Scilab Manual for
Electronic Devices And Circuits
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Experiment: 1

Determine the base,emitter,collector current of Common Base config ,given alpha value

check Appendix AP 6 for dependency:

`EX1.jpg`

Scilab code Solution 1.1 1

```
//Determine the base,emitter,collector current of
    Common base config
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

alpha=0.95      //in Ampere
Rl=5*10e3       //in kilo ohms
```

```
Vd=4.5      //in volts
Ic=Vd/Rl    //Current flowing through resistor (or) Collector Current in milli Ampere
Ie=Ic/alpha   //emitter current in milli Ampere
Ib=Ie-Ic       //base current in micro Ampere
Ic1=Ic*10e3
Ib1=Ib*10e6
Ie1=Ie*10e3
mprintf('The value of Ib is %.1fuA',Ib1)
mprintf('\nThe value of Ic is %.1fmA',Ic1)
mprintf('\nThe value of Ie is %.3fmA',Ie1)
```

Experiment: 2

Determine operating point of Fixed Bias circuit ,given transistor gain,base to emitter voltage

check Appendix AP 5 for dependency:

`EX2.jpg`

Scilab code Solution 2.2 2

```
//Determine the operating point of Fixed Bias ckt
   given transistor gain ,Vbe
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

tgain=100            //beta (or) transistor gain //
   unitless
```

```
Vcc=15                  //in volts
Vbe=0.7                //base emitter voltage in volts
Rb=1*10e6               //resistance in ohms
Rc=4*10e3               //resistance in ohms
Ic=Vcc/Rc
Icq=tgain*((Vcc-Vbe)/Rb)    //collector current in milli Ampere
Vceq=Vcc-(Icq*Rc)    //collector emitter voltage in volts
Vce=Vcc-(Ic*Rc)                   //load line equation for fixed-bias ckt
//Substituting Ic=0,Vce=Vcc=15v
Ic1x=0
Vcex=Vcc-(Ic1x*Rc)
//coordinates of load line on x-axis are(0 mA,15V)
//Substituting Vce=0,Ic=Vcc/Rc=3.75mA
Vcey=0
Icy=Vcc/Rc
//coordinates of load line on y-axis are(3.75 mA,0V)
Icq=Icq*10e3
Vce=Vce*10e3
Icy=Icy*10e3
mprintf('Collector Current Icq=%.2fmA',Icq)
mprintf('\nCollector-Emitter Voltage Vceq=%.2fV',Vceq)
mprintf('\nX-Axis Coordinates(%dmA,%dV)',Ic1x,Vcex)
mprintf('\nY-Axis Coordinates(%.2fmA,%dV)',Icy,Vcey)
mprintf('\nOperating Point is Icq=%.2fmA and Vceq=%.2fV',Icq,Vceq)

//plotting the load line
x=[Ic1x,Vcex]
y=[Icy,Vcey]
clf()
plot(x,y)
xtitle('Load Line');
xlabel('Vce(V)');ylabel('Ic(mA)');
```

Experiment: 3

Determine ouput voltage of circuit given Vbe for transistors Q1,Q2

check Appendix AP 4 for dependency:

EX3.jpg

Scilab code Solution 3.3 3

```
//Determine output voltage of a ckt
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

Vcc=15           //in volts
Vbe2=0.7         //in volts
Vq1=1.7         //in volts
Rb1=1*10^3      //in kilo ohms
Rb2=100         //in ohms
```

```
Ie1=(Vq1-Vbe2)/Rb2
Ic1=Ie1
Vc1=Vcc-(Rb1*Ie1)
Q2=Vc1
Vb2=Vc1
Ve2=Vb2-Vbe2
Vout=Ve2
Ie1=Ie1*10^3      //in milli Ampere
mprintf('Ie1:%d mA',Ie1)
mprintf('\nVc1:%d V',Vc1)
mprintf('\nQ2:%d V',Q2)
mprintf('\nVe2:%.1f V',Ve2)
mprintf('\nVout:%.1f V',Vout)
```

