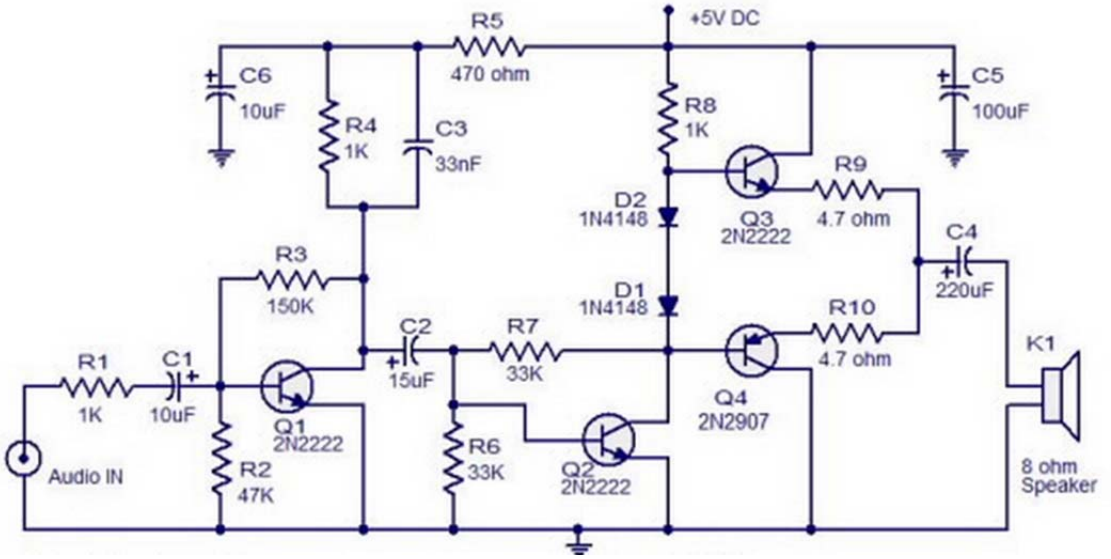
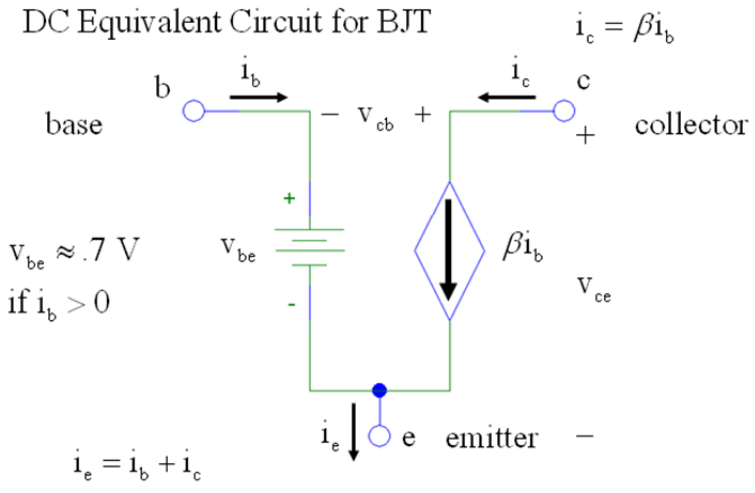
Q1. Consider the circuit shown in Figure 1. Take V_{BE}=0.7V, β=100, V_T=25mV, C_π=C_μ=2 pF. Ignore the early effect.

1. Calculate the DC bias for the circuit
2. Derive the expression for the overall voltage gain
3. Derive the expression for the 3dB high cutoff frequency (f_H).

