Assignment #7

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1. Matlab code

```
q = 1.602192e-19;
k = 1.380662e-23;
ni = 1e16;
T=300;
VT=(k*T)/q;
N1=zeros(9,1);
N2=zeros(9,1);
for i=1:9
    N1(i,1)=1*10^(15+i);
    N2(i,1)=-1*10^(15+i);
end

for i=1:9
   phi = 0.5;
   for newton = 1:10000
      Jaco = ni*(-1/VT)*exp(-phi/VT)-ni*(1/VT)*exp(phi/VT);
      res = N1(i,1)+ni*exp(-phi/VT)-ni*exp(phi/VT);
      update= Jaco\(-res);
      phi=phi+update;
   end
   phi_numerical(i,1)=phi;
end

for i=1:9
   phi = -0.5;
   for newton = 1:10000
      Jaco = ni*(-1/VT)*exp(-phi/VT)-ni*(1/VT)*exp(phi/VT);
      res = N2(i,1)+ni*exp(-phi/VT)-ni*exp(phi/VT);
      update= Jaco\(-res);
      phi=phi+update;
   end
   phi_numerical2(i,1)=phi;
end

for i = 1:9
   phi_analytic(i,1) = VT*asinh(N1(i,1)/(2*ni));
   phi_analytic2(i,1) = VT*asinh(N2(i,1)/(2*ni));
   error(i,1) = (phi_analytic(i,1)-phi_numerical(i,1))/phi_analytic(i,1)*100;
   error(i,2) = phi_analytic2(i,1)-phi_numerical2(i,1)/phi_analytic2(i,1)*100;
end
```

2. Error : ((analytic value-numerical value)/(analytic value))*100

1) For donor :

Density	Error
1E+10	1.39444020866747e-14
1E+11	1.16071612509251e-14
1E+12	0
1E+13	1.55424387462237e-14
1E+14	0
1E+15	0
1E+16	0
1E+17	0
1E+18	2.33136614943282e-14

2) For acceptor

Density	Error
1E+10	2.78888041733494e-14
1E+11	0
1E+12	0
1E+13	0
1E+14	0
1E+15	0
1E+16	0
1E+17	0
1E+18	2.33136614943282e-14