Experiment: 4

Determine value of drain current Id and gate source voltage Vgs for self bias circuit

check Appendix AP 3 for dependency:

```
EX4.jpg
```

Scilab code Solution 4.4 4

```
//Determine value of drain current-Id and gate-
    source voltage-Vgs for self-bias ckt
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

Vdd=20                  //in Volts
Vds=15                  //in Volts
Rd=4*10^3               //in ohms
Rs=0.4*10^3             //in ohms
```

```
Id=(Vdd-Vds)/(Rd+Rs)          //in milli Ampere
Vgs=Id*Rs                 //in Volts
Id=Id*10^3
mprintf('Drain Current Id is %.2fmA',Id)
mprintf('\nGate-Source Voltage Vgs is %.3fV',Vgs)
```

Experiment: 5

Find Freq of RC phase shift oscillator if the 3 resistances are equal and 3 capacitances are equal

Scilab code Solution 5.5 5

```
//Given N-channel JFET determine the value of rs to
   achieve Self Bias condition
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

Idss=40*10^-3            //in milli Ampere
Vp=-10                   //in Volts
Vgs=-5                  //in Volts
Vds=5                   //in Volts
Id=Idss*((1-(Vgs/Vp))^2)
Rs=Vds/Id
```

```
Id=Id*10^3          //in milli Ampere
mprintf('Id is %dmA',Id)
mprintf('\nRs is %d ohms',Rs)
```

Experiment: 6

Given N-channel JFET determine the value of Rs to achieve self bias condition

Scilab code Solution 6.6 6

```
//Find freq. of RC phase shift oscillator
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

R1=200*10^3          //resistance 1 in kilo ohms
R2=200*10^3          //resistance 2 in kilo ohms
R3=200*10^3          //resistance 3 in kilo ohms
C1=100*10^-12            //capacitance 1 in pico
    farads
C2=100*10^-12          //capacitance 2 in pico farads
C3=100*10^-12         //capacitance 3 in pico farads
fr=1/(2*%pi*R1*C1*sqrt(6))
fr=fr*10^-3          //in kilo Hertz
```

```
mprintf('The freqency of RC phase shift oscillator
    is %f Hz',fr)
```

Experiment: 7

Find the capacitance value in Wien-bridge oscillator given value of R and Freq of oscillation

Scilab code Solution 7.7 7

```
//Find the capacitance value in Wien−bridge
   oscillator
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

R=100*10^3        //resistance in kilo ohms
fr=10*10^3        //frequency of oscillation in kilo
   hertz
C=1/(2*%pi*R*fr)
C=C*10^12        //in pico Farad
mprintf('The capacitance value in the Wien−bridge
```

```
oscillator is: %.2f pF',C)
```

Experiment: 8

Design Zener Shunt voltage regulator with given specifications

Scilab code Solution 8.8 8

```
//Design Zener Shunt−Voltage regulator
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

Vo=10        //in volts
Vinmin=20       //lowercase Vin in volts
Vinmax=30       //uppercase Vin in volts
Ilmin=30*10^-3        //lowercase Il in volts
Ilmax=50*10^-3        //uppercase Il in volts
Izmin=20*10^-3          //lowercase Iz in milli Ampere
Izmax=40*10^-3          //uppercase Iz in milli Ampere
```

```
Vz=Vo
Pz=Vz*Izmax
mprintf('Pz:%.2f W',Pz)
//Pz=0.4W,Hence a 0.5Z 10 zener can be selected
Rlmin=(Vo/Ilmax)
Rlmax=(Vo/Ilmin)
Rmax=((Vinmax-Vo)/(Ilmin+Izmax))
Rmin=((Vinmin-Vo)/(Ilmax+Izmin))
R=(Rmax+Rmin)/2
mprintf('\nRlmin:%d ohms',Rlmin)
mprintf('\nRlmax:%d ohms',Rlmax)
mprintf('\nRmax:%d ohms',Rmax)
mprintf('\nRmin:%d ohms',Rmin)
mprintf('\nR:%d ohms',R)
```