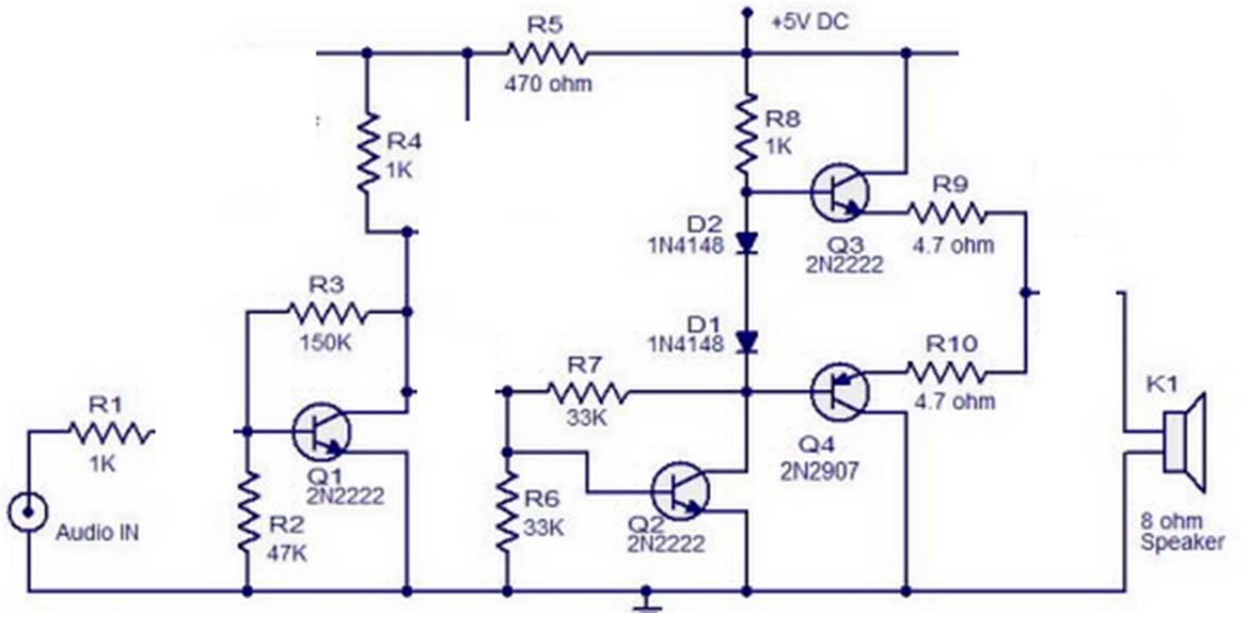


1. Use DC equivalent circuit for each BJT

Read here: http://www.fke.utm.my/mine/SEE2063/Chapter4%20BJTs%20Biasing.pdf



Ignore capacitors at this moment



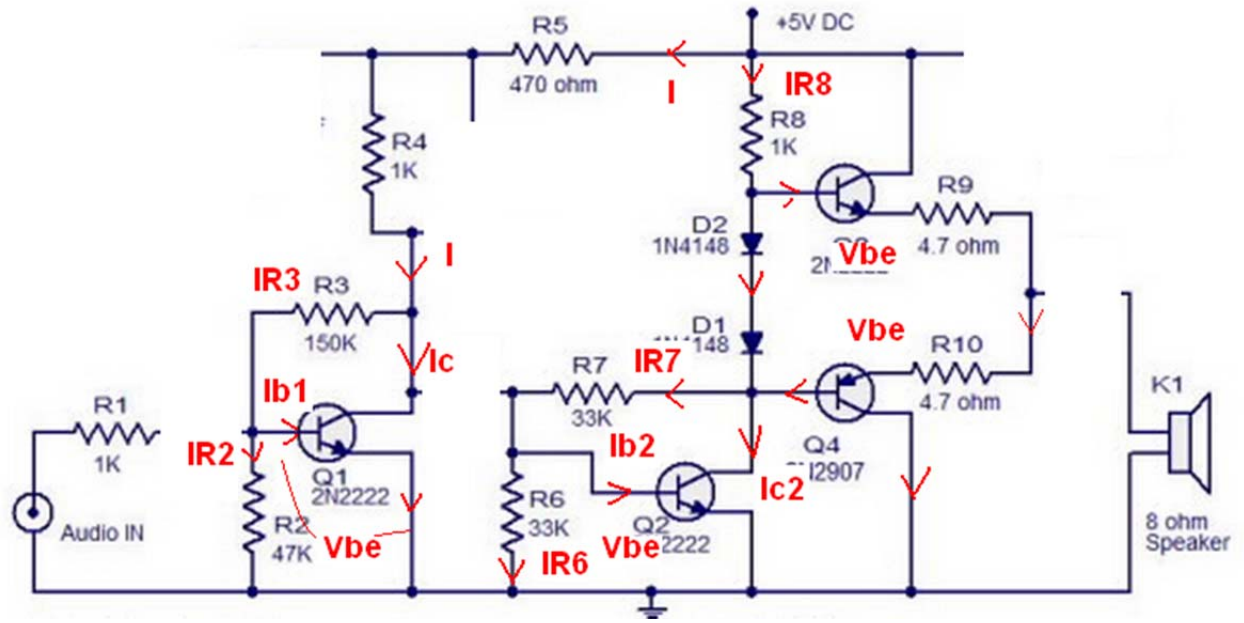
Use KVL\KCL in circuit to find all curents and voltages needed.

Ic= beta Ib

Ie= (Beta +1)Ib

Vbe=0.7V

Beta = 100



Example for Q1

Ir3=Ir2+ Ib1, Ur2=Ube=0.7V > Ir2=0.7/47k= 0.01489 mA [similar for Ur6=Ube=0.7V Ir6 = 0.7V/33k= 0.02121mA]

I= Ic+Ir3 = beta*Ib1 + Ib1+Ir2 = Ib1*101 + 0.01489mA

Vcc=5V= I (R4+R5) + Ir3 R3 + 0.7 = (Ib1*101 + 0.01489mA)(1k+0.47k) + (Ib1+ 0.01489) 150k + 0.7

Ib1(101*1,47k+ 150k) = 5- 0.7 – 0.01489*(1,47k +150k)

Ib1= 2.0456/298.47=0.00685mA=6.85uA

Ic=0.685mA

I= 0.7067mA

Uce(Q1)= Vcc- I(R4+R5)= 5-0.7067mA(1.47k)= 3.96V

……

IcQ3=0 and IcQ4 =0

KVL

Ud2 + Ud1= UbeQ3 + IeQ3*R9 + IeQ4*R10 + UbeQ4, but

Ud2=Ud1=Ube=UbeQ3=UbeQ4=Ube= 0.7V

IeQ3=IeQ4

So IeQ3(R9+R10)=0 => IeQ3=0, IeQ4=0

And in this way we can ignore IbQ3=beta*IcQ3 =0   and also IbQ4 = beta* IcQ4= 0

…….