr;
disp(FE,'Fianl Energy in MeV')
```

Scilab code Exa 16.9 FIND THE MAX ENERGY AND CORRESPONDING WAVELENGTH

```
clc;clear;
//Example 16.9

//given data
R=0.1;//radius in m
```

```
pi=3.14;//const
h=6.625*10^-34;//Plank's constant
c=3*10^8;//speed of light in m/s
roi=15;//rate of increase in Wb/s
t=4*10^-4;//period of accerleartion in s
e=1.6*10^-19;//the charge on electron in C

//calculations
N=c*t/(2*pi*R);
IE=roi;//incresed energy in eV
ME=N*IE*10^-6;
disp(ME,'Maximum energy in MeV');
ME=ME*10^6*e;//conversion in V
p=ME/c;
Y=h/p;
disp(Y,'corresponding wavelength of X-rays in m')
```