Experiment: 9

Determine input,output impedance voltage and current gain given h-parameters of transistor

check Appendix AP 2 for dependency:

EX9.jpg

Scilab code Solution 9.9 9

```
//Determine input&output impedance voltage and current gain given h-parameters of transistor
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

Ic=3*10^-3              //collector current in milli Ampere
```

```
hfe=60                  //beta value
Vcc=12                   //in Volts
Vbe=0.6                  //base emitter voltage in Volts
Rc=5.1*10^3             //resistance in kilo ohms
Rb=220*10^3            //resistance in kilo ohms
hie=500                //in ohms
Zi=hie
Zo=Rc
Av=(-hfe*Rc)/hie
mprintf('Av:%d',Av)
Al=-hfe
mprintf('\nAl:%d',Al)
//from re model
Ib=(Vcc-Vbe)/Rb
Ib1=Ib*10^6             //in micro Ampere
mprintf('\nIb:%.1f uA',Ib1)
Ie=hfe*Ib
Ie1=Ie*10^3            //in milli Ampere
mprintf('\nIe:%.3f mA',Ie1)
re=(26*10^-3)/Ie
mprintf('\nre:%.2f ohms',re)
Zi=hfe*re
mprintf('\nZi:%.1f ohms',Zi)
Zo=Rc
Zo=Zo*10^-3
mprintf('\nZo:%.1f k ohms',Zo)
Av=-Rc/re
mprintf('\nAv:%d',Av)
Al=-hfe
mprintf('\nAl:%d',Al)
```

Experiment: 10

Design Schmitt Trigger circuit using 2 silicon NPN transistors with given configuration

check Appendix AP 1 for dependency:

EX10.jpg

Scilab code Solution 10.10 10

```
//Design schmitt trigger ckt using 2 silicon npn
   transistors with given config
//Windows 10
//Scilab 6.0.0

clc;
clear;
close;

UTP=5                  //in volts
Vb2=5                  //in volts
Vbe=0.7                //in volts
Vcc=12                 //in volts
```

```
LTP=3                 //in volts
Ic=2*10^-3          //in milli Amperes
Ic2=2*10^-3          //in milli Amperes
hfemin=100
UTP=Vb2
Ve=Vb2-Vbe
mprintf('\nVe:%.2f V',Ve)
Ie=Ic
Ie=Ie*10^3
mprintf('\nIe:%d mA',Ie)
Re=Ve/Ie
mprintf('\nRe:%.2f k ohms',Re)
//taking q2 saturated
Vcesat=0.2              //in volts
IcRc2=Vcc-Ve-Vcesat
mprintf('\nIcRc2:%.1f V',IcRc2)
Rc2=(Vcc-Ve-Vcesat)/Ic
Rc2=Rc2*10^-3
mprintf('\nRc2:%.2f k ohms',Rc2)
I2=0.1*Ic2
I2=I2*10^3
mprintf('\nI2:%.2f mA',I2)
R2=Vb2/I2
mprintf('\nR2:%d k ohms',R2)
Ib2=Ic2/hfemin
Ib2=Ib2*10^6
mprintf('\nIb2:%d uA',Ib2)
I1=I2+Ib2
//substituting the values and equating I1
//(Vcc-Vb2)/(Rc1+R1)=I1=0.2*10^-3+20*106-6
//12-5/(Rc1+R1)=0.22*10^-3
Rc1r1=(Vcc-Vb2)/I1
//Rc1+R1=7/(0.22*10^-3)
//when q1 is on Vi=LTP=Vb2=3v
Vi=LTP
Vb1=3
Vb2=3
I1=Vb2/R2
```

```
//I1=I1*10^3
mprintf('\nI1:%.2f mA',I1)
Ie=(Vb1-Vbe)/Re
Ic1=Ie
mprintf('\nIc1:%.2f mA',Ic1)
mprintf('\nIe:%.2f mA',Ie)

//Vcc=Rc1(Ic1+I1)+I1(R1+R2)
Rc1=(Vcc-I1*(Rc1r1+R2))/(Ie)
Rc1=Rc1*10^-3
R1=Rc1r1-Rc1
//Rb<hfeRe
Rb=(hfemin*Re)/10
mprintf('\nRb:%.2f k ohms',Rb)
```

