Q4

Bisection:

```
%the bisection function:
function x1= bisection(f,a,b,tol,maxiter)
%This function computes a root of f in the interval [a, b]

x1=[];%define the new matrix with void value
while abs(b-a)>=tol
    mean=(a+b)/2%the interval of b is too large, change the interval
    x1=[x1, mean];
    %add the new approximate root in the array;

    if length(x1)==maxiter
        break
    elseif f(a)*f(mean)<=0
            a=a;
            b=mean;%now the new interval is a~mean left interval
    else
        a=mean;
        b=b; %now using the right half interval
    end
end

end
```

Secant:

```
%secant
function x2=secant(f, a, b, tol, maxiter)

index1=a; %defined the boundary point a
index2=b; %definedn the boundary point b

x2=[]; %define the initial matrix with void value

i=1; %set the initial value
while i<=maxiter&&tol<abs(index2-index1)
    %when not exceed the total iteration value and
    %the new range within the interval, do the loop

    %define the 3rd indicatior->delta_x
    indexn=index2-index1;
    %define the 4th indicatior->delta_y
    indexd=f(index2)-f(index1);
    %find the new narror interval
    index1=index2;
    index2=index1-f(index1)*(indexn/indexd);
    x2(i)=index2;
    i=i+1;
end
end
```

Newton:

```
%newton
function x3=newton(f, fprime, a, tol, maxiter)
i=1; %set the interaction index
%define the Newton's recursion formuala:
x1=a-f(a)/fprime(a);

%set the two boundary points:
index1=a;
index2=x1;

%give value to x3
x3=[index2];
index3=index2-index1;

while abs(index3)>=tol && i<=maxiter %iteraction
    index1=index2;
    %do the recursion
    index2=index1-f(index1)/fprime(index1);
    x3=[x3,index2];
    index3=index2-index1;
    i=i+1;

end
end
```

Fixed point:

```
%fixed point method:

function x4=fixedpoint(g, a, tol, maxiter);

%set the initial function a and gx
index1=a;
index2=g(a);
x4=[index2];

i=1;%set the initial value of index
while i<=maxiter&&abs(index2-index1)>tol

    index1=index2; %set the new index
    index2=g(index1);
    x4=[x4,index2];

    i=i+1;

end
end
```

Output:

Bisection:

Iteration	x_k	e_k	e_k/e_{k-1}	e_k/e_{k-1}^1.6	e_k/e_{k-1}^2
1	2.00000000000000	2.6795e-01			
2	1.25000000000000	4.8205e-01	4.8205e-01	1.7990e+00	6.7141e+00
3	1.62500000000000	1.0705e-01	1.0705e-01	2.2207e-01	4.6069e-01
4	1.81250000000000	8.0449e-02	8.0449e-02	7.5150e-01	7.0201e+00
5	1.71875000000000	1.3301e-02	1.3301e-02	1.6533e-01	2.0551e+00
6	1.76562500000000	3.3574e-02	3.3574e-02	2.5242e+00	1.8978e+02
7	1.74218750000000	1.0137e-02	1.0137e-02	3.0192e-01	8.9926e+00
8	1.73046875000000	1.5821e-03	1.5821e-03	1.5607e-01	1.5397e+01
9	1.73632812500000	4.2773e-03	4.2773e-03	2.7036e+00	1.7089e+03
10	1.73339843750000	1.3476e-03	1.3476e-03	3.1506e-01	7.3659e+01
11	1.73193359375000	1.1721e-04	1.1721e-04	8.6978e-02	6.4541e+01
12	1.73266601562500	6.1521e-04	6.1521e-04	5.2486e+00	4.4778e+04
13	1.73229980468750	2.4900e-04	2.4900e-04	4.0474e-01	6.5789e+02
14	1.73211669921875	6.5892e-05	6.5892e-05	2.6463e-01	1.0628e+03
15	1.73202514648438	2.5661e-05	2.5661e-05	3.8944e-01	5.9104e+03
16	1.73207092285156	2.0115e-05	2.0115e-05	7.8388e-01	3.0548e+04
17	1.73204803466797	2.7729e-06	2.7729e-06	1.3785e-01	6.8530e+03
18	1.73205947875977	8.6712e-06	8.6712e-06	3.1271e+00	1.1277e+06
19	1.73205375671387	2.9491e-06	2.9491e-06	3.4011e-01	3.9223e+04
20	1.73205089569092	8.8122e-08	8.8122e-08	2.9881e-02	1.0132e+04
21	1.73204946517944	1.3424e-06	1.3424e-06	1.5233e+01	1.7287e+08
22	1.73205018043518	6.2713e-07	6.2713e-07	4.6718e-01	3.4802e+05
23	1.73205053806305	2.6951e-07	2.6951e-07	4.2974e-01	6.8525e+05
24	1.73205071687698	9.0692e-08	9.0692e-08	3.3651e-01	1.2486e+06
25	1.73205080628395	1.2849e-09	1.2849e-09	1.4168e-02	1.5622e+05
26	1.73205085098743	4.3419e-08	4.3419e-08	3.3791e+01	2.6298e+10
27	1.73205082863569	2.1067e-08	2.1067e-08	4.8520e-01	1.1175e+07
28	1.73205081745982	9.8909e-09	9.8909e-09	4.6950e-01	2.2286e+07
29	1.73205081187189	4.3030e-09	4.3030e-09	4.3505e-01	4.3984e+07
30	1.73205080907792	1.5090e-09	1.5090e-09	3.5069e-01	8.1500e+07
31	1.73205080768093	1.1206e-10	1.1206e-10	7.4257e-02	4.9208e+07
32	1.73205080698244	5.8643e-10	5.8643e-10	5.2333e+00	4.6702e+10
33	1.73205080733169	2.3719e-10	2.3719e-10	4.0446e-01	6.8969e+08
34	1.73205080750631	6.2566e-11	6.2566e-11	2.6378e-01	1.1121e+09
35	1.73205080759362	2.4746e-11	2.4746e-11	3.9552e-01	6.3217e+09
36	1.73205080754997	1.8910e-11	1.8910e-11	7.6415e-01	3.0880e+10
37	1.73205080757180	2.9181e-12	2.9181e-12	1.5432e-01	8.1607e+09
38	1.73205080756088	7.9958e-12	7.9958e-12	2.7401e+00	9.3899e+11
39	1.73205080756634	2.5389e-12	2.5389e-12	3.1752e-01	3.9711e+10
40	1.73205080756907	1.8963e-13	1.8963e-13	7.4690e-02	2.9419e+10
41	1.73205080756770	1.1746e-12	1.1746e-12	6.1944e+00	3.2666e+13
42	1.73205080756838	4.9249e-13	4.9249e-13	4.1928e-01	3.5695e+11

Secant:

```
Which method? 2

Iteration         x_k             e_k       e_k/e_{k-1}   e_k/e_{k-1}^1.6   e_k/e_{k-1}^2
    1      1.18750000000000   5.4455e-01
    2      1.52666666666667   2.0538e-01    3.7716e-01     5.4912e-01       6.9261e-01
    3      1.77325759901750   4.1207e-02    2.0063e-01     5.3365e-01       9.7687e-01
    4      1.72948613614626   2.5647e-03    6.2239e-02     4.4674e-01       1.5104e+00
    5      1.73202063639781   3.0171e-05    1.1764e-02     4.6975e-01       4.5870e+00
    6      1.73205082992306   2.2354e-08    7.4091e-04     4.6082e-01       2.4557e+01
    7      1.73205080756868   1.9451e-13    8.7013e-06     4.6552e-01       3.8925e+02
    8      1.73205080756888   0.0000e+00    0.0000e+00     0.0000e+00       0.0000e+00
```

Newton:

```
Which method? 3

Iteration         x_k             e_k       e_k/e_{k-1}   e_k/e_{k-1}^1.6   e_k/e_{k-1}^2
    1      3.25000000000000   1.5179e+00
    2      2.08653846153846   3.5449e-01    2.3353e-01     1.8043e-01       1.5385e-01
    3      1.76216323998582   3.0112e-02    8.4946e-02     1.6125e-01       2.3963e-01
    4      1.73230809320663   2.5729e-04    8.5442e-03     7.4449e-02       2.8374e-01
    5      1.73205082667515   1.9106e-08    7.4261e-05     1.2281e-02       2.8863e-01
    6      1.73205080756888   2.2204e-16    1.1622e-08     6.8511e-04       6.0826e-01
    7      1.73205080756888   0.0000e+00    0.0000e+00     0.0000e+00       0.0000e+00
```