Appendix

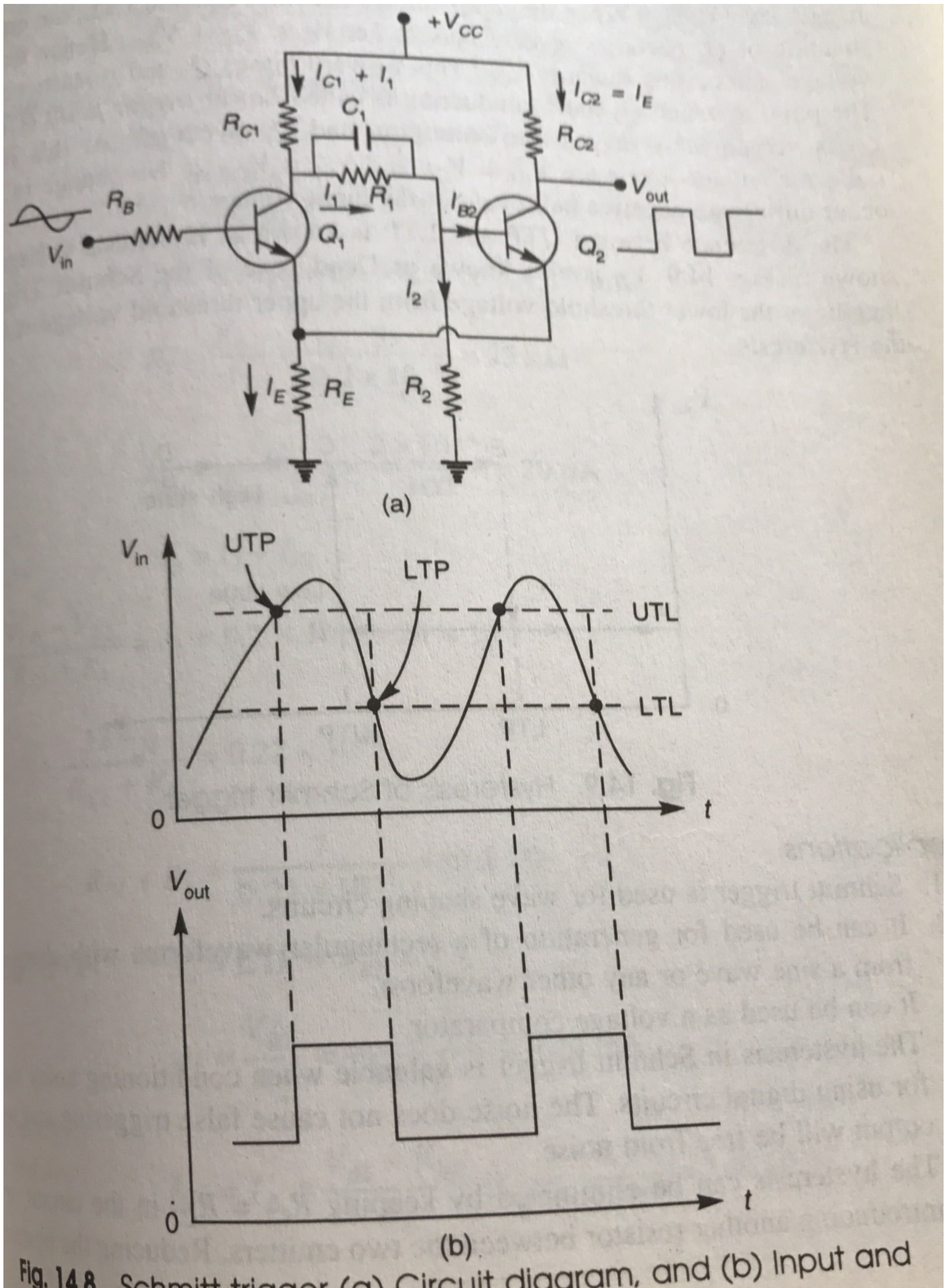

Fig. 14.8 Schmitt trigger (a) Circuit diagram, and (b) Input and output waveforms

Fig6

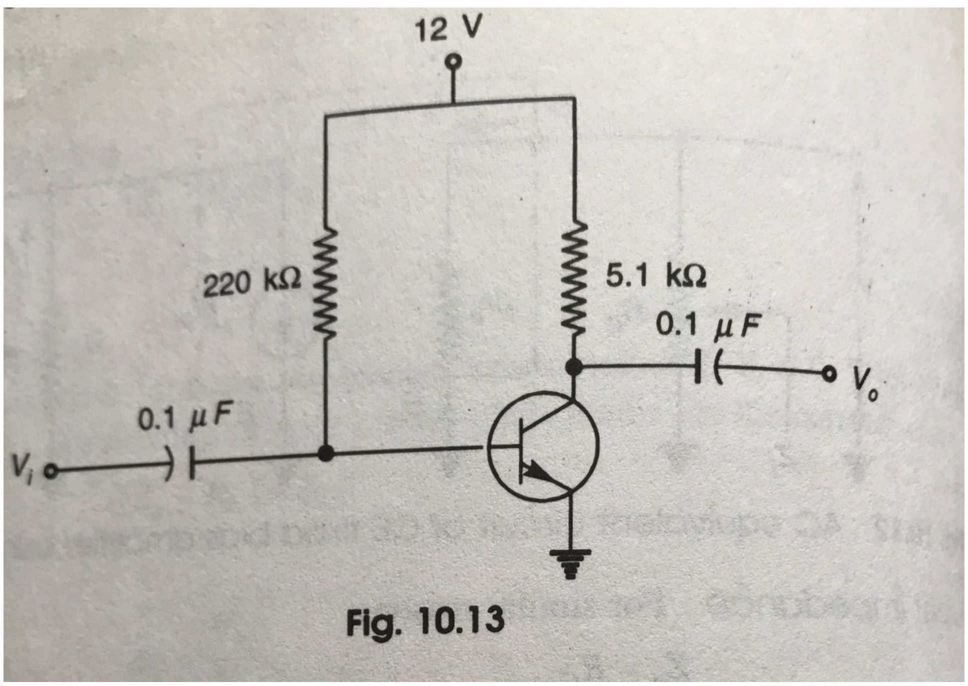

Fig5

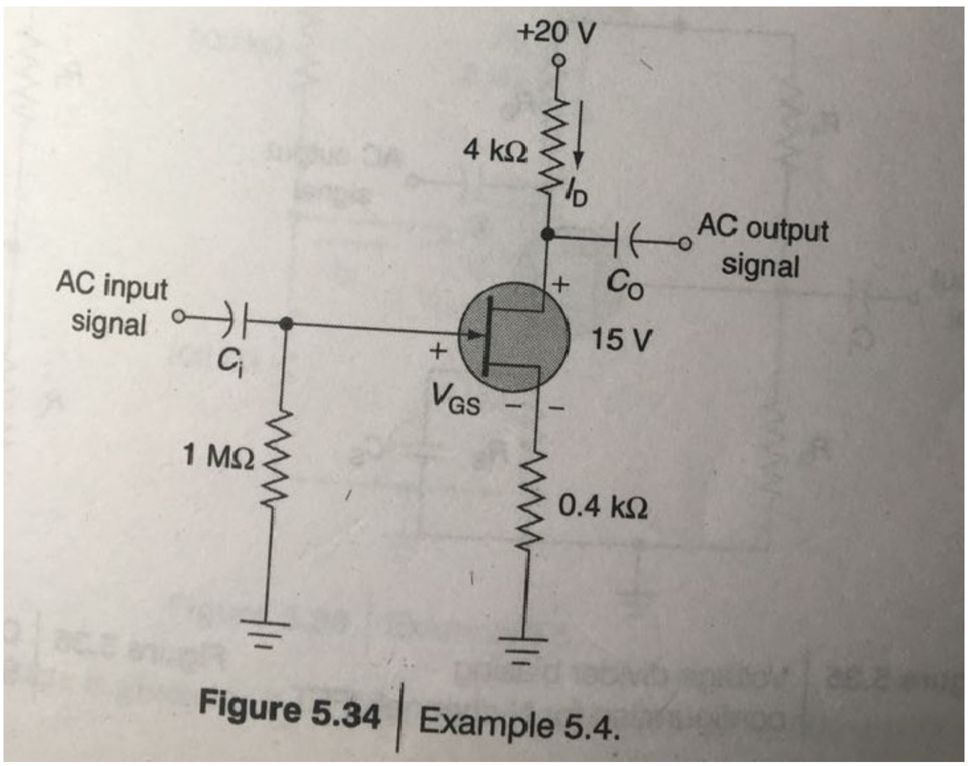
+20 V
4 kΩ
I_D
AC output signal
C_O
AC input signal