Fixed point:

```
1: bisection, 2: secant, 3: newton, 4 fixed point
Which method? 4
```

Iteration	x_k	e_k	e_k/e_{k-1}	e_k/e_{k-1}^1.6	e_k/e_{k-1}^2
1	1.69078493020360	4.1266e-02			
2	1.75194638077097	1.9896e-02	4.8213e-01	3.4576e+00	1.1684e+01
3	1.72193161989028	1.0119e-02	5.0862e-01	5.7255e+00	2.5564e+01
4	1.73706606179116	5.0153e-03	4.9562e-01	8.4730e+00	4.8978e+01
5	1.72953228898671	2.5185e-03	5.0217e-01	1.3248e+01	1.0013e+02
6	1.73330732028817	1.2565e-03	4.9891e-01	2.0147e+01	1.9810e+02
7	1.73142186755829	6.2894e-04	5.0054e-01	3.1064e+01	3.9836e+02
8	1.73236510628927	3.1430e-04	4.9973e-01	4.7567e+01	7.9456e+02
9	1.73189361543409	1.5719e-04	5.0014e-01	7.3089e+01	1.5913e+03
10	1.73212939293680	7.8585e-05	4.9993e-01	1.1211e+02	3.1804e+03
11	1.73201151221078	3.9295e-05	5.0003e-01	1.7211e+02	6.3629e+03
12	1.73207045457930	1.9647e-05	4.9998e-01	2.6412e+02	1.2724e+04
13	1.73204098389652	9.8237e-06	5.0001e-01	4.0540e+02	2.5450e+04
14	1.73205571936327	4.9118e-06	5.0000e-01	6.2217e+02	5.0897e+04
15	1.73204835166124	2.4559e-06	5.0000e-01	9.5492e+02	1.0180e+05
16	1.73205203552009	1.2280e-06	5.0000e-01	1.4656e+03	2.0359e+05
17	1.73205019359262	6.1398e-07	5.0000e-01	2.2494e+03	4.0718e+05
18	1.73205111455684	3.0699e-07	5.0000e-01	3.4523e+03	8.1436e+05
19	1.73205065407485	1.5349e-07	5.0000e-01	5.2985e+03	1.6287e+06
20	1.73205088431588	7.6747e-08	5.0000e-01	8.1320e+03	3.2575e+06
21	1.73205076919537	3.8374e-08	5.0000e-01	1.2481e+04	6.5149e+06
22	1.73205082675563	1.9187e-08	5.0000e-01	1.9155e+04	1.3030e+07
23	1.73205079797550	9.5934e-09	5.0000e-01	2.9399e+04	2.6060e+07
24	1.73205081236557	4.7967e-09	5.0000e-01	4.5122e+04	5.2119e+07
25	1.73205080517053	2.3983e-09	5.0000e-01	6.9252e+04	1.0424e+08
26	1.73205080876805	1.1992e-09	5.0000e-01	1.0629e+05	2.0848e+08
27	1.73205080696929	5.9959e-10	5.0000e-01	1.6313e+05	4.1695e+08
28	1.73205080786867	2.9979e-10	5.0000e-01	2.5036e+05	8.3391e+08
29	1.73205080741898	1.4990e-10	5.0000e-01	3.8425e+05	1.6678e+09
30	1.73205080764383	7.4948e-11	5.0000e-01	5.8975e+05	3.3357e+09
31	1.73205080753140	3.7474e-11	5.0000e-01	9.0512e+05	6.6712e+09
32	1.73205080758761	1.8737e-11	5.0001e-01	1.3892e+06	1.3343e+10
33	1.73205080755951	9.3685e-12	4.9999e-01	2.1321e+06	2.6685e+10
34	1.73205080757356	4.6843e-12	5.0000e-01	3.2723e+06	5.3370e+10
35	1.73205080756654	2.3421e-12	5.0000e-01	5.0223e+06	1.0674e+11
36	1.73205080757005	1.1711e-12	5.0000e-01	7.7081e+06	2.1348e+11
37	1.73205080756829	5.8531e-13	4.9981e-01	1.1826e+07	4.2680e+11
38	1.73205080756917	2.9265e-13	5.0000e-01	1.8161e+07	8.5425e+11