C_i
+
15 V
+
V_{GS}
−
−
1 MΩ
0.4 kΩ
Figure 5.34 | Example 5.4.

Fig4

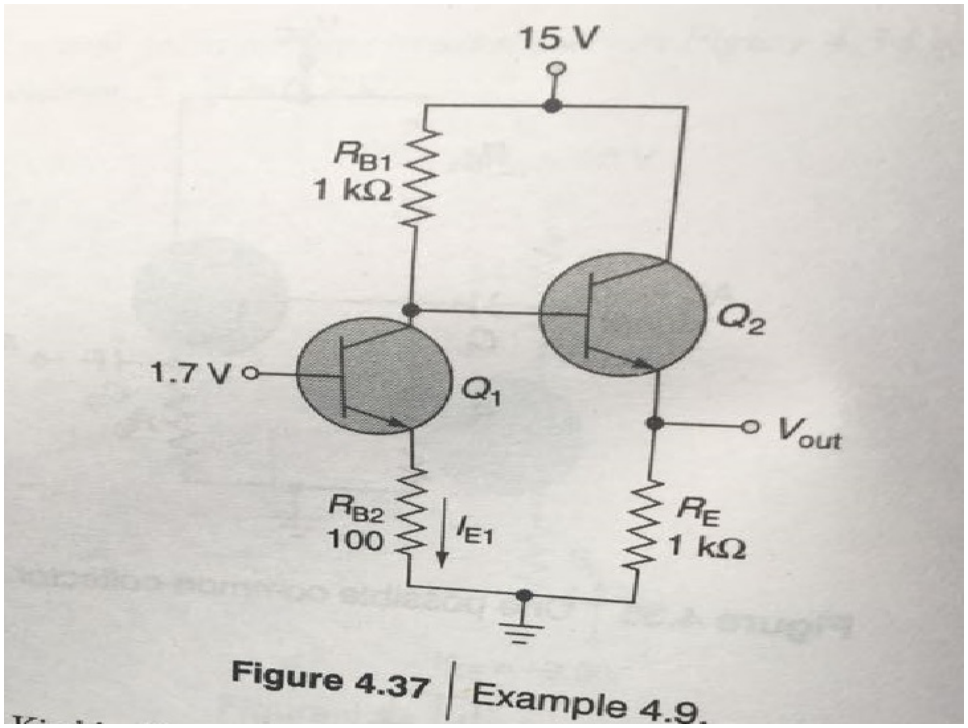

Figure 4.37 | Example 4.9.

Fig3

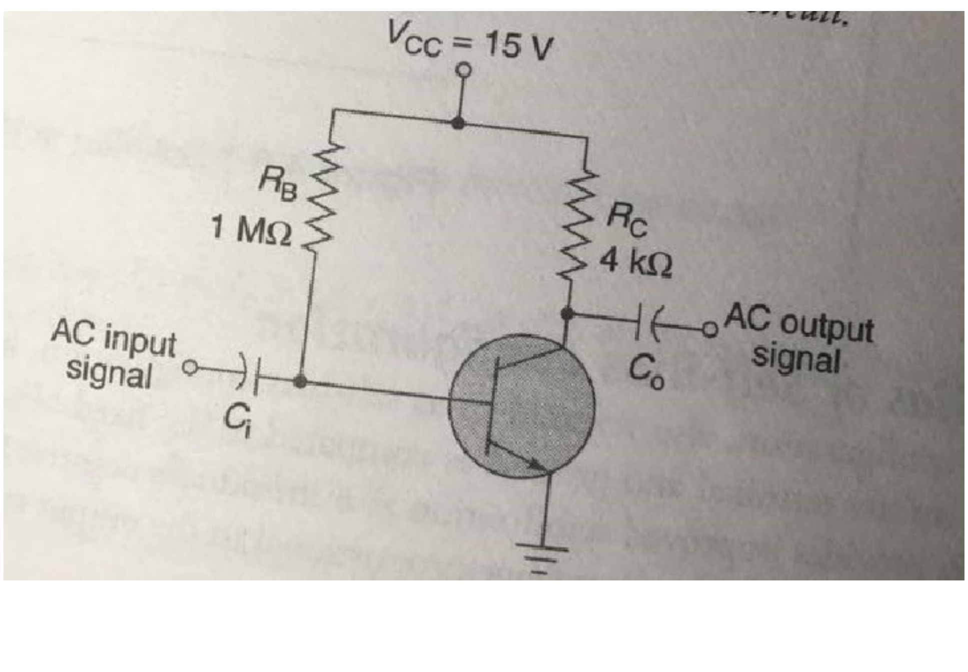

Fig2

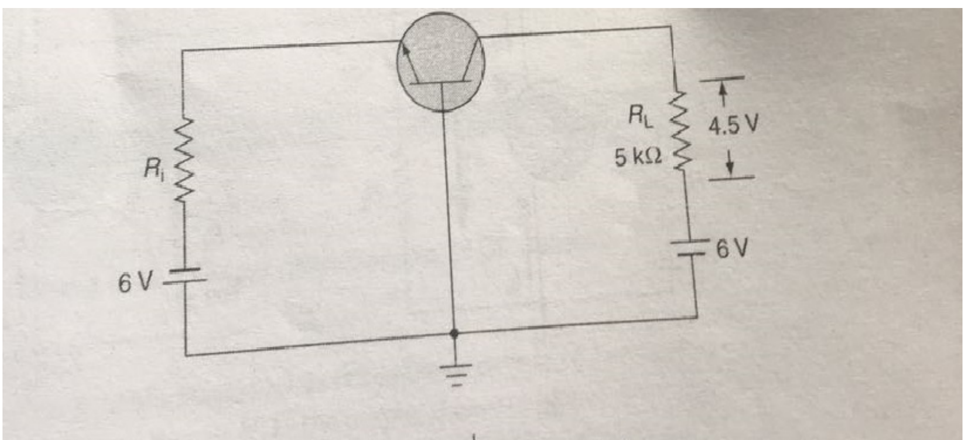

Figure 3.9 | Example 3.1.

Fig1